

**Comparison of Roundup Ready and Conventional Soybean (*Glycine Max L.*) Weed Control  
Systems for Optimizing Yield and Economic Profitability**

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## **Abstract**

Research was conducted in 2010, 2011 and 2012 at the East Tennessee Research and Education Center in Knoxville, TN, in order to compare differences in soybean yield among differing levels of weed control within Roundup Ready® [Glyphosate-resistant] (RR) and conventional soybean cultivars to gain a better understanding of the impact different intensities of weed control have on RR and conventional cropping systems. Results determined that after applying the weed control regimens, there was no significant difference ( $p < 0.05$ ) in yield ( $\text{kg ha}^{-1}$ ) [kilograms per hectare] between soybean cultivars at any level of weed control at any date or environment. Additionally, no significant difference in yield was found between the two highest levels of weed control used.

Glyphosate resistant weeds introduce new challenges and create a more costly weed control regimen, especially when using a RR based soybean cultivation operation. Therefore, calculated economic returns of RR and conventional weed management technologies used in this study were contrasted to determine profitability of each system. In a glyphosate resistant-free environment, the conventional soybean cultivar had a net return of only 0.4% greater than that of the RR cultivar. The comparison of cultivar net return and yield indicates conventional soybean production is competitive to RR productions, however the tremendous use of RR technologies leaves conventional crops vulnerable to potential damage or death due to drift. If glyphosate resistant weeds are present in an environment, RR production and hand hoeing may be the best choice for weed control.

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## **Introduction**

### **Soybean**

Soybean [*Glycine max* (L.) Merr.] is a bushy, annual herbaceous legume that produces seed, which can be used for a variety of products (Duke 1983). Soybean is the second largest crop by planted area in the United States after corn (*Zea mays* L.) (Reddy 2001). The U.S. is the current global leader in soybean production, growing 35% of all soybeans in 2010 (ASA 2012). In 2011, 30 million hectares of soybeans were planted, producing 83 million metric tons of seed (USDA 2011a). Vital to the United States' economy, 45% of soybeans produced in the U.S. were exported and farm cash receipts for soybean production in 2011 were \$40.2 billion dollars at about \$1140.61/metric ton (USDA 2011b).

### **Glyphosate-resistant Weeds**

Weed shifts occur due to selection pressures or disturbances, which favor a particular species. Herbicide use is one of the most important selective forces on a weed community in an agricultural ecosystem (Owen, Zelaya 2005). Continuous use of a single herbicide applied to a given site over time selects for increased resistance in weed species that had once been susceptible to that herbicide (LeBaron, Gressel 1982). Resistance occurs due to the selection in favor of naturally-occurring mutations of resistant plants, as herbicides do not cause mutations (Duke et al. 1991). According to Warwick (1991), herbicide resistance may be defined as the state in which a plant is able to survive the "normal field dose of a herbicide, as a result of selection and genetic response to repeated exposure."

Glyphosate has largely replaced many selective herbicides. In the U.S. 90%+ soybean, 91%+ cotton, and 60%+ corn crops are glyphosate-resistant (Powles 2008). Most growers of RR

crops utilize glyphosate alone or as the primary herbicide in their weed control regimens. After only 3 years of using only glyphosate in RR soybeans, reduced levels of control of horseweed (*Conyza canadensis*) populations were documented in Delaware (VanGessel 2001). The elimination of herbicide susceptible individuals, allows resistant individuals to fill open ecological niches. Currently, there are 23 glyphosate resistant (GR) species of weeds worldwide (Weed Science 2012). Currently GR horseweed and GR palmer pigweed (*Amarathus palmeri*) pose a major threat to the productivity of RR soybeans in Tennessee.

### **Literature Cited**

- American Soybean Association. 2012. SoyStats (online). <http://www.soystats.com/2011/Default-frames.htm>
- Duke, J.A. 1983. Handbook of energy Crops: Glycine max (L.) Merr (online).  
[http://www.hort.purdue.edu/newcrop/duke\\_energy/glycine\\_max.html](http://www.hort.purdue.edu/newcrop/duke_energy/glycine_max.html)
- Duke, S.O., A.L. Christy, F.D. Hess, and Z.S. Holt. 1991. Herbicide-Resistant Crops. Comments from CAST 1991-1, Council of Agricultural Science and Technology, Ames, IA.
- LeBaron, H.M., and J. Gressel. 1982. Herbicide Resistance in Plants. John Wiley & Sons, Inc., New York.
- Owen, M.D.K., and I.A. Zelaya. 2005. Herbicide-resistant crops and weed resistance to herbicides. *Pest Management Science*, 6:301-311.
- Powles, S.B. 2008. Evolved glyphosate-resistant weeds around the world: lessons to be learnt. *Pest Management Sci.* 64:360-365.
- Reddy, K.N. 2001. Glyphosate-resistant soybean as a weed management tool: Opportunities and challenges. *Weed Biology and Management*, 1:193-202.
- United States Department of Agriculture (USDA). 2003. Research, Education, and Economics Information System: Soybean Breeding (online).
- United States Department of Agriculture (USDA). 2011a. Adoption of Genetically Engineered Crops in the U.S. (online). <http://www.ers.usda.gov/data/biotechcrops/>  
<http://www.reeis.usda.gov/web/crisprojectpages/0181757-soybean-breeding.html>
- United States Department of Agriculture (USDA). 2011b. U.S. Soybean Industry: Background Statistics and Information (online). <http://www.ers.usda.gov/news/soybeancoverage.htm>

VanGessel, M.J. 2001. Glyphosate-Resistant Horseweed From Delaware. Weed Sci. 49, 703-705.

Warwick, S. I. 1991. Herbicide Resistance in Weedy Plants: Physiology and Population Biology. Annual Review of Ecology and Systematics. 22, 95-114.

Weed Science. 2012. International Survey of Herbicide Resistant Weeds (online).

<http://www.weedscience.org/Summary/UspeciesMOA.asp?lstMOAID=12&FmHRACGroup=Go>

## **Part I**

### **Soybean Yield and Profitability in Response to Cultivar and Level of Weed Control**

## Abstract

A 2 by 4 factorial study was conducted in 2010, 2011 and 2012 at the East Tennessee Research and Education Center in Knoxville, TN to contrast the yields of 2 near isogenic lines of soybean, the Roundup Ready® (RR) ‘Allen’ and the conventional 5601T, over 4 levels of weed control (i.e. untreated, low, medium and high). The conventional line received herbicides that range in mode of action, including pendimethalin, imazaquin, clethodim, and imazethapyr. The RR line received only POST glyphosate. The high level of weed control for both conventional and RR soybean lines also received hand hoeing to maintain a weed-free check. A partial budget analysis was used to determine financial differences between RR technology and conventional technology in soybean production systems. 5601T at the medium level of weed control did not show significantly different yield from the Allen at the medium level of weed control or the 5601T at the high level of weed control; however it did yield significantly less than Allen at the high level of weed control. Allen at the medium level of weed control did not yield differently from either the 5601T at the medium level or either of the cultivars at the high level of weed control, indicating that there is not a difference between medium and high levels of weed control when analyzed using Tukey HSD. Results from this study suggest that utilizing a herbicide treatment which provides adequate weed control will produce high yields and will have the greatest net benefit for both RR and conventional technologies.

**Nomenclature:** Soybean (*Glycine max* L.)

**Key words:** soybean (*Glycine max* L.), near isogenic lines, glyphosate-resistant, weed control, partial budget analysis, Roundup Ready®

## **Introduction**

It is well known that the presence of weeds is a major yield-limiting factor when compared to other crop pests, and some form of weed management is generally utilized to reduce competition for resources between crops and weeds. In the last century, a chemical revolution has introduced synthetic herbicides to the agricultural industry and has influenced the way growers handle weed problems. Herbicides provide crop protection simplicity, are cost efficient and have proven to be economically viable for crop production (Reddy 2001).

### **Glyphosate**

Prior to the release of RR crops, glyphosate use was limited to no-till situations prior to crop emergence or in perennial cropping systems (Powles 2008). More recently, RR weed control technology has revolutionized the agricultural industry in the U.S. (Paarlberg 2000). Glyphosate can be applied post-emergence in RR crops to control a broad spectrum of weeds without crop phytotoxicity. Glyphosate will be more than adequate on small weeds as well as large weeds and does not normally require tank mixes or sequential herbicides that other weed management systems might (Powles 2008). The widespread use of glyphosate in RR systems is attributed to simplicity, cost efficiency, favorable environmental profile, and low mammalian toxicology (Powles 2008). However, continuous exposure of large tracts of farmland to glyphosate has selected for glyphosate resistant plants of various weed species. Thus modern agriculture is demanding different, yet just as efficient, weed management practices.

Glyphosate inhibits the 5-Enolpyruvylshikimate-3-phosphate synthase (EPSPS) enzyme of the shikimate pathway by means of competing with the phosphoenolpyruvate (PEP) binding site on EPSPS (Duke and Powles 2008). EPSPS is the catalyst for the transfer of the enolpyruvyl moiety of PEP to shikimate-3-phosphate (S3P), forming EPSP and phosphate; this is a key step

in the synthesis of aromatic amino acids (Dill 2005). Without the aromatic amino acids phenylalanine, tyrosine and tryptophan, the plant is unable to make proteins causing the prevention of secondary products necessary for life (Reddy 2001). The enzyme EPSPS is present in all plants, bacteria and fungi but not in animals (Reddy 2001).

Glyphosate offers a large window of opportunity to make an application that will provide adequate weed control in soybeans. Glyphosate can be applied at any point from soybean emergence to flowering (Reddy 2001). To get the best weed control, glyphosate is applied after most weeds have emerged. Application rate and timing relative to weed growth stage will determine the effectiveness of the glyphosate application (Reddy 2001). It was found that full control of a given species can be achieved despite a difference in plant size by increasing the rate of glyphosate (Jordan et al. 1997).

### **Glyphosate-resistant Soybean**

RR is a seed trait technology which provides weed management programs that utilize POST glyphosate for weed control in glyphosate resistant (GR) crops (Hurley et al. 2009; Powles 2008). After the commercial release of transgenic soybean in 1996, U.S. farmers embraced and exponentially adopted the use of RR soybean (USDA 2011; Reddy 2001). The adoption of RR technologies has created a strong selection pressure on weed species that possess GR genes, thus introducing new challenges for U.S. growers who rely on RR technologies.

Commercialized RR soybeans were developed through the insertion of the CP4 gene into the crop's genome (Duke and Powles 2008). CP4 is a bacterial EPSPS enzyme isolated from *Agrobacterium* sp. that has a herbicide binding site identical to that of EPSPS (Dill 2005). RR crops will contain both EPSPS and CP4-EPSPS. When treated with glyphosate, the glyphosate will bind with EPSPS, PEP will be able to by-pass EPSPS and bind with CP4-EPSPS resulting in

a shikimate pathway that will function normally and the plant will maintain aromatic amino acid levels (Dill 2005; Reedy 2001). Yield drag was originally observed with RR soybean production (Elmore et al. 2001). In some field studies, it has been noted that RR lines yielded 5% less than the conventional lines (Elmore et al. 2000).

### **Soybean Near Isogenic Lines (NIL): Allen and 5601T**

Soybean cultivar 5601T is a conventional cultivar developed by the Tennessee Agricultural Experiment Station (Pantalone et al. 2003). 5601T was released in 2001 for its high yielding abilities in the southern United States, and was the highest yielding line in USDA Maturity Group V Regional test for Tennessee and Kentucky in 2005, 2006, and 2007 (Landau-Ellis and Pantalone 2009). 5601T has been used as a USDA check cultivar in the southern region and is frequently used as a check cultivar in many research experiments.

Through marker-assisted backcrossing, the soybean cultivar ‘Allen’ (originally designated as line 501TRR-292) is the BC3F2-derived RR progeny of the conventional cultivar and recurrent parent, 5601T and the donor line TN93-99RR (Pantalone et al. 2010). Due to high yield capabilities, 5601T was an optimal soybean line to be used as a recurrent parent of RR progeny for the southern region. TN93-99RR was chosen as a donor line as it shared a common parent with 5601T, ‘Hutcheson’, in addition to its high yield throughout the southern U.S. (Buss et al. 1988, Pantalone et al. 2003). Marker-assisted selection (MAS) allows plant breeders to select superior individual based on DNA. One application of MAS is to identify plants during backcrossing that are more genetically similar to the recurrent parent than to the donor parent. Utilizing 93 simple sequence repeat markers, DNA profiles of specific BC1F1, BC2F1, and BC3F1 plants containing a genome most in common with 5601T were identified (Pantalone et al. 2010). With the ability to choose and backcross lines that are most genetically similar to the

recurrent parent, MAS hastens the time needed to incorporate genes into the favorable line. As a result, the rapid MAS development of the Allen cultivar was expected to have similar genetic characteristics, including yield as 5601T. The present study was conducted to compare yield and economics of RR vs. conventional weed management technologies by using the NIL 5601T and Allen, thus reducing possible variations commonly associated with different soybean cultivars.

### **Economic Impacts**

Reduced yields due to weed pressure is of financial significance in soybean cultivation, even more so when GR weeds are present. Conventional soybean farming systems, without RR technologies, can cost between \$109.49-\$173.12/ha (Reddy and Whiting. 2000). RR technologies will cost approximately \$127.85/ha for optimum weed control utilizing a two time application program of glyphosate, if GR weeds are not present (Reddy and Whiting 2000). Both soybean weed control programs take into account costs for seed, herbicide, adjuvant, and application (Reddy and Whiting 2000). The presence of GR weeds such as horseweed in RR soybeans programs will have a cost increase of \$28.42/ha (Mueller et al. 2005).

It is important for soybean producers to accommodate and adapt to new production issues. Changes that are made to current programs will have consequences. To compare benefits and costs of these adjustments, partial budgets are used as a tool for farm planning (Roth and Hyde 2002). A partial budget will only include resources that will be adjusted, focusing on changes on income and expenses. It will have four parts: additional income, reduced costs, reduced income and additional costs (Lessley et al. 1991). Additional income will include means of generating new revenue or increasing existing enterprises. Reduced costs include expenses no longer incurred due to the change. Reduced income includes possible reduction in revenue due to the proposed change. Lastly, the additional costs section will consist of new costs associated

with the proposed change (Roth and Hyde 2002). Net income is calculated by comparing the sum of additional income and reduced costs with the sum of reduced income and additional costs (Lessley et al. 1991).

The increasing presence of GR weeds in soybean fields has much to do with the grower's crop management decision (Green and Owen 2011). GR weed best management practices include using different herbicides with different MOA and preventing weeds from setting seed (Monsanto 2012). In a study published by Johnson and others (2009), less than half of all growers surveyed believed that it was a priority to have a tank mix with glyphosate for GR weed management, and less than one third believed tillage was a GR weed management tool. Furthermore, these growers believed that following glyphosate label rates was 'the most effective strategy for reducing or preventing GR weeds' (Johnson et al. 2009). In a more recent survey, only 52% of growers who use continuous RR soybean seed were aware of GR weeds at a county level, only 45% of southern growers surveyed believed that GR weeds are a 'very serious' problem, and, alarmingly enough, 54% of farmers who use a continuous RR soybean system have found on-farm GR weeds (Prince et al. 2012). Although awareness of GR weeds has increased, most growers act to focus on weed control issues at hand rather than to be proactive to prevent the onset of GR weeds (Mueller et al. 2005). With the loss of weed control in RR systems, cost for adequate weed management will increase. Additionally, in a Delaware soybean grower survey, 48% of growers reported a \$5-\$17/ha increase for GR horseweed management, with another 28% of growers experiencing a \$17+/ha increase (Scott and VanGessel 2007).

It is indicated that greatest control of GR weeds will be in soybeans that utilize a diversity of herbicides. Greater than 80% control of GR palmer amaranth (*Amaranthus palmeri*) was achieved 90 days after POST herbicide application by using a PRE s-metolachlor and PRE

fomesafen in combination with POST fomesafen, while POST glyphosate controlled 23% of GR palmer amaranth population (Whitaker et al. 2010). In the study mentioned above, only a RR soybean cultivar was used in both the RR and conventional herbicide systems. Technology fees are associated with the RR seed trait and are avoided in conventional herbicide systems, suggesting that utilization of conventional seed and herbicide systems may be the most cost-effective option.

Previous similar research examined RR and conventional cultivars. Reddy and Whiting (2000) reported lower net returns in non-RR compared to other cultivars. They reported that major factors to consider would be yield potential, seed cost (including any technology fee), since herbicide costs were comparable among the different systems. Shaw et al (2001) also published a report related to this topic. They used 3 RR and 3 conventional soybean cultivars at 4 levels, ranging from untreated (none) to low to medium to high levels (which represented reduced rates to full rates to full rates + additional POST application). The reported results were mixed with respect to maximum net returns as affected by the examined variables.

The objectives for this study were 1) to compare differences in yield among different levels of weed control within RR and conventional soybean NIL cultivars and 2) to contrast the economic return of RR and conventional weed management technologies. A major difference in our research approach compared to previous reports is the use of a NIL soybean to eliminate the potential yield difference between the 2 cultivars. Previous reports (Reddy and Whiting 2000, Shaw et al. 2001) used disparate soybeans with varying levels of yield potential, disease tolerance, etc. Our methods also included a complete range of weed control levels from an untreated weedy control to a hand-weeded, weed-free check plot; whereas other approaches were used by the previously mentioned reports.

## **Materials and Methods**

Field research to examine the effects of cultivar and level of weed control on soybean yield and profitability was conducted at two environments within the East Tennessee Research and Education Center in Knoxville, TN: the Plant Science Unit (PSU) and the Holston Unit (HU). This experiment was repeated over a three year period (2010, 2011, 2012). Soybean seed was planted into tilled ground using a conventional till system at PSU in 2010 and 2011 and no-till system at HU in all years and PSU in 2012. Both sites had similar soil (Sequatchie loam) and good to excellent fertility levels. No supplemental irrigation was added to any trial, and no PRE herbicides were activated by irrigation. The entire plot area was fertilized with 750 kg ha<sup>-1</sup> of 12-12-12 fertilizer ~ 7 d before planting. A different plot area was used for the subsequent studies in later years. The PSU in 2011 was not harvested due to extended wet weather that precluded harvest of the plots, and the plants lost their seeds due to shattering.

This experiment is a 2 by 4 factorial study, which utilized a randomized complete block, split-plot design with 4 replications at each environment. Soybean cultivar (Allen and 5601T) was the whole plot treatment, while level of weed control (untreated, low, medium and high) was the sub-plot treatment in our design model. Sub-plots were four 76 cm rows wide by 12.2 m in length, and main plots were 16 rows wide by 12.2 m. A minimum of 4 soybean rows or 4 meters was allowed between main plots to provide a buffer zone to avoid glyphosate drift onto 5601T plots. The cultivars are a maturity group V, which is well-adapted to the climate.

The 5601T cultivar's levels of weed control consisted of four levels of weed control utilizing selective herbicides. The untreated received no herbicide application or hand hoeing. The low level received a PRE herbicide application of a mixed formulation of pendimethalin and imazaquin (Squadron®, BASF, Research Triangle Park, NC). The medium level received

the PRE as well as an EPOST application of clethodim (Select Max®, Valent U.S.A Corp., Walnut Creek, CA) and imazethapyr (Pursuit®, BASF, Research Triangle Park, NC). The high level received both the PRE and EPOST treatments as well as supplemental hand hoeing to maintain a weed-free plot.

The Allen cultivar's herbicide treatments that define the four levels of weed control are historically consistent with RR technologies, utilizing only glyphosate (Roundup WeatherMax®, Monsanto Co., St. Louis, MO). The untreated level received no herbicide applications and no hand hoeing. The low level received an EPOST application of glyphosate at 0.84 kg ae ha<sup>-1</sup> (all glyphosate applications used the same dosage). The medium level received an EPOST and a LPOST application of glyphosate. The high level received both EPOST and LPOST treatments as well as supplemental hand hoeing to maintain a weed-free plot.

Herbicides were applied using small plot equipment of 8002 flat fan nozzles delivering 225 l ha<sup>-1</sup>. Extreme care was taken not to drift glyphosate onto 5601T plots, or to have any drift from adjacent field studies. Mix size was 3 liters, and PRE applications were made the day of planting each year. EPOST applications were made to V3-V4 soybeans, and LPOST applications were made 3 to 4 weeks later.

The primary weeds present at PSU were ivyleaf morningglory (*Ipomoea hederacea* L.), johnsongrass (*Sorghum halepense* L.) and horseweed (*Conyza canadensis* L.). The primary weeds present at HU were pitted morningglory (*Ipomoea lacunosa* L.), johnsongrass (*Sorghum halepense* L.) and common cocklebur (*Xanthium strumarium* L.). Only in the PSU 2012 environment was GR horseweed present. No other GR weeds were present at any time in this study. Although clear differences were apparent in the levels of weed control, the exact amount

of weed in each plot were not determined. The objective data collected in this study were soybean yield in each plot, the various input costs, and the duration of hand hoeing for each plot.

The timing of herbicide application was determined by the growth stage of crop (PRE/POST) and by the size and growth of the weeds present. Additional hand hoeing was implemented throughout the growing season to maintain weed free plots. Yield data was collected via an on-board weigh scale and data logger in the combine on the day of harvest. Additionally, time spent hoeing high level plots were recorded at each hoeing event.

Data were analyzed using SAS 9.3 and the PROC MIXED procedure it offered. The random effects used were replication within environment and variety by replication within environment. Means were separated using Tukey's HSD at the 0.05 significance level. The relative increase in soybean yield for each increase in weed control level was calculated by the formula:

$$(\text{Yield 2} - \text{Yield 1}) / (\text{Yield 1}) * 100.$$

This was done to illustrate how the NIL responded to more complete weed control.

Utilizing a partial budget analysis equation, the net benefit of each soybean production system was determined. Resources under financial consideration included yield revenue, herbicide costs, labor for hoeing costs, and seed costs. Resources not included were labor & equipment to plant seed, labor & equipment to harvest crop, labor in herbicide application, tillage (when used), or additional inputs such as land cost or fertilization.

## **Results and Discussion**

### **Effects of Soybean Weed Control System on Yield**

Within the 2010, 2011 and 2012 dates and environments, similar patterns observed in the soybean yield data (Table 1). No yield difference was observed between medium and high weed control levels at any environment or between cultivars (statistical analysis not shown). Lowest

yields were observed in untreated and low weed control levels in both cultivars at all environments. When comparing yield at the various weed control levels, there was no statistical difference between Allen and 5601T within an environment.

Averaged across all five environments (PSU 2010, HU 2010, HU 2011, PSU 2012, HU 2012) there was no significant difference ( $p < 0.05$ ) between cultivars at any weed control level. High and medium weed control levels produced yields that were significantly higher ( $p < 0.01$ ) than that of the untreated and low weed control levels. Untreated weed control levels also yielded significantly less than low treatment levels. The high weed control level was not significantly different from the medium weed control levels, despite the incorporation of hand hoeing into the high weed control treatment.

The relative yield response of the NIL to improved weed control was similar. As the weed control level went from none to low an increase of ~100% in both Allen and 5601T. Drastically lower increases were observed when weed control level went from medium to high in both cultivars (Table 4). These results indicate several aspects of this research. The NIL respond the same way as weed population densities are reduced by successive improvements in weed control. Greatest yield increase was noted at the first levels of weed control improvement (from none to low). Only a slight improvement in yield (less than 12%) was noted as weed control was maximized (from medium to high). The data also reinforce the need for weed control to maximize yields. Although only based on conjecture, the slightly greater effect of adding hand-hoeing in 5601T might indicate slightly less complete weed control in these plots compared to Allen. To reduce artifacts due to plot disturbance, the authors at the onset of the study decided to not take any subjective visual evaluations of weed control nor any destructive harvests of weed biomass (data not reported).

The three years of the study's course had widely divergent weather patterns, and resulting yields were highly variable (Table 1). Over all treatments, the lowest yield was 331 kg ha<sup>-1</sup> and the highest yield was 4795 kg ha<sup>-1</sup>. Within a given weed control level, variability was reduced, but there was still substantial variation. In general however, the NIL produced similar yields at the various levels. At the HU 2011 location there was an infestation of grasshoppers, which was controlled with the application of acephate. There appeared to be no difference in feeding preference of the insects for either cultivar.

The two NIL appeared to be quite similar in many ways, however in the course of the study one apparent difference was noted. The Allen cultivar was approximately 5 days later to full maturity than the 5601T. This was consistent in all environments in the study, and is consistent with previous observations of the developer of these NIL (personal communication, Pantalone). One reason the authors mention this observation is to remind the readers that the introgression of a given trait is never completely perfect from a genetic standpoint, in that it is essentially impossible not to insert additional ancillary genetic material is inherited along with the desired gene.

Whenever a cost analysis is conducted, a variety of input parameters is essential. A common source of error is estimating input values for the various input costs. This analysis is not unique from that perspective. The estimates for various parameters are listed in Table 2. Our cost estimates were based on local conditions and information available to the authors at the time of this writing. As seed, herbicide and labor costs change over time it would be relatively simple to reconstruct this table for a possible follow-up analysis.

The partial budget analysis results indicated the two NIL behaved similarly within a weed control level but differed substantially across the diverse levels (Table 3). Lowest returns were

noted in the untreated weed level, with returns less than \$500 per hectare. Following the approximately 100% increase in soybean yield from untreated to low, the corresponding net returns were approximately doubled. The highest net returns were at the medium weed control level, with ~ \$1800 per hectare net. The addition of hand weeding to remove the very few weeds that were present substantially reduced net income, due to high labor cost of ~ \$1000 per hectare. From a short-term biological perspective, the medium level of weed control was the most profitable.

The authors caution that these results may not be applicable in all situations. These field plots did not have extremely problematic GR weeds, such as Palmer amaranth. If GR Palmer amaranth is present, it is advised that in the long-term interest of profitability the highest level of weed control may be the best choice to decrease the GR Palmer weed seed bank. Also important to remember is that the weed population in these plots was exceptionally high and that the hand weeding cost of a large, broad acre production field may be substantially lower for the entire field. It is common for the hand weeding efforts to be focused on a small portion of the entire field. This focusing of effort would reduce the total hand weeding cost per a given area. As such, the hand weeding cost estimates from this study represent an absolute worst-case scenario that may not be applicable in real-world situations.

Extreme care was taken not to drift glyphosate onto the 5601T plots, both from treatments inside the study and outside the study. One aspect of using RR soybean cultivars over the last 15 years in the United States is that since everybody has RR cultivars, the chance of crop injury from glyphosate drift onto soybeans is low. As weed control systems become more complex due to the diversity of traits that will soon be entering the market, drift may become a more common problem. New developments of soybeans that are tolerant of dicamba, 2,4-D and

HPPD- herbicides are expected soon and could be added to the already available glufosinate resistant soybean cultivars. The use of a conventional soybean cultivar such as 5601T, would be the most vulnerable soybean field from a drift potential perspective.

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### **Abbreviations Used**

EPOST, early post-emergence; GR, glyphosate-resistant; HU, Holston Unit; LPOST, late post-emergence; MAS, Marker Assisted Selection; MOA, mode of action; PRE, pre-emergence; PSU, Plant Science; RR, Roundup Ready.

