To the Graduate Council:

I am submitting herewith a dissertation written by Michael Aaron Krstich entitled "Field Method for Describing Root Activity Using Stable Strontium as a Tracer." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Plant and Soil Science.

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FIELD METHOD FOR DESCRIBING ROOT ACTIVITY USING STABLE STRONTIUM AS A TRACER

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Michael Aaron Krstich

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DEDICATION

I would like to dedicate this dissertation to my Mother and two brothers, Joe and Don. For in the scheme of things, that existence we call life, my family has made the sometimes seemly endless winter of dispair the summer of hope.

ABSTRACT

Stable Sr was evaluated for use as a tracer for characterizing root growth or root activity of field-grown soybeans (*Glycine max* (L.) Merr.). Root activity is defined in this study as the absorption of Sr with subsequent accumulation of Sr in the trifoliates. Previous research had established that the amount of Sr absorbed was directly and positively correlated with total root length and root weight in the zone of tracer placement in the soil. A 0.138 mole ratio of $Sr(OOCCH_3)_2 \cdot 0.5H_2O$ to $SrCl_2 \cdot 6H_2O$, containing 0.068 g Sr ml^{-1}, was injected into the soil as an aqueous solution. A syringe and needle was used to inject Sr at various depths up to 0.45 m. Needle size was reduced during the studies from 3.2 mm to 1 mm diameter in order to minimize soil disturbance. Strontium was injected on both sides of the soybean rows during the V2-V4 growth stage at 0.08-m intervals and at horizontal distances of 0.10 to 0.75 m from the stem of the plant. The amount of Sr injected ranged from 0.138 to 0.276 g per injection point. Newly developing primary trifoliates were tagged during the growing season, as to their time of development. Most trifoliates, except for the terminal trifoliates, were harvested as they senesced, and analyzed for Sr. Terminal trifoliates were harvested at the end of the growing season when the entire plant was harvested. This stable tracer technique was used successfully to differentiate root growth 1) at different depths in the soil, 2) at different vegetative growth stages, 3) among different soybean breeding lines, and 4) between conventional till and no-till systems. The technique permitted a vertical and horizontal characterization of soybean root growth. The method was tested to

determine the 1) amount of Sr to inject per injection point(0.136 g Sr), 2) row length (0.45 to 0.90 m), 3) number of injection points (10 to 20), 4) number of plants to sample (6 to 12), and 5) needle size (1 mm).

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I. INTRODUCTION

STABLE TRACERS IN ROOT STUDIES

Rooting activity can be expressed in terms of nutrient or water absorption, root extension, root proliferation, O_2-utilization and CO_2-evolution (Fox and Lipps, 1964). The use of a stable tracer allows root activity to be defined by either extension, proliferation or absorption characteristics. Extension or proliferation studies define root activity in a strictly qualitative manner, identifying the presence or absence of the tracer in the plant as a function of roots encountering the tracer in the soil. Absorption studies allow for quantitative characterization of a root system, correlating root measurements, e.g., weight and length, with the amount of tracer absorbed and its subsequent accumulation in plant shoots.

The use of stable tracers for characterizing root activity was first reported by Sayre and Morris (1940) using Li to measure the extent of corn (*Zea mays* L.) roots. Low levels of Li were later reported toxic to alfalfa (*Medicago sativa* L.) plants (Fox and Lipps, 1964). Boron was used by Hammar et al. (1953) to estimate the spread of roots from pecan (*Carya* spp.) trees. Because B is both essential to plant growth and toxic at relatively low levels, its use can result in altered growth patterns. Simpson et al. (1977) conducted a greenhouse study using Rb to determine root activity in the subsoil and concluded that it was a good indicator of root penetration. However, Rb is also toxic to plant growth.

The divalent cations Sr and Ca are alkaline earth elements. They lie next to each other within group 2A of the periodic table. Although the molecular weight of Sr (87.6) is more than twice that of Ca

(40.1), their ionic radii (Sr=1.15 A and Ca=0.99 A) and therefore their ionic potentials are similar. Collander (1941) studied selective absorption of Sr and Ca by higher plants and reported specific differences in the absorption characteristics of different plant species as well as the suppressed absorption of each ion in the presence of the other. Romney et al. (1957) reported reduced uptake of Sr by beans (*Phaseolus vulgaris*) from nutrient solutions with the addition of Ca. The same study also reported that addition of $CaCO_3$ and $CaSO_4$ reduced uptake of Sr from an acidic soil with low Ca levels. McHargue (1919) determined that the beneficial effects of $SrCO_3$ and $Sr(NO_3)_2$ on plant growth resulted from the accompanying anion. Harmful effects of Sr on plant growth were reported by Hurd-Karrer (1939) as the Sr:Ca ratio approached 1:1. At Sr:Ca ratios much less than1:1, low concentrations of stable strontium had minimal effects on plant growth (Walsh 1945; Bowen and Dymond, 1956).

Calcium and Sr are considered to be immobile elements within the plant. In his study on oats (*Avena sativa* L.), Andersen (1971a) reported that radiostrontium was transported to the developing part of the plant and remained at the site of deposition. Although the amount of Sr in plant materials varies with plant part (Menzel and Heald, 1955), presenting Sr and Ca concentrations as a ratio (Sr:Ca) in plant samples can result in values that are more independent of plant part or maturity (Fox and Lipps, 1964).

Fox and Lipps (1960) first reported the use of stable Sr as a tracer for monitoring the distribution and activity of roots in relation to soil properties. A later study (Fox and Lipps, 1964) compared stable Sr and ^{32}P

as tracers for estimating alfalfa root activity, and found both methods produced similar results. They tested the effects of thirty-six 3.2 cm holes (each hole receiving 0.48 g $SrCl_2 \cdot 6H_2O$) and nine 7.6 cm holes (each hole receiving 1.92 g $SrCl_2 \cdot 6H_2O$), in 0.91 m square plots, for characterizing root activity of alfalfa. By placing strontium chloride at various depths within the soil profile, they were able to estimate the percent of a plant's root activity at each depth as a function of Sr absorption and accumulation in the shoots.

Soileau (1973) used 15 X 30 cm cylinders to study the use of $SrCO_3$ for characterizing root growth of barley (*Hordeum vulgare* L.) seedlings. They placed Sr at three depths and monitored uptake and total root length in the zone of tracer placement. Results illustrated a linear relationship (r=0.99) between total strontium concentration in the tops and total root length in the treated zone. Soileau proposed the use of a root activity index (RAI) (Eq. 1) for quantifying root growth relative to Sr absorption.

$$\text{RAI} = \frac{\text{milligrams of Sr in the tops (X 100)}}{\text{meters of roots in Sr-treated soil}} \qquad \text{[Eq. 1]}$$

Pinkerton and Simpson (1979) combined the use of glasshouse and field studies in their determinination of $SrCl_2 \cdot 6H_2O$ as a tracer for root growth of oats, millet (*Pennisetum typhoides*) and wheat (*Triticum aestivum*). Growing millet in clear cylinders containing soil with a Sr-enriched layer, they determined that the weight of Sr in the shoots was linearly related to the root weight in the Sr-enriched layer. Using this correlation, they conducted a field test with wheat using strontium chloride placed at various depths in the soil profile, and measured Sr concentration in the shoots over time. A 7-mm stainless steel tube was used for placement of the Sr pellets in the soil. They concluded that more Sr was absorbed from shallower depths of tracer placement indicating increased root activity at these depths.

SOIL FACTORS AND THE USE OF STABLE STRONTIUM

The previously mentioned studies illustrate that root activity, defined here as the absorption of Sr with subsequent accumulation in the shoots, is positively and linearly related to root length and root weight. Yet many factors control the availability of Sr in the soil and its absorption into the plant.

Francis (1978) reviewed the influences of soil properties, e.g., texture, pH, moisture, organic matter, minerals and exchangeable Ca, on radioactive Sr movement and absorption. Variations in rooting patterns also result from soil aeration (Lipps and Fox, 1964; Glinski and Stepniewski, 1985), soil temperature (Kaspar et al., 1981; Stone and Taylor, 1983), soil moisture (Francis, 1978), cropping practices (Phillips, 1984; Maurya and Lal, 1979) and plant genotype (Kaspar et al., 1984; Murphy et al., 1982).

Soil Texture The texture of the soil can directly influence Sr availability. Francis (1978) noted that, in general, sandy soils transferred greater quantities of radiostrontium to plants than did soils with high clay content. Higher cation exchange capacities (CEC) resulting from increased clay content may increase adsorption of Sr. The amount of Sr adsorbed is also dependent on other related factors such as Ca saturation, base saturation and pH.

In a study of 63 Indiana soils, Khasawneh et al. (1968) determined that selectivity coefficients ($k_{Sr/Ca}$) ranged from 0.61 to 1.51. They also found the mineral fraction of the soil preferentially adsorbed Sr over Ca. Selectivity coefficients have been widely used to describe variability in Sr-Ca adsorption in soils (Heald, 1960; Juo and Barber, 1969a; Bole and Barber, 1971; Elgawhary and Barber, 1971). Increased adsorption of Sr over Ca is considered an electrostatic effect resulting from differing degrees of hydration of Ca and Sr ions. Strontium, the more weakly hydrated ion, is most strongly adsorbed. Kinniburgh et al. (1975) reported that nonelectrostatic adsorption mechanisms also contributed to Ca and Sr adsorption by iron and aluminum hydrous oxides.

Soil Organic Matter The contribution of soil organic matter to Sr availability and uptake varies. Khasawneh et al. (1968) reported a negative correlation between the $k_{Sr/Ca}$ and organic matter. Juo and Barber (1969b) showed that Ca was preferentially adsorbed by humic acid, stating that increased field strength of exchange sites due to the presence of carboxyl groups was responsible for the increased adsorption of the more strongly hydrated Ca ion. Evans and Dekker's (1962) study of six Canadian soils varying widely in pH, organic matter content, CEC, percent saturation and exchangeable Ca indicated organic matter content was not a dominant soil property affecting ^{90}Sr concentration in plants. Juo and Barber (1970) reported an organic soil with pH > 5 can allow Sr to exist in solution in chelated or complexed forms. Elgawhary and Barber (1973) indicated that, although plant roots absorbed chelated and unchelated forms of Sr and Ca, chelated forms were absorbed more slowly.

Soil Chemical Properties Difficulties in evaluating the effects of soil pH on plant uptake of Sr are due to the influences of exchangeable Ca, base saturation and CEC. Juo and Barber (1970) reported increased Sr adsorption by soils as the pH increased from 4 to 8. Cations occupying the exchange complex at pH values less than 4 are predominately Al^{+3} and H^{+}, which tend to restrict Sr adsorption. Rhodes (1957) determined that the adsorption of Sr by soil from distilled water adjusted to different pH values with HCl or NaOH increased with increase in pH from 6 to 10.

Juo and Barber (1970) found that adsorption of Sr by soils was influenced by the kind of saturation cations and followed the order of Na > K > Mg > Ca > Ba > H. Evans and Dekker (1962) indicated that the Ca content of six Canadian soils was the dominant soil property controlling ^{90}Sr concentration in plants.

McKeague and Wolynetz (1979) reported a high correlation (r=0.87) between total Ca and Sr in 139 Canadian soils, noting the removal of 23 calcareous samples in order to achieve this high correlation coefficient. Selectivity coefficients ($k_{Sr/Ca}$) have been used to relate the Sr:Ca ratio on the exchange sites to the Sr:Ca ratio in the soil solution (Heald, 1960; Juo and Barber, 1969a; Bole and Barber, 1971; Elgawhary and Barber, 1971). Absorption of Sr by plants was reported to be inversely related to the amount of exchangeable Ca in the soil (Andersen, 1963; Evans and Dekker, 1962). Bole and Barber (1971) used soybeans to differentiate the mechanisms supplying Sr and Ca to roots. They determined the Sr:Ca uptake ratio was similar to the Sr:Ca ratio in the soil solution when mass flow was the major supplying mechanism. However, when diffusion was the major mechanism, the Sr:Ca uptake ratio was similar to the Sr:Ca ratio on the exchange complex.

The relationship between the Sr:Ca ratio in the plant and in a culture medium has been defined as the observed ratio (OR) (Eq. 2).

$$OR = \frac{\text{Sr:Ca (plant)}}{\text{Sr:Ca (culture medium)}} \qquad \text{[Eq. 2]}$$

Bollard and Butler (1966) described a decreasing trend in the OR from the roots through the stems, leaves and seeds. Menzel and Heald (1955) reported that Sr and Ca were absorbed in a ratio 1.1 times the ratio of their concentration in nutrient solution. They also indicated a progressive decrease in Sr:Ca ratio from the roots through the stems, petioles and leaves. A review of Sr in plants and soils by Russell (1963) indicated differences in the observed ratio of different plant organs. Menzel and Heald (1959) found that the Sr:Ca ratio in alfalfa and wheat were closely related to the ratios of exchangeable Sr and Ca in the soil.

Anions can influence the availability of Sr for absorption by plants. Goss and Romney (1959) concluded that the addition of bicarbonate to nutrient solution significantly reduced the content of Sr in bean and barley plants. The presence of phosphates in base-saturated soils can result in the formation of insoluble Sr phosphates. Andersen (1971b) reported that the addition of large amounts of phosphorus as NaH_2PO_4 to soils reduced the uptake of radiostrontium by plants. Coprecipitation of Sr with Al and Fe phosphates account for additional removal of Sr from solution (Francis, 1978).

Other Soil Factors Other soil factors that influence plant absorption of Sr include bulk density (Hallmark and Barber, 1981; Gerard et al., 1982), aeration (Lipps and Fox, 1964; Glinski and Stepniewski, 1985), temperature (Kaspar et al., 1981; Stone and Taylor, 1983) and moisture (Francis, 1978). The relation of soil aeration, temperature and moisture to cation absorption by plants is well documented and although important will not be discussed. The effects of bulk density do not predominate in the control of Sr absorption by plants and therefore will also not be discussed.

NON-SOIL FACTORS AND THE USE OF STABLE STRONTIUM

The soil factors previously discussed illustrate the influences of the soil on Sr adsorption and its availability for plant absorption. Non-edaphic factors, e.g., plant genotype and cropping practice which influence variations in a plant's rooting pattern, can also affect Sr absorption. The effects of genotype and cropping practices on a plant's rooting characteristics and more specifically its activity will be reviewed.

Plant Genotype Absorption of elements has been found to differ among cultivars. For example, Al tolerance studies of wheat and barley (Foy et al., 1967), wheat (Kerridge et al., 1971), barley (Reid et al., 1971), alfalfa (Devine et al., 1976), rice (*Oryza sativa* L.) (Howeler and Cadavid, 1976), and soybeans (*Glycine max* (L.) Merr.) (Sartain and Kamprath, 1978) have established that differences among cultivars can be shown in such root growth characteristics as length and elongation rate. Howeler and Cadavid

(1976) determined that rice cultivars differ in their susceptibility to high levels of Al, with Al-tolerant cultivars having higher levels of P and Ca. They concluded that a large number of cultivars could be effectively screened for Al tolerance in nutrient solution cultures, and they indexed cultivars for Al tolerance according to the ratio of root length at high Al concentrations to root length at low Al concentrations.

Simpson et al. (1977) investigated the effects of subsoil Ca on root growth of alfalfa genotypes in acid soils. They determined that root growth of some genotypes was not indicative of shoot growth characteristics as influenced by Ca. They suggested that selection of genotypes based on root growth alone may be insufficient since increased root penetration does not mean increased shoot yields. Murphy et al. (1982) reported that shoot length of oat cultivars was more highly correlated to root length, weight and volume in fall-sown lines than in spring-sown lines, and in early and intermediate hybrids than in modern hybrids. They also found root volume to be highly correlated with root weight and proposed the omission of volume measurements in favor of weight measurements.

Sartain and Kamprath (1978) compared the effects of Al on root elongation rates of soybean varieties grown in nutrient solution. Since the rate of root growth is dependent on the root length at the beginning of the experiment (Salamon et al., 1973), they expressed root growth as a mean relative extension rate (RER) to correct for different hypocotyl lengths of seedlings, where L is root length and t is time (Eq. 3). Although Sartain

$$\mathrm{RER} = (\ln L_2 - \ln L_1) \;/\; (t_2 - t_1) \qquad \text{[Eq. 3]}$$

and Kamprath found no relation between root growth and shoot growth in soybeans, they concluded that cultivars with greatest root length tend to produce more growth at high Al saturation. Their findings also indicated that a 48-hour exposure of hypocotyls to a solution containing Al was not adequate for determining Al tolerance in soybeans and that field studies are necesssary.

Kaspar et al. (1984) studied taproot elongation rates of soybean cultivars in a glasshouse and their relation to field rooting depth. Taproot elongation rates in acrylic tubes containing vermiculite ranged from 3.0 to 5.3 cm day^{-1} depending on the cultivar. Five cultivars with fast rates of taproot elongation and five cultivars with slow rates were selected from the 105 cultivars tested and grown in a rhizotron. Taproot elongation at the observation window was not significantly different among cultivars. However, excavation of the rhizotron revealed that cultivars with faster elongation rates also had increased rooting depth, indicating that root growth at soil-container interfaces may not be representative of root growth. Measurements using the core break method (Bohm 1979) showed increased rooting depth (ca. 9 cm) and increased root density at the 150-cm depth for the soybean group with fast elongation rates. Water depletion was also measured but was only useful as a measure of root activity below the 120-cm depth, where surface moisture input had minimum influence.

<u>Cropping Practices</u> Maurya and Lal (1979) indicated that root distribution varied with tillage practice, crop and crop combination. Tillage systems can affect root growth by influencing soil structure, density or strength (Lal 1976; Jones 1983; Goss et al.,1984; Chaudhary and Prihar, 1974; Taylor and Burnett, 1964; Taylor and Gardner, 1963; Barley 1962). The influence of these soil factors on root growth may be more an effect of water

availability. Bar-Yosef and Lambert (1981) reported decreased water uptake rate with increased bulk density in the range of 1.3 to 1.8 g cm^{-3}. Younger roots were also observed to show a stronger dependency on bulk density than older roots. Cultivar root lengths of alfalfa did not change significantly as soil moisture level decreased (Carter et al., 1982). However, they did report significant differences between cultivars when total root weight and length were summed over depths.

Residue management in combination with tillage practices can also influence root growth. The use of mulch in no-till systems can affect root growth by increasing water retention through reduced evaporation (Phillips, 1984). Increasing lateral spread of roots at shallower depths (Allmaras and Nelson, 1971; Chaudhry and Prihar, 1974) and slower elongation rates (Baeumer and Bakermans, 1973) have been noted under no-till conditions. The increase in root proliferation at shallower depths is considered to be a result of increased water retention and aeration, and decreased interrow density.