### **Literature Cited**

- Buss, G.R., H.M. Camper, and C.W. Roane. 1988. Registration of 'Hutcheson' Soybean. *Crop Sci.* 28:1024-1025.
- Dill, G.M. 2005. Glyphosate-resistant crops: history, status and future. *Pest Management Sci.* 61:219-224.
- Duke, S.O., A.L. Christy, F.D. Hess, and Z.S. Holt. 1991. Herbicide-Resistant Crops. Comments from CAST 1991-1, Council of Agricultural Science and Technology, Ames, IA.
- Duke, S.O., and S.B. Powles. 2008. Glyphosate: a once-in-a-century herbicide. *Pest Management Sci.* 64:319-325.
- Elmore, R.W., F.W. Roeth, R.N. Klein, S.Z. Knezevic, A. Martin, L.A. Nelson, and C.A. Shapiro. 2001. Glyphosate-Resistant Soybean Cultivar Response to glyphosate. *Agronomy J.* 93:404-407.
- Elmore, R.W., F.W. Roeth, L.A. Nelson, C.A. Shapiro, R.N. Klein, S.Z. Knezevic, and A.Martin. 2000. Glyphosate-Resistant Soybean Cultivar Yields Compared with Sister Lines. *Agronomy J.* 93:408-412.
- Green, J.M and M.D. Owen. 2011. Herbicide-Resistant Crops: Utilities and Limitations for Herbicide-Resistant Weed Management. *Agric. and Food Chem.* 59:5819-5829.
- Hurley, T.M., P.D. Mitchell, and G.B. Frisvold. 2009. Weed Management Costs, Weed Best Management practices, and the Roundup Ready® Weed Management Program. *AgBioForum.* 12:281-290.
- Johnson, W.G., M.D. Owen, G.R. Kruger, B.G. Young, D.R. Shaw, R.G. Wilson, J.W. Wilcut, D.L. Jordan, and S.C. Weller. 2009. U.S. Farmer Awareness of Glyphosate-Resistant Weeds and Resistance Management Strategies. *Weed Tech.* 23:308-312.

- Jordan, D.L., A.C. York, J.L. Griffin, P.A. Clay, P.R. Vidrine, and D.B. Reynolds. 1997. Influence of Application Variables on Efficacy of Glyphosate. *Weed Tech.* 11:354-362.
- Keeley, P.E., C.H. Carter, and R.J. Thullen. 1987. Influence of planting date on growth of Palmer amaranth (*Amaranthus palmeri*). *Weed Sci.* 35:199-204.
- Landau-Ellis, D., and V.R. Pantalone. 2009. Marker-assisted Backcrossing to Incorporate Two Low Phytate Alleles Into the Tennessee Soybean Cultivar 5601T. Induced Plant Mutations in the Genomics Era. Food and Agriculture Organization of the United Nations, Rome. 316-318.
- Lessley, B.V., D.M. Johnson, and J.C. Hanson. 2012. Using the Partial Budget to Analyze Farm Change. The University of Maryland (online)  
<http://pubs.cas.psu.edu/freepubs/pdfs/ua366.pdf>
- Monsanto Company. 2012. Weed Management Guidelines.  
<http://www.monsanto.com/weedmanagement/Pages/weed-management-guidelines.aspx>  
retrieved December 2, 2012.
- Mueller, T.C., P.D. Mitchell, B.G. Young, A.S. Culpepper. 2005. Proactive Versus Reactive Management of Glyphosate-Resistant or –Tolerant Weeds. *Weed Tech.* 19:924-93.
- NCSOY.ORG. 2013 <http://www.ncsoy.org/ABOUT-SOYBEANS/History-of-Soybeans.aspx>
- Owen, M.D.K., and I.A. Zelaya. 2005. Herbicide-resistant crops and weed resistance to herbicides. *Pest Management Science*, 6:301-311.
- Paarlberg, R. 2000. The Global Food Fight. *Foreign Affairs.* 79:24-38.
- Pantalone, V.R., F.L. Allen, and D. Landau-Ellis. 2003. Registration of ‘5601T’ soybean. *Crop Sci.* 43:1123-1124

- Pantalone, V.R., F.L. Allen, and D. Landau-Ellis. 2003. Registration of TN93-99 soybean germplasm. *Crop Sci.* 43:1137.
- Pantalone, V. R., F. L. Allen, and D. Landau-Ellis. Soybean Varieties. 2010. Plant Utility Patent 7,777,102.
- Pantalone, V.R., D. Landau-Ellis, and F.L. Allen. 2008. Translating Genomic Information to Develop Glyphosate Resistant Soybean Cultivar 'USG Allen'. *Agronomy Abstracts*. ASA/CSSA/SSSA October 5-9, 2008. Houston TX.
- Powles, S.B. 2008. Evolved glyphosate-resistant weeds around the world: lessons to be learnt. *Pest Management Sci.* 64:360-365.
- Prince, J.M., D.R. Shaw, W.A. Givens, M.E. Newman, M.D.K. Owen, S.C. Weller, B.G. Young, R.G. Wilson, and D.L. Jordan. 2012. Benchmark Study II: A 2010 Survey to Assess Grower Awareness toward Glyphosate Resistance. *Weed Tech.* 26:531-535.
- Reddy, K.N. 2001. Glyphosate-resistant soybean as a weed management tool: Opportunities and challenges. *Weed Biology and Management*, 1:193-202.
- Reddy, K.N., and K. Whiting. 2000. Weed Control and Economic Comparisons of Glyphosate-Resistant, Sulfonylurea-Tolerant, and Conventional Soybean (*Glycine max*) Systems. *Weed Tech.* 14:204-211.
- Roth, S., and J. Hyde. 2002. Partial Budgeting for Agricultural Businesses. Penn State (online) <http://pubs.cas.psu.edu/freepubs/pdfs/ua366.pdf>
- Scott, B.A. and M.J. VanGessel. 2007. Delaware Soybean Grower Survey on Glyphosate-Resistant Horseweed (*Conyza Canadensis*). *Weed Tech* 21:270-274.

- Shaw, D.R., J. C. Arnold, C.E. Snipes, D.H. Laughlin, and J.A. Mills. 2001. Comparison of Glyphosate-Resistant and Nontransgenic Soybean (*Glycine max*) Herbicide Systems. Weed Tech. 15:676-685.
- United States Department of Agriculture (USDA). 2011. U.S. Soybean Industry: Background Statistics and Information (online). <http://www.ers.usda.gov/news/soybeancoverage.htm>
- VanGessel, M.J. 2001. Glyphosate-Resistant Horseweed From Delaware. Weed Sci. 49, 703-705.
- Warwick, S. I. 1991. Herbicide Resistance in Weedy Plants: Physiology and Population Biology. Annual Review of Ecology and Systematics. 22, 95-114.
- Weed Science. 2012. International Survey of Herbicide Resistant Weeds (online). <http://www.weedscience.org/Summary/UspeciesMOA.asp?lstMOAID=12&FmHRACGroup=Go>
- Whitaker, J.R., A.C. York, D.L. Jordan, A.S. Culpepper. 2010 Palmer Amaranth (*Amaranthus palmeri*) Control in Soybean with Glyphosate and Conventional Herbicide Systems. Weed Tech 24:403-410

## Appendix A

**Table 1.** Soybean yield in 5 field environments in Tennessee as affected by soybean cultivar and weed control level.

| Location/ Year cultivar |       | Weed Control level              |      |        |      |
|-------------------------|-------|---------------------------------|------|--------|------|
|                         |       | None                            | Low  | Medium | High |
|                         |       | ----- kg ha <sup>-1</sup> ----- |      |        |      |
| HU 10                   | Allen | 331                             | 2142 | 4427   | 4795 |
| HU 10                   | 5601T | 461                             | 1977 | 4201   | 4364 |
| PSU 10                  | Allen | 1221                            | 2218 | 3848   | 3963 |
| PSU 10                  | 5601T | 1128                            | 2671 | 3272   | 3399 |
| HU 11                   | Allen | 940                             | 1735 | 2811   | 2824 |
| HU 11                   | 5601T | 1088                            | 1822 | 2912   | 3288 |
| HU 12                   | Allen | 1022                            | 1200 | 3786   | 3779 |
| HU 12                   | 5601T | 649                             | 1207 | 2956   | 3636 |
| PSU 12                  | Allen | 1474                            | 2567 | 3695   | 3995 |
| PSU 12                  | 5601T | 1557                            | 2070 | 3463   | 4153 |
| Average                 | Allen | 998                             | 1972 | 3713   | 3871 |
| Average                 | 5601T | 976                             | 1949 | 3361   | 3768 |

**Table 2.** Variables associated with using RR or conventional weed control technologies

|                                       | Price(US\$)/Unit | Use Rate        | US\$/ha |
|---------------------------------------|------------------|-----------------|---------|
| <b>1. Seed</b>                        |                  |                 |         |
| Allen                                 | 55.00/bag        | 2.72 bags/ha    | 149.48  |
| 5601T                                 | 24.00/bag        | 2.72 bags/ha    | 65.21   |
| <b>2. Herbicide</b>                   |                  |                 |         |
| Glyphosate<br>(Roundup WeatherMax)    | 76 per 2.5gal    | 23 fl oz/a      | 13.52   |
| Pendimethalin+imazaquin<br>(Squadron) | 92.25 per 2.5gal | 3 pts/a         | 34.25   |
| clethodim<br>(Select Max)             | 265 per 2.5gal   | 12 fl oz/a      | 24.60   |
| imazethapyr<br>(Pursuit)              | 436 per gal      | 4 oz/a          | 33.73   |
| <b>3. Labor*</b>                      |                  |                 |         |
| 1 <sup>st</sup> Hand Hoe Allen        | 7.25/hour        | 78.36 hours/ha  | 568.11  |
| 2 <sup>nd</sup> Hand Hoe Allen        | 7.25/hour        | 49.41 hours/ha  | 358.22  |
| 1 <sup>st</sup> Hand Hoe 5601T        | 7.25/hour        | 108.67 hours/ha | 787.86  |
| 2 <sup>nd</sup> Hand Hoe 5601T        | 7.25/hour        | 68.86 hours/ha  | 499.24  |

\*Labor prices based off of current minimum wage and by using timed trials in plots that were 40' long with a row spacing of 30".

**Table 3.** Net benefit calculations for Allen and 5601T soybeans over all five study environments (US\$/ha)

|                                 | Untreated |        | Low     |         | Medium  |         | High    |         |
|---------------------------------|-----------|--------|---------|---------|---------|---------|---------|---------|
|                                 | Allen     | 5601T  | Allen   | 5601T   | Allen   | 5601T   | Allen   | 5601T   |
| Revenue                         | 547.11    | 535.49 | 1081.67 | 1069.13 | 2036.48 | 1843.05 | 2122.96 | 2066.53 |
| Seed Costs                      | 149.48    | 65.21  | 149.18  | 65.21   | 149.18  | 65.21   | 149.18  | 65.21   |
| Herbicide Costs                 | 0         | 0      | 13.52   | 34.25   | 27.04   | 58.84   | 27.04   | 58.84   |
| Labor Costs (Hand weeding only) | 0         | 0      | 0       | 0       | 0       | 0       | 926.33  | 1287.48 |
| Net Benefit                     | 397.93    | 470.28 | 918.97  | 969.67  | 1860.26 | 1719.00 | 1020.41 | 655.00  |

**Table 4.** Yield increase observed from change in weed control level within soybean cultivar.

| Change in Weed Control Level | Yield Increase (%) |       |
|------------------------------|--------------------|-------|
|                              | Allen              | 5601T |
| None to Low                  | 98                 | 99.7  |
| Low to Medium                | 88                 | 72    |
| Medium to High               | 4                  | 12    |

## Appendix B

**Table 5.** PSU 10 Field Trail Protocol

| Plots: 10 by 35 feet |      |                    |              |           |           |              |           |           |              |             |          |          |                        |       |     |     |     |
|----------------------|------|--------------------|--------------|-----------|-----------|--------------|-----------|-----------|--------------|-------------|----------|----------|------------------------|-------|-----|-----|-----|
| Trt No.              | Type | Treatment Name     | Form Conc    | Form Unit | Form Type | Rate         | Rate Unit | Appl Code | Spray Volume | Volume Unit | Mix Size | Mix Unit | Amt Product to Measure | Rep 1 | 2   | 3   | 4   |
| 6                    | VAR  | Allen-LOW          |              |           |           |              |           |           |              |             |          |          |                        |       |     |     |     |
|                      | HERB | Roundup WeatherMax | 5.5 LB/GAL   |           | SL        | 23 fl oz/a   |           | B         |              | 20 GAL/AC   |          | 3 Liters | 26.95 ml/mx            | 101   | 204 | 303 | 403 |
| 7                    | VAR  | Allen-MEDIUM       |              |           |           |              |           |           |              |             |          |          |                        |       |     |     |     |
|                      | HERB | Roundup WeatherMax | 5.5 LB/GAL   |           | SL        | 23 fl oz/a   |           | B         |              | 20 GAL/AC   |          | 3 Liters | 26.95 ml/mx            | 102   | 202 | 304 | 404 |
|                      | HERB | Roundup WeatherMax | 5.5 LB/GAL   |           | SL        | 23 fl oz/a   |           | C         |              | 20 GAL/AC   |          | 3 Liters | 26.95 ml/mx            |       |     |     |     |
| 5                    | VAR  | Allen-UTC          |              |           |           |              |           |           |              |             |          |          |                        | 103   | 203 | 301 | 402 |
|                      | CHK  | untreated          |              |           |           |              |           |           |              |             |          |          |                        |       |     |     |     |
| 8                    | VAR  | Allen-HIGH         |              |           |           |              |           |           |              |             |          |          |                        | 104   | 201 | 302 | 401 |
|                      | HERB | Roundup WeatherMax | 5.5 LB/GAL   |           | SL        | 23 fl oz/a   |           | B         |              | 20 GAL/AC   |          | 3 Liters | 26.95 ml/mx            |       |     |     |     |
|                      | HERB | Roundup WeatherMax | 5.5 LB/GAL   |           | SL        | 23 fl oz/a   |           | C         |              | 20 GAL/AC   |          | 3 Liters | 26.95 ml/mx            |       |     |     |     |
|                      | CULT | PLUS HANDWEED      |              |           |           |              |           |           |              |             |          |          |                        |       |     |     |     |
| 3                    | VAR  | 5601T-MEDIUM       |              |           |           |              |           |           |              |             |          |          |                        | 105   | 208 | 306 | 406 |
|                      | HERB | Squadron           | 2.33 LBA/GAL |           | EC        | 3 pt/a       |           | A         |              | 20 GAL/AC   |          | 3 Liters | 56.24 ml/mx            |       |     |     |     |
|                      | HERB | Select Max         | 0.97 LBA/GAL |           | EC        | 12 fl oz/a   |           | B         |              | 20 GAL/AC   |          | 3 Liters | 14.06 ml/mx            |       |     |     |     |
|                      | HERB | Pursuit 70 dg      | 70 %         |           | DF        | 1.44 oz wt/a |           | B         |              | 20 GAL/AC   |          | 3 Liters | 1.618 g/mx             |       |     |     |     |
|                      | ADJ  | NIS                | 100 %        |           | SL        | 0.25 % v/v   |           | B         |              | 20 GAL/AC   |          | 3 Liters | 7.499 ml/mx            |       |     |     |     |
| 2                    | VAR  | 5601T-LOW          |              |           |           |              |           |           |              |             |          |          |                        | 106   | 206 | 305 | 405 |
|                      | HERB | Squadron           | 2.33 LBA/GAL |           | EC        | 3 pt/a       |           | A         |              | 20 GAL/AC   |          | 3 Liters | 56.24 ml/mx            |       |     |     |     |
| 1                    | VAR  | 5601T-UTC          |              |           |           |              |           |           |              |             |          |          |                        | 107   | 207 | 308 | 407 |
|                      | CHK  | untreated          |              |           |           |              |           |           |              |             |          |          |                        |       |     |     |     |
| 4                    | VAR  | 5601T-HIGH         |              |           |           |              |           |           |              |             |          |          |                        | 108   | 205 | 307 | 408 |
|                      | HERB | Squadron           | 2.33 LBA/GAL |           | EC        | 3 pt/a       |           | A         |              | 20 GAL/AC   |          | 3 Liters | 56.24 ml/mx            |       |     |     |     |
|                      | HERB | Select Max         | 0.97 LBA/GAL |           | EC        | 12 fl oz/a   |           | B         |              | 20 GAL/AC   |          | 3 Liters | 14.06 ml/mx            |       |     |     |     |
|                      | HERB | Pursuit 70 dg      | 70 %         |           | DF        | 1.44 oz wt/a |           | B         |              | 20 GAL/AC   |          | 3 Liters | 1.618 g/mx             |       |     |     |     |
|                      | ADJ  | NIS                | 100 %        |           | SL        | 0.25 % v/v   |           | B         |              | 20 GAL/AC   |          | 3 Liters | 7.499 ml/mx            |       |     |     |     |
|                      | CULT | PLUS HANDWEED      |              |           |           |              |           |           |              |             |          |          |                        |       |     |     |     |

**Table 6. PSU 10 Field Trial Location Information**

| General Trial Information          |                                  |                                     |                                  |
|------------------------------------|----------------------------------|-------------------------------------|----------------------------------|
| Study Director: Tom Mueller        |                                  |                                     |                                  |
| Investigator: Tom Mueller          |                                  |                                     |                                  |
| Discipline: <sup>H</sup> herbicide |                                  |                                     |                                  |
| Trial Status: F one-year/final     |                                  |                                     |                                  |
| Initiation Date: 4/23/2010         |                                  | Planned Completion Date: 12/15/2010 |                                  |
| Personnel                          |                                  |                                     |                                  |
| Study Director: Tom Mueller        |                                  |                                     |                                  |
| Investigator: Tom Mueller          |                                  |                                     |                                  |
| Crop Description                   |                                  |                                     |                                  |
| Crop 1:                            | GLXMA Glycine max                | Soybean                             |                                  |
|                                    | Variety: Allen and 5601T         |                                     | Description: RR and conventional |
|                                    | BBCH Scale: BSOY                 |                                     | Planting Date: 4/23/2010         |
|                                    | Planting Method: PLANTD          | planted                             | Rate, Unit: 45 LB/A              |
|                                    | Depth, Unit: 1.5                 | in                                  |                                  |
|                                    | Row Spacing, Unit: 30            | in                                  | Spacing Within Row, Unit: 3      |
|                                    | Seed Bed: MEDIUM                 | medium                              | in                               |
|                                    | Harvest Date: 11/11/2010         |                                     | Harvest Equipment: plot combine  |
|                                    | Harvested Width, Unit: 5         | ft                                  | Harvested Length, Unit: 35       |
|                                    | % Standard Moisture: 13.5        |                                     | ft                               |
|                                    | Weighing Equipment: plot combine |                                     | Moisture Meter: plot combine     |
| Site and Design                    |                                  |                                     |                                  |
| Plot Width, Unit: 10               | FT                               | Site Type: FIELD                    | field                            |
| Plot Length, Unit: 35              | FT                               | Experimental Unit: 1                | PLOT plot                        |
| Plot Area, Unit: 350               | FT2                              | Tillage Type: NOTILL                | no-till                          |
| Replications: 4                    |                                  | Study Design: SPLPLO                | Split-Plot                       |
| Soil Description                   |                                  |                                     |                                  |
| Description Name: Sequatchie       |                                  |                                     |                                  |
| % Sand: 36                         | % OM: 1.4                        | Texture: L                          | loam                             |
| % Silt: 46                         | pH: 6.3                          | Soil Name: Sequatchie               |                                  |
| % Clay: 18                         | CEC: 9                           | Fert. Level: G                      | good                             |
|                                    |                                  | Soil Drainage: G                    | good                             |

**Table 7. PSU 10 Application Description**

|                        | A         | B         | C        |
|------------------------|-----------|-----------|----------|
| Application Date:      | 4/23/2010 | 5/11/2010 | 6/4/2010 |
| Time of Day:           | 10:00 AM  | 9:00 AM   | 7:45 AM  |
| Application Method:    | SPRAY     | SPRAY     | SPRAY    |
| Application Timing:    | PREMC R   | POEMC R   | POEMC R  |
| Application Placement: | BROSOI    | BROADC    | BROADC   |
| Applied By:            | TCM       | TCM       | TCM      |

**Table 8. PSU 10 Application Equipment**

|                                      | <b>A</b>        | <b>B</b>        | <b>C</b>        |
|--------------------------------------|-----------------|-----------------|-----------------|
| <b>Appl. Equipment:</b>              | TCM-6<br>Nozzle | TCM-6<br>Nozzle | TCM-6<br>Nozzle |
| <b>Equipment Type:</b>               | BACMAN          | BACMAN          | BACMAN          |
| <b>Operation Pressure,<br/>Unit:</b> | 40      PSI     | 40      PSI     | 40      PSI     |
| <b>Nozzle Type:</b>                  | flat fan        | flat fan        | flat fan        |
| <b>Nozzle Size:</b>                  | 8002            | 8002            | 8002            |
| <b>Nozzle Spacing, Unit:</b>         | 19   in         | 19   in         | 19   in         |
| <b>Nozzles/Row:</b>                  | 2               | 2               | 2               |
| <b>% Coverage:</b>                   | 100             | 100             | 100             |
| <b>Boom Length, Unit:</b>            | 10   ft         | 10   ft         | 10   ft         |
| <b>Boom Height, Unit:</b>            | 20   in         | 20   in         | 20   in         |
| <b>Ground Speed, Unit:</b>           | 3   MPH         | 3   MPH         | 3   MPH         |
| <b>Carrier:</b>                      | WATER           | WATER           | WATER           |
| <b>Spray Volume, Unit:</b>           | 20   gal/ac     | 20   gal/ac     | 20   gal/ac     |
| <b>Mix Size, Unit:</b>               | 3   liters      | 3   liters      | 3   liters      |
| <b>Propellant:</b>                   | COMCO2          | COMCO2          | COMCO2          |

**Table 9.** PSU 10 Yield in Bushel/Acre of Replication 1

|                                                                                                                                                                                                                              |                |                                 |              |           |           |              |      |           |              |             |          |                                                                                                                            |         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------|--------------|-----------|-----------|--------------|------|-----------|--------------|-------------|----------|----------------------------------------------------------------------------------------------------------------------------|---------|
| Crop Code<br>BBCH Scale<br>Crop Scientific Name<br>Crop Name<br>Part Rated<br>Rating Date<br>Rating Type<br>Rating Unit<br>Number of Subsamples<br>Days After First/Last Applic.<br>Trt-Eval Interval<br>Plant-Eval Interval |                |                                 |              |           |           |              |      |           |              |             |          | GLXMA<br>BSOY<br>Glycine max<br>Soybean<br>YIELD C<br>11/11/2010<br>YIELD<br>bu/ac<br>1<br>202 160<br>202 DA-A<br>202 DP-1 |         |
| Trt No.                                                                                                                                                                                                                      | Treatment Type | Treatment Name                  | Form Conc    | Form Unit | Form Type | Rate Rate    | Unit | Appl Code | Spray Volume | Volume Unit | Mix Size | Mix Unit                                                                                                                   | 1       |
| 6 VAR                                                                                                                                                                                                                        | HERB           | Allen-LOW Roundup WeatherMax    | 5.5 LB/GAL   |           | SL        | 23 fl oz/a   |      | B         | 20 GAL/AC    |             | 3 Liters |                                                                                                                            | 32.98 c |
| 7 VAR                                                                                                                                                                                                                        | HERB           | Allen-MEDIUM Roundup WeatherMax | 5.5 LB/GAL   |           | SL        | 23 fl oz/a   |      | B         | 20 GAL/AC    |             | 3 Liters |                                                                                                                            | 57.23 a |
|                                                                                                                                                                                                                              | HERB           | Roundup WeatherMax              | 5.5 LB/GAL   |           | SL        | 23 fl oz/a   |      | C         | 20 GAL/AC    |             | 3 Liters |                                                                                                                            |         |
| 5 VAR                                                                                                                                                                                                                        | CHK            | Allen-UTC untreated             |              |           |           |              |      |           |              |             |          |                                                                                                                            | 18.15 d |
| 8 VAR                                                                                                                                                                                                                        | HERB           | Allen-HIGH Roundup WeatherMax   | 5.5 LB/GAL   |           | SL        | 23 fl oz/a   |      | B         | 20 GAL/AC    |             | 3 Liters |                                                                                                                            | 58.93 a |
|                                                                                                                                                                                                                              | HERB           | Roundup WeatherMax              | 5.5 LB/GAL   |           | SL        | 23 fl oz/a   |      | C         | 20 GAL/AC    |             | 3 Liters |                                                                                                                            |         |
|                                                                                                                                                                                                                              | CULT           | PLUS HANDWEED                   |              |           |           |              |      |           |              |             |          |                                                                                                                            |         |
| 3 VAR                                                                                                                                                                                                                        | HERB           | 5601T-MEDIUM Squadron           | 2.33 LBA/GAL |           | EC        | 3 pt/a       |      | A         | 20 GAL/AC    |             | 3 Liters |                                                                                                                            | 48.65 b |
|                                                                                                                                                                                                                              | HERB           | Select Max                      | 0.97 LBA/GAL |           | EC        | 12 fl oz/a   |      | B         | 20 GAL/AC    |             | 3 Liters |                                                                                                                            |         |
|                                                                                                                                                                                                                              | HERB           | Pursuit 70 dg                   | 70 %         |           | DF        | 1.44 oz wt/a |      | B         | 20 GAL/AC    |             | 3 Liters |                                                                                                                            |         |
|                                                                                                                                                                                                                              | ADJ            | NIS                             | 100 %        |           | SL        | 0.25 % v/v   |      | B         | 20 GAL/AC    |             | 3 Liters |                                                                                                                            |         |
| 2 VAR                                                                                                                                                                                                                        | HERB           | 5601T-LOW Squadron              | 2.33 LBA/GAL |           | EC        | 3 pt/a       |      | A         | 20 GAL/AC    |             | 3 Liters |                                                                                                                            | 39.73 c |
| 1 VAR                                                                                                                                                                                                                        | CHK            | 5601T-UTC untreated             |              |           |           |              |      |           |              |             |          |                                                                                                                            | 16.78 d |

|                    |                |                     |              |           |           |              |      |           |              |             |          |          |          |
|--------------------|----------------|---------------------|--------------|-----------|-----------|--------------|------|-----------|--------------|-------------|----------|----------|----------|
| Trt No.            | Treatment Type | Treatment Name      | Form Conc    | Form Unit | Form Type | Rate Rate    | Unit | Appl Code | Spray Volume | Volume Unit | Mix Size | Mix Unit | 1        |
| 4 VAR              | HERB           | 5601T-HIGH Squadron | 2.33 LBA/GAL |           | EC        | 3 pt/a       |      | A         | 20 GAL/AC    |             | 3 Liters |          | 50.55 ab |
|                    | HERB           | Select Max          | 0.97 LBA/GAL |           | EC        | 12 fl oz/a   |      | B         | 20 GAL/AC    |             | 3 Liters |          |          |
|                    | HERB           | Pursuit 70 dg       | 70 %         |           | DF        | 1.44 oz wt/a |      | B         | 20 GAL/AC    |             | 3 Liters |          |          |
|                    | ADJ            | NIS                 | 100 %        |           | SL        | 0.25 % v/v   |      | B         | 20 GAL/AC    |             | 3 Liters |          |          |
|                    | CULT           | PLUS HANDWEED       |              |           |           |              |      |           |              |             |          |          |          |
| LSD (P=.05)        |                |                     |              |           |           |              |      |           |              |             |          |          | 8.386    |
| Standard Deviation |                |                     |              |           |           |              |      |           |              |             |          |          | 5.645    |
| CV                 |                |                     |              |           |           |              |      |           |              |             |          |          | 13.98    |
| Bartlett's X2      |                |                     |              |           |           |              |      |           |              |             |          |          | 14.424   |
| P(Bartlett's X2)   |                |                     |              |           |           |              |      |           |              |             |          |          | 0.044*   |
| Replicate F        |                |                     |              |           |           |              |      |           |              |             |          |          | 0.525    |
| Replicate Prob(F)  |                |                     |              |           |           |              |      |           |              |             |          |          | 0.6707   |
| Treatment F        |                |                     |              |           |           |              |      |           |              |             |          |          | 34.186   |
| Treatment Prob(F)  |                |                     |              |           |           |              |      |           |              |             |          |          | 0.0001   |

**Table 10.** PSU Yield in Bushel/Acre of Replication 2

| Crop Code<br>BBCH Scale<br>Crop Scientific Name<br>Crop Name<br>Part Rated<br>Rating Date<br>Rating Type<br>Rating Unit<br>Number of Subsamples<br>Days After First/Last Applic.<br>Trt-Eval Interval<br>Plant-Eval Interval |      |                                 |           |           |           |                |           |              |             |          |          |                          | GLXMA<br>BSOY<br>Glycine max<br>Soybean<br>YIELD C<br>11/11/2010<br>YIELD<br>bu/ac<br>1<br>202 160<br>202 DA-A<br>202 DP-1 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------|-----------|-----------|-----------|----------------|-----------|--------------|-------------|----------|----------|--------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Trt No.                                                                                                                                                                                                                      | Type | Treatment Name                  | Form Conc | Form Unit | Form Type | Rate Rate Unit | Appl Code | Spray Volume | Volume Unit | Mix Size | Mix Unit | Plot                     | 1                                                                                                                          |
| 6 VAR                                                                                                                                                                                                                        | HERB | Allen-LOW Roundup WeatherMax    | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | B         | 20           | GAL/AC      | 3        | Liters   | 101<br>204<br>303<br>403 | 23.80<br>41.40<br>37.40<br>29.30                                                                                           |
| Mean =                                                                                                                                                                                                                       |      |                                 |           |           |           |                |           |              |             |          |          |                          | 32.98                                                                                                                      |
| 7 VAR                                                                                                                                                                                                                        | HERB | Allen-MEDIUM Roundup WeatherMax | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | B         | 20           | GAL/AC      | 3        | Liters   | 102<br>202               | 56.00<br>57.80                                                                                                             |
|                                                                                                                                                                                                                              | HERB | Roundup WeatherMax              | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | C         | 20           | GAL/AC      | 3        | Liters   | 304<br>404               | 60.10<br>55.00                                                                                                             |
| Mean =                                                                                                                                                                                                                       |      |                                 |           |           |           |                |           |              |             |          |          |                          | 57.23                                                                                                                      |
| 5 VAR                                                                                                                                                                                                                        | CHK  | Allen-UTC untreated             |           |           |           |                |           |              |             |          |          | 103<br>203<br>301<br>402 | 13.10<br>17.60<br>19.70<br>22.20                                                                                           |
| Mean =                                                                                                                                                                                                                       |      |                                 |           |           |           |                |           |              |             |          |          |                          | 18.15                                                                                                                      |
| 8 VAR                                                                                                                                                                                                                        | HERB | Allen-HIGH Roundup WeatherMax   | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | B         | 20           | GAL/AC      | 3        | Liters   | 104<br>201               | 56.30<br>61.40                                                                                                             |
|                                                                                                                                                                                                                              | HERB | Roundup WeatherMax              | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | C         | 20           | GAL/AC      | 3        | Liters   | 302                      | 57.40                                                                                                                      |
|                                                                                                                                                                                                                              | CULT | PLUS HANDWEED                   |           |           |           |                |           |              |             |          |          | 401                      | 60.60                                                                                                                      |
| Mean =                                                                                                                                                                                                                       |      |                                 |           |           |           |                |           |              |             |          |          |                          | 58.93                                                                                                                      |

| Trt No. | Type | Treatment Name        | Form Conc | Form Unit | Form Type | Rate Rate Unit | Appl Code | Spray Volume | Volume Unit | Mix Size | Mix Unit | Plot                     | 1                                |
|---------|------|-----------------------|-----------|-----------|-----------|----------------|-----------|--------------|-------------|----------|----------|--------------------------|----------------------------------|
| 3 VAR   | HERB | 5601T-MEDIUM Squadron | 2.33      | LBA/GAL   | EC        | 3 pt/a         | A         | 20           | GAL/AC      | 3        | Liters   | 105<br>208               | 54.70<br>38.40                   |
|         | HERB | Select Max            | 0.97      | LBA/GAL   | EC        | 12 fl oz/a     | B         | 20           | GAL/AC      | 3        | Liters   | 306                      | 54.10                            |
|         | HERB | Pursuit 70 dg         | 70 %      |           | DF        | 1.44 oz wt/a   | B         | 20           | GAL/AC      | 3        | Liters   | 406                      | 47.40                            |
|         | ADJ  | NIS                   | 100 %     |           | SL        | 0.25 % v/v     | B         | 20           | GAL/AC      | 3        | Liters   |                          |                                  |
| Mean =  |      |                       |           |           |           |                |           |              |             |          |          |                          | 48.65                            |
| 2 VAR   | HERB | 5601T-LOW Squadron    | 2.33      | LBA/GAL   | EC        | 3 pt/a         | A         | 20           | GAL/AC      | 3        | Liters   | 106<br>206<br>305<br>405 | 34.30<br>29.00<br>47.30<br>48.30 |
| Mean =  |      |                       |           |           |           |                |           |              |             |          |          |                          | 39.73                            |
| 1 VAR   | CHK  | 5601T-UTC untreated   |           |           |           |                |           |              |             |          |          | 107<br>207<br>308<br>407 | 18.20<br>15.40<br>17.60<br>15.90 |
| Mean =  |      |                       |           |           |           |                |           |              |             |          |          |                          | 16.78                            |
| 4 VAR   | HERB | 5601T-HIGH Squadron   | 2.33      | LBA/GAL   | EC        | 3 pt/a         | A         | 20           | GAL/AC      | 3        | Liters   | 108<br>205               | 55.40<br>53.80                   |
|         | HERB | Select Max            | 0.97      | LBA/GAL   | EC        | 12 fl oz/a     | B         | 20           | GAL/AC      | 3        | Liters   | 307                      | 42.40                            |
|         | HERB | Pursuit 70 dg         | 70 %      |           | DF        | 1.44 oz wt/a   | B         | 20           | GAL/AC      | 3        | Liters   | 408                      | 50.60                            |
|         | ADJ  | NIS                   | 100 %     |           | SL        | 0.25 % v/v     | B         | 20           | GAL/AC      | 3        | Liters   |                          |                                  |
|         | CULT | PLUS HANDWEED         |           |           |           |                |           |              |             |          |          |                          |                                  |
| Mean =  |      |                       |           |           |           |                |           |              |             |          |          |                          | 50.55                            |

**Table 11.** HU 10 Field Trial Protocol

| Trt No. | Type | Treatment Name     | Form Conc    | Form Unit | Form Type | Rate Unit    | Appl Code | Spray Volume Unit | Mix Size Unit | Mix Unit | Amt Product to Measure | Rep 1 | 2   | 3   | 4   |
|---------|------|--------------------|--------------|-----------|-----------|--------------|-----------|-------------------|---------------|----------|------------------------|-------|-----|-----|-----|
| 3       | VAR  | 5601T-MEDIUM       |              |           |           |              |           |                   |               |          |                        | 101   | 208 | 306 | 406 |
|         | HERB | Squadron           | 2.33 LBA/GAL | EC        |           | 3 pt/a       | A         | 20 GAL/AC         |               | 3 Liters | 56.24 ml/mx            |       |     |     |     |
|         | HERB | Select Max         | 0.97 LBA/GAL | EC        |           | 12 fl oz/a   | B         | 20 GAL/AC         |               | 3 Liters | 14.06 ml/mx            |       |     |     |     |
|         | HERB | Pursuit 70 dg      | 70 %         | DF        |           | 1.44 oz wt/a | B         | 20 GAL/AC         |               | 3 Liters | 1.618 g/mx             |       |     |     |     |
|         | ADJ  | NIS                | 100 %        | SL        |           | 0.25 % v/v   | B         | 20 GAL/AC         |               | 3 Liters | 7.499 ml/mx            |       |     |     |     |
| 2       | VAR  | 5601T-LOW          |              |           |           |              |           |                   |               |          |                        | 102   | 206 | 305 | 405 |
|         | HERB | Squadron           | 2.33 LBA/GAL | EC        |           | 3 pt/a       | A         | 20 GAL/AC         |               | 3 Liters | 56.24 ml/mx            |       |     |     |     |
| 1       | VAR  | 5601T-UTC          |              |           |           |              |           |                   |               |          |                        | 103   | 207 | 308 | 407 |
|         | CHK  | untreated          |              |           |           |              |           |                   |               |          |                        |       |     |     |     |
| 4       | VAR  | 5601T-HIGH         |              |           |           |              |           |                   |               |          |                        | 104   | 205 | 307 | 408 |
|         | HERB | Squadron           | 2.33 LBA/GAL | EC        |           | 3 pt/a       | A         | 20 GAL/AC         |               | 3 Liters | 56.24 ml/mx            |       |     |     |     |
|         | HERB | Select Max         | 0.97 LBA/GAL | EC        |           | 12 fl oz/a   | B         | 20 GAL/AC         |               | 3 Liters | 14.06 ml/mx            |       |     |     |     |
|         | HERB | Pursuit 70 dg      | 70 %         | DF        |           | 1.44 oz wt/a | B         | 20 GAL/AC         |               | 3 Liters | 1.618 g/mx             |       |     |     |     |
|         | ADJ  | NIS                | 100 %        | SL        |           | 0.25 % v/v   | B         | 20 GAL/AC         |               | 3 Liters | 7.499 ml/mx            |       |     |     |     |
|         | CULT | PLUS HANDWEED      |              |           |           |              |           |                   |               |          |                        |       |     |     |     |
| 8       | VAR  | Allen-HIGH         |              |           |           |              |           |                   |               |          |                        | 105   | 201 | 302 | 401 |
|         | HERB | Roundup WeatherMax | 5.5 LB/GAL   | SL        |           | 23 fl oz/a   | B         | 20 GAL/AC         |               | 3 Liters | 26.95 ml/mx            |       |     |     |     |
|         | HERB | Roundup WeatherMax | 5.5 LB/GAL   | SL        |           | 23 fl oz/a   | C         | 20 GAL/AC         |               | 3 Liters | 26.95 ml/mx            |       |     |     |     |
|         | CULT | PLUS HANDWEED      |              |           |           |              |           |                   |               |          |                        |       |     |     |     |
| 7       | VAR  | Allen-MEDIUM       |              |           |           |              |           |                   |               |          |                        | 106   | 202 | 304 | 404 |
|         | HERB | Roundup WeatherMax | 5.5 LB/GAL   | SL        |           | 23 fl oz/a   | B         | 20 GAL/AC         |               | 3 Liters | 26.95 ml/mx            |       |     |     |     |
|         | HERB | Roundup WeatherMax | 5.5 LB/GAL   | SL        |           | 23 fl oz/a   | C         | 20 GAL/AC         |               | 3 Liters | 26.95 ml/mx            |       |     |     |     |
| 5       | VAR  | Allen-UTC          |              |           |           |              |           |                   |               |          |                        | 107   | 203 | 301 | 402 |
|         | CHK  | untreated          |              |           |           |              |           |                   |               |          |                        |       |     |     |     |
| 6       | VAR  | Allen-LOW          |              |           |           |              |           |                   |               |          |                        | 108   | 204 | 303 | 403 |
|         | HERB | Roundup WeatherMax | 5.5 LB/GAL   | SL        |           | 23 fl oz/a   | B         | 20 GAL/AC         |               | 3 Liters | 26.95 ml/mx            |       |     |     |     |

**Table 12.** HU 10 Field Trial Location Information

| General Trial Information                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                      |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Study Director: Tom Mueller<br>Investigator: Tom Mueller                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                      |  |
| Personnel                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                      |  |
| Study Director: Tom Mueller<br>Investigator: Tom Mueller                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                      |  |
| Crop Description                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                      |  |
| Crop 1:                                                                                                                                                                                                                                | GLXMA Glycine max<br>Variety: Allen and 5601T<br>BBCH Scale: BSOY<br>Planting Method: PLANTD planted<br>Depth, Unit: 1.5 in<br>Row Spacing, Unit: 30 in<br>Seed Bed: MEDIUM medium<br>Harvest Date: 11/2/2010<br>Harvested Width, Unit: 5 ft<br>% Standard Moisture: 13.5<br>Weighing Equipment: plot combine | Soybean<br>Description: RR and conventional<br>Planting Date: 4/30/2010<br>Rate, Unit: 45 LB/A<br>Spacing Within Row, Unit: 3 in<br>Harvest Equipment: plot combine<br>Harvested Length, Unit: 35 ft<br>Moisture Meter: plot combine |  |
| Site and Design                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                      |  |
| Plot Width, Unit: 10 FT<br>Plot Length, Unit: 35 FT<br>Plot Area, Unit: 350 FT2<br>Replications: 4                                                                                                                                     | Site Type: FIELD field<br>Experimental Unit: 1 PLOT plot<br>Tillage Type: NOTILL no-till<br>Study Design: SPLPLO Split-Plot                                                                                                                                                                                   |                                                                                                                                                                                                                                      |  |
| Field Prep./Maintenance:                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                      |  |
| on september 2, 20110 (9-2-10) sprayed Warrior on all plots for grasshopper control. loaded 40 mL of Warrior product into a 3 gallon Stainless Steel tank and sprayed with tractor boom over-hanging plots. used 8002 nozzles on boom. |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                      |  |
| Soil Description                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                      |  |
| Description Name: Sequatchie<br>% Sand: 36 % OM: 1.4 Texture: L loam<br>% Silt: 46 pH: 6.3 Soil Name: Sequatchie<br>% Clay: 18 CEC: 9 Fert. Level: G good<br>Soil Drainage: G good                                                     |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                      |  |

**Table 13.** HU 10 Application Description

|                        | A         | B         | C        |
|------------------------|-----------|-----------|----------|
| Application Date:      | 4/30/2010 | 5/28/2010 | 6/9/2010 |
| Time of Day:           | 1:30 pm   | 11:45 AM  | 9:15 am  |
| Application Method:    | SPRAY     | SPRAY     | SPRAY    |
| Application Timing:    | PREMCR    | POEMCR    | POEMCR   |
| Application Placement: | BROSOI    | BROADC    | BROADC   |
| Applied By:            | TCM       | TCM       | TCM      |

**Table 14.** HU 10 Application Equipment

|                                  | <b>A</b>     | <b>B</b>     | <b>C</b>     |
|----------------------------------|--------------|--------------|--------------|
| <b>Appl. Equipment:</b>          | TCM-6 Nozzle | TCM-6 Nozzle | TCM-6 Nozzle |
| <b>Equipment Type:</b>           | BACMAN       | BACMAN       | BACMAN       |
| <b>Operation Pressure, Unit:</b> | 40 PSI       | 40 PSI       | 40 PSI       |
| <b>Nozzle Type:</b>              | flat fan     | flat fan     | flat fan     |
| <b>Nozzle Size:</b>              | 8002         | 8002         | 8002         |
| <b>Nozzle Spacing, Unit:</b>     | 19 in        | 19 in        | 19 in        |
| <b>Nozzles/Row:</b>              | 2            | 2            | 2            |
| <b>% Coverage:</b>               | 100          | 100          | 100          |
| <b>Boom Length, Unit:</b>        | 10 ft        | 10 ft        | 10 ft        |
| <b>Boom Height, Unit:</b>        | 20 in        | 20 in        | 20 in        |
| <b>Ground Speed, Unit:</b>       | 3 MPH        | 3 MPH        | 3 MPH        |
| <b>Carrier:</b>                  | WATER        | WATER        | WATER        |
| <b>Spray Volume, Unit:</b>       | 20 gal/ac    | 20 gal/ac    | 20 gal/ac    |
| <b>Mix Size, Unit:</b>           | 3 liters     | 3 liters     | 3 liters     |
| <b>Propellant:</b>               | COMCO2       | COMCO2       | COMCO2       |

**Table 15.** HU 10 Yield in Bushel/Acre Replication 1

| Crop Code                     |                         |           |           |           |                |           |              |             |                   | GLXMA       |
|-------------------------------|-------------------------|-----------|-----------|-----------|----------------|-----------|--------------|-------------|-------------------|-------------|
| BBCH Scale                    |                         |           |           |           |                |           |              |             |                   | BSOY        |
| Crop Scientific Name          |                         |           |           |           |                |           |              |             |                   | Glycine max |
| Crop Name                     |                         |           |           |           |                |           |              |             |                   | Soybean     |
| Part Rated                    |                         |           |           |           |                |           |              |             |                   | YIELD C     |
| Rating Date                   |                         |           |           |           |                |           |              |             |                   | 11/2/2010   |
| Rating Type                   |                         |           |           |           |                |           |              |             |                   | YIELD       |
| Rating Unit                   |                         |           |           |           |                |           |              |             |                   | bu/ac       |
| Number of Subsamples          |                         |           |           |           |                |           |              |             |                   | 1           |
| Days After First/Last Applic. |                         |           |           |           |                |           |              |             |                   | 186 146     |
| Plant-Eval Interval           |                         |           |           |           |                |           |              |             |                   | 186 DP-1    |
| Trt No. Type                  | Treatment Name          | Form Conc | Form Unit | Form Type | Rate Rate Unit | Appl Code | Spray Volume | Volume Unit | Mix Mix Size Unit |             |
| 3 VAR                         | 5601T-MEDIUM            |           |           |           |                |           |              |             |                   | 1           |
|                               | HERB Squadron           | 2.33      | LBA/GAL   | EC        | 3 pt/a         | A         |              | 20 GAL/AC   | 3 Liters          | 62.48 a     |
|                               | HERB Select Max         | 0.97      | LBA/GAL   | EC        | 12 fl oz/a     | B         |              | 20 GAL/AC   | 3 Liters          |             |
|                               | HERB Pursuit 70 dg      | 70 %      |           | DF        | 1.44 oz wt/a   | B         |              | 20 GAL/AC   | 3 Liters          |             |
|                               | ADJ NIS                 | 100 %     |           | SL        | 0.25 % v/v     | B         |              | 20 GAL/AC   | 3 Liters          |             |
| 2 VAR                         | 5601T-LOW               |           |           |           |                |           |              |             |                   | 29.40 b     |
|                               | HERB Squadron           | 2.33      | LBA/GAL   | EC        | 3 pt/a         | A         |              | 20 GAL/AC   | 3 Liters          |             |
| 1 VAR                         | 5601T-UTC               |           |           |           |                |           |              |             |                   | 6.85 c      |
|                               | CHK untreated           |           |           |           |                |           |              |             |                   |             |
| 4 VAR                         | 5601T-HIGH              |           |           |           |                |           |              |             |                   | 64.90 a     |
|                               | HERB Squadron           | 2.33      | LBA/GAL   | EC        | 3 pt/a         | A         |              | 20 GAL/AC   | 3 Liters          |             |
|                               | HERB Select Max         | 0.97      | LBA/GAL   | EC        | 12 fl oz/a     | B         |              | 20 GAL/AC   | 3 Liters          |             |
|                               | HERB Pursuit 70 dg      | 70 %      |           | DF        | 1.44 oz wt/a   | B         |              | 20 GAL/AC   | 3 Liters          |             |
|                               | ADJ NIS                 | 100 %     |           | SL        | 0.25 % v/v     | B         |              | 20 GAL/AC   | 3 Liters          |             |
|                               | CULT PLUS HANDWEED      |           |           |           |                |           |              |             |                   |             |
| 8 VAR                         | Allen-HIGH              |           |           |           |                |           |              |             |                   | 71.30 a     |
|                               | HERB Roundup WeatherMax | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | B         |              | 20 GAL/AC   | 3 Liters          |             |
|                               | HERB Roundup WeatherMax | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | C         |              | 20 GAL/AC   | 3 Liters          |             |
|                               | CULT PLUS HANDWEED      |           |           |           |                |           |              |             |                   |             |
| 7 VAR                         | Allen-MEDIUM            |           |           |           |                |           |              |             |                   | 65.83 a     |
|                               | HERB Roundup WeatherMax | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | B         |              | 20 GAL/AC   | 3 Liters          |             |
|                               | HERB Roundup WeatherMax | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | C         |              | 20 GAL/AC   | 3 Liters          |             |
| 5 VAR                         | Allen-UTC               |           |           |           |                |           |              |             |                   | 4.93 c      |
|                               | CHK untreated           |           |           |           |                |           |              |             |                   |             |
| 6 VAR                         | Allen-LOW               |           |           |           |                |           |              |             |                   | 31.85 b     |
|                               | HERB Roundup WeatherMax | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | B         |              | 20 GAL/AC   | 3 Liters          |             |
| LSD (P=.05)                   |                         |           |           |           |                |           |              |             |                   | 11.997      |
| Standard Deviation            |                         |           |           |           |                |           |              |             |                   | 8.076       |
| CV                            |                         |           |           |           |                |           |              |             |                   | 19.14       |
| Bartlett's X2                 |                         |           |           |           |                |           |              |             |                   | 35.405      |
| P(Bartlett's X2)              |                         |           |           |           |                |           |              |             |                   | 0.001*      |
| Replicate F                   |                         |           |           |           |                |           |              |             |                   | 2.104       |
| Replicate Prob(F)             |                         |           |           |           |                |           |              |             |                   | 0.1355      |
| Treatment F                   |                         |           |           |           |                |           |              |             |                   | 45.925      |
| Treatment Prob(F)             |                         |           |           |           |                |           |              |             |                   | 0.0001      |

**Table 16.** HU 10 Yield in Bushel/Acre Replication 2

|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          |                                                                                                               |       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------|-----------|-----------|----------------|-----------|--------------|-------------|----------|----------|---------------------------------------------------------------------------------------------------------------|-------|
| Crop Code<br>BBCH Scale<br>Crop Scientific Name<br>Crop Name<br>Part Rated<br>Rating Date<br>Rating Type<br>Rating Unit<br>Number of Subsamples<br>Days After First/Last Applic.<br>Plant-Eval Interval |                         |           |           |           |                |           |              |             |          |          | GLXMA<br>BSOY<br>Glycine max<br>Soybean<br>YIELD C<br>11/2/2010<br>YIELD<br>bu/ac<br>1<br>186 146<br>186 DP-1 |       |
| Trt No.                                                                                                                                                                                                 | Treatment Name          | Form Conc | Form Unit | Form Type | Rate Rate Unit | Appl Code | Spray Volume | Volume Unit | Mix Size | Mix Unit | Plot                                                                                                          | 1     |
| 3 VAR                                                                                                                                                                                                   | 5601T-MEDIUM            |           |           |           |                |           |              |             |          |          | 101                                                                                                           | 65.90 |
|                                                                                                                                                                                                         | HERB Squadron           | 2.33      | LBA/GAL   | EC        | 3 pt/a         | A         | 20           | GAL/AC      | 3        | Liters   | 208                                                                                                           | 58.30 |
|                                                                                                                                                                                                         | HERB Select Max         | 0.97      | LBA/GAL   | EC        | 12 fl oz/a     | B         | 20           | GAL/AC      | 3        | Liters   | 306                                                                                                           | 73.70 |
|                                                                                                                                                                                                         | HERB Pursuit 70 dg      | 70 %      |           | DF        | 1.44 oz wt/a   | B         | 20           | GAL/AC      | 3        | Liters   | 406                                                                                                           | 52.00 |
|                                                                                                                                                                                                         | ADJ NIS                 | 100 %     |           | SL        | 0.25 % v/v     | B         | 20           | GAL/AC      | 3        | Liters   |                                                                                                               |       |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | Mean =                                                                                                        | 62.48 |
| 2 VAR                                                                                                                                                                                                   | 5601T-LOW               |           |           |           |                |           |              |             |          |          | 102                                                                                                           | 15.20 |
|                                                                                                                                                                                                         | HERB Squadron           | 2.33      | LBA/GAL   | EC        | 3 pt/a         | A         | 20           | GAL/AC      | 3        | Liters   | 206                                                                                                           | 39.30 |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | 305                                                                                                           | 50.00 |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | 405                                                                                                           | 13.10 |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | Mean =                                                                                                        | 29.40 |
| 1 VAR                                                                                                                                                                                                   | 5601T-UTC               |           |           |           |                |           |              |             |          |          | 103                                                                                                           | 6.70  |
|                                                                                                                                                                                                         | CHK untreated           |           |           |           |                |           |              |             |          |          | 207                                                                                                           | 4.90  |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | 308                                                                                                           | 8.60  |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | 407                                                                                                           | 7.20  |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | Mean =                                                                                                        | 6.85  |
| 4 VAR                                                                                                                                                                                                   | 5601T-HIGH              |           |           |           |                |           |              |             |          |          | 104                                                                                                           | 63.80 |
|                                                                                                                                                                                                         | HERB Squadron           | 2.33      | LBA/GAL   | EC        | 3 pt/a         | A         | 20           | GAL/AC      | 3        | Liters   | 205                                                                                                           | 65.10 |
|                                                                                                                                                                                                         | HERB Select Max         | 0.97      | LBA/GAL   | EC        | 12 fl oz/a     | B         | 20           | GAL/AC      | 3        | Liters   | 307                                                                                                           | 65.70 |
|                                                                                                                                                                                                         | HERB Pursuit 70 dg      | 70 %      |           | DF        | 1.44 oz wt/a   | B         | 20           | GAL/AC      | 3        | Liters   | 408                                                                                                           | 65.00 |
|                                                                                                                                                                                                         | ADJ NIS                 | 100 %     |           | SL        | 0.25 % v/v     | B         | 20           | GAL/AC      | 3        | Liters   |                                                                                                               |       |
|                                                                                                                                                                                                         | CULT PLUS HANDWEED      |           |           |           |                |           |              |             |          |          |                                                                                                               |       |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | Mean =                                                                                                        | 64.90 |
| 8 VAR                                                                                                                                                                                                   | Allen-HIGH              |           |           |           |                |           |              |             |          |          | 105                                                                                                           | 65.00 |
|                                                                                                                                                                                                         | HERB Roundup WeatherMax | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | B         | 20           | GAL/AC      | 3        | Liters   | 201                                                                                                           | 67.90 |
|                                                                                                                                                                                                         | HERB Roundup WeatherMax | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | C         | 20           | GAL/AC      | 3        | Liters   | 302                                                                                                           | 80.00 |
|                                                                                                                                                                                                         | CULT PLUS HANDWEED      |           |           |           |                |           |              |             |          |          | 401                                                                                                           | 72.30 |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | Mean =                                                                                                        | 71.30 |
| 7 VAR                                                                                                                                                                                                   | Allen-MEDIUM            |           |           |           |                |           |              |             |          |          | 106                                                                                                           | 53.20 |
|                                                                                                                                                                                                         | HERB Roundup WeatherMax | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | B         | 20           | GAL/AC      | 3        | Liters   | 202                                                                                                           | 65.40 |
|                                                                                                                                                                                                         | HERB Roundup WeatherMax | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | C         | 20           | GAL/AC      | 3        | Liters   | 304                                                                                                           | 73.40 |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | 404                                                                                                           | 71.30 |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | Mean =                                                                                                        | 65.83 |
| 5 VAR                                                                                                                                                                                                   | Allen-UTC               |           |           |           |                |           |              |             |          |          | 107                                                                                                           | 5.40  |
|                                                                                                                                                                                                         | CHK untreated           |           |           |           |                |           |              |             |          |          | 203                                                                                                           | 4.50  |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | 301                                                                                                           | 5.30  |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | 402                                                                                                           | 4.50  |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | Mean =                                                                                                        | 4.93  |
| 6 VAR                                                                                                                                                                                                   | Allen-LOW               |           |           |           |                |           |              |             |          |          | 108                                                                                                           | 36.70 |
|                                                                                                                                                                                                         | HERB Roundup WeatherMax | 5.5       | LB/GAL    | SL        | 23 fl oz/a     | B         | 20           | GAL/AC      | 3        | Liters   | 204                                                                                                           | 19.70 |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | 303                                                                                                           | 29.50 |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | 403                                                                                                           | 41.50 |
|                                                                                                                                                                                                         |                         |           |           |           |                |           |              |             |          |          | Mean =                                                                                                        | 31.85 |