Objectives The objectives of the following studies were to test and refine the use of stable Sr as a tracer for characterizing root growth in field-grown soybeans. Refinements of the technique would 1) minimize chemical changes at the site of tracer placement, 2) result in a Sr level in the plant above the background concentration, 3) permit easy placement of Sr in the soil, and 4) minimize soil disturbance during placement. A sampling system that would allow root growth or Sr absorption to be monitored throughout the growing season was needed to allow identification of new growth and its time of development. The method then needed to be tested for its ability to differentiate among root growth differences related to 1) depth within the soil profile, 2) tillage systems, 3) vegetative growth stages and 4) breeding lines.

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II. FIELD METHOD FOR STABLE TRACER USE IN DESCRIBING ROOT GROWTH

ABSTRACT

Stable strontium was evaluated for use as a tracer in determining root activity of field-grown soybeans (*Glycine max* (L) Merr.). Based on previously reported correlations between Sr concentration in leaves and the plant's total root length and weight, root activity was characterized for eight soybean lines grown under different field conditions. A syringe was used to inject an aqueous tracer solution through a 3.2 mm diameter tube into the soil. A 0.138 mole ratio of $Sr(OOCCH_3)_2 \cdot 0.5H_2O$ to $SrCl_2 \cdot 6H_2O$ solution was injected into the soil at rates of 0.136, 0.204 and 0.272 g Sr per injection point at depths of 0.40 m (Plateau Experiment Station) and 0.15 and 0.40 m (Knoxville Plant Science Farm). This ratio of acetate to chloride resulted in minimum soil pH change at the point of injection. Strontium was injected at 0.08-m intervals parallel to the soybean row and at a distance 0.10 m from the plant's stem on both sides of the row. Newly developing primary trifoliates were tagged during the growing season, allowing for Sr concentration determination at various stages of growth. Strontium concentration in trifoliates was greater at the tracer injection depth of 0.15 m than at 0.40 m. The amount of Sr absorbed was directly and positively related to the amount of Sr injected. Root growth measured by Sr uptake differed significant among breeding lines.

INTRODUCTION

The use of a stable tracer like Sr permits root activity to be defined either by root extension or proliferation, or by foliar absorption of Sr. Extension or proliferation studies define root activity in strictly a qualitative manner, identifying the presence or absence of roots in the tracer zone. A root system can be quantitatively characterized using absorption studies that correlate root measurements, e.g., weight and length, with the amount of tracer accumulated in the plant's shoots.

Earlier studies have used Li (Sayre and Morris,1940), B (Hammar et al., 1953) and Rb (Simpson et al., 1977) to characterize the root systems of plants. However, all of these tracers are toxic to plants at relatively low concentrations in the soil. Fox and Lipps (1960) first reported the use of stable Sr as a tracer for monitoring the distribution and activity of roots in relation to soil properties.

Many studies have examined the relationship of Sr and Ca in the soil to the bio-availability of Sr. The influence on plant growth of different Sr:Ca ratios in the soil was studied by Hurd-Karrer (1939) who found harmful effects on plant growth as the Sr:Ca ratio approached 1:1. At Sr:Ca ratios much less than 1:1, low concentrations of stable Sr showed minimal effects on plant growth (Walsh 1945; Bowen and Dymond, 1956).

Strontium and Ca are considered to be immobile elements within the plant. Andersen (1971) reported that radiostrontium in oats (*Avena sativa* L.) was immediately transported to and remained at the site of deposition. Although the amount of Sr in plant materials varies with plant part (Menzel and Heald, 1955), presenting Sr and Ca concentrations in plant samples as a ratio (Sr:Ca) can result in values that are more independent of plant part or maturity (Fox and Lipps, 1964).

Stable Sr and ^{32}P provided similar estimates of alfalfa (*Medicago sativa* L.) root activity (Fox and Lipps, 1964). Placing strontium chloride at different depths within the soil, they were able to estimate the percent of a plant's root activity at each depth based on the amount of Sr accumulated in the shoots. Soileau (1973) measured the activity of barley (*Hordeum vulgare* L.) seedling roots in soil-filled cylinders by placing Sr at three depths and monitoring Sr uptake and total root length in the zone of tracer placement. Results indicated a linear relationship (r=0.99) between total Sr concentration in the tops and total root length in the Sr-treated zone.

Pinkerton and Simpson (1979) found that total root weight also highly correlated with Sr absorption. They investigated the use of stable Sr as a tracer in the greenhouse by growing millet (*Pennisetum typhoides*) in clear cylinders containing soil with a Sr-enriched layer. They determined that the weight of Sr in the shoots was linearly related to the root weight in the Sr-enriched layer. Using this correlation, they conducted a field test with wheat by placing strontium chloride at different depths in the soil and measuring Sr concentration in the shoots over time. They concluded that more Sr was absorbed from shallower depths, indicating higher levels of root activity at these depths.

The objectives of this research were to improve the current methodology for stable tracer use in field studies and to determine its effectiveness in differentiating root activity of field-grown soybeans (*Glycine max* (L) Merr.). An additional objective was to test the potential for using a Sr tracer to characterize differences among soybean breeding lines based on root activity.

MATERIALS AND METHODS

Soybean fields at two locations in Tennessee, Knoxville Plant Science Farm (KPS) and Plateau Experiment Station (PES) at Crossville, were selected for this study. Soils consisted of a Tilsit (fine-silty mixed mesic Fragiudult) at PES and a Sequatchie (fine-loamy siliceous thermic Humic Hapludult) at KPS. Some of the chemical and physical properties of these soils are listed in Table 1. Soil samples were collected from 0-0.15, 0.15-0.30, and 0.30-0.45 m depths (PES) and 0-0.10, 0.10-0.20, 0.20-0.35 and 0.35-0.45 m depths (KPS), air dried, sieved (2 mm) and stored until analyzed. Atomic absorption was used to determine Sr, Ca, Mg, K concentrations and flame emission to determine Na on neutral 1 mol L^{-1} NH_4OAc extracts (Jackson 1958) containing 1% La as $LaCl_3$. Soil pH was determined using a 1:1 (v/v) soil to water ratio. Total carbon was determined using a Leco Carbon Analyzer (Model CR12). Exchangeable acidity was determined by titration of KCl extracts (Jackson 1958). Cation exchange capacity (CEC) was calculated by cation summation. The hydrometer method (Day, 1965) was used for textural class determination. Each field was plowed and disked to a depth of 0.20 m, fertilized with 29 kg P ha^{-1} and 56 kg K ha^{-1} and limed to adjust the pH to about 6.5. The herbicide a,a,a-trifluoro-2,6- dinitro-N,N-dipropyl-p-toluidine (Treflan) was applied prior to planting at manufacturer's recommended rate and sodium-5-[2-chloro-4-(trifluoromethyl)-phenoxy]-2-nitrobenzoate plus

Table 1. Selected chemical and physical properties of the soils at PES and KPS.

	LOCATION						
	PES			KPS			
	DEPTHS (m)						
	0.00-0.15	0.15-0.30	0.30-0.45	0.00-0.10	0.10-0.20	0.20-0.35	0.35-0.45
pH (1:1 v/v H_2O)	5.7	5.4	4.8	6.5	6.4	6.3	6.2
Organic C g kg^{-1}	11.4	8.0	2.8	6.3	6.6	4.9	4.0
	mmol (+) kg^{-1}						
Exch. Ca^{2+}	30.6	32.8	11.4	24.4	23.4	25.8	25.6
Exch. Mg^{2+}	2.8	3.2	1.6	7.8	7.6	10.4	11.4
Exch. K^{+}	2.5	1.9	1.1	1.3	1.3	1.0	0.8
Exch. Na^{+}	0.3	0.2	0.1	0.0	0.0	0.0	0.2
Exch. Sr^{2+}	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exch. H^{+}	2.9	7.7	35.8	0.1	0.0	0.1	0.1
CEC	39.1	45.8	50.0	33.6	32.3	37.3	38.1
	g kg^{-1}						
Sand*	337	331	387	656	631	556	525
Silt	463	438	394	200	225	250	231
Clay	200	231	219	144	144	194	244

*Day (1965), sand determined by difference.

3-(1-methylethyl)-1H- 2,1,3-benzothiadiazin-4(3H)-one-2,2-dioxide (Blazer and Basagran, respectively) were applied at the manufacturers' recommended rates when weeds reached 0.05 -0.07 m height.

Soybeans for a breeding line trial were planted on 14 May 1985 at PES and 30 May at KPS. Seven lines, TN82-230, TN82-232, TN82-238, TN82-264, TN82-269, TN82-271, TN82-277 and one cultivar, 'Forrest', were selected from these fields for use in this study. Seeding rate was 300,000 plants ha^{-1}.

A single 6-m row per plot was planted at PES, while three 6-m rows per plot were planted at KPS. Each plot contained a single soybean line or cultivar. All rows were planted on 0.91-m centers, and rows containing tracer injections were separated by at least one spacer row. For the purpose of tracer injection, 0.45-m subplots were randomly allocated in treatment rows. All subplots were separated by at least 1.6 m. At PES, two subplots per plot were located at the ends of each row, with the center 5 m being harvested for yield analysis in the breeding line trial. At KPS, a total of five subplots per plot were located within the two border rows leaving the middle row for yield analysis. Three replications of each treatment were used at PES, while six replications were used at KPS.

A 0.138 mole ratio of $Sr(OOCCH_3)_2 \cdot 0.5H_2O$ to $SrCl_2 \cdot 6H_2O$ as an aqueous solution, containing 0.068 g Sr mL^{-1}, was used as the stable tracer in these experiments. Preliminary laboratory experiments varying the ratio of strontium acetate to strontium chloride indicated that a 0.138 mole ratio resulted in minimum soil pH change after a seven-day equilibration period (Fig. 1.).

Figure 2 shows the location of injection points at 0.08 m intervals

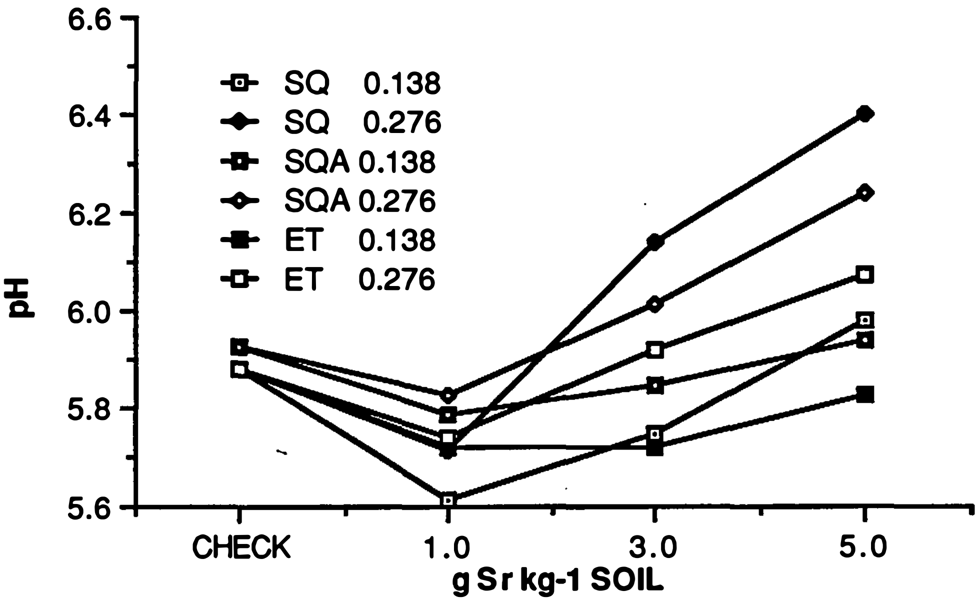

Figure 1. Effects of 0.138 and 0.276 mole ratios of strontium acetate to strontium chloride on pH of three soils (ET=Etowah, SQA=Sequoia, and SQ=Sequatchie).

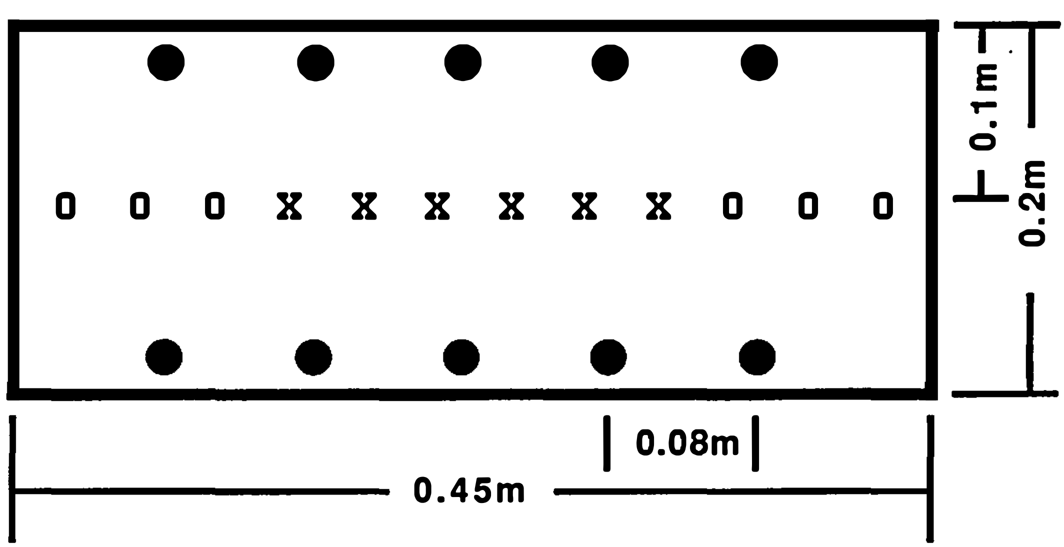

Figure 2. A 0.45 m subplot design (● designates injection points, O border plants and X plants harvested for analysis).

parallel to the soybean row and at a distance 0.10 m from the plant stem on both sides of the row. Treatments consisted of 0.136, 0.204 and 0.272 g Sr at each of the ten injection points. Placement of the liquid tracer was accomplished with a 3.2-mm (OD) stainless steel tube with inner metal stylet, drilled into the soil with an electric drill. A syringe and needle were used to inject the tracer via the stainless steel tube to the desired depth. Strontium was injected 4-5 weeks after planting during the third or fourth vegetaive growth stage (V3-V4), with subsequent tagging of newly developing primary trifoliates every 10-14 days.

The amount of Sr injected and the depth of placement were different with location and soybean line. At PES, subplots located in plots containing TN82-230, TN82-232, TN82-238 and 'Forrest' received either 0.136 or 0.204 g Sr per injection point at the 0.40 m depth. Subplots containing Lines TN82-264, TN82-269, TN82-271 and TN82-277 received either 0.136 or 0.272 g Sr per injection point at 0.40 m depths. Subplots at KPS, containing lines TN82-230, TN82-232, TN82-238 and 'Forrest', received 0.136 or 0.204 g Sr at 0.15 or 0.40 m depths. TN82-264, TN82-269, TN82-271 and TN82-277 received 0.136 or 0.272 g Sr at 0.15 or 0.40 m depths. The fifth subplot served as a check.

Each subplot contained approximately 12 soybean plants with the middle six plants being harvested for analysis. Because lower trifoliates senesced as the plant matured, early tagged trifoliates were harvested during the later V-stages while later tagged trifoliates were harvested during the early R-stages (reproductive growth stages).

Plant samples were dried at 60^{o} C. Leaflets were separated from the petiole for each trifoliate, and ground to pass a 20-mesh screen. Dry ashing followed a modified procedure of Greweling (1976) in which plant samples (0.50 g) were ashed at 500^{o}C for 6 hours, cooled, treated with 2 mL 5 mol L^{-1} HNO_3, evaporated, ashed at 400^{o}C for 1 h, cooled, dissolved in 1 mL 20% HCl with 5% La as $LaCl_3$ and brought to 5 mL volume with 4 mL deionized H_2O. Strontium and Ca were determined using a Perkin-Elmer 5000 atomic absorption spectrophotometer.

Rainfall for the two locations during the 1985 growing season was measured. Data for PES and KPS are presented in Table 2.

The experimental design was a randomized complete block with three replications (PES) and six replications (KPS), and contained unequal subclass frequencies. Standard analysis of variance was determined using GLM (SAS, 1982) with mean separation by the Student-Newman-Keul test. The confidence level for all analyses was set at 0.05.

RESULTS AND DISCUSSION

Plateau Experiment Station (PES) The absorption of Sr and Ca, as a function of the amount of Sr injected, is illustrated in Figure 3. These values averaged across lines and time indicate a direct positive relationship between the amount of Sr injected and the amount of Sr absorbed by the plant. The Ca levels were unaffected by the amount of tracer injected. The least amount of tracer injected (0.136 g Sr) provided a detectable quantity of Sr in trifoliates, above the background concentration, throughout the growing season.

The amount of Sr and Ca absorbed by the plant varied during the

Table 2. Rainfall data for two locations (PES and KPS) during the 1985 growing season.