**Table 17. HU 11 Field Trial Protocol**

| Plots: 10 by 40 feet |      |                                        |             |           |           |              |           |           |              |             |          |          |                        |
|----------------------|------|----------------------------------------|-------------|-----------|-----------|--------------|-----------|-----------|--------------|-------------|----------|----------|------------------------|
| Trt No.              | Type | Treatment Name                         | Form Conc   | Form Unit | Form Type | Rate         | Rate Unit | Appl Code | Spray Volume | Volume Unit | Mix Size | Mix Unit | Amt Product to Measure |
| 1                    | CHK  | Conventional 5601T Untreated Check     |             |           |           |              |           |           |              |             |          |          |                        |
| 2                    | CHK  | Conventional 5601T Handweeded Check    |             |           |           |              |           |           |              |             |          |          |                        |
|                      | HERB | Squadron                               | 2.3 LBA/GAL | EC        |           | 3 pt/a       | A         |           | 20 GAL/AC    |             | 3 Liters |          | 56.24 ml/mx            |
|                      | HERB | Select Max                             | 0.97 LB/GAL | EC        |           | 12 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          | 14.06 ml/mx            |
|                      | HERB | Pursuit                                | 70 %        | DF        |           | 1.44 oz wt/a | C         |           | 20 GAL/AC    |             | 3 Liters |          | 1.618 g/mx             |
|                      | ADJ  | NIS                                    | 100 %       | SL        |           | 0.25 % v/v   | C         |           | 20 GAL/AC    |             | 3 Liters |          | 7.499 ml/mx            |
| 3                    | CHK  | Conventional 5601T low weed control    |             |           |           |              |           |           |              |             |          |          |                        |
|                      | HERB | Squadron                               | 2.3 LBA/GAL | EC        |           | 3 pt/a       | A         |           | 20 GAL/AC    |             | 3 Liters |          | 56.24 ml/mx            |
| 4                    | CHK  | Conventional 5601T medium weed control |             |           |           |              |           |           |              |             |          |          |                        |
|                      | HERB | Squadron                               | 2.3 LBA/GAL | EC        |           | 3 pt/a       | A         |           | 20 GAL/AC    |             | 3 Liters |          | 56.24 ml/mx            |
|                      | HERB | Select Max                             | 0.97 LB/GAL | EC        |           | 12 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          | 14.06 ml/mx            |
|                      | HERB | Pursuit                                | 70 %        | DF        |           | 1.44 oz wt/a | C         |           | 20 GAL/AC    |             | 3 Liters |          | 1.618 g/mx             |
|                      | ADJ  | NIS                                    | 100 %       | SL        |           | 0.25 % v/v   | C         |           | 20 GAL/AC    |             | 3 Liters |          | 7.499 ml/mx            |
| 5                    | CHK  | RoundupReady Allen Untreated Check     |             |           |           |              |           |           |              |             |          |          |                        |
| 6                    | CHK  | RoundupReady Allen Handweeded Check    |             |           |           |              |           |           |              |             |          |          |                        |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal | SL        |           | 23 fl oz/a   | B         |           | 20 GAL/AC    |             | 3 Liters |          | 26.95 ml/mx            |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal | SL        |           | 23 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          | 26.95 ml/mx            |
| 7                    | CHK  | RoundupReady Allen low weed control    |             |           |           |              |           |           |              |             |          |          |                        |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal | SL        |           | 23 fl oz/a   | B         |           | 20 GAL/AC    |             | 3 Liters |          | 26.95 ml/mx            |
| 8                    | CHK  | RoundupReady Allen medium weed control |             |           |           |              |           |           |              |             |          |          |                        |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal | SL        |           | 23 fl oz/a   | B         |           | 20 GAL/AC    |             | 3 Liters |          | 26.95 ml/mx            |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal | SL        |           | 23 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          | 26.95 ml/mx            |

**Table 18.** HU 11 Field Trial Location Information

| General Trial Information                                                                                                                                                          |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                     |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Study Director: Tom Mueller<br>Investigator: Tom Mueller                                                                                                                           |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                     |  |
| Personnel                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                     |  |
| Study Director: Tom Mueller<br>Investigator: Tom Mueller                                                                                                                           |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                     |  |
| Crop Description                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                     |  |
| Crop 1:                                                                                                                                                                            | GLXMA Glycine max<br>Variety: Allen and 5601T<br>BBCH Scale: BSOY<br>Planting Method: PLANTD planted<br>Depth, Unit: 1.5 in<br>Row Spacing, Unit: 30 in<br>Seed Bed: MEDIUM medium<br>Harvest Date: 11/2/2011<br>Harvested Width, Unit: 5 ft<br>% Standard Moisture: 13.5<br>Weighing Equipment: plot combine | Soybean<br>Description: RR and conventional<br>Planting Date: 5/9/2011<br>Rate, Unit: 45 LB/A<br>Spacing Within Row, Unit: 3 in<br>Harvest Equipment: plot combine<br>Harvested Length, Unit: 35 ft<br>Moisture Meter: plot combine |  |
| Site and Design                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                     |  |
| Plot Width, Unit: 10 FT<br>Plot Length, Unit: 40 FT<br>Plot Area, Unit: 400 FT2<br>Replications: 4                                                                                 | Site Type: FIELD field<br>Experimental Unit: 1<br>Tillage Type: NOTILL no-till<br>Study Design: SPLPLO Split-Plot                                                                                                                                                                                             | PLOT plot<br>no-till                                                                                                                                                                                                                |  |
| Soil Description                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                     |  |
| Description Name: Sequatchie<br>% Sand: 36 % OM: 1.4 Texture: L loam<br>% Silt: 46 pH: 6.3 Soil Name: Sequatchie<br>% Clay: 18 CEC: 9 Fert. Level: G good<br>Soil Drainage: G good |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                     |  |

**Table 19.** HU 11 Application Description

|                        | A        | B         | C        |
|------------------------|----------|-----------|----------|
| Application Date:      | 5/9/2011 | 5/31/2011 | 7/6/2011 |
| Time of Day:           | 1:30 PM  | 5:00 PM   | 8:30 AM  |
| Application Method:    | SPRAY    | SPRAY     | SPRAY    |
| Application Timing:    | PREMCR   | POEMCR    | POEMCR   |
| Application Placement: | BROSOI   | BROADC    | BROADC   |
| Applied By:            | TCM      | TCM       | TCM      |

**Table 20.** HU 11 Application Equipment

|                                  | <b>A</b>     | <b>B</b>     | <b>C</b>     |
|----------------------------------|--------------|--------------|--------------|
| <b>Appl. Equipment:</b>          | TCM-6 Nozzle | TCM-6 Nozzle | TCM-6 Nozzle |
| <b>Equipment Type:</b>           | BACMAN       | BACMAN       | BACMAN       |
| <b>Operation Pressure, Unit:</b> | 40 PSI       | 40 PSI       | 40 PSI       |
| <b>Nozzle Type:</b>              | flat fan     | flat fan     | flat fan     |
| <b>Nozzle Size:</b>              | 8002         | 8002         | 8002         |
| <b>Nozzle Spacing, Unit:</b>     | 19 in        | 19 in        | 19 in        |
| <b>Nozzles/Row:</b>              | 2            | 2            | 2            |
| <b>% Coverage:</b>               | 100          | 100          | 100          |
| <b>Boom Length, Unit:</b>        | 10 ft        | 10 ft        | 10 ft        |
| <b>Boom Height, Unit:</b>        | 20 in        | 20 in        | 20 in        |
| <b>Ground Speed, Unit:</b>       | 3 MPH        | 3 MPH        | 3 MPH        |
| <b>Carrier:</b>                  | WATER        | WATER        | WATER        |
| <b>Spray Volume, Unit:</b>       | 20 gal/ac    | 20 gal/ac    | 20 gal/ac    |
| <b>Mix Size, Unit:</b>           | 3 liters     | 3 liters     | 3 liters     |
| <b>Propellant:</b>               | COMCO2       | COMCO2       | COMCO2       |

**Table 21.** HU 11 Yield in Bushel/Acre of Replication 1

|                               |                |                                        |           |           |           |                |           |              |             |                   |             |
|-------------------------------|----------------|----------------------------------------|-----------|-----------|-----------|----------------|-----------|--------------|-------------|-------------------|-------------|
| Crop Code                     |                |                                        |           |           |           |                |           |              |             |                   | GLXMA       |
| BBCH Scale                    |                |                                        |           |           |           |                |           |              |             |                   | BSOY        |
| Crop Scientific Name          |                |                                        |           |           |           |                |           |              |             |                   | Glycine max |
| Crop Name                     |                |                                        |           |           |           |                |           |              |             |                   | Soybean     |
| Description                   |                |                                        |           |           |           |                |           |              |             |                   | yield       |
| Part Rated                    |                |                                        |           |           |           |                |           |              |             |                   | SEED C      |
| Rating Date                   |                |                                        |           |           |           |                |           |              |             |                   | 11/2/2011   |
| Rating Type                   |                |                                        |           |           |           |                |           |              |             |                   | YIELD       |
| Rating Unit                   |                |                                        |           |           |           |                |           |              |             |                   | bu/ac       |
| Number of Subsamples          |                |                                        |           |           |           |                |           |              |             |                   | 177 119     |
| Days After First/Last Applic. |                |                                        |           |           |           |                |           |              |             |                   | 177 DP-1    |
| Plant-Eval Interval           |                |                                        |           |           |           |                |           |              |             |                   |             |
| Trt No.                       | Treatment Type | Treatment Name                         | Form Conc | Form Unit | Form Type | Rate Rate Unit | Appl Code | Spray Volume | Volume Unit | Mix Mix Size Unit |             |
| 1                             | CHK            | Conventional 5601T Untreated Check     |           |           |           |                |           |              |             |                   | 16.15 c     |
| 2                             | CHK            | Conventional 5601T Handweeded Check    |           |           |           |                |           |              |             |                   | 48.90 a     |
|                               | HERB           | Squadron                               | 2.3       | LBA/GAL   | EC        | 3 pt/a         | A         | 20           | GAL/AC      | 3 Liters          |             |
|                               | HERB           | Select Max                             | 0.97      | LB/GAL    | EC        | 12 fl oz/a     | C         | 20           | GAL/AC      | 3 Liters          |             |
|                               | HERB           | Pursuit                                | 70        | %         | DF        | 1.44 oz wt/a   | C         | 20           | GAL/AC      | 3 Liters          |             |
|                               | ADJ            | NIS                                    | 100       | %         | SL        | 0.25 % v/v     | C         | 20           | GAL/AC      | 3 Liters          |             |
| 3                             |                | Conventional 5601T low weed control    |           |           |           |                |           |              |             |                   | 27.10 b     |
|                               | HERB           | Squadron                               | 2.3       | LBA/GAL   | EC        | 3 pt/a         | A         | 20           | GAL/AC      | 3 Liters          |             |
| 4                             |                | Conventional 5601T medium weed control |           |           |           |                |           |              |             |                   | 43.30 a     |
|                               | HERB           | Squadron                               | 2.3       | LBA/GAL   | EC        | 3 pt/a         | A         | 20           | GAL/AC      | 3 Liters          |             |
|                               | HERB           | Select Max                             | 0.97      | LB/GAL    | EC        | 12 fl oz/a     | C         | 20           | GAL/AC      | 3 Liters          |             |
|                               | HERB           | Pursuit                                | 70        | %         | DF        | 1.44 oz wt/a   | C         | 20           | GAL/AC      | 3 Liters          |             |
|                               | ADJ            | NIS                                    | 100       | %         | SL        | 0.25 % v/v     | C         | 20           | GAL/AC      | 3 Liters          |             |
| 5                             | CHK            | RoundupReady Allen Untreated Check     |           |           |           |                |           |              |             |                   | 13.98 c     |
| 6                             | CHK            | RoundupReady Allen Handweeded Check    |           |           |           |                |           |              |             |                   | 42.00 a     |
|                               | HERB           | Roundup WeatherMax                     | 5.5       | lba/gal   | SL        | 23 fl oz/a     | B         | 20           | GAL/AC      | 3 Liters          |             |
|                               | HERB           | Roundup WeatherMax                     | 5.5       | lba/gal   | SL        | 23 fl oz/a     | C         | 20           | GAL/AC      | 3 Liters          |             |
| 7                             |                | RoundupReady Allen low weed control    |           |           |           |                |           |              |             |                   | 25.80 b     |
|                               | HERB           | Roundup WeatherMax                     | 5.5       | lba/gal   | SL        | 23 fl oz/a     | B         | 20           | GAL/AC      | 3 Liters          |             |
| 8                             |                | RoundupReady Allen medium weed control |           |           |           |                |           |              |             |                   | 41.80 a     |
|                               | HERB           | Roundup WeatherMax                     | 5.5       | lba/gal   | SL        | 23 fl oz/a     | B         | 20           | GAL/AC      | 3 Liters          |             |
|                               | HERB           | Roundup WeatherMax                     | 5.5       | lba/gal   | SL        | 23 fl oz/a     | C         | 20           | GAL/AC      | 3 Liters          |             |
| LSD (P=.05)                   |                |                                        |           |           |           |                |           |              |             |                   | 7.185       |
| Standard Deviation            |                |                                        |           |           |           |                |           |              |             |                   | 4.836       |
| CV                            |                |                                        |           |           |           |                |           |              |             |                   | 14.94       |
| Bartlett's X2                 |                |                                        |           |           |           |                |           |              |             |                   | 6.85        |
| P(Bartlett's X2)              |                |                                        |           |           |           |                |           |              |             |                   | 0.445       |
| Replicate F                   |                |                                        |           |           |           |                |           |              |             |                   | 4.693       |
| Replicate Prob(F)             |                |                                        |           |           |           |                |           |              |             |                   | 0.0137      |
| Treatment F                   |                |                                        |           |           |           |                |           |              |             |                   | 30.462      |
| Treatment Prob(F)             |                |                                        |           |           |           |                |           |              |             |                   | 0.0001      |

**Table 22.** HU 11 Yield in Bushel/Acre of Replication 2

|                               |                     |             |           |           |                |           |              |             |          |          |        |       |             |
|-------------------------------|---------------------|-------------|-----------|-----------|----------------|-----------|--------------|-------------|----------|----------|--------|-------|-------------|
| Crop Code                     |                     |             |           |           |                |           |              |             |          |          |        |       | GLXMA       |
| BBCH Scale                    |                     |             |           |           |                |           |              |             |          |          |        |       | BSOY        |
| Crop Scientific Name          |                     |             |           |           |                |           |              |             |          |          |        |       | Glycine max |
| Crop Name                     |                     |             |           |           |                |           |              |             |          |          |        |       | Soybean     |
| Description                   |                     |             |           |           |                |           |              |             |          |          |        |       | yield       |
| Part Rated                    |                     |             |           |           |                |           |              |             |          |          |        |       | SEED C      |
| Rating Date                   |                     |             |           |           |                |           |              |             |          |          |        |       | 11/2/2011   |
| Rating Type                   |                     |             |           |           |                |           |              |             |          |          |        |       | YIELD       |
| Rating Unit                   |                     |             |           |           |                |           |              |             |          |          |        |       | bu/ac       |
| Number of Subsamples          |                     |             |           |           |                |           |              |             |          |          |        |       | 1           |
| Days After First/Last Applic. |                     |             |           |           |                |           |              |             |          |          |        |       | 177 119     |
| Plant-Eval Interval           |                     |             |           |           |                |           |              |             |          |          |        |       | 177 DP-     |
| Trt No.                       | Treatment Type      | Form Conc   | Form Unit | Form Type | Rate Rate Unit | Appl Code | Spray Volume | Volume Unit | Mix Size | Mix Unit | Plot   | 1     |             |
| 1                             | Conventional 5601T  |             |           |           |                |           |              |             |          |          | 101    | 22.40 |             |
| CHK                           | Untreated Check     |             |           |           |                |           |              |             |          |          | 206    | 11.40 |             |
|                               |                     |             |           |           |                |           |              |             |          |          | 302    | 14.30 |             |
|                               |                     |             |           |           |                |           |              |             |          |          | 401    | 16.50 |             |
|                               |                     |             |           |           |                |           |              |             |          |          | Mean = | 16.15 |             |
| 2                             | Conventional 5601T  |             |           |           |                |           |              |             |          |          | 102    | 48.50 |             |
| CHK                           | Handweeded Check    |             |           |           |                |           |              |             |          |          | 207    | 44.10 |             |
| HERB                          | Squadron            | 2.3 LBA/GAL | EC        |           | 3 pt/a         | A         |              | 20 GAL/AC   |          | 3 Liters | 304    | 53.00 |             |
| HERB                          | Select Max          | 0.97 LB/GAL | EC        |           | 12 fl oz/a     | C         |              | 20 GAL/AC   |          | 3 Liters | 402    | 50.00 |             |
| HERB                          | Pursuit             | 70 %        | DF        |           | 1.44 oz wt/a   | C         |              | 20 GAL/AC   |          | 3 Liters |        |       |             |
| ADJ                           | NIS                 | 100 %       | SL        |           | 0.25 % v/v     | C         |              | 20 GAL/AC   |          | 3 Liters |        |       |             |
|                               |                     |             |           |           |                |           |              |             |          |          | Mean = | 48.90 |             |
| 3                             | Conventional 5601T  |             |           |           |                |           |              |             |          |          | 103    | 38.60 |             |
|                               | low weed control    |             |           |           |                |           |              |             |          |          | 208    | 30.00 |             |
| HERB                          | Squadron            | 2.3 LBA/GAL | EC        |           | 3 pt/a         | A         |              | 20 GAL/AC   |          | 3 Liters | 303    | 22.80 |             |
|                               |                     |             |           |           |                |           |              |             |          |          | 404    | 17.00 |             |
|                               |                     |             |           |           |                |           |              |             |          |          | Mean = | 27.10 |             |
| 4                             | Conventional 5601T  |             |           |           |                |           |              |             |          |          | 104    | 43.90 |             |
|                               | medium weed control |             |           |           |                |           |              |             |          |          | 205    | 38.80 |             |
| HERB                          | Squadron            | 2.3 LBA/GAL | EC        |           | 3 pt/a         | A         |              | 20 GAL/AC   |          | 3 Liters | 301    | 46.20 |             |
| HERB                          | Select Max          | 0.97 LB/GAL | EC        |           | 12 fl oz/a     | C         |              | 20 GAL/AC   |          | 3 Liters | 403    | 44.30 |             |
| HERB                          | Pursuit             | 70 %        | DF        |           | 1.44 oz wt/a   | C         |              | 20 GAL/AC   |          | 3 Liters |        |       |             |
| ADJ                           | NIS                 | 100 %       | SL        |           | 0.25 % v/v     | C         |              | 20 GAL/AC   |          | 3 Liters |        |       |             |
|                               |                     |             |           |           |                |           |              |             |          |          | Mean = | 43.30 |             |
|                               |                     |             |           |           |                |           |              |             |          |          |        |       |             |
| 5                             | RoundupReady Allen  |             |           |           |                |           |              |             |          |          | 105    | 14.90 |             |
| CHK                           | Untreated Check     |             |           |           |                |           |              |             |          |          | 204    | 23.50 |             |
|                               |                     |             |           |           |                |           |              |             |          |          | 306    | 8.60  |             |
|                               |                     |             |           |           |                |           |              |             |          |          | 406    | 8.90  |             |
|                               |                     |             |           |           |                |           |              |             |          |          | Mean = | 13.98 |             |
| 6                             | RoundupReady Allen  |             |           |           |                |           |              |             |          |          | 106    | 39.30 |             |
| CHK                           | Handweeded Check    |             |           |           |                |           |              |             |          |          | 202    | 56.00 |             |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a     | B         |              | 20 GAL/AC   |          | 3 Liters | 308    | 31.20 |             |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a     | C         |              | 20 GAL/AC   |          | 3 Liters | 407    | 41.50 |             |
|                               |                     |             |           |           |                |           |              |             |          |          | Mean = | 42.00 |             |
| 7                             | RoundupReady Allen  |             |           |           |                |           |              |             |          |          | 107    | 29.50 |             |
|                               | low weed control    |             |           |           |                |           |              |             |          |          | 201    | 38.40 |             |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a     | B         |              | 20 GAL/AC   |          | 3 Liters | 305    | 15.00 |             |
|                               |                     |             |           |           |                |           |              |             |          |          | 408    | 20.30 |             |
|                               |                     |             |           |           |                |           |              |             |          |          | Mean = | 25.80 |             |
| 8                             | RoundupReady Allen  |             |           |           |                |           |              |             |          |          | 108    | 35.60 |             |
|                               | medium weed control |             |           |           |                |           |              |             |          |          | 203    | 52.00 |             |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a     | B         |              | 20 GAL/AC   |          | 3 Liters | 307    | 40.60 |             |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a     | C         |              | 20 GAL/AC   |          | 3 Liters | 405    | 39.00 |             |
|                               |                     |             |           |           |                |           |              |             |          |          | Mean = | 41.80 |             |

**Table 23.** HU 12 Field Trial Protocol

| Plots: 10 by 40 feet |      |                                        |             |           |           |              |           |           |              |             |          |          |                        |       |     |     |     |
|----------------------|------|----------------------------------------|-------------|-----------|-----------|--------------|-----------|-----------|--------------|-------------|----------|----------|------------------------|-------|-----|-----|-----|
| Trt No.              | Type | Treatment Name                         | Form Conc   | Form Unit | Form Type | Rate         | Rate Unit | Appl Code | Spray Volume | Volume Unit | Mix Size | Mix Unit | Amt Product to Measure | Rep 1 | 2   | 3   | 4   |
| 1                    | CHK  | Conventional 5601T Untreated Check     |             |           |           |              |           |           |              |             |          |          |                        | 101   | 206 | 302 | 401 |
| 2                    | CHK  | Conventional 5601T Handweeded Check    |             |           |           |              |           |           |              |             |          |          |                        | 102   | 207 | 304 | 402 |
|                      | HERB | Squadron                               | 2.3 LBA/GAL | EC        |           | 3 pt/a       |           | A         |              | 20 GAL/AC   |          | 3 Liters | 56.24 ml/mx            |       |     |     |     |
|                      | HERB | Select Max                             | 0.97 LB/GAL | EC        |           | 12 fl oz/a   |           | C         |              | 20 GAL/AC   |          | 3 Liters | 14.06 ml/mx            |       |     |     |     |
|                      | HERB | Pursuit                                | 70 %        | DF        |           | 1.44 oz wt/a |           | C         |              | 20 GAL/AC   |          | 3 Liters | 1.618 g/mx             |       |     |     |     |
|                      | ADJ  | NIS                                    | 100 %       | SL        |           | 0.25 % v/v   |           | C         |              | 20 GAL/AC   |          | 3 Liters | 7.499 ml/mx            |       |     |     |     |
| 3                    | CHK  | Conventional 5601T low weed control    |             |           |           |              |           |           |              |             |          |          |                        | 103   | 208 | 303 | 404 |
|                      | HERB | Squadron                               | 2.3 LBA/GAL | EC        |           | 3 pt/a       |           | A         |              | 20 GAL/AC   |          | 3 Liters | 56.24 ml/mx            |       |     |     |     |
| 4                    | CHK  | Conventional 5601T medium weed control |             |           |           |              |           |           |              |             |          |          |                        | 104   | 205 | 301 | 403 |
|                      | HERB | Squadron                               | 2.3 LBA/GAL | EC        |           | 3 pt/a       |           | A         |              | 20 GAL/AC   |          | 3 Liters | 56.24 ml/mx            |       |     |     |     |
|                      | HERB | Select Max                             | 0.97 LB/GAL | EC        |           | 12 fl oz/a   |           | C         |              | 20 GAL/AC   |          | 3 Liters | 14.06 ml/mx            |       |     |     |     |
|                      | HERB | Pursuit                                | 70 %        | DF        |           | 1.44 oz wt/a |           | C         |              | 20 GAL/AC   |          | 3 Liters | 1.618 g/mx             |       |     |     |     |
|                      | ADJ  | NIS                                    | 100 %       | SL        |           | 0.25 % v/v   |           | C         |              | 20 GAL/AC   |          | 3 Liters | 7.499 ml/mx            |       |     |     |     |
| 5                    | CHK  | RoundupReady Allen Untreated Check     |             |           |           |              |           |           |              |             |          |          |                        | 105   | 204 | 306 | 406 |
| 6                    | CHK  | RoundupReady Allen Handweeded Check    |             |           |           |              |           |           |              |             |          |          |                        | 106   | 202 | 308 | 407 |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal | SL        |           | 23 fl oz/a   |           | B         |              | 20 GAL/AC   |          | 3 Liters | 26.95 ml/mx            |       |     |     |     |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal | SL        |           | 23 fl oz/a   |           | C         |              | 20 GAL/AC   |          | 3 Liters | 26.95 ml/mx            |       |     |     |     |
| 7                    | CHK  | RoundupReady Allen low weed control    |             |           |           |              |           |           |              |             |          |          |                        | 107   | 201 | 305 | 408 |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal | SL        |           | 23 fl oz/a   |           | B         |              | 20 GAL/AC   |          | 3 Liters | 26.95 ml/mx            |       |     |     |     |
| 8                    | CHK  | RoundupReady Allen medium weed control |             |           |           |              |           |           |              |             |          |          |                        | 108   | 203 | 307 | 405 |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal | SL        |           | 23 fl oz/a   |           | B         |              | 20 GAL/AC   |          | 3 Liters | 26.95 ml/mx            |       |     |     |     |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal | SL        |           | 23 fl oz/a   |           | C         |              | 20 GAL/AC   |          | 3 Liters | 26.95 ml/mx            |       |     |     |     |

**Table 24.** HU 12 Field Trial Location Information

| General Trial Information                                |                                  |                                  |  |
|----------------------------------------------------------|----------------------------------|----------------------------------|--|
| Study Director: Tom Mueller<br>Investigator: Tom Mueller |                                  |                                  |  |
| Personnel                                                |                                  |                                  |  |
| Study Director: Tom Mueller<br>Investigator: Tom Mueller |                                  |                                  |  |
| Crop Description                                         |                                  |                                  |  |
| Crop 1:                                                  | GLXMA Glycine max                | Soybean                          |  |
|                                                          | Variety: Allen and 5801T         | Description: RR and conventional |  |
|                                                          | BBCH Scale: BSOY                 | Planting Date: 4/30/2012         |  |
|                                                          | Planting Method: PLANTD planted  | Rate, Unit: 45 LB/A              |  |
|                                                          | Depth, Unit: 1.5 in              |                                  |  |
|                                                          | Row Spacing, Unit: 30 in         | Spacing Within Row, Unit: 3 in   |  |
|                                                          | Seed Bed: MEDIUM medium          |                                  |  |
|                                                          | Harvest Date: 11/9/2012          | Harvest Equipment: plot combine  |  |
|                                                          | Harvested Width, Unit: 5 ft      | Harvested Length, Unit: 35 ft    |  |
|                                                          | % Standard Moisture: 13.5        | Moisture Meter: plot combine     |  |
|                                                          | Weighing Equipment: plot combine |                                  |  |
| Site and Design                                          |                                  |                                  |  |
| Plot Width, Unit: 10 FT                                  |                                  |                                  |  |
| Plot Length, Unit: 40 FT                                 |                                  |                                  |  |
| Plot Area, Unit: 400 FT2                                 |                                  |                                  |  |
| Replications: 4 Study Design: SPLPLO Split-Plot          |                                  |                                  |  |
| Soil Description                                         |                                  |                                  |  |
| Description Name: Sequatchie                             |                                  |                                  |  |
| % Sand: 38 % OM: 1.4 Texture: L loam                     |                                  |                                  |  |
| % Silt: 48 pH: 6.3 Soil Name: Sequatchie                 |                                  |                                  |  |
| % Clay: 18 CEC: 9 Fert. Level: G good                    |                                  |                                  |  |
| Soil Drainage: G good                                    |                                  |                                  |  |

**Table 25.** HU 12 Application Description

|                        | A         | B         | C        |
|------------------------|-----------|-----------|----------|
| Application Date:      | 4/30/2012 | 5/18/2012 | 6/7/2012 |
| Application Method:    | SPRAY     | SPRAY     | SPRAY    |
| Application Timing:    | PREMCR    | POEMCR    | POEMCR   |
| Application Placement: | BROSOI    | BROADC    | BROADC   |
| Applied By:            | Gaban     | Gaban     | Gaban    |

**Table 26.** HU 12 Application Equipment

|                                  | <b>A</b>     | <b>B</b>     | <b>C</b>     |
|----------------------------------|--------------|--------------|--------------|
| <b>Appl. Equipment:</b>          | TCM-6 Nozzle | TCM-6 Nozzle | TCM-6 Nozzle |
| <b>Equipment Type:</b>           | BACMAN       | BACMAN       | BACMAN       |
| <b>Operation Pressure, Unit:</b> | 40 PSI       | 40 PSI       | 40 PSI       |
| <b>Nozzle Type:</b>              | flat fan     | flat fan     | flat fan     |
| <b>Nozzle Size:</b>              | 8002         | 8002         | 8002         |
| <b>Nozzle Spacing, Unit:</b>     | 19 in        | 19 in        | 19 in        |
| <b>Nozzles/Row:</b>              | 2            | 2            | 2            |
| <b>% Coverage:</b>               | 100          | 100          | 100          |
| <b>Boom Length, Unit:</b>        | 10 ft        | 10 ft        | 10 ft        |
| <b>Boom Height, Unit:</b>        | 20 in        | 20 in        | 20 in        |
| <b>Ground Speed, Unit:</b>       | 3 MPH        | 3 MPH        | 3 MPH        |
| <b>Carrier:</b>                  | WATER        | WATER        | WATER        |
| <b>Spray Volume, Unit:</b>       | 20 gal/ac    | 20 gal/ac    | 20 gal/ac    |
| <b>Mix Size, Unit:</b>           | 3 liters     | 3 liters     | 3 liters     |
| <b>Propellant:</b>               | COMCO2       | COMCO2       | COMCO2       |

**Table 27.** HU 12 Yield in Bushel/Acre of Replication 1

|                               |                     |             |           |           |              |           |           |              |             |          |          |             |
|-------------------------------|---------------------|-------------|-----------|-----------|--------------|-----------|-----------|--------------|-------------|----------|----------|-------------|
| Crop Code                     |                     |             |           |           |              |           |           |              |             |          |          | GLXMA       |
| BBCH Scale                    |                     |             |           |           |              |           |           |              |             |          |          | BSOY        |
| Crop Scientific Name          |                     |             |           |           |              |           |           |              |             |          |          | Glycine max |
| Crop Name                     |                     |             |           |           |              |           |           |              |             |          |          | Soybean     |
| Description                   |                     |             |           |           |              |           |           |              |             |          |          | yield       |
| Part Rated                    |                     |             |           |           |              |           |           |              |             |          |          | SEED C      |
| Rating Date                   |                     |             |           |           |              |           |           |              |             |          |          | 11/9/2012   |
| Rating Type                   |                     |             |           |           |              |           |           |              |             |          |          | YIELD       |
| Rating Unit                   |                     |             |           |           |              |           |           |              |             |          |          | bu/ac       |
| Number of Subsamples          |                     |             |           |           |              |           |           |              |             |          |          | 193         |
| Days After First/Last Applic. |                     |             |           |           |              |           |           |              |             |          |          | 193         |
| Trt-Eval Interval             |                     |             |           |           |              |           |           |              |             |          |          | 193 DA-A    |
| Plant-Eval Interval           |                     |             |           |           |              |           |           |              |             |          |          | 193 DP-1    |
| Trt No.                       | Treatment Type      | Form Conc   | Form Unit | Form Type | Rate Rate    | Rate Unit | Appl Code | Spray Volume | Volume Unit | Mix Size | Mix Unit |             |
| 1                             | Conventional 5601T  |             |           |           |              |           |           |              |             |          |          | 1           |
| CHK                           | Untreated Check     |             |           |           |              |           |           |              |             |          |          | 9.65 d      |
| 2                             | Conventional 5601T  |             |           |           |              |           |           |              |             |          |          | 54.08 a     |
| CHK                           | Handweeded Check    |             |           |           |              |           |           |              |             |          |          |             |
| HERB                          | Squadron            | 2.3 LBA/GAL | EC        |           | 3 pt/a       | A         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| HERB                          | Select Max          | 0.97 LB/GAL | EC        |           | 12 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| HERB                          | Pursuit             | 70 %        | DF        |           | 1.44 oz wt/a | C         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| ADJ                           | NIS                 | 100 %       | SL        |           | 0.25 % v/v   | C         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| 3                             | Conventional 5601T  |             |           |           |              |           |           |              |             |          |          | 17.95 c     |
| HERB                          | low weed control    |             |           |           |              |           |           |              |             |          |          |             |
| HERB                          | Squadron            | 2.3 LBA/GAL | EC        |           | 3 pt/a       | A         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| 4                             | Conventional 5601T  |             |           |           |              |           |           |              |             |          |          | 43.95 b     |
| HERB                          | medium weed control |             |           |           |              |           |           |              |             |          |          |             |
| HERB                          | Squadron            | 2.3 LBA/GAL | EC        |           | 3 pt/a       | A         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| HERB                          | Select Max          | 0.97 LB/GAL | EC        |           | 12 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| HERB                          | Pursuit             | 70 %        | DF        |           | 1.44 oz wt/a | C         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| ADJ                           | NIS                 | 100 %       | SL        |           | 0.25 % v/v   | C         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| 5                             | RoundupReady Allen  |             |           |           |              |           |           |              |             |          |          | 15.20 cd    |
| CHK                           | Untreated Check     |             |           |           |              |           |           |              |             |          |          |             |
| 6                             | RoundupReady Allen  |             |           |           |              |           |           |              |             |          |          | 56.20 a     |
| CHK                           | Handweeded Check    |             |           |           |              |           |           |              |             |          |          |             |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a   | B         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| 7                             | RoundupReady Allen  |             |           |           |              |           |           |              |             |          |          | 17.60 c     |
| HERB                          | low weed control    |             |           |           |              |           |           |              |             |          |          |             |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a   | B         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| 8                             | RoundupReady Allen  |             |           |           |              |           |           |              |             |          |          | 56.30 a     |
| HERB                          | medium weed control |             |           |           |              |           |           |              |             |          |          |             |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a   | B         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          |             |
| LSD (P=.05)                   |                     |             |           |           |              |           |           |              |             |          |          | 6.391       |
| Standard Deviation            |                     |             |           |           |              |           |           |              |             |          |          | 4.302       |
| CV                            |                     |             |           |           |              |           |           |              |             |          |          | 12.7        |
| Bartlett's X2                 |                     |             |           |           |              |           |           |              |             |          |          | 13.498      |
| P(Bartlett's X2)              |                     |             |           |           |              |           |           |              |             |          |          | 0.061       |
| Replicate F                   |                     |             |           |           |              |           |           |              |             |          |          | 2.946       |
| Replicate Prob(F)             |                     |             |           |           |              |           |           |              |             |          |          | 0.0608      |
| Treatment F                   |                     |             |           |           |              |           |           |              |             |          |          | 91.549      |
| Treatment Prob(F)             |                     |             |           |           |              |           |           |              |             |          |          | 0.0001      |

**Table 28.** HU 12 Yield in Bushel/Acre of Replication 2

|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          |                                                                                                                                  |       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------|-----------|-----------|--------------|-----------|-----------|--------------|-------------|----------|----------|----------------------------------------------------------------------------------------------------------------------------------|-------|
| Crop Code<br>BBCH Scale<br>Crop Scientific Name<br>Crop Name<br>Description<br>Part Rated<br>Rating Date<br>Rating Type<br>Rating Unit<br>Number of Subsamples<br>Days After First/Last Applic.<br>Trt-Eval Interval<br>Plant-Eval Interval |                     |             |           |           |              |           |           |              |             |          |          | GLXMA<br>BSOY<br>Glycine max<br>Soybean<br>yield<br>SEED C<br>11/9/2012<br>YIELD<br>bu/ac<br>1<br>193 193<br>193 DA-<br>193 DP-1 |       |
| Trt No.                                                                                                                                                                                                                                     | Treatment Name      | Form Conc   | Form Unit | Form Type | Rate Rate    | Rate Unit | Appl Code | Spray Volume | Volume Unit | Mix Mix  | Mix Size | Plot                                                                                                                             | 1     |
| 1                                                                                                                                                                                                                                           | Conventional 5601T  |             |           |           |              |           |           |              |             |          |          | 101                                                                                                                              | 8.90  |
| CHK                                                                                                                                                                                                                                         | Untreated Check     |             |           |           |              |           |           |              |             |          |          | 206                                                                                                                              | 9.90  |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | 302                                                                                                                              | 8.30  |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | 401                                                                                                                              | 11.50 |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | Mean =                                                                                                                           | 9.65  |
| 2                                                                                                                                                                                                                                           | Conventional 5601T  |             |           |           |              |           |           |              |             |          |          | 102                                                                                                                              | 48.40 |
| CHK                                                                                                                                                                                                                                         | Handweeded Check    |             |           |           |              |           |           |              |             |          |          | 207                                                                                                                              | 53.60 |
| HERB                                                                                                                                                                                                                                        | Squadron            | 2.3 LBA/GAL | EC        |           | 3 pt/a       | A         |           | 20 GAL/AC    |             | 3 Liters |          | 304                                                                                                                              | 57.10 |
| HERB                                                                                                                                                                                                                                        | Select Max          | 0.97 LB/GAL | EC        |           | 12 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          | 402                                                                                                                              | 57.20 |
| HERB                                                                                                                                                                                                                                        | Pursuit             | 70 %        | DF        |           | 1.44 oz wt/a | C         |           | 20 GAL/AC    |             | 3 Liters |          |                                                                                                                                  |       |
| ADJ                                                                                                                                                                                                                                         | NIS                 | 100 %       | SL        |           | 0.25 % v/v   | C         |           | 20 GAL/AC    |             | 3 Liters |          |                                                                                                                                  |       |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | Mean =                                                                                                                           | 54.08 |
| 3                                                                                                                                                                                                                                           | Conventional 5601T  |             |           |           |              |           |           |              |             |          |          | 103                                                                                                                              | 10.20 |
|                                                                                                                                                                                                                                             | low weed control    |             |           |           |              |           |           |              |             |          |          | 208                                                                                                                              | 25.60 |
| HERB                                                                                                                                                                                                                                        | Squadron            | 2.3 LBA/GAL | EC        |           | 3 pt/a       | A         |           | 20 GAL/AC    |             | 3 Liters |          | 303                                                                                                                              | 14.70 |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | 404                                                                                                                              | 21.30 |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | Mean =                                                                                                                           | 17.95 |
| 4                                                                                                                                                                                                                                           | Conventional 5601T  |             |           |           |              |           |           |              |             |          |          | 104                                                                                                                              | 40.00 |
|                                                                                                                                                                                                                                             | medium weed control |             |           |           |              |           |           |              |             |          |          | 205                                                                                                                              | 54.50 |
| HERB                                                                                                                                                                                                                                        | Squadron            | 2.3 LBA/GAL | EC        |           | 3 pt/a       | A         |           | 20 GAL/AC    |             | 3 Liters |          | 301                                                                                                                              | 33.60 |
| HERB                                                                                                                                                                                                                                        | Select Max          | 0.97 LB/GAL | EC        |           | 12 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          | 403                                                                                                                              | 47.70 |
| HERB                                                                                                                                                                                                                                        | Pursuit             | 70 %        | DF        |           | 1.44 oz wt/a | C         |           | 20 GAL/AC    |             | 3 Liters |          |                                                                                                                                  |       |
| ADJ                                                                                                                                                                                                                                         | NIS                 | 100 %       | SL        |           | 0.25 % v/v   | C         |           | 20 GAL/AC    |             | 3 Liters |          |                                                                                                                                  |       |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | Mean =                                                                                                                           | 43.95 |
| 5                                                                                                                                                                                                                                           | RoundupReady Allen  |             |           |           |              |           |           |              |             |          |          | 105                                                                                                                              | 12.80 |
| CHK                                                                                                                                                                                                                                         | Untreated Check     |             |           |           |              |           |           |              |             |          |          | 204                                                                                                                              | 16.60 |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | 306                                                                                                                              | 16.00 |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | 406                                                                                                                              | 15.40 |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | Mean =                                                                                                                           | 15.20 |
| 6                                                                                                                                                                                                                                           | RoundupReady Allen  |             |           |           |              |           |           |              |             |          |          | 106                                                                                                                              | 51.50 |
| CHK                                                                                                                                                                                                                                         | Handweeded Check    |             |           |           |              |           |           |              |             |          |          | 202                                                                                                                              | 56.60 |
| HERB                                                                                                                                                                                                                                        | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a   | B         |           | 20 GAL/AC    |             | 3 Liters |          | 308                                                                                                                              | 57.50 |
| HERB                                                                                                                                                                                                                                        | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          | 407                                                                                                                              | 59.20 |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | Mean =                                                                                                                           | 56.20 |
| 7                                                                                                                                                                                                                                           | RoundupReady Allen  |             |           |           |              |           |           |              |             |          |          | 107                                                                                                                              | 17.40 |
|                                                                                                                                                                                                                                             | low weed control    |             |           |           |              |           |           |              |             |          |          | 201                                                                                                                              | 11.10 |
| HERB                                                                                                                                                                                                                                        | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a   | B         |           | 20 GAL/AC    |             | 3 Liters |          | 305                                                                                                                              | 25.30 |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | 408                                                                                                                              | 16.60 |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | Mean =                                                                                                                           | 17.60 |
| 8                                                                                                                                                                                                                                           | RoundupReady Allen  |             |           |           |              |           |           |              |             |          |          | 108                                                                                                                              | 54.20 |
|                                                                                                                                                                                                                                             | medium weed control |             |           |           |              |           |           |              |             |          |          | 203                                                                                                                              | 56.60 |
| HERB                                                                                                                                                                                                                                        | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a   | B         |           | 20 GAL/AC    |             | 3 Liters |          | 307                                                                                                                              | 53.80 |
| HERB                                                                                                                                                                                                                                        | Roundup WeatherMax  | 5.5 lba/gal | SL        |           | 23 fl oz/a   | C         |           | 20 GAL/AC    |             | 3 Liters |          | 405                                                                                                                              | 60.60 |
|                                                                                                                                                                                                                                             |                     |             |           |           |              |           |           |              |             |          |          | Mean =                                                                                                                           | 56.30 |

**Table 29.** PSU 12 Field Trial Protocol

| Plots: 10 by 40 feet |      |                                        |              |           |           |              |           |           |                        |       |     |     |     |
|----------------------|------|----------------------------------------|--------------|-----------|-----------|--------------|-----------|-----------|------------------------|-------|-----|-----|-----|
| Trt No.              | Type | Treatment Name                         | Form Conc    | Form Unit | Form Type | Rate         | Rate Unit | Appl Code | Amt Product to Measure | Rep 1 | 2   | 3   | 4   |
| 1                    | CHK  | RoundupReady Allen Untreated Check     |              |           |           |              |           |           |                        | 101   | 207 | 306 | 405 |
| 2                    | CHK  | RoundupReady Allen Handweeded Check    |              |           |           |              |           |           |                        | 102   | 205 | 308 | 406 |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal  |           | SL        | 23 fl oz/a   |           | B         | 26.95 ml/mx            |       |     |     |     |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal  |           | SL        | 23 fl oz/a   |           | C         | 26.95 ml/mx            |       |     |     |     |
| 3                    |      | RoundupReady Allen low weed control    |              |           |           |              |           |           |                        | 103   | 208 | 305 | 407 |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal  |           | SL        | 23 fl oz/a   |           | B         | 26.95 ml/mx            |       |     |     |     |
| 4                    |      | RoundupReady Allen medium weed control |              |           |           |              |           |           |                        | 104   | 206 | 307 | 408 |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal  |           | SL        | 23 fl oz/a   |           | B         | 26.95 ml/mx            |       |     |     |     |
|                      | HERB | Roundup WeatherMax                     | 5.5 lba/gal  |           | SL        | 23 fl oz/a   |           | C         | 26.95 ml/mx            |       |     |     |     |
| 5                    | CHK  | Conventional 5601T Untreated Check     |              |           |           |              |           |           |                        | 105   | 203 | 301 | 404 |
| 6                    | CHK  | Conventional 5601T Handweeded Check    |              |           |           |              |           |           |                        | 106   | 202 | 304 | 403 |
|                      | HERB | Squadron                               | 2.33 LBA/GAL |           | EC        | 3 pt/a       |           | A         | 56.24 ml/mx            |       |     |     |     |
|                      | HERB | SelectMax                              | 0.97 LB/GAL  |           | EC        | 12 fl oz/a   |           | B         | 14.06 ml/mx            |       |     |     |     |
|                      | HERB | Pursuit                                | 70 %         |           | DG        | 1.44 oz wt/a |           | B         | 1.618 g/mx             |       |     |     |     |
|                      | ADJ  | NIS                                    | 100 %        |           | SL        | 0.25 % v/v   |           | B         | 7.499 ml/mx            |       |     |     |     |
| 7                    |      | Conventional 5601T low weed control    |              |           |           |              |           |           |                        | 107   | 204 | 303 | 401 |
|                      | HERB | Squadron                               | 2.33 LBA/GAL |           | EC        | 3 pt/a       |           | A         | 56.24 ml/mx            |       |     |     |     |
| 8                    |      | Conventional 5601T medium weed control |              |           |           |              |           |           |                        | 108   | 201 | 302 | 402 |
|                      | HERB | Squadron                               | 2.33 LBA/GAL |           | EC        | 3 pt/a       |           | A         | 56.24 ml/mx            |       |     |     |     |
|                      | HERB | SelectMax                              | 0.97 LB/GAL  |           | EC        | 12 fl oz/a   |           | B         | 14.06 ml/mx            |       |     |     |     |
|                      | HERB | Pursuit                                | 70 %         |           | DG        | 1.44 oz wt/a |           | B         | 1.618 g/mx             |       |     |     |     |
|                      | ADJ  | NIS                                    | 100 %        |           | SL        | 0.25 % v/v   |           | B         | 7.499 ml/mx            |       |     |     |     |

**Table 30.** PSU 12 Field Trial Location Information

| General Trial Information                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Study Director: Tom Mueller<br>Investigator: Tom Mueller                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                  |
| Objectives:<br><br>Compare weed control, soybean yield, and profitability with RR to conventional soybeans. RR line = Allen, and conventional = 5601T<br><br>Care should be taken to avoid glyphosate drift onto conventional soybeans.<br><br>Due to plot size, will need to mix two (2) 3 liter bottles of each mix for each application to have enough. |                                                                                                                                                                                                                                  |
| Personnel                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                  |
| Study Director: Tom Mueller<br>Investigator: Tom Mueller                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                  |
| Crop Description                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                  |
| Crop 1: GLXMA Glycine max Soybean<br>Variety: Allen and 5601T<br>BBCH Scale: BSOY<br>Planting Method: PLANTD planted<br>Depth, Unit: 1.5 in<br>Row Spacing, Unit: 30 in<br>Seed Bed: MEDIUM medium<br>Harvest Date: 11/12/2012<br>Harvested Width, Unit: 5 ft<br>% Standard Moisture: 13.5<br>Weighing Equipment: plot combine                             | Description: RR and conventional<br>Planting Date: 5/8/2012<br>Rate, Unit: 45 LB/A<br><br>Spacing Within Row, Unit: 3 in<br><br>Harvest Equipment: plot combine<br>Harvested Length, Unit: 35 ft<br>Moisture Meter: plot combine |
| Site and Design                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                  |
| Plot Width, Unit: 10 FT<br>Plot Length, Unit: 40 FT<br>Plot Area, Unit: 400 FT2<br>Replications: 4                                                                                                                                                                                                                                                         | Site Type: FIELD field<br>Experimental Unit: 1 PLOT plot<br>Tillage Type: NOTILL no-till<br>Study Design: SPLPLO Split-Plot                                                                                                      |
| Soil Description                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                  |
| Description Name: Sequatchie<br>% Sand: 36 % OM: 1.4 Texture: L loam<br>% Silt: 48 pH: 6.3 Soil Name: Sequatchie<br>% Clay: 18 CEC: 9 Fert. Level: G good<br>Soil Drainage: G good                                                                                                                                                                         |                                                                                                                                                                                                                                  |

**Table 31.** PSU 12 Application Description

|                        | A        | B         | C         |
|------------------------|----------|-----------|-----------|
| Application Date:      | 5/8/2012 | 5/30/2012 | 6/13/2012 |
| Application Method:    | SPRAY    | SPRAY     | SPRAY     |
| Application Timing:    | PREMCR   | POEMCR    | POEMCR    |
| Application Placement: | BROSOI   | BROADC    | BROADC    |
| Applied By:            | Gaban    | Gaban     | Gaban     |

**Table 32.** PSU 12 Application Equipment

|                           | <b>A</b>     | <b>B</b>     | <b>C</b>     |
|---------------------------|--------------|--------------|--------------|
| Appl. Equipment:          | TCM-6 Nozzle | TCM-6 Nozzle | TCM-6 Nozzle |
| Equipment Type:           | BACMAN       | BACMAN       | BACMAN       |
| Operation Pressure, Unit: | 40 PSI       | 40 PSI       | 40 PSI       |
| Nozzle Type:              | flat fan     | flat fan     | flat fan     |
| Nozzle Size:              | 8002         | 8002         | 8002         |
| Nozzle Spacing, Unit:     | 19 in        | 19 in        | 19 in        |
| Nozzles/Row:              | 2            | 2            | 2            |
| % Coverage:               | 100          | 100          | 100          |
| Boom Length, Unit:        | 10 ft        | 10 ft        | 10 ft        |
| Boom Height, Unit:        | 20 in        | 20 in        | 20 in        |
| Ground Speed, Unit:       | 3 MPH        | 3 MPH        | 3 MPH        |
| Carrier:                  | WATER        | WATER        | WATER        |
| Spray Volume, Unit:       | 20 gal/ac    | 20 gal/ac    | 20 gal/ac    |
| Mix Size, Unit:           | 3 liters     | 3 liters     | 3 liters     |
| Propellant:               | COMCO2       | COMCO2       | COMCO2       |

**Table 33.** PSU 12 Yield in Bushel/Acre of Replication 1

| Crop Code                     |                |                                        |              |           |           |                | GLXMA       |
|-------------------------------|----------------|----------------------------------------|--------------|-----------|-----------|----------------|-------------|
| BBCH Scale                    |                |                                        |              |           |           |                | BSOY        |
| Crop Scientific Name          |                |                                        |              |           |           |                | Glycine max |
| Crop Name                     |                |                                        |              |           |           |                | Soybean     |
| Part Rated                    |                |                                        |              |           |           |                | SEED C      |
| Rating Date                   |                |                                        |              |           |           |                | 11/12/2012  |
| Rating Type                   |                |                                        |              |           |           |                | YIELD       |
| Rating Unit                   |                |                                        |              |           |           |                | bu/ac       |
| Number of Subsamples          |                |                                        |              |           |           |                | 1           |
| Days After First/Last Applic. |                |                                        |              |           |           |                | 188 188     |
| Trt-Eval Interval             |                |                                        |              |           |           |                | 188 DA-A    |
| Plant-Eval Interval           |                |                                        |              |           |           |                | 188 DP-1    |
| Trt No.                       | Treatment Type | Form Name                              | Form Conc    | Form Unit | Form Type | Rate Rate Unit | Appl Code   |
| 1                             | CHK            | RoundupReady Allen Untreated Check     |              |           |           |                | 21.93 e     |
| 2                             | CHK            | RoundupReady Allen Handweeded Check    |              |           |           |                | 59.40 a     |
|                               | HERB           | Roundup WeatherMax                     | 5.5 lba/gal  |           | SL        | 23 fl oz/a B   |             |
|                               | HERB           | Roundup WeatherMax                     | 5.5 lba/gal  |           | SL        | 23 fl oz/a C   |             |
| 3                             |                | RoundupReady Allen low weed control    |              |           |           |                | 38.18 c     |
|                               | HERB           | Roundup WeatherMax                     | 5.5 lba/gal  |           | SL        | 23 fl oz/a B   |             |
| 4                             |                | RoundupReady Allen medium weed control |              |           |           |                | 54.95 ab    |
|                               | HERB           | Roundup WeatherMax                     | 5.5 lba/gal  |           | SL        | 23 fl oz/a B   |             |
|                               | HERB           | Roundup WeatherMax                     | 5.5 lba/gal  |           | SL        | 23 fl oz/a C   |             |
| 5                             | CHK            | Conventional 5601T Untreated Check     |              |           |           |                | 23.10 de    |
| 6                             | CHK            | Conventional 5601T Handweeded Check    |              |           |           |                | 61.75 a     |
|                               | HERB           | Squadron                               | 2.33 LBA/GAL |           | EC        | 3 pt/a A       |             |
|                               | HERB           | SelectMax                              | 0.97 LB/GAL  |           | EC        | 12 fl oz/a B   |             |
|                               | HERB           | Pursuit                                | 70 %         |           | DG        | 1.44 oz wt/a B |             |
|                               | ADJ            | NIS                                    | 100 %        |           | SL        | 0.25 % v/v B   |             |
| 7                             |                | Conventional 5601T low weed control    |              |           |           |                | 30.78 cd    |
|                               | HERB           | Squadron                               | 2.33 LBA/GAL |           | EC        | 3 pt/a A       |             |
| 8                             |                | Conventional 5601T medium weed control |              |           |           |                | 51.50 b     |
|                               | HERB           | Squadron                               | 2.33 LBA/GAL |           | EC        | 3 pt/a A       |             |
|                               | HERB           | SelectMax                              | 0.97 LB/GAL  |           | EC        | 12 fl oz/a B   |             |
|                               | HERB           | Pursuit                                | 70 %         |           | DG        | 1.44 oz wt/a B |             |
|                               | ADJ            | NIS                                    | 100 %        |           | SL        | 0.25 % v/v B   |             |
| LSD (P=.05)                   |                |                                        |              |           |           |                | 7.820       |
| Standard Deviation            |                |                                        |              |           |           |                | 5.264       |
| CV                            |                |                                        |              |           |           |                | 12.33       |
| Bartlett's X2                 |                |                                        |              |           |           |                | 10.98       |
| P(Bartlett's X2)              |                |                                        |              |           |           |                | 0.139       |
| Replicate F                   |                |                                        |              |           |           |                | 4.251       |
| Replicate Prob(F)             |                |                                        |              |           |           |                | 0.0195      |
| Treatment F                   |                |                                        |              |           |           |                | 38.110      |
| Treatment Prob(F)             |                |                                        |              |           |           |                | 0.0001      |