DATE		LOCATION	
MONTH	DAY	PES	KPS
		cm	
MAY	1-15	1.88	2.21
	16-31	5.82	1.78
JUNE	1-15	7.67	4.47
	16-30	2.64	3.33
JULY	1-15	5.99	4.01
	16-31	4.29	5.00
AUGUST	1-15	3.68	6.17
	16-31	11.53	11.09
SEPTEMBER	1-15	1.17	0.00
	16-30	3.86	0.00

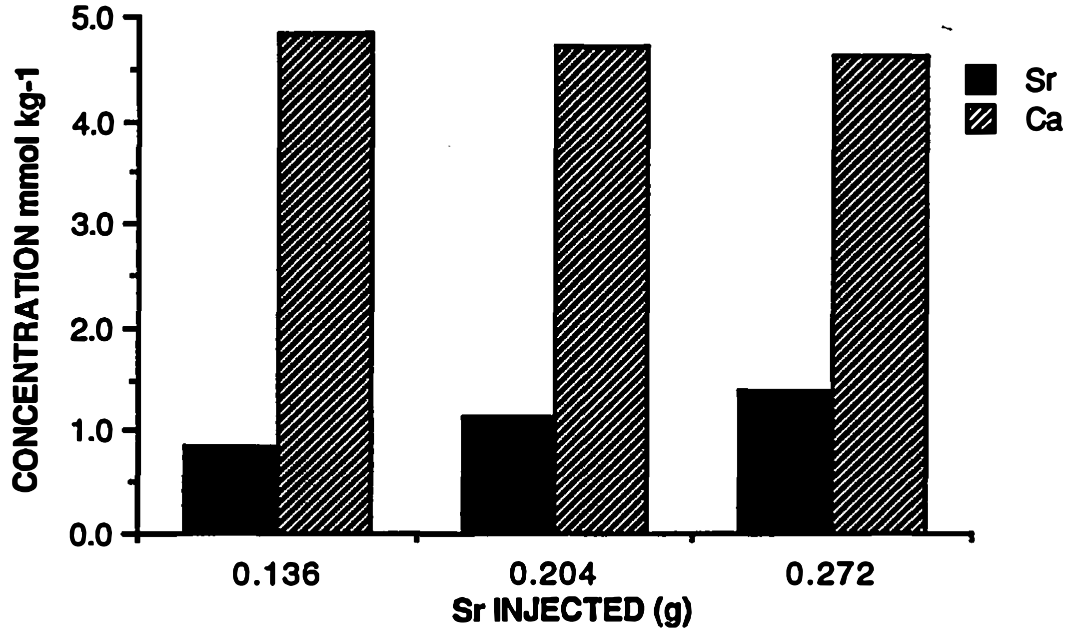

Figure 3. Concentration of Sr and Ca in soybean leaves, averaged across lines and vegetative stages, as a function of the amount of Sr injected (PES).

growing season. The trend for plants at PES (Fig. 4) depicts a high rate of Sr absorption from 0.40 m at the V7-8 stages, followed by a decline as the plant matured. The concentration of Ca in the trifoliates during the growing season also followed a similar trend. Interactions among lines, growth stages and the amount of Sr injected were not significant.

Figure 5 illustrates Sr absorption by individual lines at PES during the growing season for each of the three tracer levels. The concentration of Sr in each line varied among vegetative growth stages. However, there were no significant differences among lines within each of the three levels of Sr injected.

Table 3 contains Sr and Ca values, averaged across Sr treatments and growth stages, for seven lines and one cultivar. The Sr concentration varied between soybean lines from 0.84 mmol kg^{-1} for line TN82-230 to 1.15 mmol kg^{-1} for TN82-264; however, no significant differences were observed. Analysis of individual lines by treatments and growth periods also indicated nonsignificant differences. The Ca concentration did vary significantly between lines, ranging from a high of 520 mmol kg^{-1} for TN82-232 to 420 mmol kg^{-1} for TN82-277. Statistical analysis of the data as Sr:Ca ratios did not result in delineating further significant differences.

Analysis of selected chemical properties of the soil at PES (Table 1) indicated that organic carbon and pH decreased with depth, while the CEC increased slightly with depth. Although these soil factors influence Sr availability for plant uptake, their affects on Sr absorption were not evaluated. Development of the V5-10 growth stages corresponded to the July rainfall period and the V11-14 stages to August rainfall (Table 2).

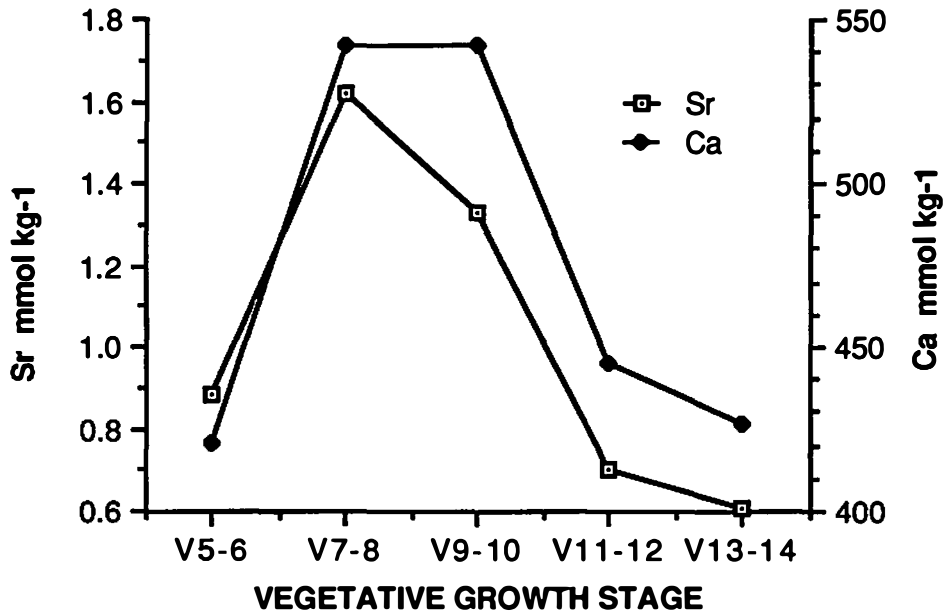

Figure 4. Concentration of Sr and Ca in soybean leaves, averaged across lines and Sr levels, at different growth stages (PES).

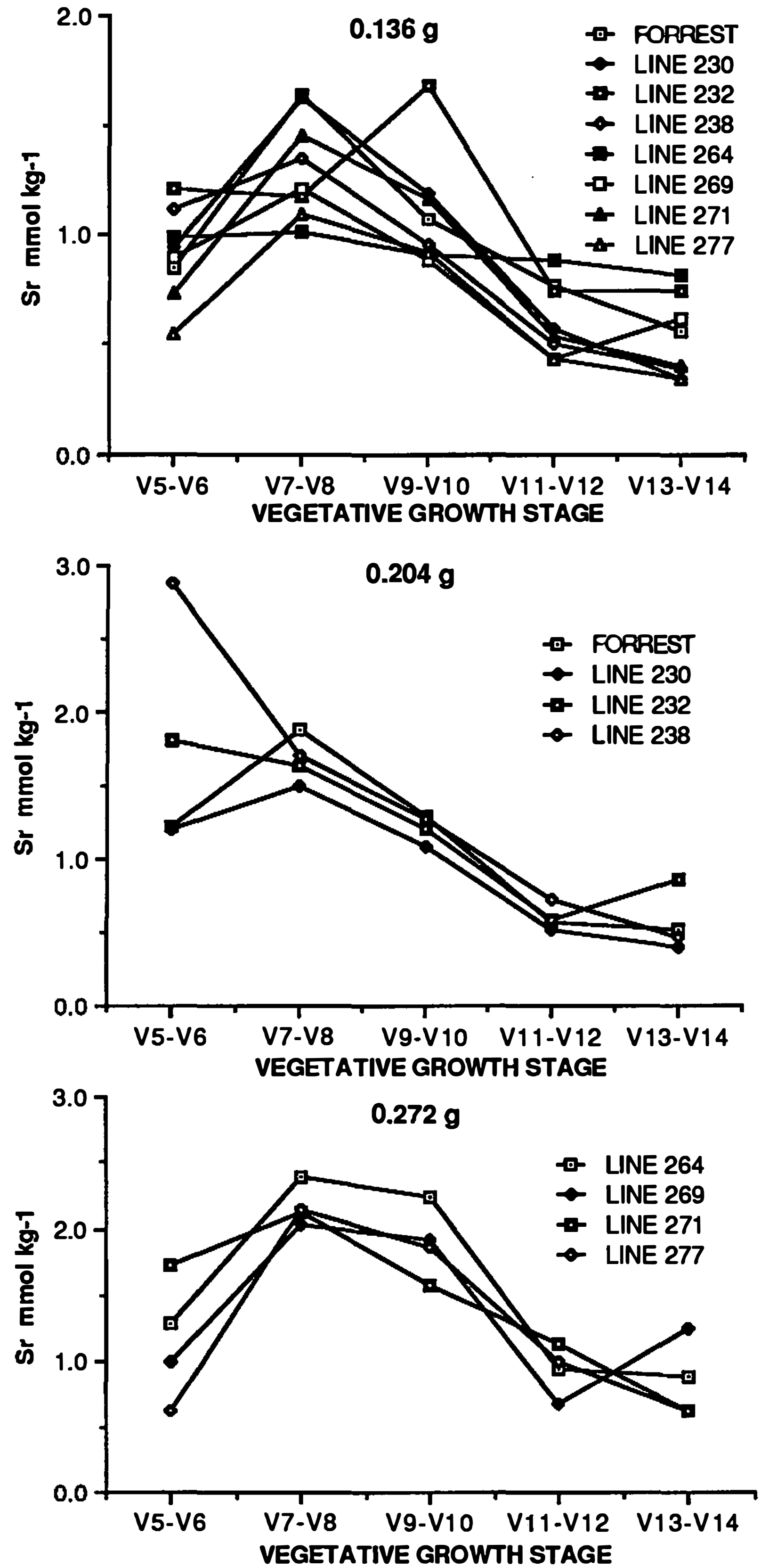

Figure 5. Strontium absorption patterns of individual lines during vegetative growth for different Sr treatments (PES).

Table 3. Strontium and calcium concentrations of seven soybean lines and one cultivar averaged across Sr treatments and growth stages at two locations.

	ELEMENTAL CONCENTRATION			
	PES		KPS	
	Sr	Ca	Sr	Ca
	mmol kg^{-1}			
'FORREST'	0.97 a*	487 ab	1.00 b	552 bc
TN82-230	0.84 a	485 ab	1.10 b	532 bcd
TN82-232	1.05 a	520 a	1.24 b	530 bcd
TN82-238	1.03 a	457 bc	1.03 b	522 cd
TN82-264	1.15 a	470 abc	1.58 a	570 b
TN82-269	1.04 a	500 ab	1.05 b	607 a
TN82-271	1.02 a	427 c	1.16 b	495 d
TN82-277	0.88 a	420 c	0.90 b	447 e

* Means in the same column followed by the same letter are not significantly different at P = 0.05.

Yields for soybean lines at PES are shown in Figure 6. Values ranged from 2153 kg ha^{-1} for line TN82-232 to 1445 kg ha^{-1} for TN82-277. The highest yielding line TN82-232 also had the second highest Sr concentration. However, no significant differences among lines were observed for either Sr concentration in trifoliates or yield.

Knoxville Plant Science Farm (KPS) Soybean plants at KPS showed Sr absorption characteristics similar to those displayed at PES. Figure 7 illustrates Sr and Ca levels in trifoliates at four tracer levels and two depths of placement. These values averaged across time and lines indicate a direct positive relationship between the quantity of tracer injected and the amount of Sr absorbed by plants at 0.15 and 0.40 m. The amount of Sr absorbed from 0.15 m was nearly three times that absorbed from 0.40 m suggesting a threefold difference in root activity. The least amount of tracer injected (0.136 g Sr) again provided a level of Sr within the plant at 0.15 and 0.40 m significantly higher than the check. Calcium concentration did not vary with different levels of Sr.

Strontium and Ca concentrations at different vegetative growth stages, averaged across the amount of Sr injected, depths of injection and lines, are illustrated in Figure 8. The concentration of Sr during the V4-5 growth stages was significantly higher than during the other growth stages. However, line by Sr level and line by vegetative growth stage interactions were significant. Strontium concentration declined from 1.79 mmol kg^{-1} at the V4-5 growth stage to 1.27 mmol kg^{-1} by the V6-7 stage. This was followed by a gradual decline to a Sr concentration of 0.87 mmol kg^{-1} by the V14-15 growth stage.

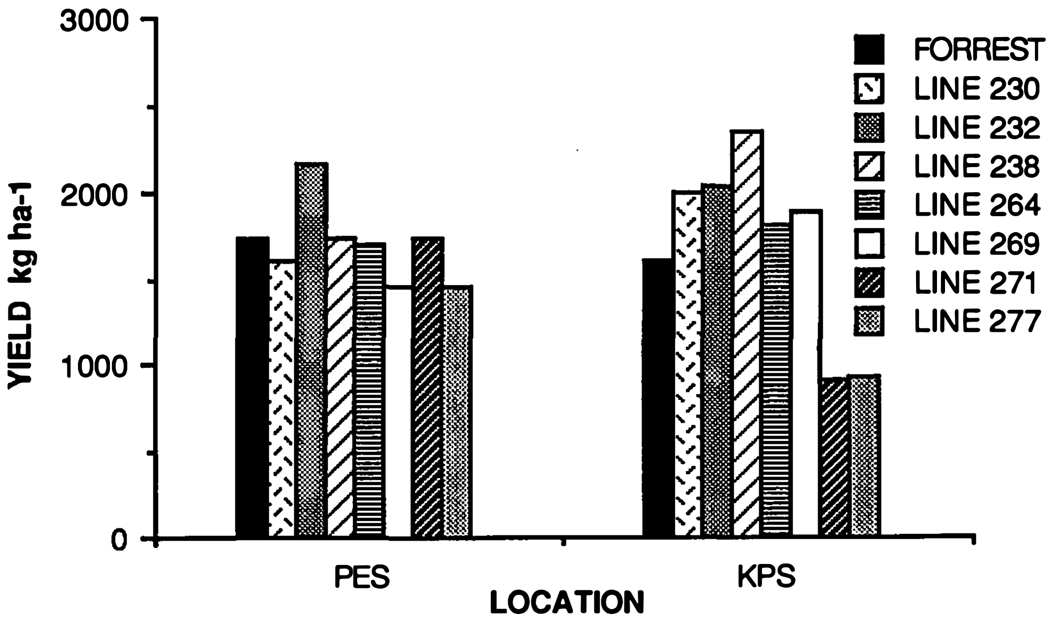

Figure 6. Soybean yield (dry weight) at two locations.

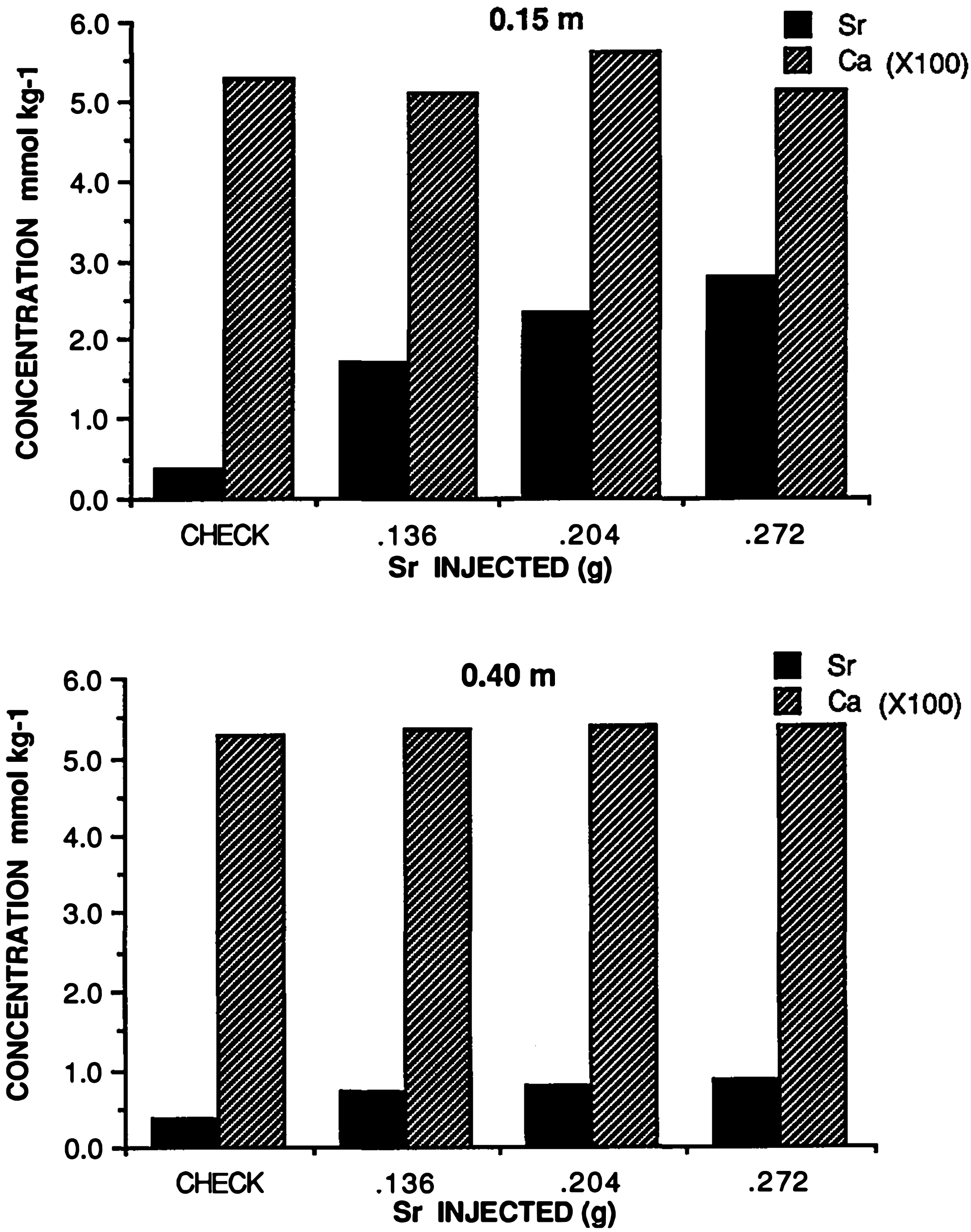

Figure 7. Concentration of Sr and Ca in soybean leaves, averaged across lines, as a function of the amount of tracer injected and depth of placement (KPS).

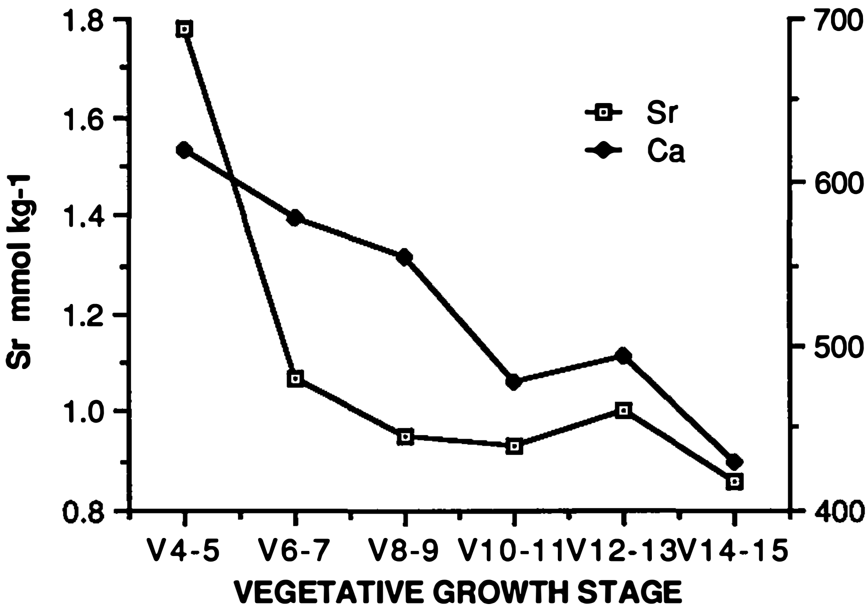

Figure 8. Concentration of Sr and Ca in soybean leaves, averaged across lines, depths, and Sr levels at different growth stages (KPS).