**Table 34.** PSU 12 Yield in Bushel/Acre of Replication 2

| Crop Code                     |                     |              |           |              |           |           | GLXMA          |
|-------------------------------|---------------------|--------------|-----------|--------------|-----------|-----------|----------------|
| BBCH Scale                    |                     |              |           |              |           |           | BSOY           |
| Crop Scientific Name          |                     |              |           |              |           |           | Glycine max    |
| Crop Name                     |                     |              |           |              |           |           | Soybean        |
| Part Rated                    |                     |              |           |              |           |           | SEED C         |
| Rating Date                   |                     |              |           |              |           |           | 11/12/2012     |
| Rating Type                   |                     |              |           |              |           |           | YIELD          |
| Rating Unit                   |                     |              |           |              |           |           | bu/ac          |
| Number of Subsamples          |                     |              |           |              |           |           | 1              |
| Days After First/Last Applic. |                     |              |           |              |           |           | 188 188        |
| Trt-Eval Interval             |                     |              |           |              |           |           | 188 DA-A       |
| Plant-Eval Interval           |                     |              |           |              |           |           | 188 DP-1       |
| Trt No.                       | Treatment Type      | Form Conc    | Form Unit | Form Type    | Rate Rate | Unit Unit | Appl Code Plot |
| 1                             | RoundupReady Allen  |              |           |              |           |           | 101            |
| CHK                           | Untreated Check     |              |           |              |           |           | 207            |
|                               |                     |              |           |              |           |           | 308            |
|                               |                     |              |           |              |           |           | 405            |
| Mean =                        |                     |              |           |              |           |           | 21.93          |
| 2                             | RoundupReady Allen  |              |           |              |           |           | 102            |
| CHK                           | Handweeded Check    |              |           |              |           |           | 205            |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal  | SL        | 23 fl oz/a   | B         | 308       | 60.20          |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal  | SL        | 23 fl oz/a   | C         | 408       | 51.30          |
| Mean =                        |                     |              |           |              |           |           | 59.40          |
| 3                             | RoundupReady Allen  |              |           |              |           |           | 103            |
|                               | low weed control    |              |           |              |           |           | 208            |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal  | SL        | 23 fl oz/a   | B         | 305       | 32.40          |
|                               |                     |              |           |              |           |           | 407            |
| Mean =                        |                     |              |           |              |           |           | 38.18          |
| 4                             | RoundupReady Allen  |              |           |              |           |           | 104            |
|                               | medium weed control |              |           |              |           |           | 208            |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal  | SL        | 23 fl oz/a   | B         | 307       | 60.80          |
| HERB                          | Roundup WeatherMax  | 5.5 lba/gal  | SL        | 23 fl oz/a   | C         | 408       | 54.70          |
| Mean =                        |                     |              |           |              |           |           | 54.95          |
| 5                             | Conventional 5801T  |              |           |              |           |           | 105            |
| CHK                           | Untreated Check     |              |           |              |           |           | 203            |
|                               |                     |              |           |              |           |           | 301            |
|                               |                     |              |           |              |           |           | 404            |
| Mean =                        |                     |              |           |              |           |           | 23.10          |
| 6                             | Conventional 5801T  |              |           |              |           |           | 108            |
| CHK                           | Handweeded Check    |              |           |              |           |           | 202            |
| HERB                          | Squadron            | 2.33 LBA/GAL | EC        | 3 pt/a       | A         | 304       | 59.60          |
| HERB                          | SelectMax           | 0.97 LB/GAL  | EC        | 12 fl oz/a   | B         | 403       | 59.50          |
| HERB                          | Pursuit             | 70 %         | DG        | 1.44 oz wt/a | B         |           |                |
| ADJ                           | NIS                 | 100 %        | SL        | 0.25 % v/v   | B         |           |                |
| Mean =                        |                     |              |           |              |           |           | 61.75          |
| 7                             | Conventional 5801T  |              |           |              |           |           | 107            |
|                               | low weed control    |              |           |              |           |           | 204            |
| HERB                          | Squadron            | 2.33 LBA/GAL | EC        | 3 pt/a       | A         | 303       | 23.30          |
|                               |                     |              |           |              |           |           | 401            |
| Mean =                        |                     |              |           |              |           |           | 30.78          |
| 8                             | Conventional 5801T  |              |           |              |           |           | 108            |
|                               | medium weed control |              |           |              |           |           | 201            |
| HERB                          | Squadron            | 2.33 LBA/GAL | EC        | 3 pt/a       | A         | 302       | 50.30          |
| HERB                          | SelectMax           | 0.97 LB/GAL  | EC        | 12 fl oz/a   | B         | 402       | 50.10          |
| HERB                          | Pursuit             | 70 %         | DG        | 1.44 oz wt/a | B         |           |                |
| ADJ                           | NIS                 | 100 %        | SL        | 0.25 % v/v   | B         |           |                |
| Mean =                        |                     |              |           |              |           |           | 51.50          |

## Appendix C

**Table 35.** Weather Data for Holston Locations 2010, 2011, and 2012

| Year | Month | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|-------|-----|---------------------|---------------------|--------------|----------------------|
| 2010 | April | 14  |                     |                     |              |                      |
| 2010 | April | 15  | 85.5                | 49.1                | 0            |                      |
| 2010 | April | 16  | 84.8                | 52.5                | 0            |                      |
| 2010 | April | 17  | 72.9                | 56.1                | 0            |                      |
| 2010 | April | 18  | 69                  | 39.3                | 0            |                      |
| 2010 | April | 19  | 71.3                | 39.3                | 0            |                      |
| 2010 | April | 20  | 56.5                | 49.6                | 0.33         |                      |
| 2010 | April | 21  | 67.1                | 49                  | 0.01         |                      |
| 2010 | April | 22  | 75.3                | 43.2                | 0.01         |                      |
| 2010 | April | 23  | 83.3                | 53.6                | 0.05         |                      |
| 2010 | April | 24  | 73.6                | 59.8                | 1.04         |                      |
| 2010 | April | 25  | 77.8                | 61.2                | 0.21         |                      |
| 2010 | April | 26  | 63.3                | 55.6                | 0            |                      |
| 2010 | April | 27  | 56.8                | 46                  | 0.23         |                      |
| 2010 | April | 28  | 65.7                | 40.4                | 0.02         |                      |
| 2010 | April | 29  | 74.4                | 40                  | 0            |                      |
| 2010 | April | 30  | 86.5                | 44.9                | 0            |                      |
| 2010 | May   | 1   | 79.9                | 54.4                | 0.05         |                      |
| 2010 | May   | 2   | 89.9                | 62.4                | 0.42         |                      |
| 2010 | May   | 3   | 83                  | 62.3                | 1.68         |                      |
| 2010 | May   | 4   | 83                  | 57.4                | 0            |                      |
| 2010 | May   | 5   | 85.9                | 52.8                | 0            |                      |
| 2010 | May   | 6   | 87.8                | 57.9                | 0            |                      |
| 2010 | May   | 7   | 89.8                | 57.7                | 0            |                      |
| 2010 | May   | 8   | 78.1                | 56.7                | 0            |                      |
| 2010 | May   | 9   | 65.4                | 43.8                | 0            |                      |
| 2010 | May   | 10  | 65.4                | 41.4                | 0.03         |                      |
| 2010 | May   | 11  | 76.8                | 52.6                | 0.09         |                      |
| 2010 | May   | 12  | 82.6                | 60.7                | 0            |                      |
| 2010 | May   | 13  | 87.3                | 57.9                | 0            |                      |
| 2010 | May   | 14  | 89                  | 63.8                | 0.02         |                      |
| 2010 | May   | 15  | 85.2                | 60                  | 0.18         |                      |
| 2010 | May   | 16  | 79.1                | 62.6                | 0.47         |                      |
| 2010 | May   | 17  | 77                  | 63.7                | 0.17         |                      |
| 2010 | May   | 18  | 73.9                | 59.9                | 0.01         |                      |
| 2010 | May   | 19  | 71.1                | 54.2                | 0            |                      |
| 2010 | May   | 20  | 81.9                | 50.6                | 0            |                      |
| 2010 | May   | 21  | 79                  | 62.3                | 0.03         |                      |
| 2010 | May   | 22  | 83.5                | 64.7                | 0            |                      |
| 2010 | May   | 23  | 88.2                | 60.5                | 0            |                      |
| 2010 | May   | 24  | 86                  | 60                  | 0            |                      |
| 2010 | May   | 25  | 86.3                | 60.5                | 0            |                      |
| 2010 | May   | 26  | 85.7                | 62.5                | 0.09         |                      |
| 2010 | May   | 27  | 86.6                | 62                  | 0.01         |                      |
| 2010 | May   | 28  | 86.4                | 63.3                | 0.18         |                      |

**Table 35.** Continued

| Year | Month | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|-------|-----|---------------------|---------------------|--------------|----------------------|
| 2010 | May   | 29  | 86.4                | 60.2                | 0.01         |                      |
| 2010 | May   | 30  | 84.6                | 63.9                | 0.02         |                      |
| 2010 | May   | 31  | 83.2                | 66.3                | 0.29         |                      |
| 2010 | June  | 1   | 83.1                | 67.1                | 0.22         |                      |
| 2010 | June  | 2   | 87.8                | 66                  | 0.01         |                      |
| 2010 | June  | 3   | 89.6                | 65.3                | 0            |                      |
| 2010 | June  | 4   | 84.7                | 68.2                | 0.07         |                      |
| 2010 | June  | 5   | 89.2                | 67.9                | 0            |                      |
| 2010 | June  | 6   | 82.7                | 70.9                | 0.14         |                      |
| 2010 | June  | 7   | 83.6                | 58                  | 0            |                      |
| 2010 | June  | 8   | 87.7                | 59.4                | 0            |                      |
| 2010 | June  | 9   | 75.3                | 66.5                | 0.53         |                      |
| 2010 | June  | 10  | 85.1                | 68.4                | 0.1          |                      |
| 2010 | June  | 11  | 90.8                | 67.4                | 0            |                      |
| 2010 | June  | 12  | 90.7                | 71.2                | 0.04         |                      |
| 2010 | June  | 13  | 92.2                | 72.8                | 0            |                      |
| 2010 | June  | 14  | 94                  | 70.8                | 0            |                      |
| 2010 | June  | 15  | 94.3                | 68.3                | 0.01         |                      |
| 2010 | June  | 16  | 89                  | 69                  | 0            |                      |
| 2010 | June  | 17  | 90.5                | 69.4                | 0            |                      |
| 2010 | June  | 18  | 91.1                | 63.8                | 0            |                      |
| 2010 | June  | 19  | 88.3                | 68.6                | 0.02         |                      |
| 2010 | June  | 20  | 93.5                | 69                  | 0.01         |                      |
| 2010 | June  | 21  | 96.2                | 65.7                | 0            |                      |
| 2010 | June  | 22  | 96                  | 65                  | 0            |                      |
| 2010 | June  | 23  | 96.8                | 70.4                | 0            |                      |
| 2010 | June  | 24  | 91.7                | 70.4                | 0            |                      |
| 2010 | June  | 25  | 92.9                | 68.4                | 0            |                      |
| 2010 | June  | 26  | 94.8                | 67.3                | 0            |                      |
| 2010 | June  | 27  | 94.2                | 71.1                | 0            |                      |
| 2010 | June  | 28  | 94.4                | 72                  | 0.41         |                      |
| 2010 | June  | 29  | 88.9                | 70.4                | 0.01         |                      |
| 2010 | June  | 30  | 88.9                | 67.4                | 0            |                      |
| 2010 | July  | 1   | 87.3                | 62.2                | 0            |                      |
| 2010 | July  | 2   | 91.1                | 57.3                | 0            |                      |
| 2010 | July  | 3   | 92.2                | 66.3                | 0            |                      |
| 2010 | July  | 4   | 92.3                | 65                  | 0            |                      |
| 2010 | July  | 5   | 96                  | 65.6                | 0            |                      |
| 2010 | July  | 6   | 96.2                | 64.6                | 0            |                      |
| 2010 | July  | 7   | 97.9                | 64.1                | 0            |                      |
| 2010 | July  | 8   | 99.6                | 65.7                | 0            |                      |
| 2010 | July  | 9   | 92.6                | 66.9                | 0.3          |                      |
| 2010 | July  | 10  | 90.3                | 69.8                | 0.01         |                      |
| 2010 | July  | 11  | 95.6                | 64.9                | 0            |                      |
| 2010 | July  | 12  | 85.2                | 71.2                | 0.81         |                      |
| 2010 | July  | 13  | 87.8                | 70                  | 0.05         |                      |
| 2010 | July  | 14  | 91.2                | 70.9                | 0.01         |                      |
| 2010 | July  | 15  | 96.8                | 65.8                | 0            |                      |
| 2010 | July  | 16  | 98.7                | 67.9                | 0            |                      |
| 2010 | July  | 17  | 87.9                | 72.9                | 0            |                      |
| 2010 | July  | 18  | 90.9                | 71.2                | 0            |                      |
| 2010 | July  | 19  | 90.6                | 71.5                | 0.39         |                      |
| 2010 | July  | 20  | 92.7                | 69.3                | 0.36         |                      |
| 2010 | July  | 21  | 90.5                | 69.5                | 0.41         |                      |
| 2010 | July  | 22  | 90                  | 69.4                | 0.32         |                      |

**Table 35.** Continued

| Year | Month     | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|-----------|-----|---------------------|---------------------|--------------|----------------------|
| 2010 | July      | 23  | 95.8                | 70.3                | 0            |                      |
| 2010 | July      | 24  | 97.7                | 70.6                | 0            |                      |
| 2010 | July      | 25  | 96.9                | 76.3                | 0            |                      |
| 2010 | July      | 26  | 96.9                | 71.8                | 0            |                      |
| 2010 | July      | 27  | 92.1                | 73.3                | 0            |                      |
| 2010 | July      | 28  | 92.4                | 71.6                | 0            |                      |
| 2010 | July      | 29  | 89.7                | 73.2                | 0.51         |                      |
| 2010 | July      | 30  | 92                  | 71.1                | 0.16         |                      |
| 2010 | July      | 31  | 84.8                | 69.3                | 0.63         |                      |
| 2010 | August    | 1   | 92.9                | 71.8                | 0.13         |                      |
| 2010 | August    | 2   | 94                  | 69.7                | 0            |                      |
| 2010 | August    | 3   | 95                  | 74.2                | 0            |                      |
| 2010 | August    | 4   | 97.4                | 71                  | 0            |                      |
| 2010 | August    | 5   | 94.5                | 71.7                | 0.24         |                      |
| 2010 | August    | 6   | 89.9                | 68.9                | 0            |                      |
| 2010 | August    | 7   | 91.9                | 64.6                | 0            |                      |
| 2010 | August    | 8   | 95.7                | 63.6                | 0            |                      |
| 2010 | August    | 9   | 98.7                | 67.6                | 0            |                      |
| 2010 | August    | 10  | 98.1                | 72                  | 0            |                      |
| 2010 | August    | 11  | 97.9                | 73                  | 0            |                      |
| 2010 | August    | 12  | 93.2                | 72.7                | 0.76         |                      |
| 2010 | August    | 13  | 99                  | 70.1                | 0            |                      |
| 2010 | August    | 14  | 96.1                | 72.4                | 0.03         |                      |
| 2010 | August    | 15  | 96.8                | 71.2                | 0            |                      |
| 2010 | August    | 16  | 88.8                | 71.6                | 1.01         |                      |
| 2010 | August    | 17  | 90.5                | 70.1                | 0.14         |                      |
| 2010 | August    | 18  | 89.2                | 71.9                | 0.01         |                      |
| 2010 | August    | 19  | 87.8                | 72.3                | 0.48         |                      |
| 2010 | August    | 20  | 93.5                | 68.3                | 0.03         |                      |
| 2010 | August    | 21  | 83.5                | 72.7                | 0.29         |                      |
| 2010 | August    | 22  | 89.5                | 70.2                | 0.07         |                      |
| 2010 | August    | 23  | 88.2                | 64.9                | 0            |                      |
| 2010 | August    | 24  | 86.3                | 60.8                | 0            |                      |
| 2010 | August    | 25  | 85.7                | 61.5                | 0            |                      |
| 2010 | August    | 26  | 90                  | 61.2                | 0            |                      |
| 2010 | August    | 27  | 90.3                | 61.5                | 0            |                      |
| 2010 | August    | 28  | 91.4                | 63.9                | 0            |                      |
| 2010 | August    | 29  | 90                  | 62.6                | 0            |                      |
| 2010 | August    | 30  | 91.5                | 65.7                | 0            |                      |
| 2010 | August    | 31  | 92.2                | 60.5                | 0            |                      |
| 2010 | September | 1   | 94.3                | 58.6                | 0            |                      |
| 2010 | September | 2   | 94.5                | 60.7                | 0            |                      |
| 2010 | September | 3   | 88.8                | 62.8                | 0.16         |                      |
| 2010 | September | 4   | 80.5                | 53.8                | 0.01         |                      |
| 2010 | September | 5   | 83.7                | 48.2                | 0            |                      |
| 2010 | September | 6   | 91                  | 50.2                | 0            |                      |
| 2010 | September | 7   | 93.8                | 55.8                | 0            |                      |
| 2010 | September | 8   | 83.7                | 68.1                | 0.45         |                      |
| 2010 | September | 9   | 83.6                | 61.4                | 0.01         |                      |
| 2010 | September | 10  | 76                  | 63.6                | 0.01         |                      |
| 2010 | September | 11  | 87.9                | 64.1                | 2.33         |                      |
| 2010 | September | 12  | 82.1                | 57.5                | 0.01         |                      |
| 2010 | September | 13  | 85.6                | 52.8                | 0            |                      |
| 2010 | September | 14  | 89.7                | 55.7                | 0            |                      |
| 2010 | September | 15  | 90.3                | 57.9                | 0            |                      |

**Table 35.** Continued

| Year | Month     | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|-----------|-----|---------------------|---------------------|--------------|----------------------|
| 2010 | September | 16  | 85.8                | 62.8                | 0.32         |                      |
| 2010 | September | 17  | 85.8                | 63.1                | 0.36         |                      |
| 2010 | September | 18  | 89.6                | 58.1                | 0.01         |                      |
| 2010 | September | 19  | 90.7                | 59.9                | 0            |                      |
| 2010 | September | 20  | 90.5                | 61.9                | 0            |                      |
| 2010 | September | 21  | 93.9                | 61.5                | 0            |                      |
| 2010 | September | 22  | 90                  | 65.4                | 0.38         |                      |
| 2010 | September | 23  | 92.5                | 64.8                | 0.01         |                      |
| 2010 | September | 24  | 90.2                | 62.2                | 0            |                      |
| 2010 | September | 25  | 81.7                | 65.4                | 0            |                      |
| 2010 | September | 26  | 86.3                | 63.2                | 0.15         |                      |
| 2010 | September | 27  | 84.2                | 58.4                | 1.03         |                      |
| 2010 | September | 28  | 72.3                | 54.8                | 0.15         |                      |
| 2010 | September | 29  | 80.1                | 52.7                | 0            |                      |
| 2010 | September | 30  | 77.6                | 57.1                | 0.12         |                      |
| 2010 | October   | 1   | 74.2                | 52.9                | 0            |                      |
| 2010 | October   | 2   | 76.8                | 46.4                | 0            |                      |
| 2010 | October   | 3   | 57.4                | 47.1                | 0            |                      |
| 2010 | October   | 4   | 57.8                | 41.8                | 0            |                      |
| 2010 | October   | 5   | 64.7                | 39.9                | 0            |                      |
| 2010 | October   | 6   | 72.2                | 38.6                | 0            |                      |
| 2010 | October   | 7   | 80.9                | 43.5                | 0.01         |                      |
| 2010 | October   | 8   | 82.2                | 48.2                | 0            |                      |
| 2010 | October   | 9   | 83.3                | 47.3                | 0.01         |                      |
| 2010 | October   | 10  | 84.8                | 47.5                | 0            |                      |
| 2010 | October   | 11  | 84.9                | 48.9                | 0.01         |                      |
| 2010 | October   | 12  | 75                  | 50.1                | 0.02         |                      |
| 2010 | October   | 13  | 79.5                | 55.6                | 0.01         |                      |
| 2010 | October   | 14  | 67.4                | 44.6                | 0.1          |                      |
| 2010 | October   | 15  | 70.4                | 41.7                | 0            |                      |
| 2010 | October   | 16  | 71.2                | 39.4                | 0            |                      |
| 2010 | October   | 17  | 76.8                | 39.3                | 0            |                      |
| 2010 | October   | 18  | 78.2                | 43.1                | 0            |                      |
| 2010 | October   | 19  | 78.6                | 44.6                | 0.02         |                      |
| 2010 | October   | 20  | 71.2                | 46.9                | 0.16         |                      |
| 2010 | October   | 21  | 77.2                | 42.7                | 0            |                      |
| 2010 | October   | 22  | 72.4                | 37.6                | 0            |                      |
| 2010 | October   | 23  | 76.4                | 38.3                | 0            |                      |
| 2010 | October   | 24  | 80.8                | 43.7                | 0            |                      |
| 2010 | October   | 25  | 74.2                | 55.2                | 1.19         |                      |
| 2010 | October   | 26  | 84.4                | 57.6                | 0.95         |                      |
| 2010 | October   | 27  | 69.8                | 56                  | 0.99         |                      |
| 2010 | October   | 28  | 73.2                | 54.3                | 0            |                      |
| 2010 | October   | 29  | 62.1                | 39.9                | 0            |                      |
| 2010 | October   | 30  | 70.8                | 33.2                | 0            |                      |
| 2010 | October   | 31  | 71.9                | 42.5                | 0            |                      |
| 2010 | November  | 1   |                     |                     |              |                      |

**Table 35.** Continued

| Year | Month    | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|----------|-----|---------------------|---------------------|--------------|----------------------|
| 2011 | January  | 7   | 39.6                | 34.4                | 0.06         |                      |
| 2011 | January  | 8   | 34.1                | 16                  | 0            |                      |
| 2011 | January  | 9   | 29.2                | 9                   | 0            |                      |
| 2011 | January  | 10  | 30.8                | 22.9                | 0            |                      |
| 2011 | January  | 11  | 34.4                | 28.5                | 0.12         |                      |
| 2011 | January  | 12  | 27.9                | 21.5                | 0            |                      |
| 2011 | January  | 13  | 29.1                | 17.3                | 0            |                      |
| 2011 | January  | 14  | 39                  | 11.3                | 0            |                      |
| 2011 | January  | 15  | 45.7                | 20.3                | 0            |                      |
| 2011 | January  | 16  | 49.5                | 28                  | 0            |                      |
| 2011 | January  | 17  | 45.1                | 27.8                | 0            |                      |
| 2011 | January  | 18  | 43.6                | 31.1                | 0.15         |                      |
| 2011 | January  | 19  | 44.1                | 35.9                | 0.04         |                      |
| 2011 | January  | 20  | 46                  | 29.5                | 0.02         |                      |
| 2011 | January  | 21  | 33.5                | 21.5                | 0            |                      |
| 2011 | January  | 22  | 38.3                | 21.5                | 0            |                      |
| 2011 | January  | 23  | 42                  | 18.6                | 0            |                      |
| 2011 | January  | 24  | 54.7                | 27.6                | 0            |                      |
| 2011 | January  | 25  | 44.6                | 31.4                | 0.05         |                      |
| 2011 | January  | 26  | 42.2                | 31.7                | 0.49         |                      |
| 2011 | January  | 27  | 45.1                | 28.3                | 0            |                      |
| 2011 | January  | 28  | 50.7                | 28.3                | 0            |                      |
| 2011 | January  | 29  | 63.3                | 24                  | 0            |                      |
| 2011 | January  | 30  | 68.4                | 28.8                | 0            |                      |
| 2011 | January  | 31  | 60.5                | 38.9                | 0            | 2.99                 |
| 2011 | February | 1   | 57.1                | 45.7                | 0.35         |                      |
| 2011 | February | 2   | 54.1                | 25.9                | 0            |                      |
| 2011 | February | 3   | 36.3                | 22.2                | 0            |                      |
| 2011 | February | 4   | 37.7                | 33.5                | 0.08         |                      |
| 2011 | February | 5   | 47.4                | 32                  | 0.05         |                      |
| 2011 | February | 6   | 49.1                | 30.4                | 0            |                      |
| 2011 | February | 7   | 50.5                | 26.8                | 0.12         |                      |
| 2011 | February | 8   | 37.2                | 23.7                | 0            |                      |
| 2011 | February | 9   | 39.7                | 20.5                | 0            |                      |
| 2011 | February | 10  | 40.7                | 22                  | 0            |                      |
| 2011 | February | 11  | 43.9                | 18.4                | 0            |                      |
| 2011 | February | 12  | 51.2                | 27.5                | 0            |                      |
| 2011 | February | 13  | 60.9                | 23                  | 0            |                      |
| 2011 | February | 14  | 65.9                | 44.1                | 0            |                      |
| 2011 | February | 15  | 57.4                | 27.5                | 0            |                      |
| 2011 | February | 16  | 64.4                | 29.3                | 0            |                      |
| 2011 | February | 17  | 72.2                | 30.8                | 0            |                      |
| 2011 | February | 18  | 65.8                | 51.4                | 0.04         |                      |
| 2011 | February | 19  | 61.7                | 35.4                | 0.01         |                      |
| 2011 | February | 20  | 66.1                | 33.7                | 0            |                      |
| 2011 | February | 21  | 68.6                | 46.5                | 0            |                      |
| 2011 | February | 22  | 62.4                | 39.4                | 0.15         |                      |
| 2011 | February | 23  | 60.2                | 29.4                | 0            |                      |
| 2011 | February | 24  | 52.1                | 45.3                | 0.73         |                      |
| 2011 | February | 25  | 64.7                | 37.4                | 0.67         |                      |
| 2011 | February | 26  | 63.2                | 29.4                | 0            |                      |
| 2011 | February | 27  | 61.1                | 38.4                | 0.33         |                      |
| 2011 | February | 28  | 68.4                | 47                  | 2.63         | 5.16                 |
| 2011 | March    | 1   | 59.1                | 36.9                | 0            |                      |
| 2011 | March    | 2   | 64.9                | 31                  | 0.01         |                      |