Figure 9 illustrates the Sr absorption patterns, averaged across lines, for individual injection depths and Sr levels. The concentration of Sr in trifoliates for the 0.15 m injection depth was significantly greater than for the 0.40 m depth for the three levels of Sr. The 0.204 and 0.272 g Sr treatments resulted in high Sr concentrations in trifoliates during the V4-5 growth stages, followed by a sharp decline in Sr by the V5-6 stage and a gradual leveling off in concentration during the remainder of the growing season. This pattern was not evident at 0.40 m. At no time did the Sr concentration for the 0.40 m injection depth exceed the Sr concentration for the 0.15 m treatment for any of the three Sr levels. All three levels of Sr injected provided significantly higher levels of Sr in trifoliates than the check treatment for all vegetative growth stages and depths.

The Sr and Ca concentrations (Table 3) for seven soybean lines and one cultivar are averaged across treatments and growth stages. Strontium concentration ranged from a low of 0.90 mmol kg^{-1} for TN82-277 to 1.58 mmol kg^{-1} for TN82-264. Only line TN82-264 was significantly higher in Sr concentration than the other lines tested.

Analysis of selected chemical properties at KPS (Table 1) indicated that organic carbon decreased from 6.6 g kg^{-1} at 0.15 m to 4.0 g kg^{-1} at the 0.40 m depth. There was an increase in CEC and clay content with increased depth. Development of the V4-9 growth stages for soybeans at KPS corresponded to the July rainfall period (Table 2). The V10-15 growth stages developed during the August rainfall period.

Soybean yield at KPS is illustrated in Figure 6. Line TN82-238 was highest yielding and lines TN82-271 and TN82-277 lowest yielding (P=0.05). There was no indication that lines containing high Sr concentrations had

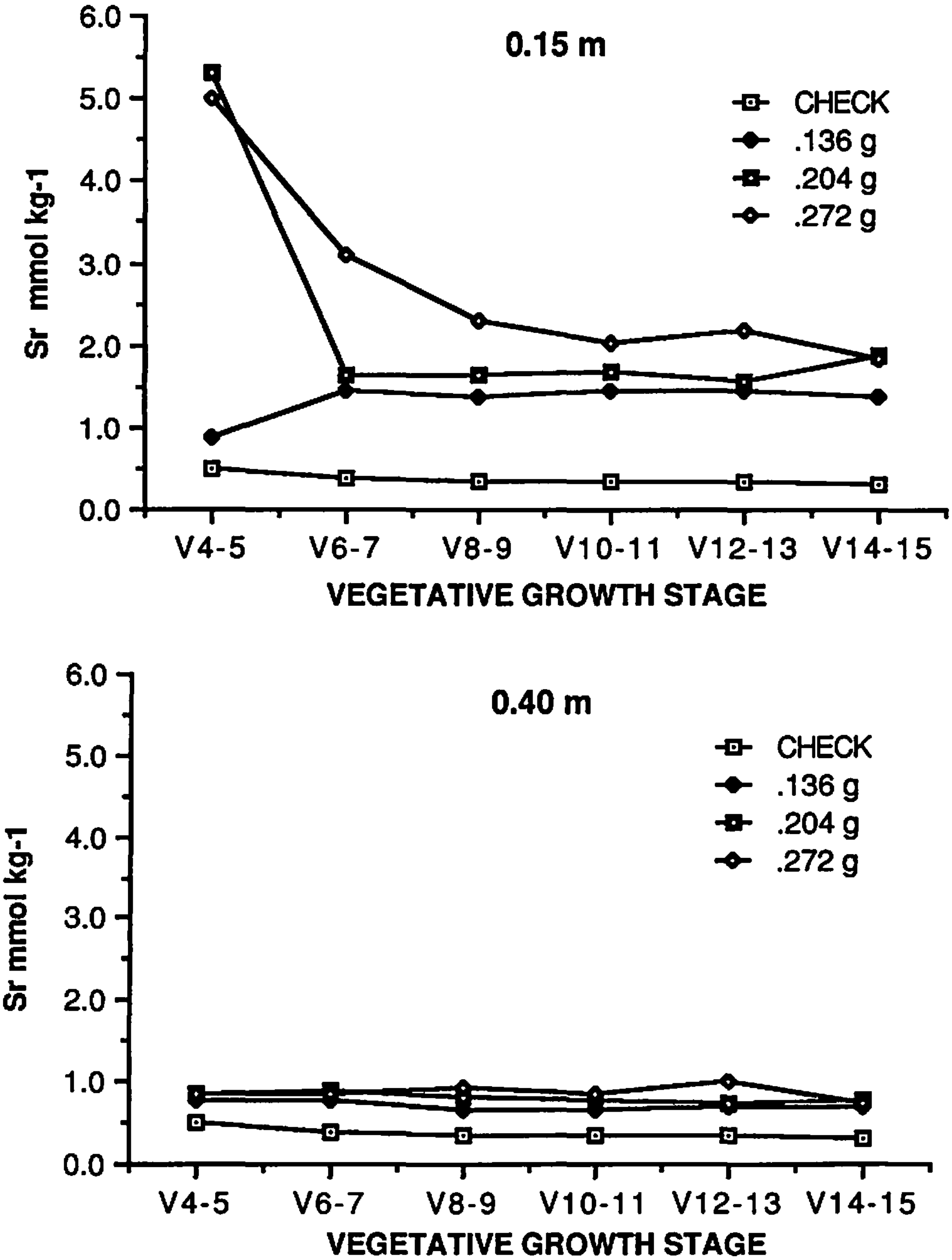

Figure 9. Strontium concentration, averaged across lines, during vegetative growth stages for three Sr levels and two depths of tracer placement (KPS).

similarily high yields. Line TN82-264 contained significantly more Sr than the other lines, yet it was the fifth highest yielding. The yield for line TN82-238 was significantly greater than any other lines but contained only the sixth highest concentration of Sr.

CONCLUSIONS

The method described in this paper for stable tracer use in field situations allows for a qualitative estimation of root growth or "activity" at different zones within the soil profile. The method is relatively easy and efficient and compatible with other research efforts taking place in the same soybean plots.

A 0.138 mole ratio of $Sr(OOCCH_3)_2 \cdot 0.5H_2O$ to $SrCl_2 \cdot 6H_2O$ aqueous solution provided an ideal tracer for field application. This particular ratio of acetate to chloride minimized soil pH change at the site of injection. Placement of Sr by a syringe and needle, using access tubes, was a relatively rapid technique. A 3.2 mm OD stainless steel injection tube confined soil disturbance and potential for root channeling to occur.

The least amount of tracer injected per injection point (0.136 g Sr) provided a Sr level greater than the check treatment in soybean trifoliates during the entire growing season. The concentration of Sr in trifoliates was directly and positively related to amount of Sr injected. Calcium concentrations were unaffected by Sr levels.

Injecting Sr at 0.15 and 0.40 m at KPS illustrated that variable root activity as a function of depth and vegetative growth stage could be determined. A linear absorption relationship between the amount of Sr injected and Sr concentration in the trifoliates was also observed.

Strontium concentration was nearly three times greater in trifoliates for the 0.15 m treatment depth than for the 0.40 m treatment.

Monitoring Sr absorption during the growing season allowed for continual observation of root activity from tracer injection to harvest. The interpretation of this data must be premised with the awareness of the physiological changes in the plant during the growing season as well as the availability of Sr at the point of injection. Ongoing physiological changes in the plant could lead to altered patterns of Sr accumulation. Additionally, the availability of the injected Sr would be expected to change with time and therefore confound the measurement of root activity over time. However, differences in some of the chemical and physical properties of the soils at PES and KPS may have influenced Sr absorption.

Yield differences were not significant among lines at PES but were significant at KPS. Differences in yields between locations for individual lines were also observed. Although differences in yields and Sr concentrations between the two locations may be a function of soil properties, time of planting, or climatic conditions, their influence was not evaluated in this study.

The differences in the amount of Sr absorbed by soybean lines at KPS indicated that dissimilarities in root activity may exist among lines. Comparison of KPS and PES data indicate that certain lines contained higher levels of Sr than other lines; however, few significant differences were noted.

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III. STABLE STRONTIUM AS A TRACER FOR DETERMINING ROOT GROWTH IN CONVENTIONAL TILL AND NO-TILL SOYBEANS

ABSTRACT

The feasibility of using stable strontium to measure root proliferation of field-grown soybeans (*Glycine max* (L.) Merr.) was investigated. Root activity was determined for each of four lines and one variety of soybeans in conventional till and no-till systems. The tracer, a 0.138 mole ratio of $Sr(OOCCH_3)_2 \cdot 0.5H_2O$ to $SrCl_2 \cdot 6H_2O$ aqueous solution, contained 0.068 g ml^{-1} Sr. Injecting 0.136 g Sr at each of 10 points (5 points per side) within a 0.45-m section of row provided a sufficient amount of tracer for root activity determination. Primary trifoliates were marked as to time of development during the growing season following tracer injection. Two depths (0.15 and 0.40 m) of tracer placement allowed comparison of root activity at different depths within the soil. Higher Sr levels in soybean trifoliates resulted from the 0.15-m injection treatment, indicating greater root growth or activity at 0.15 m than at 0.40 m. Fluctuations of Sr concentrations in the trifoliates among vegetative growth stages indicated variable levels of root activity during the growing season at both depths. Differences in Sr levels among soybean lines indicated the method's potential for determining variations in root activity during field breeding line trials. No-till plants contained more Sr than conventional till plants during the early stages of growth indicating increased root activity at 0.15 m. Increased activity levels at 0.40 m were noted in conventional till soybeans during later stages of growth.

INTRODUCTION

Root growth can be influenced by tillage and residue management. Certain tillage systems can influence soil structure or density, thereby affecting root distribution (Lal 1976; Jones 1983; Goss et al., 1984). No-till systems may restrict the lateral spread of roots during the early stages of growth in that interrow compaction by traffic increases surface layer density (Chaudhary and Prihar, 1974). Taylor and Burnett (1964) and Taylor and Gardner (1963) noted that soil strength, not bulk density, was the critical impedance factor controlling root penetration. Findings by Barley (l962) indicated that as soil strength increased the rate of root elongation decreased and root diameter increased. Taylor and Gardner (1963) reported decreasing root penetration with increasing soil strength.

Decreased root growth may be only indirectly related to increased bulk density, since densities in the range of 1.3 to 1.8 g cm^{-3} have been shown to decrease water uptake rate (Bar-Yosef and Lambert, 1981). The use of mulch in no-till systems may influence root growth and distribution by increasing soil water retention through reduced evaporation (Phillips, 1984). Availability of nutrients and water to the plant can be influenced by root distribution. Increased root activity (Al-Ithawi et al., 1980) and increased root development (Osmond and Raper, 1982; Stone et al., 1976) have been attributed to increased soil water, as soil water content approached an optimum level.

Residue management is critical with respect to the influence of tillage on root growth. Barber (1971) determined that corn (*Zea mays* L.) root development was depressed in the 0-0.10 m depth when residues were removed compared with development when residues had been returned. He also reported longer and finer roots per unit weight and more roots at greater depths in conventional till than no-till corn. Yet, many studies have indicated that straw mulch on no-till soil enhances root growth in the upper 0.15 m of soil by increasing lateral spread of roots during the early stages of plant development (Barber 1971; Chaudhry and Prihar, 1974). Allmaras and Nelson (1971) studied the influence of tillage and straw mulch strips on soil moisture, soil temperature and corn root growth. They determined, in a two year study, that during the year of higher soil temperature and decreased soil moisture availability that straw mulch strips between the rows increased lateral root proliferation and that straw mulch strips over the rows decreased lateral root proliferation. Baeumer and Bakermans (1973) noted in their review that roots elongate more slowly for no-till than for conventional till systems. However, lateral branching in the surface soil is more prolific during the early stages of growth in no-till, resulting in a dense but shallow rooting system. A study by Maurya and Lal (1979) illustrated that root density at 0.10 m was greater for no-till corn and cowpeas (*Vigna unguiculata*) later in the growing season than for conventional tillage.

Variations in root growth may be as much a factor of genetics as environment. Work with barley (*Hordeum vulgare* L.) (Pettersson, 1978; Glass and Perley, 1980; Glass et al., 1981), oats (*Avena sativa* L.) (Murphy and Long, 1979; Murphy et al., 1982), alfalfa (*Medicago sativa* L.) (Simpson et al., 1977; Carter et al., 1982) and peanuts (*Arachis hypogaea*) (Ketring, 1984) have indicated varietal differences in root growth or activity. Recent studies with soybeans (*Glycine max* (L.) Merr.) have indicated genotypic variation in root elongation (Kaspar et al., 1984; Garay and Wilhelm, 1983; Stone and Taylor, 1983). Genotypic variation in root activity as a function of tillage treatment has not received much attention.

The use of stable tracers provides an alternative method to core sampling techniques for measurement of root growth. Previous research in the use of a stable tracer to quantify root activity has demonstrated a positive relationship between Sr absorption and total root length (Soileau, 1973) and root weight (Pinkerton and Simpson, 1979). This correlation between Sr absorption (root activity) and root growth enables the use of stable Sr as a tracer for characterizing root growth in the field.

The objective of this research was to evaluate the use of stable Sr tracer in field conditions for characterizing root growth of no-till and conventional till soybeans. In addition, several soybean lines were used to determine the method's potential for identifying variation in root activity among lines as a function of soil depth and tillage system.

MATERIALS AND METHODS

Soybean fields at two locations in Tennessee, the Knoxville Plant Science farm (KPS) and the Plateau Experiment Station (PES) at Crossville, were selected for this study. Soils were a Tilsit (fine-silty mixed mesic Typic Fragiudult) at PES and a Sequatchie (fine-loamy siliceous thermic Humic Hapludult) at KPS. Some of the chemical and physical properties of these soils are listed in Tables 1 and 2. Soil samples were collected from depths of 0-0.10, 0.10-0.20, 0.20-0.35 and 0.35-0.45 m, air dried, sieved (2 mm) and stored until analyzed. Atomic absorption was used to determine

Table 1. Selected chemical and physical properties of soils used at PES.

	CONVENTIONAL TILL				NO-TILL			
	DEPTHS (m)							
	0.00-0.10	0.10-0.20	0.20-0.35	0.35-0.45	0.00-0.10	0.15-0.20	0.20-0.35	0.35-0.45
pH (1:1 v/v H_2O)	6.2	6.3	6.2	5.5	6.1	6.4	5.8	5.4
Organic C g kg^{-1}	11.5	12.6	8.2	2.2	17.6	16.8	8.8	2.5
	mmol (+) kg^{-1}							
Exch. Ca^{2+}	45.0	45.0	40.4	25.0	53.8	57.4	42.0	24.4
Exch. Mg^{2+}	7.6	5.6	6.8	2.4	4.8	4.6	4.2	2.2
Exch. K^+	7.0	5.9	5.2	2.4	5.2	4.0	3.3	1.6
Exch. Na^+	0.2	0.3	0.3	0.1	0.3	0.4	0.5	0.2
Exch. Sr^{2+}	0.0	0.4	0.0	0.0	0.0	0.6	0.0	0.2
Exch. H^+	0.3	0.2	0.4	3.9	1.2	0.7	5.4	13.1
CEC	60.1	57.4	53.1	33.8	65.3	67.7	55.4	41.7
	g kg^{-1}							
Sand*	393	405	388	530	400	463	455	475
Silt	450	433	450	295	438	380	370	313
Clay	157	162	162	175	162	157	175	212

*Day (1965), sand determined by difference.

Table 2. Selected chemical and physical properties of soils used at KPS.

	CONVENTIONAL TILL				NO-TILL			
	DEPTHS (m)							
	0.00-0.10	0.10-0.20	0.20-0.35	0.35-0.45	0.00-0.10	0.10-0.20	0.20-0.35	0.35-0.45
pH (1:1 v/v H_2O)	6.9	6.8	5.9	5.7	6.6	6.4	5.5	5.4
Organic C g kg^{-1}	7.4	7.0	6.5	5.1	7.3	6.9	4.3	2.5
	mmol (+) kg^{-1}							
Exch. Ca^{2+}	33.4	33.6	28.4	26.0	29.2	27.8	21.4	23.8
Exch. Mg^{2+}	11.6	11.2	11.2	8.6	9.4	9.0	7.6	8.4
Exch. K^+	3.9	3.1	2.4	1.7	4.1	2.4	1.7	1.3
Exch. Na^+	0.1	0.2	0.1	0.2	0.2	0.1	0.4	0.2
Exch. Sr^{2+}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exch. H^+	0.1	0.1	0.3	0.9	0.1	0.2	3.3	4.0
CEC	49.1	48.2	42.4	37.4	43.0	39.5	34.4	37.7
	g kg^{-1}							
Sand*	575	593	543	518	475	588	500	488
Silt	293	275	275	287	388	275	255	237
Clay	132	132	182	195	137	137	245	275

*Day (1965), sand determined by difference.

Sr, Ca, Mg, and K concentrations, and flame emission to determine Na in neutral 1 mol L^{-1} NH_4OAc extracts (Jackson, 1958) containing 1% La as $LaCl_3$. Soil pH was determined using a 1:1 (v/v) soil to water ratio. Total carbon was determined using a Leco Carbon Analyzer (Model CR12). Exchangeable acidity was determined by titration of KCl extracts (Jackson 1958). Cation exchange capacity (CEC) was calculated by cation summation. The hydrometer method (Day, 1965) was used for textural class determination.

Two tillage treatments were implemented following a wheat crop. Conventional till soils were plowed and disked to a depth of 0.20 m prior to planting. No-till soils were seeded directly in the wheat stubble. Both soils were fertilized with 29 kg P ha^{-1} and 56 kg K ha^{-1} and limed to adjust pH to about 6.5. Conventional till herbicides consisted of 3.41 L ha^{-1} a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine (Treflan) applied prior to planting and 2.82 L ha^{-1} each of sodium-5-[2-chloro-4-(trifluoromethyl)- phenoxy]-2-nitrobenzoate (Blazer) plus 3-(1-methylethyl)-1H-2,1,3- benzothiadiazin-4(3H)-one-2,2-dioxide (Basagran) 30 days after planting. No-till soils received 2.35 L ha^{-1} 1,1'-dimethyl-4,4'-bipyridinium dichloride (Paraquat) prior to planting plus 2.82 L ha^{-1} each of Blazer and Basagran 30 days after planting.

Planting dates were 14 May 1985 (PES) and 30 May (KPS) for conventional till and 19 June (PES and KPS) for no-till. Four lines, TN82-183, TN82-193, TN82-281, TN82-294, and 'Forrest', were used in this study. Conventional till soybeans were planted in rows 0.91 m on center, while no-till soybeans were planted in rows 0.45 m apart. All rows containing tracer injections were separated by at least one spacer row. Each 6.2-m row (plot), representing a single soybean line or cultivar contained three 0.45-m subplots. All subplots were separated by at least 1.6 m within the row.

The tracer was a 0.138 mole ratio of $Sr(OOCCH_3)_2 \cdot 0.5H_2O$ to $SrCl_2 \cdot 6H_2O$ aqueous solution containing 0.068 g ml^{-1} strontium. Each subplot contained 10 injection points (5 per side) with each injection point receiving 0.136 g Sr. Injection points were located at 0.08-m intervals parallel to the soybean row and at a distance 0.10 m from the plant stem on both sides of the row. Strontium was injected at depths of 0.15 and 0.40 m. Subplots were randomly allocated within each treatment row, and each treatment was replicated three times.

Placement of the liquid tracer was accomplished with a 3.2-mm (OD) stainless steel tube with inner metal stylet, drilled into the soil with an electric drill. A syringe and needle were used to inject the tracer via the stainless steel tube to the desired depth. Strontium was injected 4-5 weeks after planting during the third or fourth vegetative growth stage (V3-V4), with subsequent tagging of newly developing primary trifoliates every 10-14 days.

Each subplot contained approximately 12 soybean plants with the middle 6 plants being harvested for analysis. Because lower trifoliates senesced as the plant matured, early tagged trifoliates were harvested during the later V-stages while later tagged trifoliates were harvested during the early R-stages (reproductive growth stages).

Plant samples were dried at 60^{o} C. Leaflets were separated from the petiole for each trifoliate, ground to pass a 20-mesh screen. Dry ashing followed a modified procedure of Greweling (1976) in which plant samples (0.50 g) were ashed at 500^{o}C for 6 hours, cooled, treated with 2 mL 5 mol L^{-1} HNO_3, evaporated, ashed at 400^{o}C for 1 h, cooled, dissolved in 1 mL 20% HCl with 5% La as $LaCl_3$ and brought to 5 mL volume with 4 mL deionized H_2O. Strontium and Ca were determined using a Perkin-Elmer 5000 atomic absorption spectrophotometer.

Rainfall for the two locations during the 1985 growing season was measured. Data for PES and KPS are presented in Table 3.

The experimental design was a randomized complete block with three replications. Standard analysis of variance was determined using GLM (SAS, 1982) with mean separation by the Duncan's multiple range test. The confidence level for all analyses was set at 0.05.

RESULTS AND DISCUSSION

Plateau Experiment Station (PES) Figure 1 illustrates the significantly higher levels of Sr in the soybean trifoliates when Sr was injected at 0.15- and 0.40-m depths as compared to the check treatment (P = 0.05). Strontium concentration in trifoliates was also significantlly higher for tracer injection at 0.15 m as compared to 0.40 m (P = 0.05). This absorption pattern was evident in both the conventional till and no-till systems. Calcium concentration was not significantly affected by Sr treatments. All values were averaged across lines and vegetative growth stages.

Strontium and Ca concentrations for different vegetative growth stages and depths of tracer placement are illustrated for conventional till

Table 3. Rainfall data for two locations (PES and KPS) during the 1985 growing season.

DATE		LOCATION	
MONTH	DAY	PES	KPS
		cm	
MAY	1-15	1.88	2.21
	16-31	5.82	1.78
JUNE	1-15	7.67	4.47
	16-30	2.64	3.33
JULY	1-15	5.99	4.01
	16-31	4.29	5.00
AUGUST	1-15	3.68	6.17
	16-31	11.53	11.09
SEPTEMBER	1-15	1.17	0.00
	16-30	3.86	0.00

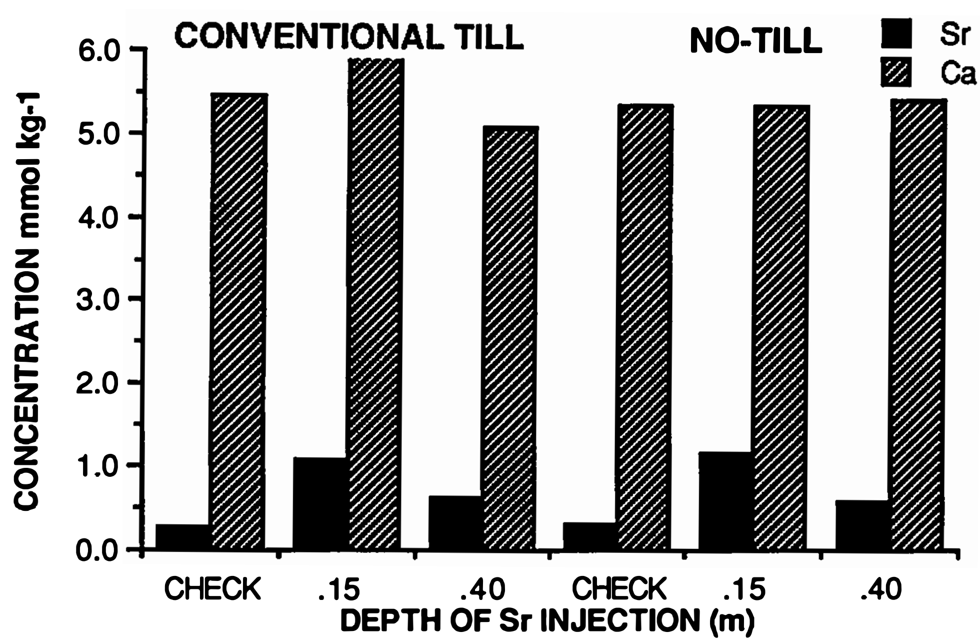

Figure 1. Concentration of Sr and Ca in conventional till and no-till soybean leaves, averaged across lines and growth stages, at two Sr injection depths (PES).

(Figure 2) and no-till (Figure 3) systems. These values were averaged across four lines and one cultivar. Strontium concentrations were corrected for background or check treatment values. The Sr concentration in trifoliates for both tillage systems and depths of tracer injection declined from the maximum levels of the early growth stages. There were significant differences in Sr levels among individual growth stages for both tillage systems and tracer placement depths (P=0.05). Strontium concentration in no-till soybeans during the V3-4 stages for the 0.15-m treatment was significantly higher than in conventional till (P = 0.05). However, by the V9-10 stages, Sr concentration was greater in conventional till than in no-till for tracer injection at 0.15 m (P = 0.05). No significant differences in Sr levels between tillage systems occurred for the 0.40-m injection depth.

Variations in Sr levels among lines are indicated in Table 4. These values were averaged across all Sr treatments and growth stages. Line X Sr treatments and line X growth stage interactions were not significant (P = 0.05). Strontium levels in TN82-281 and 'Forrest' were significantly higher than in the other three lines under conventional tillage (P = 0.05). However, under no-till, only TN82-281 contained significantly more Sr than the other lines (P = 0.05).

Strontium concentrations during the growing season for individual lines and both depths of tracer placement are illustrated for conventional till (Figure 4) and no-till (Figure 5) soybeans. Although the pattern of Sr concentration among lines during the growing season varied, there were few significant differences in Sr levels as a result of the type of tillage system used. TN82-281 absorbed significantly more Sr from 0.15 m in no-till than

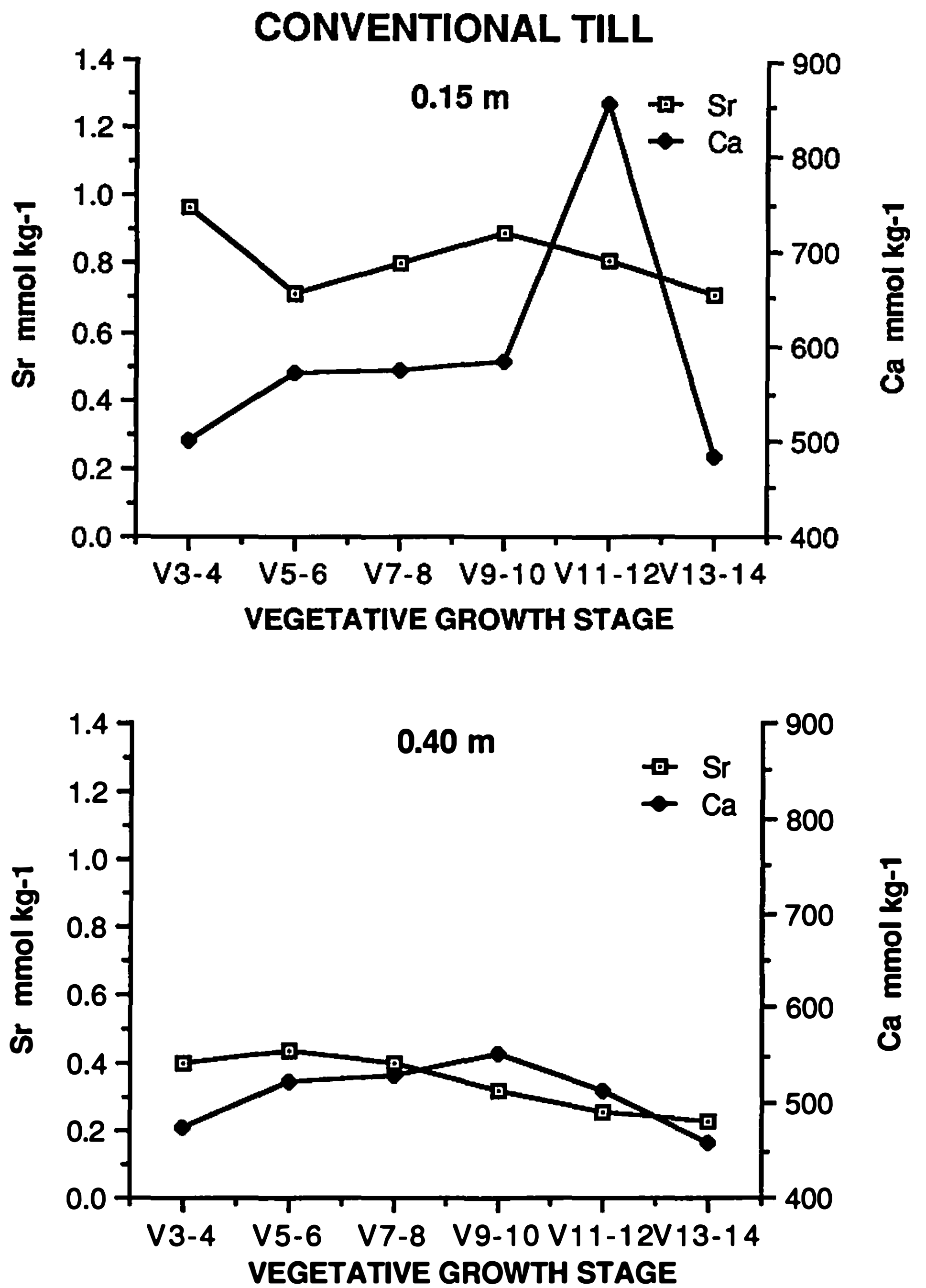

Figure 2. Concentration of Ca and added Sr in conventional till soybeans, averaged across lines, at different growth stages and two depths of tracer injection (PES).

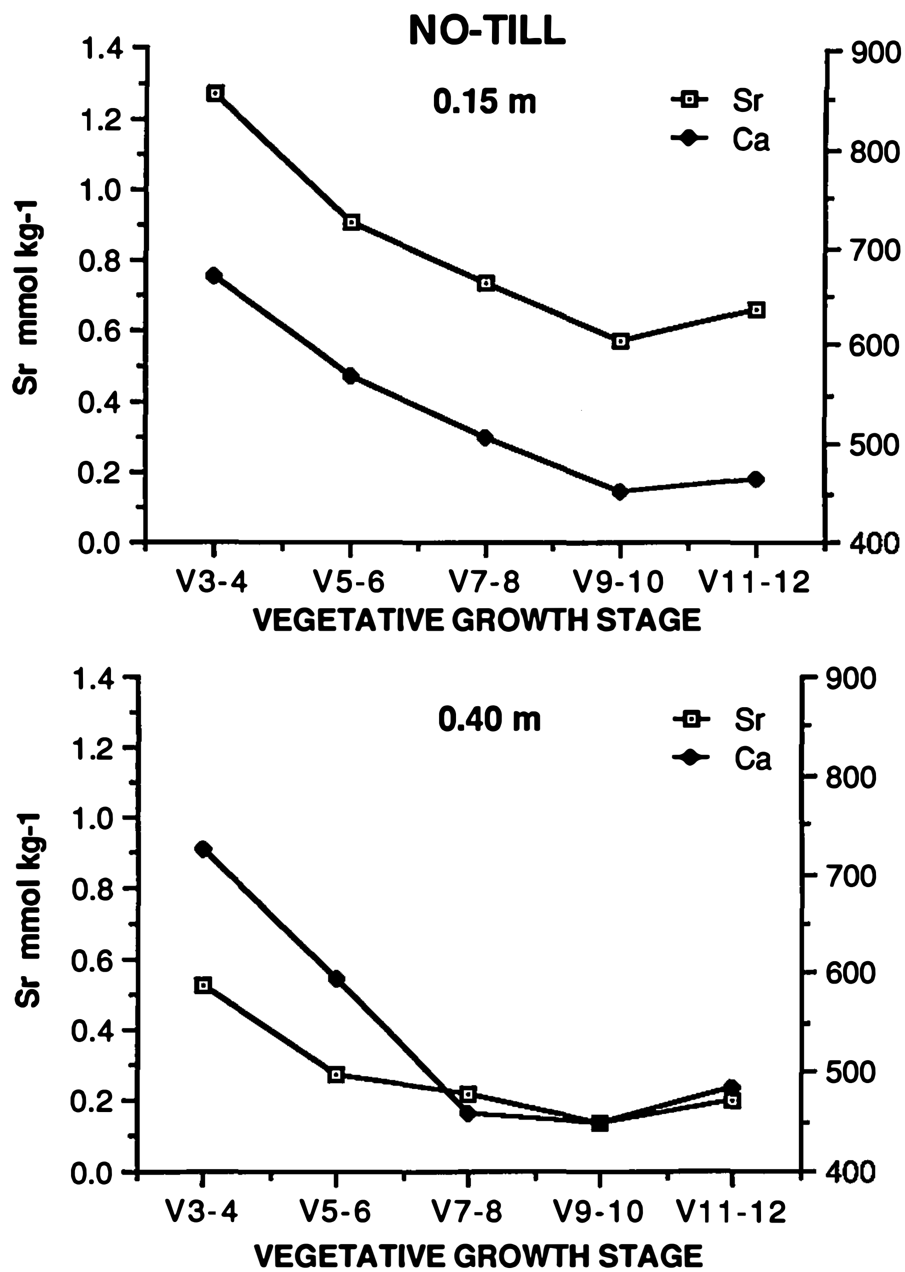

Figure 3. Concentration of Ca and added Sr in no-till soybeans, averaged across lines, at different growth stages and two depths of tracer injection (PES).

Table 4. Strontium and calcium concentrations of four soybean lines and one cultivar averaged across Sr treatments and growth stages (PES).

	ELEMENTAL CONCENTRATION			
	CONVENTIONAL TILL		NO-TILL	
Line	Sr	Ca	Sr	Ca
	mmol kg^{-1}			
TN82-183	0.625 b*	517 a	0.538 bc	580 a
TN82-193	0.526 c	578 a	0.745 b	484 b
FORREST	0.771 a	589 a	0.673 bc	568 a
TN82-281	0.715 a	558 a	0.985 a	605 a
TN82-294	0.631 b	511 a	0.499 c	459 b

* Means in the same column followed by the same letter are not significantly different at P = 0.05.

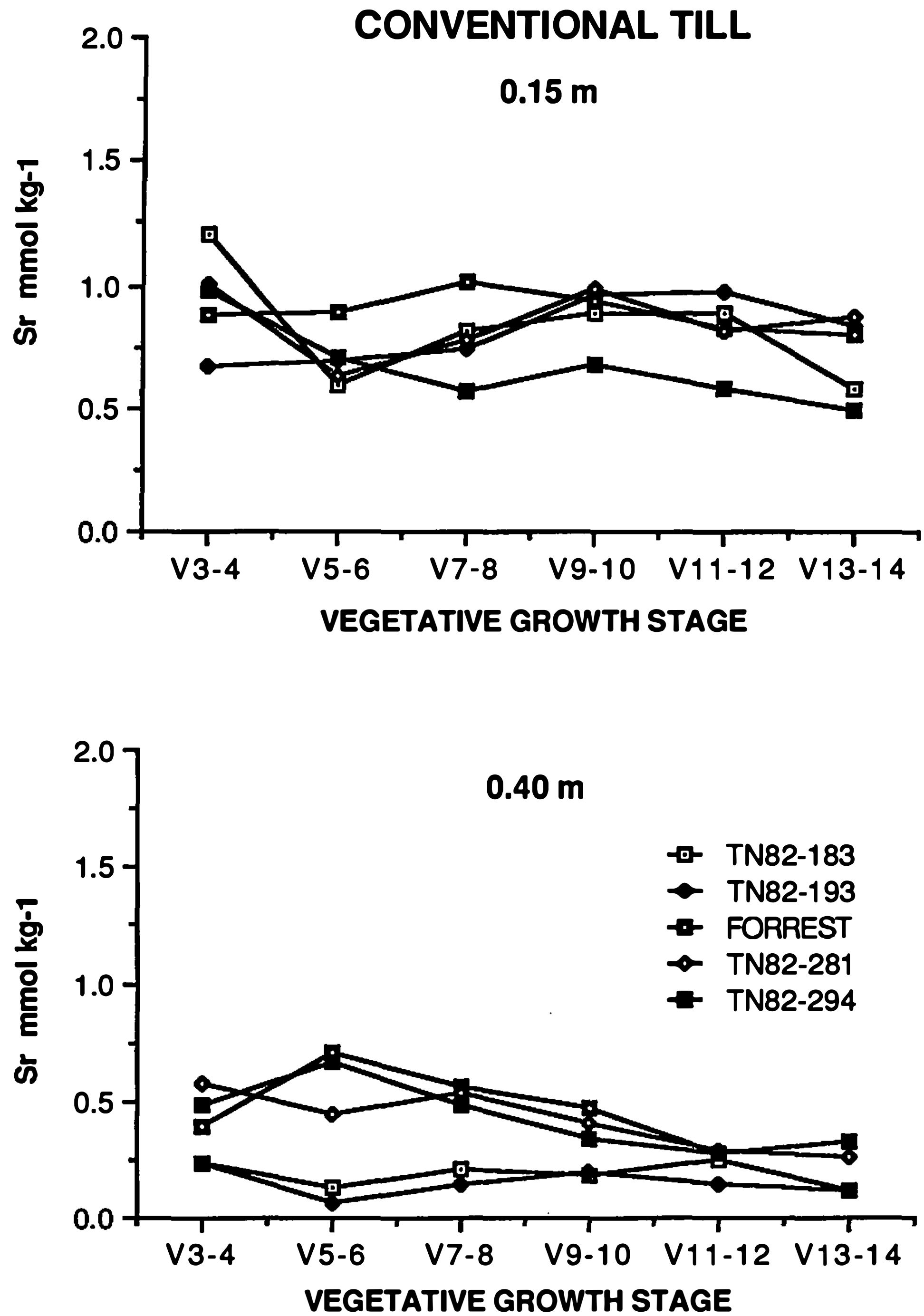

Figure 4. Strontium concentrations of individual lines at different vegetative growth stages for two injection depths in conventional till soybeans (PES).