**Table 35.** Continued

| Year | Month | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|-------|-----|---------------------|---------------------|--------------|----------------------|
| 2011 | March | 3   | 68.2                | 34.7                | 0            | 6.01                 |
| 2011 | March | 4   | 67                  | 36.6                | 0            |                      |
| 2011 | March | 5   | 62.4                | 49                  | 0.53         |                      |
| 2011 | March | 6   | 53.1                | 35                  | 1.14         |                      |
| 2011 | March | 7   | 50.8                | 32.4                | 0            |                      |
| 2011 | March | 8   | 62.9                | 35.7                | 0.25         |                      |
| 2011 | March | 9   | 57.7                | 45.9                | 0.91         |                      |
| 2011 | March | 10  | 51.2                | 38.9                | 1.14         |                      |
| 2011 | March | 11  | 50                  | 32.4                | 0.01         |                      |
| 2011 | March | 12  | 70.4                | 30.5                | 0            |                      |
| 2011 | March | 13  | 70.9                | 40.5                | 0            |                      |
| 2011 | March | 14  | 58.7                | 43                  | 0            |                      |
| 2011 | March | 15  | 60.3                | 47.8                | 0.37         |                      |
| 2011 | March | 16  | 54.7                | 37                  | 0            |                      |
| 2011 | March | 17  | 73.1                | 32.6                | 0.01         |                      |
| 2011 | March | 18  | 79.2                | 43.9                | 0            |                      |
| 2011 | March | 19  | 70.2                | 52.6                | 0            |                      |
| 2011 | March | 20  | 77                  | 46.9                | 0            |                      |
| 2011 | March | 21  | 75.4                | 51.3                | 0            |                      |
| 2011 | March | 22  | 79.4                | 49                  | 0            |                      |
| 2011 | March | 23  | 69.7                | 55                  | 0.42         |                      |
| 2011 | March | 24  | 53.8                | 40                  | 0            |                      |
| 2011 | March | 25  | 53                  | 38.4                | 0.01         |                      |
| 2011 | March | 26  | 51.4                | 45.2                | 0.39         |                      |
| 2011 | March | 27  | 47.5                | 40.2                | 0.02         |                      |
| 2011 | March | 28  | 48.2                | 34.9                | 0.3          |                      |
| 2011 | March | 29  | 65.3                | 34.8                | 0.03         |                      |
| 2011 | March | 30  | 55.5                | 40.2                | 0.45         |                      |
| 2011 | March | 31  | 41.9                | 39.7                | 0.02         |                      |
| 2011 | April | 1   | 53.9                | 33.1                | 0            |                      |
| 2011 | April | 2   | 64.6                | 38.6                | 0.06         |                      |
| 2011 | April | 3   | 78.5                | 34.1                | 0            |                      |
| 2011 | April | 4   | 77                  | 59.5                | 0.72         |                      |
| 2011 | April | 5   | 60.1                | 42.4                | 1.03         |                      |
| 2011 | April | 6   | 71.6                | 31.1                | 0            |                      |
| 2011 | April | 7   | 75.1                | 40.3                | 0            |                      |
| 2011 | April | 8   | 78.7                | 50.3                | 0            |                      |
| 2011 | April | 9   | 84.5                | 57.8                | 0            |                      |
| 2011 | April | 10  | 86.8                | 55.5                | 0            |                      |
| 2011 | April | 11  | 82.3                | 61.9                | 0            |                      |
| 2011 | April | 12  | 66                  | 46.5                | 0.51         |                      |
| 2011 | April | 13  | 69.4                | 39.9                | 0.01         |                      |
| 2011 | April | 14  | 77.2                | 38.2                | 0            |                      |
| 2011 | April | 15  | 73.7                | 45.2                | 0.82         |                      |
| 2011 | April | 16  | 60.1                | 50.2                | 1.49         |                      |
| 2011 | April | 17  | 70.3                | 36.2                | 0            |                      |
| 2011 | April | 18  | 77.2                | 41.6                | 0            |                      |
| 2011 | April | 19  | 84.9                | 53.8                | 0            |                      |
| 2011 | April | 20  | 77.4                | 60.7                | 0.21         |                      |
| 2011 | April | 21  | 70.3                | 53.6                | 0            |                      |
| 2011 | April | 22  | 79.2                | 51.8                | 0.03         |                      |
| 2011 | April | 23  | 81.6                | 57.4                | 0            |                      |
| 2011 | April | 24  | 84.9                | 57                  | 0            |                      |
| 2011 | April | 25  | 85.6                | 53.2                | 0.02         |                      |
| 2011 | April | 26  | 82.2                | 59.3                | 0.02         |                      |

**Table 35.** Continued

| Year | Month | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|-------|-----|---------------------|---------------------|--------------|----------------------|
| 2011 | April | 27  | 84.2                | 60.5                | 0.65         | 5.58                 |
| 2011 | April | 28  | 68.5                | 48.1                | 0.01         |                      |
| 2011 | April | 29  | 74.4                | 43.5                | 0            |                      |
| 2011 | April | 30  | 81.3                | 57.6                | 0            |                      |
| 2011 | May   | 1   | 79.2                | 54.5                | 0            |                      |
| 2011 | May   | 2   | 82.1                | 54.5                | 0            |                      |
| 2011 | May   | 3   | 77.8                | 47.6                | 0.78         |                      |
| 2011 | May   | 4   | 56.6                | 41.2                | 0.01         |                      |
| 2011 | May   | 5   | 68.5                | 35.6                | 0.01         |                      |
| 2011 | May   | 6   | 69.5                | 42.5                | 0            |                      |
| 2011 | May   | 7   | 71.8                | 42.5                | 0            | 1.64                 |
| 2011 | May   | 8   | 83.3                | 54.1                | 0.03         |                      |
| 2011 | May   | 9   | 86.2                | 55.5                | 0            |                      |
| 2011 | May   | 10  | 88.3                | 59.5                | 0            |                      |
| 2011 | May   | 11  | 88.9                | 59.8                | 0            |                      |
| 2011 | May   | 12  | 89.1                | 61.7                | 0            |                      |
| 2011 | May   | 13  | 85.2                | 62.6                | 0.03         |                      |
| 2011 | May   | 14  | 76.8                | 60.9                | 0.06         |                      |
| 2011 | May   | 15  | 63.2                | 56.3                | 0            |                      |
| 2011 | May   | 16  | 61.1                | 52.2                | 0.11         |                      |
| 2011 | May   | 17  | 51.8                | 48.1                | 0.07         |                      |
| 2011 | May   | 18  | 59.7                | 47.8                | 0.01         |                      |
| 2011 | May   | 19  | 73.8                | 53.1                | 0            |                      |
| 2011 | May   | 20  | 80.6                | 58.1                | 0.01         |                      |
| 2011 | May   | 21  | 88.5                | 55.2                | 0            |                      |
| 2011 | May   | 22  | 91.4                | 61.1                | 0.1          |                      |
| 2011 | May   | 23  | 86.8                | 60.1                | 0            |                      |
| 2011 | May   | 24  | 87.2                | 65.7                | 0            |                      |
| 2011 | May   | 25  | 92.6                | 61.3                | 0            |                      |
| 2011 | May   | 26  | 77.7                | 62.3                | 0.41         |                      |
| 2011 | May   | 27  | 79.8                | 62.6                | 0.01         |                      |
| 2011 | May   | 28  | 87.4                | 56.9                | 0            |                      |
| 2011 | May   | 29  | 93.7                | 58.7                | 0            |                      |
| 2011 | May   | 30  | 95                  | 65                  | 0            |                      |
| 2011 | May   | 31  | 93.4                | 66.7                | 0            |                      |
| 2011 | June  | 1   | 94.6                | 67                  | 0            |                      |
| 2011 | June  | 2   | 93.5                | 66.5                | 0            |                      |
| 2011 | June  | 3   | 92.3                | 65.6                | 0            |                      |
| 2011 | June  | 4   | 94.9                | 61                  | 0            |                      |
| 2011 | June  | 5   | 94.3                | 63.3                | 0            |                      |
| 2011 | June  | 6   | 94.3                | 65.5                | 0            |                      |
| 2011 | June  | 7   | 95.1                | 62.8                | 0            |                      |
| 2011 | June  | 8   | 98.1                | 65.7                | 0            |                      |
| 2011 | June  | 9   | 94.8                | 65.7                | 0            |                      |
| 2011 | June  | 10  | 94.4                | 60.8                | 0            |                      |
| 2011 | June  | 11  | 95.5                | 64.8                | 0.05         |                      |
| 2011 | June  | 12  | 91                  | 66.7                | 0.03         |                      |
| 2011 | June  | 13  | 86.6                | 64.5                | 0.02         |                      |
| 2011 | June  | 14  | 81.5                | 57.7                | 0            |                      |
| 2011 | June  | 15  | 78.1                | 57.1                | 0.27         |                      |
| 2011 | June  | 16  | 87                  | 62.2                | 0.19         |                      |
| 2011 | June  | 17  | 86.1                | 60.5                | 0.04         |                      |
| 2011 | June  | 18  | 80.8                | 66.7                | 0.08         |                      |
| 2011 | June  | 19  | 83.3                | 66.1                | 1.05         |                      |
| 2011 | June  | 20  | 86.2                | 67.1                | 0.03         |                      |

**Table 35.** Continued

| Year | Month  | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|--------|-----|---------------------|---------------------|--------------|----------------------|
| 2011 | June   | 21  | 93                  | 84.7                | 0.18         | 4.49                 |
| 2011 | June   | 22  | 81.3                | 67.3                | 0.58         |                      |
| 2011 | June   | 23  | 84.7                | 66.8                | 0.12         |                      |
| 2011 | June   | 24  | 88.1                | 65.9                | 1.77         |                      |
| 2011 | June   | 25  | 88.6                | 66.2                | 0            |                      |
| 2011 | June   | 26  | 88                  | 65.5                | 0.12         |                      |
| 2011 | June   | 27  | 90.7                | 68.5                | 0            |                      |
| 2011 | June   | 28  | 82.2                | 68.7                | 0            |                      |
| 2011 | June   | 29  | 87.9                | 64.6                | 0            |                      |
| 2011 | June   | 30  | 89.9                | 60.9                | 0            |                      |
| 2011 | July   | 1   | 92.2                | 58.7                | 0            |                      |
| 2011 | July   | 2   | 94.9                | 61.4                | 0            |                      |
| 2011 | July   | 3   | 96.7                | 65.4                | 0            |                      |
| 2011 | July   | 4   | 90.9                | 68.5                | 0.25         |                      |
| 2011 | July   | 5   | 90.9                | 68.1                | 0            |                      |
| 2011 | July   | 6   | 91.7                | 66.3                | 0.3          |                      |
| 2011 | July   | 7   | 93.4                | 67.5                | 1.38         |                      |
| 2011 | July   | 8   | 89.7                | 68.1                | 0.35         |                      |
| 2011 | July   | 9   | 91.9                | 72.5                | 0            |                      |
| 2011 | July   | 10  | 97.5                | 70                  | 0            |                      |
| 2011 | July   | 11  | 97.7                | 69.7                | 0            |                      |
| 2011 | July   | 12  | 88.9                | 70.6                | 0.22         |                      |
| 2011 | July   | 13  | 93.8                | 69.2                | 0            |                      |
| 2011 | July   | 14  | 94.3                | 69.9                | 0            |                      |
| 2011 | July   | 15  | 81.6                | 69.5                | 0.43         |                      |
| 2011 | July   | 16  | 79.9                | 67.4                | 0.02         |                      |
| 2011 | July   | 17  | 91.1                | 66.2                | 0            |                      |
| 2011 | July   | 18  | 94.5                | 68.4                | 0            |                      |
| 2011 | July   | 19  | 92.6                | 69.5                | 0.16         |                      |
| 2011 | July   | 20  | 97.2                | 74.6                | 0.01         |                      |
| 2011 | July   | 21  | 83                  | 72.6                | 0.37         |                      |
| 2011 | July   | 22  | 95.7                | 71.2                | 0            |                      |
| 2011 | July   | 23  | 98.4                | 71.3                | 0.51         |                      |
| 2011 | July   | 24  | 94.5                | 71.6                | 0.36         |                      |
| 2011 | July   | 25  | 90.7                | 73.3                | 0.11         |                      |
| 2011 | July   | 26  | 93.4                | 71.8                | 0            | 5.35                 |
| 2011 | July   | 27  | 95.9                | 68.5                | 0            |                      |
| 2011 | July   | 28  | 99.5                | 68.1                | 0            |                      |
| 2011 | July   | 29  | 92.8                | 70.1                | 0            |                      |
| 2011 | July   | 30  | 98.5                | 71.8                | 0.87         |                      |
| 2011 | July   | 31  | 92                  | 70.8                | 0.01         |                      |
| 2011 | August | 1   | 95.1                | 69.9                | 0            |                      |
| 2011 | August | 2   | 98.8                | 66.9                | 0            |                      |
| 2011 | August | 3   | 98.6                | 64.5                | 0            |                      |
| 2011 | August | 4   | 93.9                | 72.3                | 0.02         |                      |
| 2011 | August | 5   | 97.3                | 69.4                | 0            |                      |
| 2011 | August | 6   | 87.3                | 73.6                | 0            |                      |
| 2011 | August | 7   | 92.8                | 69                  | 0            |                      |
| 2011 | August | 8   | 92.2                | 70.9                | 0.18         |                      |
| 2011 | August | 9   | 89.9                | 69.2                | 0.01         |                      |
| 2011 | August | 10  | 92.3                | 65.2                | 0            |                      |
| 2011 | August | 11  | 92.2                | 68.4                | 0            |                      |
| 2011 | August | 12  | 94.4                | 63.6                | 0            |                      |
| 2011 | August | 13  | 91.8                | 63.6                | 0            |                      |
| 2011 | August | 14  | 88.8                | 67.7                | 0.07         |                      |

**Table 35.** Continued

| Year | Month     | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|-----------|-----|---------------------|---------------------|--------------|----------------------|
| 2011 | August    | 15  | 83.9                | 61.4                | 0            | 1.14                 |
| 2011 | August    | 16  | 88.5                | 57.8                | 0            |                      |
| 2011 | August    | 17  | 94.7                | 59.1                | 0            |                      |
| 2011 | August    | 18  | 94.7                | 64.7                | 0.01         |                      |
| 2011 | August    | 19  | 92.2                | 65.6                | 0.83         |                      |
| 2011 | August    | 20  | 94.4                | 65.5                | 0.01         |                      |
| 2011 | August    | 21  | 91.6                | 67.7                | 0            |                      |
| 2011 | August    | 22  | 89                  | 64.8                | 0            |                      |
| 2011 | August    | 23  | 93.5                | 57.7                | 0            |                      |
| 2011 | August    | 24  | 95                  | 58.1                | 0            |                      |
| 2011 | August    | 25  | 98.6                | 64.9                | 0            |                      |
| 2011 | August    | 26  | 97.7                | 68.4                | 0            |                      |
| 2011 | August    | 27  | 88.1                | 63.1                | 0            |                      |
| 2011 | August    | 28  | 87.1                | 58.9                | 0.01         |                      |
| 2011 | August    | 29  | 88.6                | 54                  | 0            |                      |
| 2011 | August    | 30  | 94.4                | 56.5                | 0            |                      |
| 2011 | August    | 31  | 96.9                | 62.5                | 0            |                      |
| 2011 | September | 1   | 97.5                | 63.7                | 0            |                      |
| 2011 | September | 2   | 99.5                | 64.4                | 0            |                      |
| 2011 | September | 3   | 98.8                | 67.1                | 0.52         |                      |
| 2011 | September | 4   | 88.8                | 66.2                | 0.09         |                      |
| 2011 | September | 5   | 70.9                | 63.1                | 3.63         |                      |
| 2011 | September | 6   | 78.8                | 62.5                | 1.24         |                      |
| 2011 | September | 7   | 67.8                | 61.4                | 0.02         |                      |
| 2011 | September | 8   | 72.1                | 59.5                | 0.02         |                      |
| 2011 | September | 9   | 73.6                | 57.4                | 0.01         |                      |
| 2011 | September | 10  | 83.8                | 53.9                | 0            |                      |
| 2011 | September | 11  | 85                  | 54.1                | 0.12         |                      |
| 2011 | September | 12  | 86                  | 58.7                | 0.01         |                      |
| 2011 | September | 13  | 88.1                | 58                  | 0            |                      |
| 2011 | September | 14  | 90.2                | 58                  | 0            |                      |
| 2011 | September | 15  | 68.6                | 57.7                | 0.06         |                      |
| 2011 | September | 16  | 68.8                | 52.1                | 0            |                      |
| 2011 | September | 17  | 79.2                | 56.7                | 0            |                      |
| 2011 | September | 18  | 82.7                | 56                  | 0            |                      |
| 2011 | September | 19  | 75.1                | 60                  | 0            |                      |
| 2011 | September | 20  | 82.9                | 62.6                | 0.03         |                      |
| 2011 | September | 21  | 84.3                | 65.8                | 0.09         |                      |
| 2011 | September | 22  | 82                  | 66.3                | 0            |                      |
| 2011 | September | 23  | 75.7                | 61.5                | 0.06         |                      |
| 2011 | September | 24  | 80.4                | 55.8                | 0            |                      |
| 2011 | September | 25  | 84.3                | 52.7                | 0            |                      |
| 2011 | September | 26  | 84.2                | 60.4                | 0.14         |                      |
| 2011 | September | 27  | 77.4                | 56.7                | 0.06         |                      |
| 2011 | September | 28  | 80.2                | 52.3                | 0            |                      |
| 2011 | September | 29  | 81.6                | 59.1                | 0            |                      |
| 2011 | September | 30  | 70.3                | 54.7                | 0            | 6.1                  |
| 2011 | October   | 1   | 56.1                | 42.2                | 0            |                      |
| 2011 | October   | 2   | 63.9                | 39.4                | 0            |                      |
| 2011 | October   | 3   | 71.9                | 38.2                | 0            |                      |
| 2011 | October   | 4   | 77.8                | 41.7                | 0            |                      |
| 2011 | October   | 5   | 82                  | 47.1                | 0.01         |                      |
| 2011 | October   | 6   | 83.2                | 49.6                | 0            |                      |
| 2011 | October   | 7   | 82.4                | 51.5                | 0.01         |                      |
| 2011 | October   | 8   | 79.7                | 49.3                | 0.01         |                      |

**Table 35.** Continued

| Year | Month    | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|----------|-----|---------------------|---------------------|--------------|----------------------|
| 2011 | October  | 9   | 73.1                | 50.2                | 0            | 0.32                 |
| 2011 | October  | 10  | 80.2                | 56.3                | 0.01         |                      |
| 2011 | October  | 11  | 72.1                | 59.2                | 0.05         |                      |
| 2011 | October  | 12  | 69.5                | 58.1                | 0.02         |                      |
| 2011 | October  | 13  | 68.9                | 60                  | 0.02         |                      |
| 2011 | October  | 14  | 74.1                | 50.8                | 0.01         |                      |
| 2011 | October  | 15  | 71.9                | 46.4                | 0.01         |                      |
| 2011 | October  | 16  | 79.9                | 41                  | 0.01         |                      |
| 2011 | October  | 17  | 83.4                | 51.4                | 0.01         |                      |
| 2011 | October  | 18  | 81.9                | 51.8                | 0.01         |                      |
| 2011 | October  | 19  | 64                  | 45.8                | 0.01         |                      |
| 2011 | October  | 20  | 52.9                | 44.6                | 0.01         |                      |
| 2011 | October  | 21  | 63                  | 41.4                | 0.02         |                      |
| 2011 | October  | 22  | 66.1                | 35.7                | 0.01         |                      |
| 2011 | October  | 23  | 68.6                | 36.6                | 0.01         |                      |
| 2011 | October  | 24  | 73                  | 43.3                | 0.02         |                      |
| 2011 | October  | 25  | 78                  | 42.5                | 0.01         |                      |
| 2011 | October  | 26  | 76.8                | 43.8                | 0.01         |                      |
| 2011 | October  | 27  | 66.7                | 50.3                | 0.01         |                      |
| 2011 | October  | 28  | 51.2                | 42                  | 0            |                      |
| 2011 | October  | 29  | 54.4                | 35.7                | 0.01         |                      |
| 2011 | October  | 30  | 61.5                | 32.7                | 0.02         |                      |
| 2011 | October  | 31  | 61.1                | 33.6                | 0            |                      |
| 2011 | November | 1   | 66.2                | 32.7                | 0.02         |                      |
| 2011 | November | 2   | 68.7                | 34.6                | 0            |                      |
| 2011 | November | 3   | 65.7                | 35.2                | 0.01         |                      |
| 2011 | November | 4   | 57.1                | 43.7                | 0.01         |                      |
| 2011 | November | 5   | 65.6                | 34.8                | 0            |                      |
| 2011 | November | 6   | 64.2                | 33.2                | 0.01         |                      |
| 2011 | November | 7   | 71.3                | 35.5                | 0.01         |                      |
| 2011 | November | 8   | 72.1                | 38.9                | 0.01         |                      |
| 2011 | November | 9   | 66.3                | 41.2                | 0            |                      |
| 2011 | November | 10  | 56.1                | 41.9                | 0.01         |                      |
| 2011 | November | 11  | 52.4                | 27.8                | 1.12         |                      |
| 2011 | November | 12  | 63.8                | 27.9                | 0.05         |                      |
| 2011 | November | 13  | 68.8                | 40.4                | 0            |                      |
| 2011 | November | 14  | 71.6                | 51.1                | 0            |                      |
| 2011 | November | 15  | 72.1                | 61.2                | 0.37         |                      |
| 2011 | November | 16  | 65.6                | 52.5                | 0.04         |                      |
| 2011 | November | 17  | 52.2                | 31.2                | 0.02         |                      |
| 2011 | November | 18  | 55.1                | 25.2                | 1.2          |                      |
| 2011 | November | 19  | 63.8                | 29.4                | 0.08         |                      |
| 2011 | November | 20  | 66.1                | 46.3                | 0.02         |                      |
| 2011 | November | 21  | 63.5                | 54.8                | 0.14         |                      |
| 2011 | November | 22  | 74                  | 53.3                | 0.07         |                      |
| 2011 | November | 23  | 60.1                | 40.4                | 0.03         |                      |
| 2011 | November | 24  | 62.5                | 32.6                | 0.02         |                      |
| 2011 | November | 25  | 63.2                | 32.5                | 0.02         |                      |
| 2011 | November | 26  | 65.9                | 34.9                | 0.01         |                      |
| 2011 | November | 27  | 59.4                | 42.9                | 0.01         |                      |
| 2011 | November | 28  | 66.1                | 44.3                | 0.03         |                      |
| 2011 | November | 29  | 43.1                | 38.2                | 0.03         |                      |
| 2011 | November | 30  | 47.1                | 29.7                | 0.01         | 3.35                 |
| 2011 | December | 1   | 54.5                | 25.6                | 0.95         |                      |
| 2011 | December | 2   | 60                  | 25.5                | 0.61         |                      |

**Table 35.** Continued

| Year | Month    | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|----------|-----|---------------------|---------------------|--------------|----------------------|
| 2011 | December | 3   | 60.5                | 29.6                | 0.01         |                      |
| 2011 | December | 4   | 65.7                | 30.3                | 0            |                      |
| 2011 | December | 5   | 72.9                | 40.6                | 0.07         |                      |
| 2011 | December | 6   | 60.1                | 50.6                | 0.25         |                      |
| 2011 | December | 7   | 50                  | 35.6                | 0.15         |                      |
| 2011 | December | 8   | 48.3                | 27.9                | 0.95         |                      |
| 2011 | December | 9   | 52                  | 26.3                | 0.31         |                      |
| 2011 | December | 10  | 45                  | 27.4                | 0            |                      |
| 2011 | December | 11  | 51.2                | 23.4                | 0            |                      |
| 2011 | December | 12  | 53.9                | 29.8                | 0            |                      |
| 2011 | December | 13  | 55.3                | 42.3                | 0            |                      |
| 2011 | December | 14  | 66.9                | 41.3                | 0.01         |                      |
| 2011 | December | 15  | 65.4                | 40.2                | 0.09         |                      |
| 2011 | December | 16  | 57                  | 39.9                | 0.16         |                      |
| 2011 | December | 17  | 47.1                | 31.3                | 0.05         |                      |
| 2011 | December | 18  | 51                  | 26.5                | 0.18         |                      |
| 2011 | December | 19  | 55.1                | 27.9                | 0.01         |                      |
| 2011 | December | 20  | 56.9                | 34.2                | 0            |                      |
| 2011 | December | 21  | 64.4                | 44.4                | 0.04         |                      |
| 2011 | December | 22  | 62.1                | 42.3                | 0.08         |                      |
| 2011 | December | 23  | 50.8                | 45.2                | 0.11         |                      |
| 2011 | December | 24  | 48.1                | 34.2                | 0.02         |                      |
| 2011 | December | 25  | 52.4                | 31.7                | 0.03         |                      |
| 2011 | December | 26  | 47.4                | 27.9                | 0.12         |                      |
| 2011 | December | 27  | 47.2                | 38.5                | 0.02         |                      |
| 2011 | December | 28  | 46.1                | 30.6                | 0.02         |                      |
| 2011 | December | 29  | 53.5                | 26.6                | 0.4          |                      |
| 2011 | December | 30  | 62.1                | 33.3                | 0            |                      |
| 2011 | December | 31  | 59.5                | 36                  | 0            | 4.64                 |
| 2012 | January  | 1   | 61.4                | 31.8                | 0.07         |                      |
| 2012 | January  | 2   | 42.1                | 22.5                | 0.02         |                      |
| 2012 | January  | 3   | 31.7                | 20                  | 0            |                      |
| 2012 | January  | 4   | 46.9                | 16.5                | 0            |                      |
| 2012 | January  | 5   | 53.9                | 27.1                | 0            |                      |
| 2012 | January  | 6   | 61.8                | 25.6                | 0            |                      |
| 2012 | January  | 7   | 60.1                | 41.9                | 0.11         |                      |
| 2012 | January  | 8   | 50.8                | 43.9                | 0.05         |                      |
| 2012 | January  | 9   | 50.7                | 44.8                | 0.04         |                      |
| 2012 | January  | 10  | 52.7                | 39.5                | 0.02         |                      |
| 2012 | January  | 11  | 59.4                | 45.3                | 0.02         |                      |
| 2012 | January  | 12  | 52.2                | 28.2                | 0.02         |                      |
| 2012 | January  | 13  | 29.7                | 23.3                | 0            |                      |

**Table 35.** Continued

| Year | Month    | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|----------|-----|---------------------|---------------------|--------------|----------------------|
| 2012 | January  | 14  | 42.9                | 21                  | 0.04         | 2.98                 |
| 2012 | January  | 15  | 46.3                | 26.4                | 0.19         |                      |
| 2012 | January  | 16  | 47.7                | 25.9                | 0.03         |                      |
| 2012 | January  | 17  | 61.4                | 40.3                | 0.34         |                      |
| 2012 | January  | 18  | 37.5                | 27.2                | 0.03         |                      |
| 2012 | January  | 19  | 41.3                | 22.6                | 0            |                      |
| 2012 | January  | 20  | 49.3                | 34                  | 0.05         |                      |
| 2012 | January  | 21  | 53.4                | 41.9                | 0.71         |                      |
| 2012 | January  | 22  | 54.3                | 42.3                | 0.13         |                      |
| 2012 | January  | 23  | 64.6                | 48.8                | 0.54         |                      |
| 2012 | January  | 24  | 60                  | 35.4                | 0.21         |                      |
| 2012 | January  | 25  | 62.9                | 32.7                | 0.05         |                      |
| 2012 | January  | 26  | 59.4                | 41.9                | 0.04         |                      |
| 2012 | January  | 27  | 56.5                | 33.2                | 0.04         |                      |
| 2012 | January  | 28  | 51                  | 28.1                | 0.23         |                      |
| 2012 | January  | 29  | 50.6                | 23.3                | 0            |                      |
| 2012 | January  | 30  | 59.9                | 26.5                | 0            |                      |
| 2012 | January  | 31  | 63.8                | 28.9                | 0            |                      |
| 2012 | February | 1   | 52.2                | 39.2                | 0.27         |                      |
| 2012 | February | 2   | 61.6                | 40.2                | 0.13         |                      |
| 2012 | February | 3   | 59.1                | 32.9                | 0.04         |                      |
| 2012 | February | 4   | 49.5                | 39.9                | 0.02         |                      |
| 2012 | February | 5   | 56.7                | 46.5                | 0.04         |                      |
| 2012 | February | 6   | 53.5                | 36.6                | 0.02         |                      |
| 2012 | February | 7   | 55.8                | 28.1                | 0.32         |                      |
| 2012 | February | 8   | 47.9                | 33.7                | 0            |                      |
| 2012 | February | 9   | 47.8                | 32.1                | 0            |                      |
| 2012 | February | 10  | 45.6                | 27                  | 0            |                      |
| 2012 | February | 11  | 38.5                | 23.4                | 0.01         |                      |
| 2012 | February | 12  | 37.7                | 17                  | 0            |                      |
| 2012 | February | 13  | 43.1                | 18                  | 0            |                      |
| 2012 | February | 14  | 44.9                | 33.7                | 0.07         |                      |
| 2012 | February | 15  | 55.7                | 40.2                | 0            |                      |
| 2012 | February | 16  | 60.5                | 44.7                | 0.33         |                      |
| 2012 | February | 17  | 60.5                | 39.2                | 0            |                      |
| 2012 | February | 18  | 63.9                | 36                  | 0            |                      |
| 2012 | February | 19  | 51                  | 35.3                | 0.58         |                      |
| 2012 | February | 20  | 51.1                | 29.2                | 0.14         |                      |
| 2012 | February | 21  | 61.5                | 29.9                | 0.01         |                      |
| 2012 | February | 22  | 53.7                | 33.8                | 0.28         |                      |
| 2012 | February | 23  | 77.4                | 46.6                | 0.15         |                      |
| 2012 | February | 24  | 70.7                | 41                  | 0.03         |                      |
| 2012 | February | 25  | 50.5                | 32.9                | 0            | 2.6                  |
| 2012 | February | 26  | 59.4                | 25.6                | 0            |                      |
| 2012 | February | 27  | 66.2                | 32.5                | 0            |                      |
| 2012 | February | 28  | 72.3                | 33.8                | 0            |                      |
| 2012 | February | 29  | 71.5                | 52.2                | 0.16         |                      |