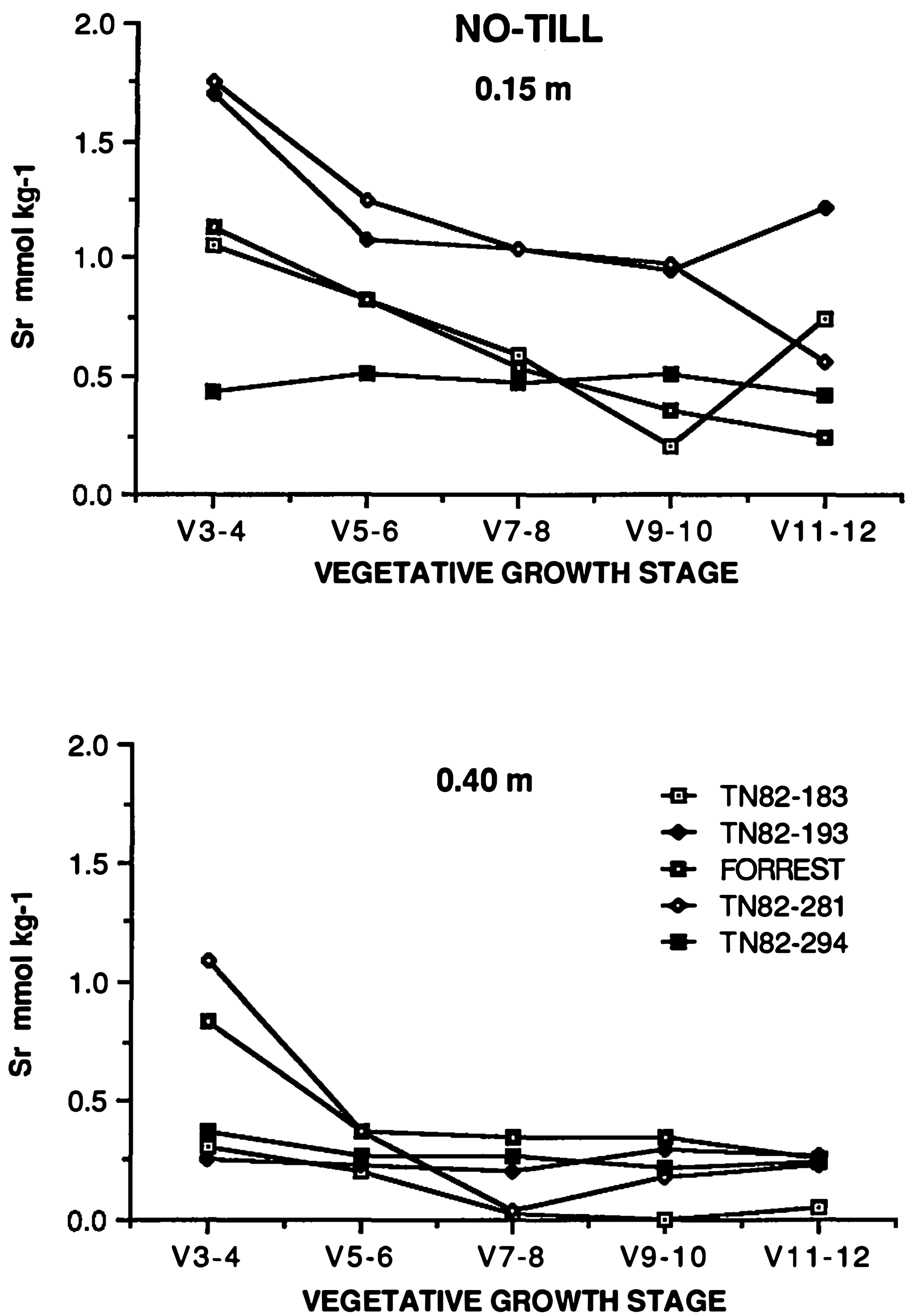

Figure 5. Strontium concentrations of individual lines at different vegetative growth stages for two injection depths in no-till soybeans (PES).

conventional till during the V3-4 growth stages (P = 0.05). Line TN82-183 absorbed more Sr from 0.15 and 0.40 m during the V7-8 and V9-10 stages in conventional till than in no-till (P = 0.05). These differences in Sr concentration for 0.15 and 0.40 m injection depths indicate that tillage may influence root activity of some lines.

Higher levels of organic carbon and CEC (Table 1) were observed at 0-0.10 and 0.10-0.20 m depths in no-till as compared to conventional till. In the no-till system, development of the V3-8 growth stages corresponds to the late July through August rainfall period and the V9-12 stages to September rainfall (Table 3). The V5-10 growth stage in conventional till developed during July and the V11-14 stages during August.

Knoxville Plant Science Farm (KPS) Figure 6 illustrates Sr and Ca concentrations in soybean trifoliates, averaged across lines and growth stages, at KPS for both depths of tracer injection. This Sr absorption pattern is similar to Figure 1 (PES). Line X Sr treatment interactions were determined to be significant (P = 0.05). Higher levels of Sr in trifoliates were observed for both injection depths compared to the check, with significantly more Sr being absorbed from the 0.15-m depth (P = 0.05). Calcium levels in soybeans were not influenced by any Sr treatments.

Strontium and Ca concentrations in soybeans during the growing season are illustrated for conventional till (Figure 7) and no-till (Figure 8) soybeans at two depths of tracer placement. Conventional till soybeans contained a significantly higher level of Sr during the V5-6 growth stages for the 0.15-m injection depth than during any other growth stage (P = 0.05). This was also a significantly higher Sr concentration than observed for the

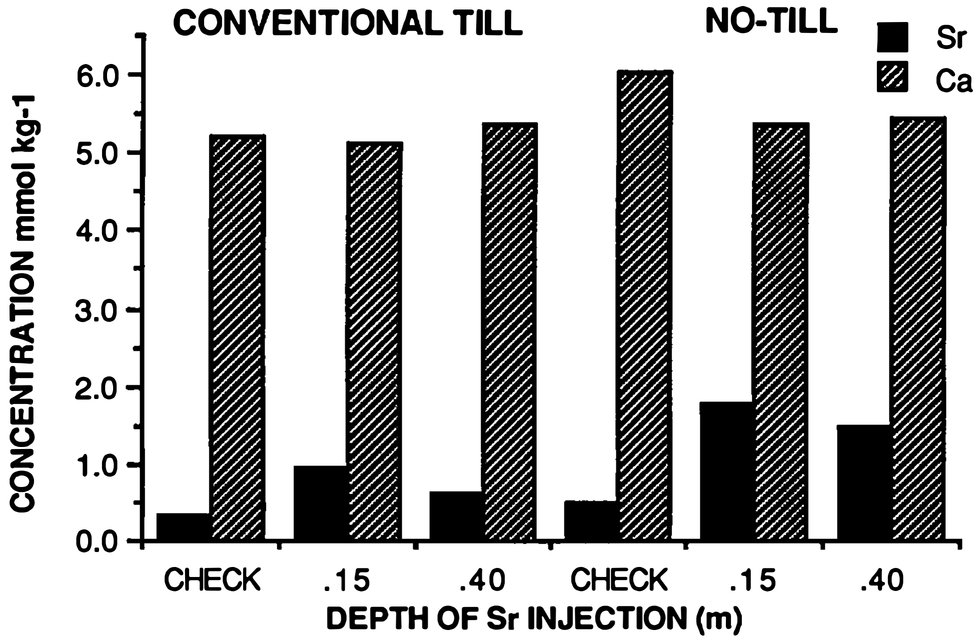

Figure 6. Concentration of Sr and Ca in conventional till and no-till soybean leaves, averaged across lines and growth stages, at two Sr injection depths (KPS).

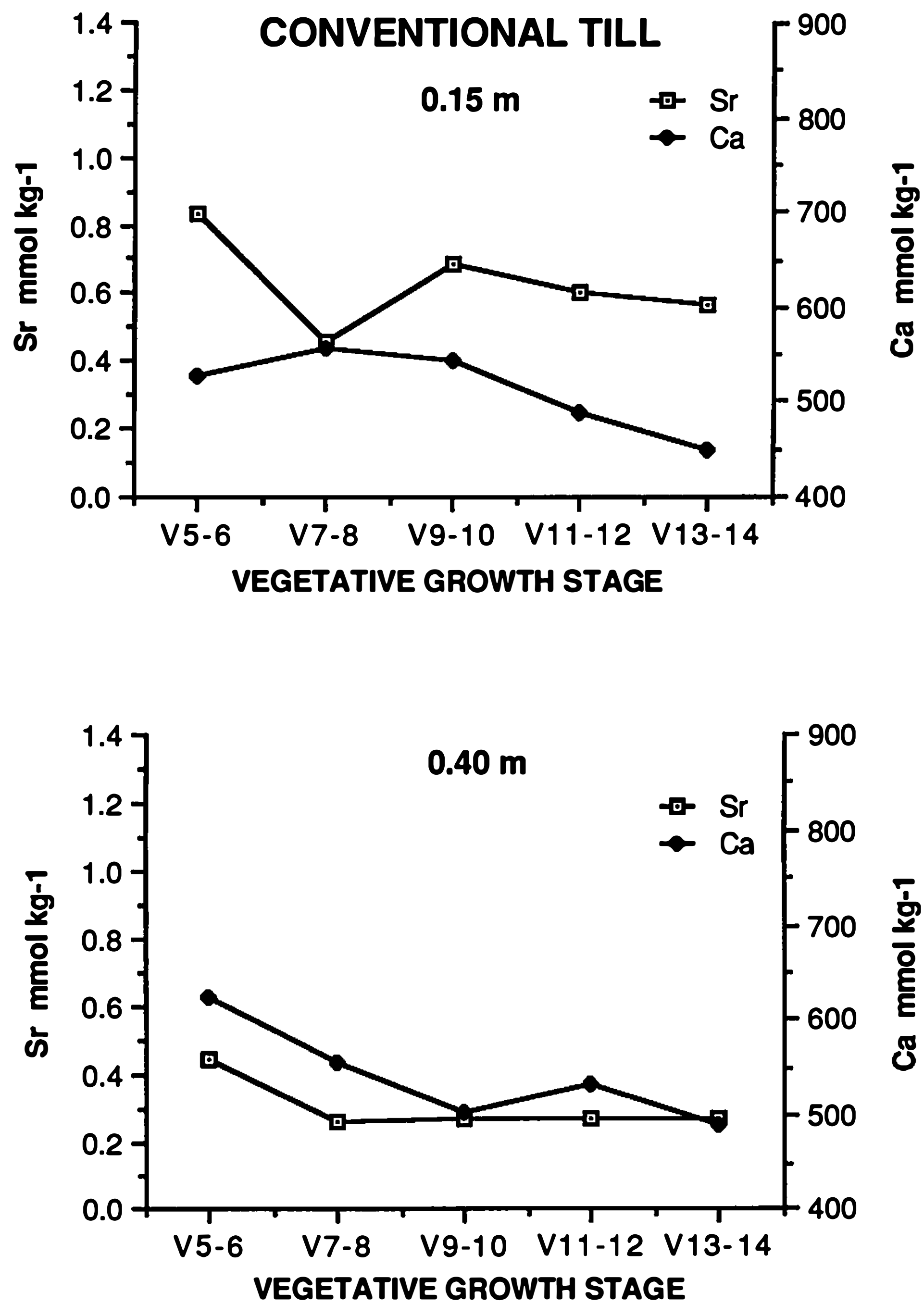

Figure 7. Concentration of Ca and added Sr in conventional till soybeans, averaged across lines, at different growth stages and two depths of tracer injection (KPS).

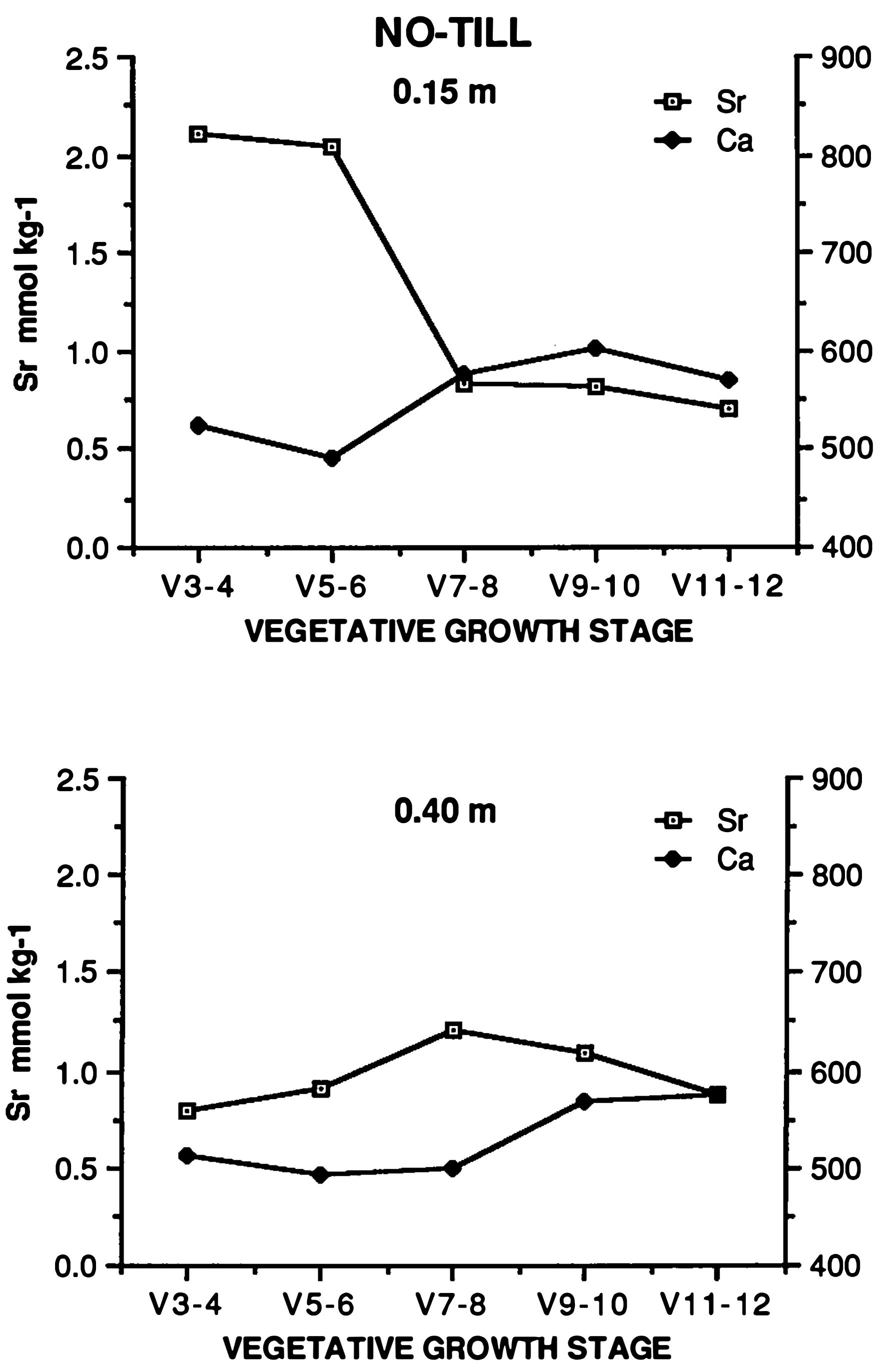

Figure 8. Concentration of Ca and added Sr in no-till soybeans, averaged across lines, at different growth stages and two depths of tracer injection (KPS).

0.40-m treatment during the same growth stage. Significantly higher levels of Sr occurred in trifoliates during the V3-4 and V5-6 growth stages than during the remaining growth stages, in no-till for the 0.15-m tracer injection (P = 0.05). In the no-till system there was a significant increase in Sr concentrations for the 0.40-m treatment during the V7-8 and V9-10 growth stages as compared to the other growth stages.

Table 5 lists the Sr and Ca levels of individual soybean lines grown under both tillage systems averaged across all growth stages and Sr injection depths. TN82-281 contained significantly more Sr than any other lines when grown under conventional till (P = 0.05). TN82-183 and 'Forrest' contained the next highest levels of Sr, and TN82-193 had the least amount of Sr in the trifoliates (P = 0.05). Strontium levels did not vary among lines in no-till. Strontium concentrations during the growing season for individual lines at two tracer injection depths are illustrated for conventional till (Figure 9) and no-till (Figure 10) soybeans. Although the pattern of Sr concentration varied among lines throughout the growing season, no significant differences among vegetative growth stages were observed.

Analysis of selected chemical and physical properties at KPS (Table 2) indicated no great differences in soil characteristics between the two systems. Conventional till soybean V5-8 growth stages developed during July and the V9-14 growth stages during the latter part of July through August (Table 4). The V3-8 growth stages in no-till developed during August and V9-12 stages during September.

Table 5. Strontium and calcium concentrations of four soybean lines and one cultivar averaged across Sr treatments and growth stages (KPS).

	ELEMENTAL CONCENTRATION			
	CONVENTIONAL TILL		NO-TILL	
Line	Sr	Ca	Sr	Ca
	mmol kg^{-1}			
TN82-183	0.754 ab*	608 a	1.500 a	677 a
TN82-193	0.566 c	456 d	0.961 a	463 b
FORREST	0.747 ab	558 b	1.622 a	559 a
TN82-281	0.810 a	542 b	1.294 a	558 a
TN82-294	0.651 bc	489 c	1.111 a	510 a

* Means in the same column followed by the same letter are not significantly different at P = 0.05.

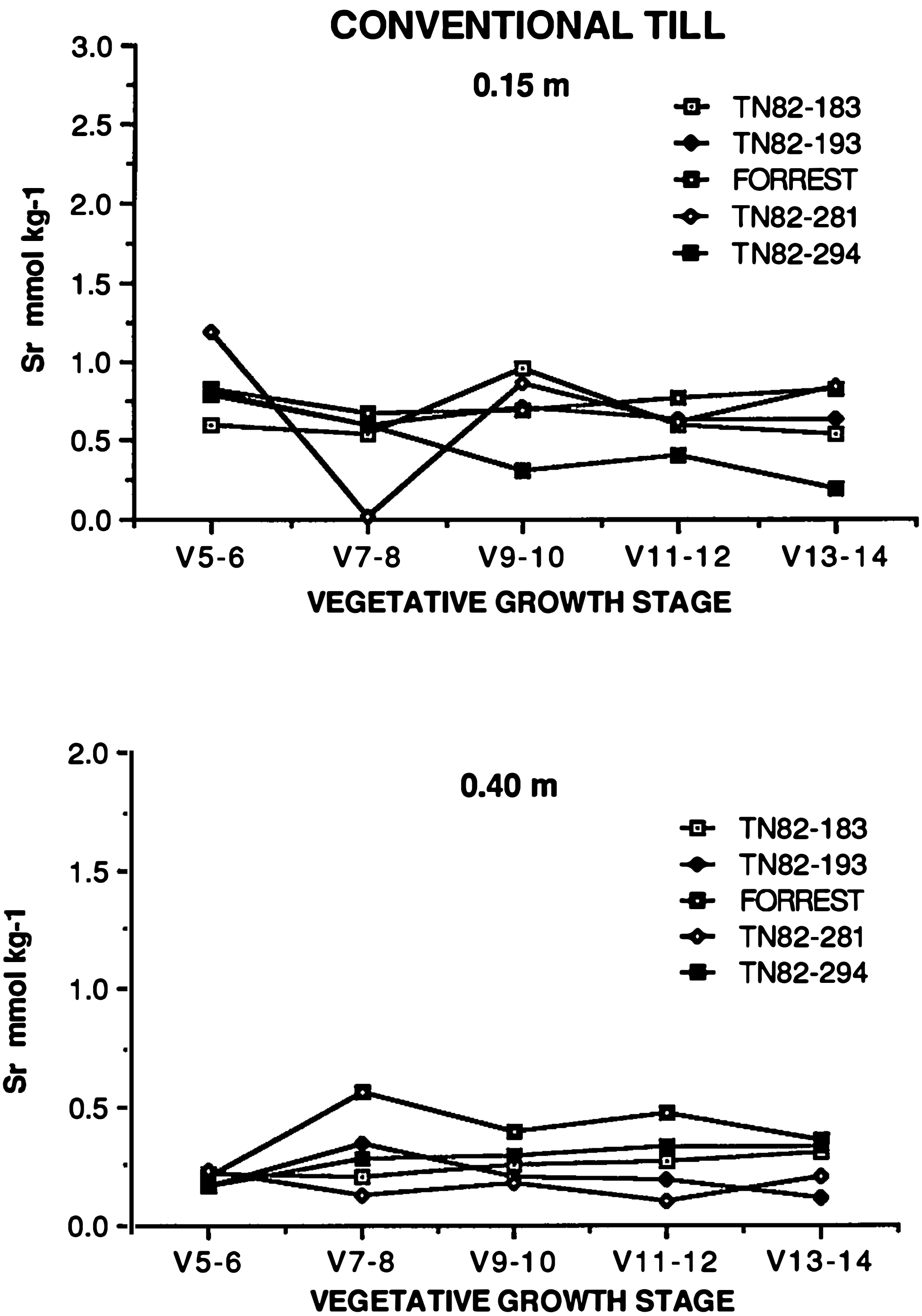

Figure 9. Strontium concentrations of individual lines at different vetetative growth stages for two injection depths in conventional till soybeans.

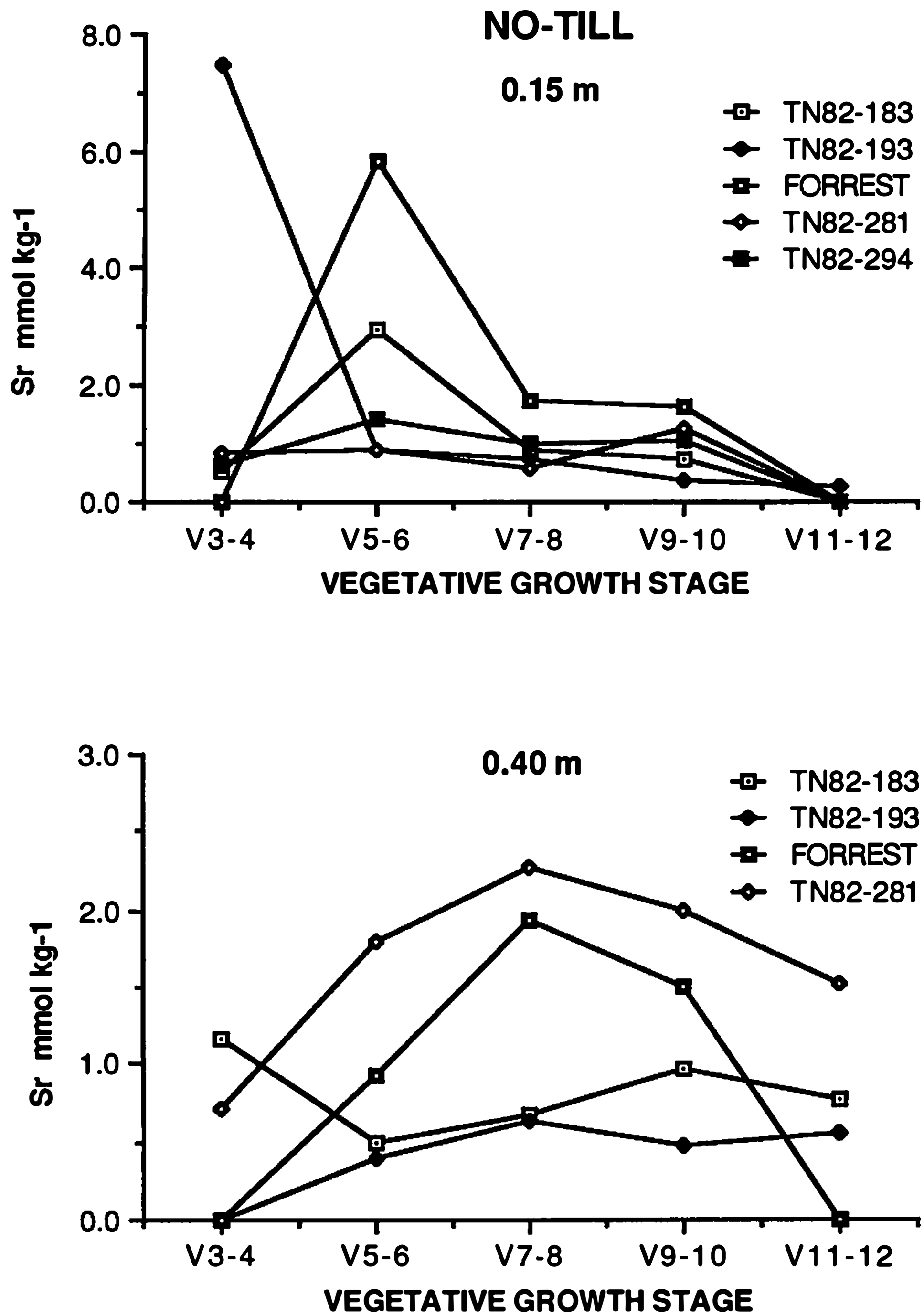

Figure 10. Strontium concentrations of individual lines at different vegetative growth stages for two injection depths in no-till soybeans (KPS).

CONCLUSIONS

The characterization of soybean root growth based on Sr concentrations in trifoliates provided a qualitative estimation of the root system. The use of stable Sr as an aqueous tracer allowed easy placement of the tracer at depths of both 0.15 and 0.40 m. Strontium concentrations varied in soybeans as a result of the 1) two depths of tracer injection, 2) vegetative growth stages, 3) two tillage systems, and 4) five breeding lines. However, significant differences in Sr concentrations were limited to a few individual cases.

The injection of 0.136 g Sr at 0.15 and 0.40 m provided a sufficient level of Sr in the plant to qualify differences in root growth. Strontium concentrations were significantly higher in trifoliates as a result of tracer injection at both depths as compared to the check treatment. Injection of Sr at 0.15 m resulted in significantly higher levels of Sr in trifoliates than tracer injection at 0.40 m. Results for both locations and tillage systems indicated the method's effectiveness in differentiating root growth at the two depths.

Differences in Sr concentrations in soybeans during the growing season illustrated the method's capability to monitor variations in Sr absorption at different vegetative growth stages. Certain factors may confound these results, such as changes in the physiological response of soybean during the growing season and changes in the availability of Sr in the soil at the point of tracer placement. The pattern of Sr concentrations for tracer injection at 0.15 m showed higher levels of Sr in trifoliates during the early growth stages, followed by a decline during the growing season. Data from no-till soybeans at KPS illustrated that as Sr concentration in trifoliates for the

0.15-m injection treatment declined during the early growth stages, subsequent increased Sr concentration in trifoliates occurred for the 0.40-m injection during the next growth stages.

Variations in Sr concentration in trifoliates due to different tillage systems were evident in this study only at KPS. Slightly higher Sr levels were observed in no-till soybeans as compared to conventional till soybeans during the early growth stages for tracer placement at 0.15 m. These differences in Sr concentration in trifoliates indicated that no-till soybeans exhibited greater Sr absorption from 0.15 m than conventional till soybeans during the early vegetative growth stages. There were no differences in Sr concentrations in soybeans between tillage systems as a result of tracer placement at 0.40 m. These results indicate that the type of tillage system used can influence the distribution of root growth.

Strontium concentrations also varied among soybean lines. TN82-281 and 'Forrest' contained higher levels of Sr than the other three lines under conventional till at PES. TN82-281 also contained more Sr than the other lines in no-till at PES. Results for conventional till at KPS also indicated that TN82-281 had the highest Sr concentration. TN82-193 contained significantly less Sr than the other lines under conventional till at both locations. Differences in tillage systems were observed to influence the response of certain lines at PES. For example, TN82-281 and 'Forrest' contained higher levels of Sr in conventional till, but only TN82-281 contained more Sr than the other lines in no-till. These results illustrate that the stable tracer technique can be use to detect differences in Sr concentration among soybean lines. The influence of tillage on Sr concentration within an individual line can also be determined.

The injection of a stable Sr solution into soil using a syringe and a 3.2 mm stainless steel tube resulted in little soil disturbance while placing the tracer at the desired depths. Harvesting only above-ground vegetation for Sr analysis allowed for a relatively quick and efficient technique for characterizing variable root growth in the field. Monitoring the time of development of new growth during the growing season permitted the measurement of Sr concentration or root growth at different growth stages.

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IV. EVALUATION OF A FIELD METHOD FOR CHARACTERIZING SOYBEAN ROOT GROWTH USING A STABLE STRONTIUM TRACER

ABSTRACT

Stable strontium use as a tracer for characterizing soybean (*Glycine max* (L.) Merr. 'Forrest') root growth in field conditions was further evaluated. In the root characterization study, a syringe was used to inject 0.136 g of Sr, in solution, into the soil through a 1-mm stainless steel needle. Placement of the tracer at three depths, 0.15, 0.30 and 0.45 m and five horizontal distances from the soybean row, at 0.15, 0.30, 0.45, 0.60, and 0.75 m, allowed for characterization of root growth based on Sr absorption from 15 separate zones in the soil. Maximum Sr absorption occurred as a result of Sr injection at 0.15-m depth and 0.15-m horizontal distance from the plant's stem. In the subplot size study, single row subplots 0.05, 0.25, 0.45, 0.90, and 1.35 m long were used to determine the effectiveness of subplot size. Coefficient of variations were relatively high for all treatments, ranging from 32.2 for the 0.90-m subplot to 74.2 for the 0.05-m subplot. Significant differences in Sr concentrations among vegetative growth stages were observed for subplot sizes of 0.45 and 0.90 m. In a third study, a soil containing a shallow hardpan was used to investigate root channelling along the injection path for both 1.0- and 3.2-mm injection holes. Determination of channelling by both Sr absorption and the profile trench method indicated that root growth does occur along these injection holes.

INTRODUCTION

The use of stable strontium for characterizing soybean (*Glycine max* (L.) Merr.) root growth or root activity in field studies provides the basis for a tracer technique that possesses many advantages. Injecting an aqueous Sr solution using a syringe and needle resulted in 1) rapid placement of the tracer, 2) minimal soil disturbance, and 3) tracer placement depths up to at least 0.40 m (Krstich et al., 1987). Root activity can be measured throughout the growing season by injecting Sr into the soil at or near the cotyledon stage, and identifying new growth and the time of development. Harvesting individual primary trifoliates for Sr analysis allows for characterization of root growth throughout the growing season based on differences in Sr concentrations.

The technique is an indirect means for characterizing root growth, based on a direct positive correlation between the amount of Sr accumulated in shoot tissue and root weight (Pinkerton and Simpson, 1979) and root length (Soileau, 1973). Differences in Sr concentration in the trifoliates can provide a means for characterizing root growth patterns or differences in root activity. Placement of Sr at two depths in the soil resulted in more Sr being absorbed from 0.15 m than from 0.40 m indicating increased root activity at the shallower depth (Krstich et al., 1987).

Krstich and Lewis (1987) used the stable tracer technique to characterize root growth of soybean lines grown under conventional till and no-till systems. They determined that no-till soybeans contained higher concentrations of Sr than conventional till soybeans for the 0.15-m treatment depth during the early vegetative growth stages, indicating more root growth in the treated zone. The study also indicated that the two tillage systems differed in their effect on root growth of individual soybean lines. They observed that one of the five lines had significantly higher levels of Sr than most of the other lines in both tillage systems. They also observed that tillage affected the Sr concentration for an individual line, suggesting differences in root growth based on the type of tillage system. Results showed that in no-till soybeans Sr concentration in trifoliates declined for the 0.15-m treatment depth during the V3-8 growth stages. At one location, they observed an increased Sr concentration in no-till soybeans trifoliates for the 0.40-m treatment during V7-8 growth stages.

The above findings illustrate the capability of the technique to measure differences in Sr concentrations of soybean trifoliates as affected by differences in Sr injection depth, tillage system and soybean lines. The results also show that the extent of root growth can be monitored throughout the growing season. The objectives of the research were to 1) further refine the technique, 2) evaluate the technique's effectiveness in characterizing root growth, and 3) evaluate the occurrence of root channelling as a result of soil disturbance due tracer placement.

METHODS AND MATERIALS

Subplot Size Study Soybeans were planted on 4 June 1986 on 0.9 m centers at the University of Tennessee Plant Science Farm, Knoxville, Tennessee. The soil was a Sequatchie (fine-loamy siliceous thermic Humic Hapludult). Some of the physical and chemical properties of this soil are given in Table 1. Soil samples were collected from depths of 0-0.10, 0.10-0.20, 0.20-0.35 and 0.35-0.45 m air dried, sieved (2 mm) and stored until analyzed.

Table 1. Selected chemical and physical properties of the Sequatchie soil.

	DEPTHS (m)			
	0.00-0.10	0.10-0.20	0.20-0.35	0.35-0.45
pH (1:1 v/v H_2O)	6.5	6.4	6.3	6.2
Organic C g kg^{-1}	6.3	6.6	4.9	4.0
	mmol (+) kg^{-1}			
Exch. Ca^{2+}	24.4	23.4	25.8	25.6
Exch. Mg^{2+}	7.8	7.6	10.4	11.4
Exch. K^+	1.3	1.3	1.0	0.8
Exch. Na^+	0.0	0.0	0.0	0.2
Exch. Sr^{2+}	0.0	0.0	0.0	0.0
Exch. H^+	0.1	0.0	0.1	0.1
CEC	33.6	32.3	37.3	38.1
	g kg^{-1}			
Sand*	656	631	556	525
Silt	200	225	250	231
Clay	144	144	194	244

*Day (1965), Sand determined by difference.

Atomic absorption was used to determine Sr, Ca, Mg, and K concentrations, and flame emission to determine Na in neutral 1 mol L^{-1} NH_4OAc extracts (Jackson 1958) containing 1% La as $LaCl_3$. Soil pH was determined using a 1:1 (v/v) soil to water ratio. Total carbon was determined using a Leco Carbon Analyzer (Model CR12). Exchangeable acidity was determined by titration of KCl extracts (Jackson, 1958). Cation exchange capacity (CEC) was calculated by cation summation. The hydrometer method (Day, 1965) was used for textural class determination.

The field was plowed and disked to depth of 0.20 m, fertilized with 29 kg P ha^{-1} and 56 kg K ha^{-1}, and limed to adjust the pH to about 6.5. The nematacide 2-methyl-2-[methylthio]propionaldehyde 0-[methylcarbamoyl]oxime (Temik) was applied prior to planting. Mechanical cultiviation was used during the V3 growth stage to control weeds.

A 0.138 mole ratio of $Sr(OOCCH_3)_2 \cdot 0.5H_2O$ to $SrCl_2 \cdot 6H_2O$ as an aqueous solution, containing 0.068 g Sr mL^{-1}, was used as the stable tracer in this experiment. A 1.0-mm (OD) stainless steel needle with inner metal stylet was inserted into the soil using an electric drill. A syringe was used to inject the tracer via the stainless steel needle to the desired depth. Strontium was injected approximately four weeks after planting during the second or third vegetative growth stage (V2-V3).