**Table 35.** Continued

| Year | Month | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|-------|-----|---------------------|---------------------|--------------|----------------------|
| 2012 | March | 1   | 69.4                | 44                  | 0.16         |                      |
| 2012 | March | 2   | 71.5                | 40.6                | 0.16         |                      |
| 2012 | March | 3   | 57.3                | 42.2                | 0.25         |                      |
| 2012 | March | 4   | 46.2                | 32.5                | 0            |                      |
| 2012 | March | 5   | 48.4                | 30.1                | 0            |                      |
| 2012 | March | 6   | 64                  | 25.8                | 0            |                      |
| 2012 | March | 7   | 68.3                | 33.4                | 0            |                      |
| 2012 | March | 8   | 69.2                | 43.4                | 0.39         |                      |
| 2012 | March | 9   | 57                  | 40.9                | 0.66         |                      |
| 2012 | March | 10  | 63                  | 32.5                | 0            |                      |
| 2012 | March | 11  | 69.1                | 31.3                | 0            |                      |
| 2012 | March | 12  | 68.2                | 46.2                | 0.02         |                      |
| 2012 | March | 13  | 77.5                | 53.1                | 0.07         |                      |
| 2012 | March | 14  | 80.6                | 46.1                | 0            |                      |
| 2012 | March | 15  | 84                  | 49                  | 0.46         |                      |
| 2012 | March | 16  | 76.9                | 52.6                | 0.1          |                      |
| 2012 | March | 17  | 78.8                | 51                  | 0.04         |                      |
| 2012 | March | 18  | 80.7                | 57.3                | 0.47         |                      |
| 2012 | March | 19  | 82.7                | 51.8                | 0            |                      |
| 2012 | March | 20  | 85.9                | 54.1                | 0.1          |                      |
| 2012 | March | 21  | 84.7                | 53.1                | 0.01         |                      |
| 2012 | March | 22  | 81.4                | 53.3                | 0            |                      |
| 2012 | March | 23  | 72.5                | 57.4                | 0.21         |                      |
| 2012 | March | 24  | 66.6                | 50.9                | 0.6          |                      |
| 2012 | March | 25  | 69.2                | 50.1                | 0.1          |                      |
| 2012 | March | 26  | 76.3                | 50.5                | 0            |                      |
| 2012 | March | 27  | 78.1                | 47.8                | 0            |                      |
| 2012 | March | 28  | 78.9                | 50.9                | 0            |                      |
| 2012 | March | 29  | 79.4                | 59.9                | 0.08         |                      |
| 2012 | March | 30  | 77.7                | 53.7                | 0.03         |                      |
| 2012 | March | 31  | 73.4                | 55.6                | 0.11         | 4.02                 |
| 2012 | April | 2   | 86.2                | 54.9                | 0.37         |                      |
| 2012 | April | 3   | 83.7                | 57.7                | 0.04         |                      |
| 2012 | April | 4   | 81.6                | 55.1                | 0.01         |                      |
| 2012 | April | 5   | 76.9                | 55.4                | 0.64         |                      |
| 2012 | April | 6   | 68.3                | 50                  | 0.06         |                      |
| 2012 | April | 7   | 74                  | 37.8                | 0            |                      |
| 2012 | April | 8   | 74.1                | 42.9                | 0            |                      |
| 2012 | April | 9   | 73.8                | 39.9                | 0            |                      |
| 2012 | April | 10  | 68.3                | 42.7                | 0            |                      |
| 2012 | April | 11  | 57.6                | 34.4                | 0            |                      |

**Table 35.** Continued

| Year | Month | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |  |
|------|-------|-----|---------------------|---------------------|--------------|----------------------|--|
| 2012 | April | 12  | 64.5                | 30.5                | 0            |                      |  |
| 2012 | April | 13  | 72                  | 33.6                | 0            |                      |  |
| 2012 | April | 14  | 79.1                | 42.9                | 0            |                      |  |
| 2012 | April | 15  | 82.6                | 47.8                | 0            |                      |  |
| 2012 | April | 16  | 81.7                | 55.3                | 0            |                      |  |
| 2012 | April | 17  | 70.3                | 57                  | 0            |                      |  |
| 2012 | April | 18  | 61.2                | 52.1                | 0.21         |                      |  |
| 2012 | April | 19  | 76.2                | 50.6                | 0            |                      |  |
| 2012 | April | 20  | 76                  | 48.4                | 0            |                      |  |
| 2012 | April | 21  | 69.1                | 54.7                | 0.01         |                      |  |
| 2012 | April | 22  | 54.5                | 44.3                | 0            |                      |  |
| 2012 | April | 23  | 58.3                | 42.8                | 0            |                      |  |
| 2012 | April | 24  | 63.2                | 39.6                | 0.06         |                      |  |
| 2012 | April | 25  | 79.3                | 49.4                | 0.07         |                      |  |
| 2012 | April | 26  | 71.8                | 59.3                | 0.48         |                      |  |
| 2012 | April | 27  | 75.8                | 55.2                | 0            |                      |  |
| 2012 | April | 28  | 83.4                | 53.6                | 0            |                      |  |
| 2012 | April | 29  | 87.1                | 56                  | 0            |                      |  |
| 2012 | April | 30  | 86.4                | 57.1                | 0            | 1.99                 |  |
| 2012 | May   | 1   | 88.8                | 58.9                | 0            |                      |  |
| 2012 | May   | 2   | 90.7                | 62.9                | 0            |                      |  |
| 2012 | May   | 3   | 89.1                | 61.2                | 0.01         |                      |  |
| 2012 | May   | 4   | 85.4                | 64.5                | 0.1          |                      |  |
| 2012 | May   | 5   | 83.4                | 64.5                | 0.3          |                      |  |
| 2012 | May   | 6   | 86.8                | 60.8                | 0            |                      |  |
| 2012 | May   | 7   | 83.8                | 60.9                | 0.8          |                      |  |
| 2012 | May   | 8   | 79.6                | 66.3                | 0.02         |                      |  |
| 2012 | May   | 9   | 70.4                | 55.7                | 0.02         |                      |  |
| 2012 | May   | 10  | 71.9                | 47.8                | 0            |                      |  |
| 2012 | May   | 11  | 77.8                | 45.1                | 0            |                      |  |
| 2012 | May   | 12  | 78.7                | 53.5                | 0            |                      |  |
| 2012 | May   | 13  | 67.8                | 61.2                | 0.39         |                      |  |
| 2012 | May   | 14  | 76.2                | 60.9                | 1.91         |                      |  |
| 2012 | May   | 15  | 77                  | 57.7                | 0            |                      |  |
| 2012 | May   | 16  | 81.7                | 54.9                | 0            |                      |  |
| 2012 | May   | 17  | 85.1                | 54.7                | 0            |                      |  |
| 2012 | May   | 18  | 85.7                | 57.6                | 0            |                      |  |
| 2012 | May   | 19  | 86.6                | 60.5                | 0            |                      |  |
| 2012 | May   | 20  | 87.3                | 60.5                | 0            |                      |  |
| 2012 | May   | 21  | 84.2                | 59.1                | 0.15         |                      |  |

**Table 35.** Continued

| Year | Month | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|-------|-----|---------------------|---------------------|--------------|----------------------|
| 2012 | May   | 22  | 75.6                | 62.7                | 0.13         | 4.51                 |
| 2012 | May   | 23  | 78.5                | 63.3                | 0.59         |                      |
| 2012 | May   | 24  | 87.6                | 62.9                | 0            |                      |
| 2012 | May   | 25  | 91.7                | 60.2                | 0            |                      |
| 2012 | May   | 26  | 92.9                | 64.1                | 0            |                      |
| 2012 | May   | 27  | 92.2                | 66                  | 0            |                      |
| 2012 | May   | 28  | 93.9                | 65.7                | 0            |                      |
| 2012 | May   | 29  | 89.7                | 66.6                | 0            |                      |
| 2012 | May   | 30  | 90.3                | 66                  | 0            |                      |
| 2012 | May   | 31  | 90.3                | 60.5                | 0.09         |                      |
| 2012 | June  | 1   | 72.1                | 59.5                | 0.6          | 1.79                 |
| 2012 | June  | 2   | 73.5                | 51.4                | 0.01         |                      |
| 2012 | June  | 3   | 82.9                | 53.4                | 0            |                      |
| 2012 | June  | 4   | 83.1                | 63.4                | 0            |                      |
| 2012 | June  | 5   | 78.5                | 60.5                | 0.36         |                      |
| 2012 | June  | 6   | 79.9                | 54.2                | 0            |                      |
| 2012 | June  | 7   | 83                  | 56.2                | 0            |                      |
| 2012 | June  | 8   | 85.2                | 55.8                | 0            |                      |
| 2012 | June  | 9   | 86.7                | 58                  | 0            |                      |
| 2012 | June  | 10  | 81.9                | 66.9                | 0.03         |                      |
| 2012 | June  | 11  | 81.8                | 66.9                | 0.17         |                      |
| 2012 | June  | 12  | 82.8                | 68.4                | 0.43         |                      |
| 2012 | June  | 13  | 87.9                | 64.4                | 0            |                      |
| 2012 | June  | 14  | 89.5                | 61.3                | 0            |                      |
| 2012 | June  | 15  | 89.3                | 64.5                | 0            |                      |
| 2012 | June  | 16  | 84.6                | 66.4                | 0.19         |                      |
| 2012 | June  | 17  | 86.6                | 65.6                | 0            |                      |
| 2012 | June  | 18  | 89.9                | 64                  | 0            |                      |
| 2012 | June  | 19  | 93.5                | 63.1                | 0            |                      |
| 2012 | June  | 20  | 94.6                | 66.8                | 0            |                      |
| 2012 | June  | 21  | 95.4                | 66.8                | 0            |                      |
| 2012 | June  | 22  | 93.6                | 70.3                | 0            |                      |
| 2012 | June  | 23  | 93.4                | 66                  | 0            |                      |
| 2012 | June  | 24  | 97                  | 61.6                | 0            |                      |
| 2012 | June  | 25  | 94.7                | 63.7                | 0            |                      |
| 2012 | June  | 26  | 86.9                | 65.7                | 0            |                      |
| 2012 | June  | 27  | 92.7                | 52.9                | 0            |                      |
| 2012 | June  | 28  | 101.7               | 55.7                | 0            |                      |
| 2012 | June  | 29  | 103.8               | 60.9                | 0            |                      |
| 2012 | June  | 30  | 106.4               | 66.4                | 0            |                      |
| 2012 | July  | 1   | 105.4               | 69.2                | 0            |                      |
| 2012 | July  | 2   | 96.7                | 71.8                | 0.03         |                      |
| 2012 | July  | 3   | 96.9                | 68.6                | 0            |                      |
| 2012 | July  | 4   | 97.7                | 65.8                | 0            |                      |
| 2012 | July  | 5   | 101                 | 67.8                | 0.17         |                      |
| 2012 | July  | 6   | 96.2                | 66.6                | 0            |                      |
| 2012 | July  | 7   | 101.4               | 69.2                | 0            |                      |

**Table 35.** Continued

| Year | Month  | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|--------|-----|---------------------|---------------------|--------------|----------------------|
| 2012 | July   | 8   | 100.5               | 75.7                | 0            |                      |
| 2012 | July   | 9   | 89.4                | 73.4                | 0.05         |                      |
| 2012 | July   | 10  | 88                  | 68.5                | 0.58         |                      |
| 2012 | July   | 11  | 79.3                | 69.1                | 0.31         |                      |
| 2012 | July   | 12  | 73.8                | 68.9                | 0.46         |                      |
| 2012 | July   | 13  | 87.1                | 68.9                | 0.42         |                      |
| 2012 | July   | 14  | 87.2                | 72                  | 0.17         |                      |
| 2012 | July   | 15  | 90.7                | 68.1                | 0.01         |                      |
| 2012 | July   | 16  | 89.7                | 70.7                | 0            |                      |
| 2012 | July   | 17  | 89.3                | 71.1                | 0            |                      |
| 2012 | July   | 18  | 90.2                | 68.5                | 0.64         |                      |
| 2012 | July   | 19  | 92.8                | 69.5                | 0            |                      |
| 2012 | July   | 20  | 88.9                | 68.8                | 2.01         |                      |
| 2012 | July   | 21  | 88.4                | 69                  | 0            |                      |
| 2012 | July   | 22  | 92.1                | 72.3                | 0.01         |                      |
| 2012 | July   | 23  | 92                  | 69.8                | 0            |                      |
| 2012 | July   | 24  | 95.1                | 72.7                | 0            |                      |
| 2012 | July   | 25  | 95.6                | 73.6                | 0            |                      |
| 2012 | July   | 26  | 94.7                | 72.5                | 0            |                      |
| 2012 | July   | 27  | 93.9                | 73.6                | 0            |                      |
| 2012 | July   | 28  | 92.2                | 68                  | 0            |                      |
| 2012 | July   | 29  | 89.5                | 64.2                | 0            |                      |
| 2012 | July   | 30  | 95                  | 68                  | 0            |                      |
| 2012 | July   | 31  | 91.9                | 69.4                | 0.35         | 5.21                 |
| 2012 | August | 1   | 93.1                | 64.2                | 0.03         |                      |
| 2012 | August | 2   | 93.8                | 65.5                | 0            |                      |
| 2012 | August | 3   | 86.1                | 69.7                | 0.09         |                      |
| 2012 | August | 4   | 90.6                | 68.6                | 0.15         |                      |
| 2012 | August | 5   | 91.9                | 69.1                | 0.42         |                      |
| 2012 | August | 6   | 88.5                | 69                  | 0.03         |                      |
| 2012 | August | 7   | 92.1                | 70.8                | 0.07         |                      |
| 2012 | August | 8   | 93.6                | 70                  | 0.01         |                      |
| 2012 | August | 9   | 88.3                | 67.7                | 1.13         |                      |
| 2012 | August | 10  | 80.6                | 65.9                | 0.5          |                      |
| 2012 | August | 11  | 83.2                | 61.5                | 0.01         |                      |
| 2012 | August | 12  | 85.4                | 55.9                | 0            |                      |
| 2012 | August | 13  | 84.8                | 59                  | 0            |                      |
| 2012 | August | 14  | 84.8                | 63.2                | 0.76         |                      |
| 2012 | August | 15  | 85.6                | 65.6                | 0.25         |                      |
| 2012 | August | 16  | 88.8                | 61.2                | 0            |                      |
| 2012 | August | 17  | 82.7                | 64.6                | 0.01         |                      |
| 2012 | August | 18  | 87.9                | 66.7                | 0            |                      |
| 2012 | August | 19  | 81.4                | 65.1                | 0.09         |                      |
| 2012 | August | 20  | 84.9                | 59.9                | 0.01         |                      |
| 2012 | August | 21  | 85.9                | 55.3                | 0            |                      |
| 2012 | August | 22  | 89.9                | 56                  | 0            |                      |
| 2012 | August | 23  | 90                  | 56.7                | 0            |                      |
| 2012 | August | 24  | 92.1                | 59.8                | 0            |                      |
| 2012 | August | 25  | 92.5                | 61                  | 0            |                      |
| 2012 | August | 26  | 93.9                | 61.9                | 0            |                      |
| 2012 | August | 27  | 94.5                | 62.3                | 0.01         |                      |
| 2012 | August | 28  | 96.3                | 62.7                | 0            |                      |
| 2012 | August | 29  | 92.8                | 69.2                | 0.43         |                      |
| 2012 | August | 30  | 87.4                | 66.8                | 0            |                      |
| 2012 | August | 31  | 89.8                | 69.2                | 0            | 4                    |

**Table 35.** Continued

| Year | Month     | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|-----------|-----|---------------------|---------------------|--------------|----------------------|
| 2012 | September | 1   | 92.5                | 68                  | 0            | 7.58                 |
| 2012 | September | 2   | 92.6                | 70.5                | 0.42         |                      |
| 2012 | September | 3   | 83.4                | 69.4                | 0.29         |                      |
| 2012 | September | 4   | 85.6                | 71.5                | 0.01         |                      |
| 2012 | September | 5   | 89.6                | 70.1                | 0            |                      |
| 2012 | September | 6   | 90.4                | 69.6                | 0.13         |                      |
| 2012 | September | 7   | 92.4                | 65.3                | 0.01         |                      |
| 2012 | September | 8   | 79.9                | 57.5                | 0.37         |                      |
| 2012 | September | 9   | 80.6                | 54                  | 0.01         |                      |
| 2012 | September | 10  | 82.1                | 54.7                | 0            |                      |
| 2012 | September | 11  | 85                  | 54.8                | 0            |                      |
| 2012 | September | 12  | 84.7                | 64.5                | 0            |                      |
| 2012 | September | 13  | 84.1                | 59.4                | 0            |                      |
| 2012 | September | 14  | 85.4                | 59.1                | 0            |                      |
| 2012 | September | 15  | 88.1                | 56.7                | 0            |                      |
| 2012 | September | 16  | 84.7                | 63.2                | 0            |                      |
| 2012 | September | 17  | 70.1                | 64.5                | 1.97         |                      |
| 2012 | September | 18  | 73                  | 59.1                | 3.83         |                      |
| 2012 | September | 19  | 75.8                | 48.8                | 0            |                      |
| 2012 | September | 20  | 80.9                | 51                  | 0            |                      |
| 2012 | September | 21  | 82                  | 54.4                | 0            |                      |
| 2012 | September | 22  | 81.6                | 54.2                | 0            |                      |
| 2012 | September | 23  | 74.7                | 47.3                | 0            |                      |
| 2012 | September | 24  | 73.5                | 41.3                | 0            |                      |
| 2012 | September | 25  | 80.6                | 44.9                | 0.01         |                      |
| 2012 | September | 26  | 83.8                | 55                  | 0            |                      |
| 2012 | September | 27  | 85                  | 55.9                | 0            |                      |
| 2012 | September | 28  | 81.6                | 60.7                | 0.51         |                      |
| 2012 | September | 29  | 76.2                | 61.2                | 0.01         |                      |
| 2012 | September | 30  | 74.3                | 53.3                | 0.01         |                      |
| 2012 | October   | 1   | 73.2                | 58                  | 0.34         | 7.58                 |
| 2012 | October   | 2   | 77.5                | 65                  | 0.3          |                      |
| 2012 | October   | 3   | 76.5                | 60.5                | 0            |                      |
| 2012 | October   | 4   | 79.2                | 56                  | 0            |                      |
| 2012 | October   | 5   | 80.8                | 52.5                | 0            |                      |
| 2012 | October   | 6   | 61.9                | 53.8                | 0.02         |                      |
| 2012 | October   | 7   | 57.3                | 43                  | 0.15         |                      |
| 2012 | October   | 8   | 51                  | 43.7                | 0.3          |                      |
| 2012 | October   | 9   | 60.3                | 46.5                | 0            |                      |
| 2012 | October   | 10  | 63.7                | 44.7                | 0.01         |                      |
| 2012 | October   | 11  | 69.8                | 39.4                | 0            |                      |
| 2012 | October   | 12  | 68.8                | 52.1                | 0            |                      |
| 2012 | October   | 13  | 77.1                | 47.8                | 0            |                      |
| 2012 | October   | 14  | 74.8                | 51.1                | 0            |                      |
| 2012 | October   | 15  | 70.9                | 49                  | 0.58         |                      |
| 2012 | October   | 16  | 69.9                | 44.9                | 0.01         |                      |
| 2012 | October   | 17  | 76                  | 44.9                | 0            |                      |
| 2012 | October   | 18  | 66.7                | 48.8                | 0.11         |                      |
| 2012 | October   | 19  | 68.7                | 41.5                | 0.01         |                      |
| 2012 | October   | 20  | 64.4                | 47.9                | 0            |                      |
| 2012 | October   | 21  | 72.3                | 41.3                | 0            |                      |
| 2012 | October   | 22  | 79.6                | 44.2                | 0.01         |                      |
| 2012 | October   | 23  | 79.1                | 48.5                | 0            |                      |
| 2012 | October   | 24  | 81.5                | 47.4                | 0.01         |                      |
| 2012 | October   | 25  | 80.6                | 46.7                | 0.01         |                      |

**Table 35.** Continued

| Year | Month    | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|----------|-----|---------------------|---------------------|--------------|----------------------|
| 2012 | October  | 26  | 80.6                | 51.8                | 0            |                      |
| 2012 | October  | 27  | 58.9                | 50.6                | 0            |                      |
| 2012 | October  | 28  | 50.6                | 44.9                | 0.41         |                      |
| 2012 | October  | 29  | 44.2                | 42.3                | 0.01         |                      |
| 2012 | October  | 30  | 44.7                | 41                  | 0            |                      |
| 2012 | October  | 31  | 58.5                | 42.2                | 0            | 2.28                 |
| 2012 | November | 1   | 59.6                | 33.8                | 0            |                      |
| 2012 | November | 2   | 69                  | 40.1                | 0            |                      |
| 2012 | November | 3   | 70.4                | 34.4                | 0.1          |                      |
| 2012 | November | 4   | 60.4                | 39.2                | 0            |                      |
| 2012 | November | 5   | 58.8                | 32.9                | 0.01         |                      |
| 2012 | November | 6   | 51.1                | 41.5                | 0.05         |                      |
| 2012 | November | 7   | 48.5                | 44                  | 0.21         |                      |
| 2012 | November | 8   | 59.6                | 33.9                | 0.01         |                      |
| 2012 | November | 9   | 65                  | 30.7                | 0            |                      |
| 2012 | November | 10  | 71.1                | 34.7                | 0            |                      |
| 2012 | November | 11  | 72.9                | 34.9                | 0.01         |                      |
| 2012 | November | 12  | 70.2                | 41.5                | 0.28         |                      |
| 2012 | November | 13  | 51.7                | 30.6                | 0            |                      |
| 2012 | November | 14  | 52.3                | 28.1                | 0            |                      |
| 2012 | November | 15  | 60.6                | 33.1                | 0.01         |                      |
| 2012 | November | 16  | 59.6                | 30.1                | 0            |                      |
| 2012 | November | 17  | 62.8                | 29.9                | 0            |                      |
| 2012 | November | 18  | 62.6                | 29.4                | 0            |                      |
| 2012 | November | 19  | 63.3                | 30.9                | 0.01         |                      |
| 2012 | November | 20  | 67.4                | 36.3                | 0            |                      |
| 2012 | November | 21  | 68.9                | 39.4                | 0            |                      |
| 2012 | November | 22  | 69.1                | 34.5                | 0.01         |                      |
| 2012 | November | 23  | 60.4                | 34.9                | 0            |                      |
| 2012 | November | 24  | 44.9                | 26.3                | 0            |                      |
| 2012 | November | 25  | 54.9                | 23.5                | 0            |                      |
| 2012 | November | 26  | 62.5                | 27.9                | 0.04         |                      |
| 2012 | November | 27  | 47                  | 41.2                | 0.2          |                      |
| 2012 | November | 28  | 52.3                | 29.9                | 0            |                      |
| 2012 | November | 29  | 57.9                | 25.4                | 0            |                      |
| 2012 | November | 30  | 61.4                | 27.9                | 0            | 0.94                 |
| 2012 | December | 1   | 66.2                | 37.5                | 0.01         |                      |
| 2012 | December | 2   | 70.9                | 36.9                | 0            |                      |
| 2012 | December | 3   | 73.2                | 41.6                | 0            |                      |
| 2012 | December | 4   | 70.7                | 42.8                | 0.01         |                      |
| 2012 | December | 5   | 62.1                | 37.9                | 0.02         |                      |
| 2012 | December | 6   | 52                  | 36.8                | 0.01         |                      |
| 2012 | December | 7   | 65.8                | 40.9                | 0            |                      |
| 2012 | December | 8   | 70.8                | 49.7                | 0            |                      |
| 2012 | December | 9   | 70.8                | 52.8                | 0.01         |                      |
| 2012 | December | 10  | 59.1                | 42                  | 1.04         |                      |
| 2012 | December | 11  | 42.3                | 32.9                | 0            |                      |
| 2012 | December | 12  | 47.1                | 30.1                | 0            |                      |
| 2012 | December | 13  | 54.3                | 26.6                | 0            |                      |
| 2012 | December | 14  | 57                  | 27.8                | 0            |                      |
| 2012 | December | 15  | 60.3                | 34.9                | 0            |                      |
| 2012 | December | 16  | 57.3                | 47.1                | 1            |                      |
| 2012 | December | 17  | 57.8                | 46                  | 0.2          |                      |
| 2012 | December | 18  | 54.6                | 34.6                | 0.01         |                      |
| 2012 | December | 19  | 64.5                | 34                  | 0            |                      |

**Table 35.** Continued

| Year | Month    | Day | Max<br>Temp<br>(C°) | Min<br>Temp<br>(C°) | Rain<br>(in) | Average<br>rain (in) |
|------|----------|-----|---------------------|---------------------|--------------|----------------------|
| 2012 | December | 20  | 51.5                | 37.8                | 0.94         |                      |
| 2012 | December | 21  | 42.1                | 31.7                | 0            |                      |
| 2012 | December | 22  | 45.2                | 22.8                | 0            |                      |
| 2012 | December | 23  | 49                  | 22.1                | 0.11         |                      |
| 2012 | December | 24  | 46.5                | 41.3                | 0.73         |                      |
| 2012 | December | 25  | 48.8                | 43.6                | 0.26         |                      |
| 2012 | December | 26  | 48.6                | 34.1                | 0.62         |                      |
| 2012 | December | 27  | 35                  | 32.8                | 0            |                      |
| 2012 | December | 28  | 42.2                | 32.6                | 0.09         |                      |
| 2012 | December | 29  | 41.3                | 32                  | 0.08         |                      |
| 2012 | December | 30  | 41.1                | 26.1                | 0            |                      |
| 2012 | December | 31  | 43.9                | 25.3                | 0            | 5.14                 |

## **Conclusion**

Soybeans have been grown around the world since about 1100 BC, and in United States since the late 1800s (ncsoy.org 2013). We've gone from incomplete weed control in the 1970s and 80s, to good control in the early 1990s, to essentially perfect control with no soybean injury in the Roundup Ready era. As GR weeds become more prevalent, this new post-RR era of weed control of soybeans will be more complicated, more expensive, with less complete weed control and higher possible crop injury to both the target crop and non-target species. This study clearly indicates that weed control can be accomplished with glyphosate in a RR system, but also that soybeans can be profitably grown in a non-RR production system.

### **Vita**

The first of two daughters, Brittany L. Gaban was born March 30, 1988 in Easton, Maryland. Brittany grew up in Centreville, MD on Maryland's Eastern Shore. After finishing high school, she attended the University of Maryland where she was introduced to agronomic technologies at an academic level. In May of 2011 she graduated from the University of Maryland with two Bachelors of Science degrees; one in Agricultural Sciences and Technologies, and the other in Plant Sciences. By the first week of June 2011, she had already started her graduate studies at the University of Tennessee, Knoxville. Brittany graduated from the University of Tennessee in May 2013 with a Masters of Science degree in Plant Sciences. She has since moved home, is currently happily married to Timothy E. Fahrman and is working for Monsanto Company as a Discovery Soybean Breeding Research Assistant in Galena, Maryland.