The subplot sizes or row lengths used in this study were 0.05, 0.20, 0.45, 0.90, and 1.35 m. These subplot sizes differed in the number of Sr injection points, 2, 6, 10, 20, and 30 respectively, and in the number of plants harvested and analyzed for Sr, 1, 3, 6, 12, and 18 respectively.

Because lower trifoliates senesced as the plant matured, the V4-6 trifoliates were harvested during the later V-stages while the V7-13 trifoliates were harvested during the early R-stages (reproductive growth stages). Each treatment was replicated three times.

Plant samples were dried at 60^{o} C. Leaflets were separated from the petiole for each trifoliate, and ground to pass a 20-mesh screen. Dry ashing followed a modified procedure of Greweling (1976) in which plant samples (0.50 g) were ashed at $500^{o}C$ for 6 hours, cooled, treated with 2 mL 5 mol L^{-1} HNO_3, evaporated, ashed at $400^{o}C$ for 1 h, cooled, dissolved in 1 mL 20% HCl with 5% La as $LaCl_3$ and brought to 5 mL volume with 4 mL deionized H_2O. Strontium was determined using a Perkin-Elmer 5000 atomic absorption spectrophotometer.

<u>Root Characterization Study</u> The study location, soil, soybeans, cropping practices, Sr tracer and injection needles are identical to those described in the plot size study. The Sr injection points were at three depths, 0.15, 0.30 and 0.45 m, and five horizontal distances from the plant's stem, 0.15, 0.30, 0.45, 0.60, and 0.75 m. Each subplot (0.45 m row length) constituted a single treatment and contained a single depth and horizontal distance for Sr placement. Each plot contained three subplots with the two outside rows containing similar treatments and the middle row a different treatment (Figure 1). Because of the design of subplots within plots, the number of replications varied between 3 and 9.

The tracer was injected when soybeans were at the V2 growth stage, or during the development of the first primarily trifoliate. Each primary

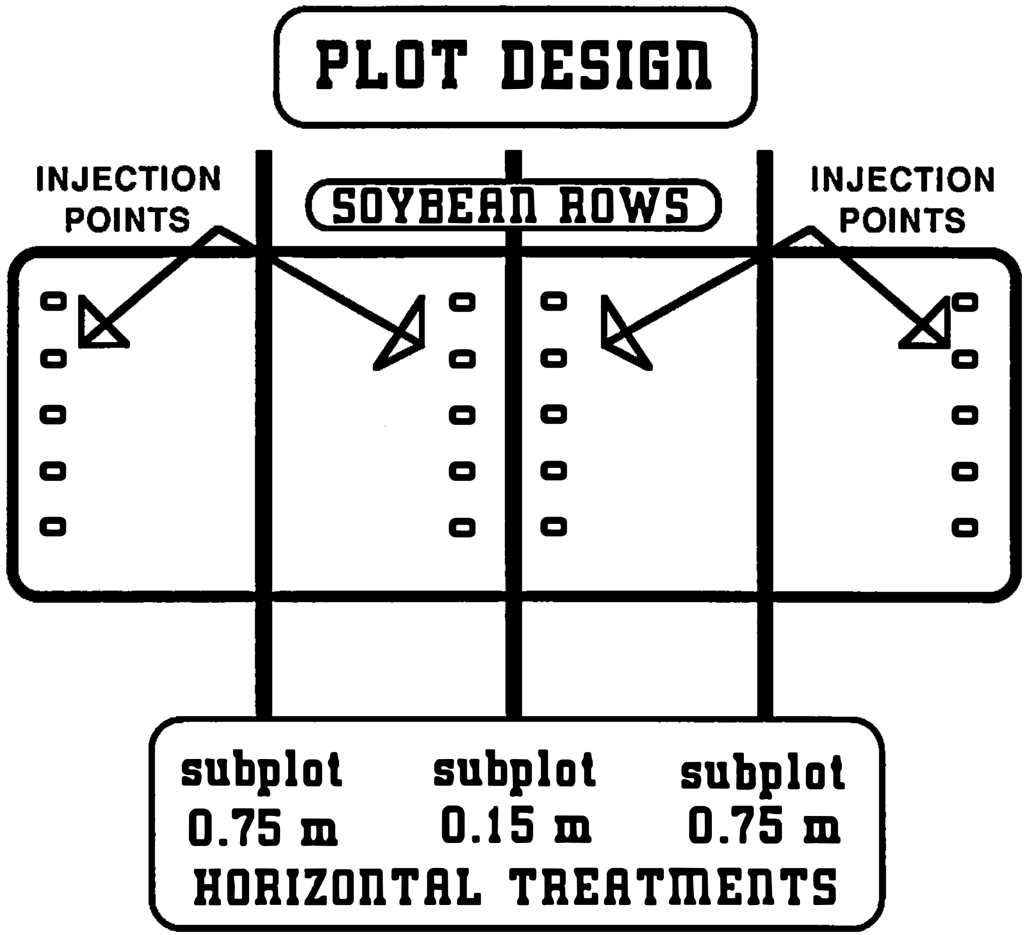

Figure 1. An example of a plot design containing three subplots. The two outside rows or subplots are similar treatments and the center row a different treatment.

trifoliate constituted a specific growth stage and was analyzed separately from the other growth stages. Trifoliates were harvested from the center six plants within each subplot. Primary trifoliates were harvested during the growing season as they became mature and began to senesce.

Soil and plant preparation and analyzes were conducted as outlined in the plot size study. The experimental design was a randomized complete block. Standard analysis of variance was determined using GLM (SAS, 1982) with mean separation by Duncan's multiple range test.

Root Channelling Study A soybean field in west Tennessee was selected for use. The soil, a Grenada (fine-silty mixed thermic glossic Fragiudalf) contained a restrictive layer at ca. 0.15 m depth. Soybeans were planted on 9 June 1986 using standard tillage and planting practices.

The Sr tracer solution was injected at 0.10 or 0.40 m using either a 1- or 3.2- mm stainless steel needle. The treatments consisted of 1) no injection, 2) Sr at 0.10 m using a 1-mm needle, 3) Sr at 0.40 m using a 1-mm needle, 4) Sr at 0.10 m using a 3.2-mm needle, and 5) Sr at 0.40 m using a 3.2-mm needle. Each treatment was replicated five times. Individual vegetative growth stages constituted separate sampling periods. Plant samples were prepared and analyzed for Sr according to the procedures described in the above studies. The profile trench method (Bohm, 1979) was used at the end of the growing season to visually determine whether channels existed due to the use of needles necessary for tracer injection and whether roots grew downward through these channels.

RESULTS AND DISCUSSION

Subplot Size Study Table 2 contains Sr concentration values of soybeans for all five subplot sizes and the coefficient of variation (CV) within each treatment. The Sr concentration values, averaged across the ten vegetative growth stages analyzed, ranged from a high of 1.72 mmol kg^{-1} for the 0.45 m subplot to a low of 1.19 mmol kg^{-1} for the 0.20 m subplot. Analysis of variance, using GLM, indicated that Sr concentration for the 0.45-m subplot was significantly higher than for other subplot sizes while Sr concentration for the 0.20-subplot was significantly lower than the other subplot sizes.

The coefficient of variation (CV) within a treatment ranged from 32.2 for the 0.90-m subplot to 74.2 for the 0.05 m subplot. Excluding the 0.05-m subplot size, the remaining subplots all resulted in CV's in the range of 32 to 54.

Trifoliates from individual vegetative growth stages were also analyzed for Sr concentration. Table 3 illustrates the variation in Sr concentration among subplot sizes during the growing season. Significant differences in Sr concentrations among vegetative growth stages were observed for subplot sizes of 0.45 and 0.90 m. Strontium concentration in trifoliates during the V5 growth stage in the 0.45-m subplot was significantly higher than during the other growth stages. The 0.90-m subplot resulted in trifoliates containing significantly more Sr during the V4, V5 and V6 growth stages than the other growth stages

Root Characterization Study The pattern of root growth based on Sr concentration in trifoliates for the V3-15 growth stages is illustrated in Figure 2. Letter changes in the diagram denote differences in Sr

Table 2. Strontium concentration and coefficient of variation for different row lengths or subplot sizes.

ROW LENGTH meters	INJECTION POINTS	PLANTS HARVESTED	STRONTIUM CONCENTRATION mmol kg^{-1}	COEFFICIENT OF VARIATION
0.05	2	1	1.31	74.2
0.20	6	3	1.19	40.5
0.45	10	6	1.72	53.8
0.90	20	12	1.56	32.2
1.35	30	18	1.48	46.6

Table 3. Strontium concentration of soybean leaves at different vegetative growth stages for each of the five row lengths .

VEGETATIVE GROWTH STAGE	ROW LENGTH m				
	0.05	0.20	0.45	0.90	1.35
	mmol kg^{-1}				
4	2.07	1.69	1.37	1.98*	1.57
5	1.11	1.60	3.89*	2.51*	1.98
6	1.18	1.51	2.21	1.93*	2.08
7	1.89	1.38	1.85	1.56	1.89
8	1.67	0.95	1.50	1.40	1.15
9	1.10	0.99	1.34	1.29	1.16
10	1.11	0.81	1.32	1.19	1.23
11	1.07	0.88	1.26	1.23	1.27
12	2.36	1.00	1.33	1.28	1.22
13	0.94	1.11	1.32	1.26	1.12

*Means in the same column are significantly higher in Sr concentration than other means at $P = 0.05$.

ROOT ACTIVITY PATTERN

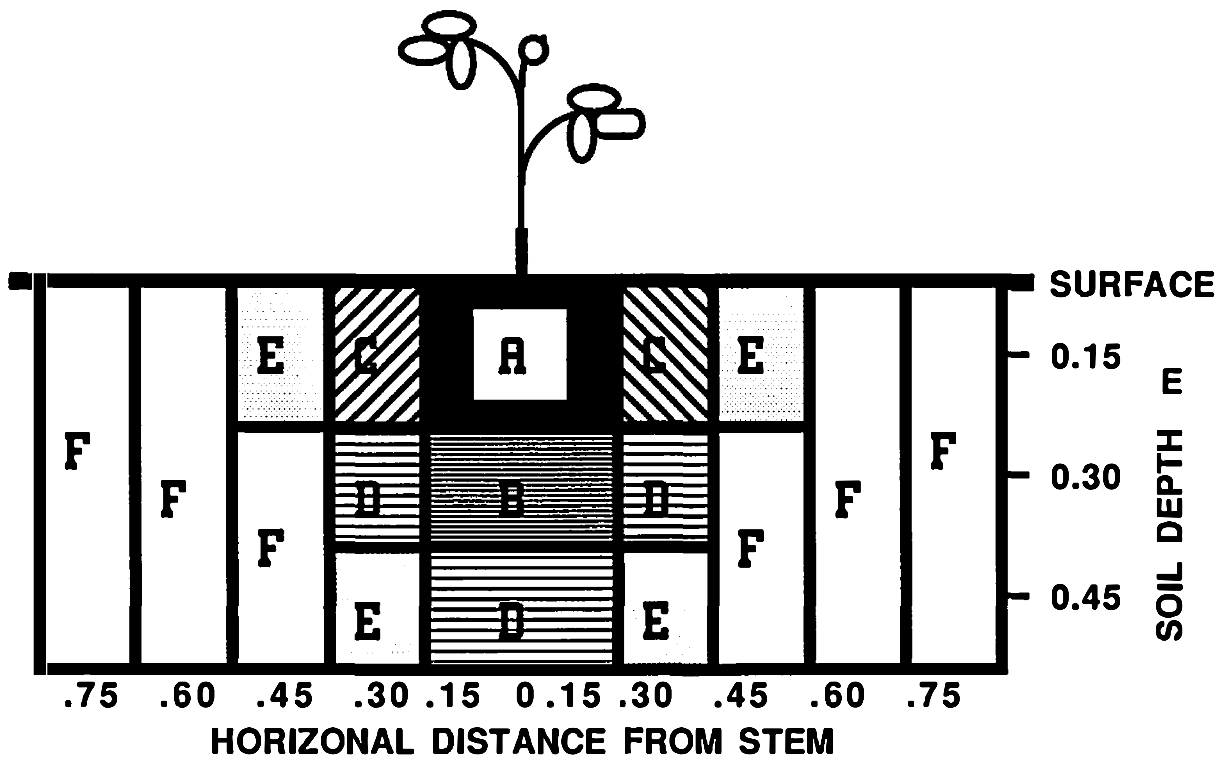

Figure 2. The root activity pattern of a soybean plant derived by injecting Sr at three depths and five horizontal distances. Letters denote mean separation differences in Sr concentrations due to treatments.

concentration among treatments. Strontium concentrations for each treatment, adjusted by subtracting Sr concentration in check treatment, were averaged across all vegetative growth stages. Strontium concentrations resulting from each of the fifteen "zones" of tracer injection, represented in Figure 2, are listed in Table 4. The letters represent mean separation differences between treatments and were derived using a Student-Newman-Keul test. The "A" zone corresponds to Sr injection at 0.15-m depth and 0.15-m horizontal distance, and represent the zone of greatest root activity. More Sr was absorbed from this zone, 1.39 mmol kg^{-1}, than from any other zone in the soil profile. The next highest level of root activity was in zone "B", or Sr injection at 0.30-m depth and 0.15- horizontal distance. The concentration of Sr in trifoliates resulting from tracer injection in this zone was 1.21 mmol kg^{-1}. Zone "C", or Sr injection at 0.15-m depth and 0.30-m horizontal distance was the next highest level of root activity, with trifoliates containing 1.06 mmol kg^{-1} Sr. Root activity in zone "D" represents Sr injection treatments, 0.45-m depth and 0.15-m horizontal distance, and 0.30-m depth and 0.30-m horizontal distance. Strontium concentration in this zone ranged from 0.68 to 0.72 mmol kg^{-1}. Zone "E" represents the next level of root activity, and denotes Sr placement at 0.45-m depth and 0.30-m horizontal distance, and 0.15-m depth and 0.45-m horizontal distance. Strontium concentration in trifoliates ranged from 0.52 to 0.53 mmol kg^{-1}. Strontium concentration in zone "F" ranged from 0.30 to 0.42 mmol kg^{-1}.

The concentration of Sr in trifoliates, averaged across all Sr treatments, is illustrated in Figure 3. Strontium concentration increased to a maximum level of 0.62 mmol kg^{-1} by the V5 growth stage. This was

Table 4. Strontium concentration of soybean trifoliates, averaged across vegetative growth stages, for different horizontal and vertical distances of tracer injection in the soil.

VERTICAL DISTANCE m	HORIZONTAL DISTANCE m				
	0.15	0.30	0.45	0.60	0.75
	mmol kg^{-1}				
0.15	1.39 a*	1.06 c	0.52 e	0.30 f	0.33 f
0.30	1.21 b	0.68 d	0.42 f	0.32 f	0.38 f
0.45	0.72 d	0.53 e	0.36 f	0.34 f	0.32 f

* Means followed by the same letter are not significantly different at $p = 0.05$.

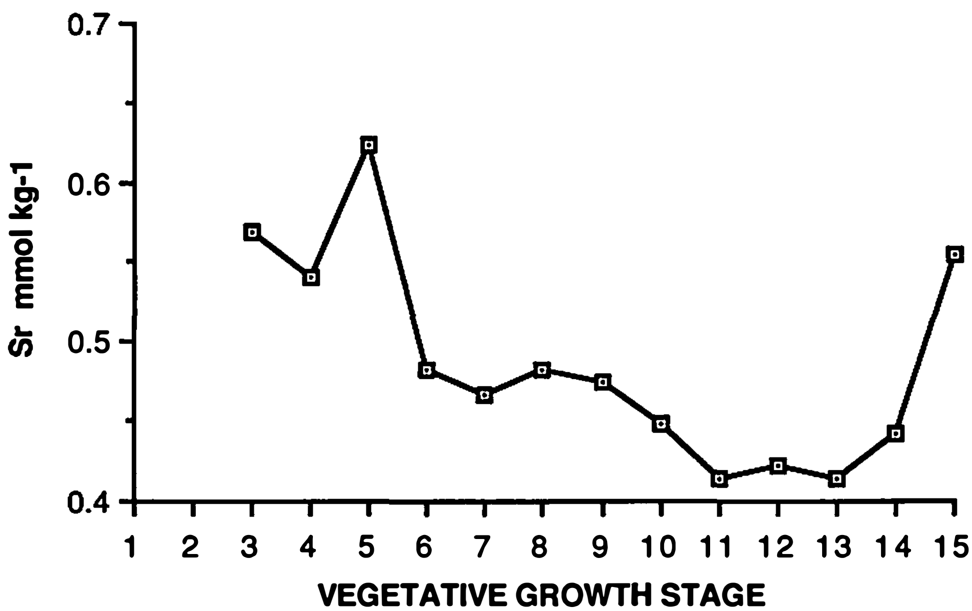

Figure 3. Strontium concentration in soybean leaves at different vegetative growth stages, averaged across all depths and horizontal distances of tracer injection.

followed by a sharp decline to 0.48 mmol kg^{-1} by the V6 stage, with a gradual decline in Sr levels through the V13 growth stage. The high Sr concentration at the V15 stage is probably a result of that sampling consisting of the two or three terminal trifoliates that were not fully mature.

Strontium concentration in the soybeans throughout the growing season for individual tracer injection zones is illustrated in Figures 4, 5, and 6. Figure 4 illustrates the Sr concentration in trifoliates for tracer injection at the 0.15-m horizontal distance and three depths, 0.15, 0.30 and 0.45 m. A high level of Sr in the trifoliates was observed during the V3 through V5 growth stages for the 0.15-m injection depth. This concentration of Sr declines with increasing depth of tracer injection and vegetative growth stage. Figure 5 shows the Sr concentration for the 0.30-m horizontal distance and three depths of tracer placement. The Sr level in trifoliates for the 0.15-m treatment was highest during the V6 and V7 growth stages. Comparison of Figures 4 and 5 illustrates that Sr concentration for the 0.15-m injection depth was highest during the early growth stages closest to the plant; but as the plant matured, the Sr concentration in trifoliates increased for the 0.30-m horizontal injection distance and decreased for the 0.15-m treatment. A leveling off of Sr concentration in trifoliates was noted with increasing depth and vegetative growth stage. Little or no differences in Sr concentrations in soybeans for tracer injections beyond the 0.30-m horizontal distance was evident, regardless of depth or growth stage (Figure 6).

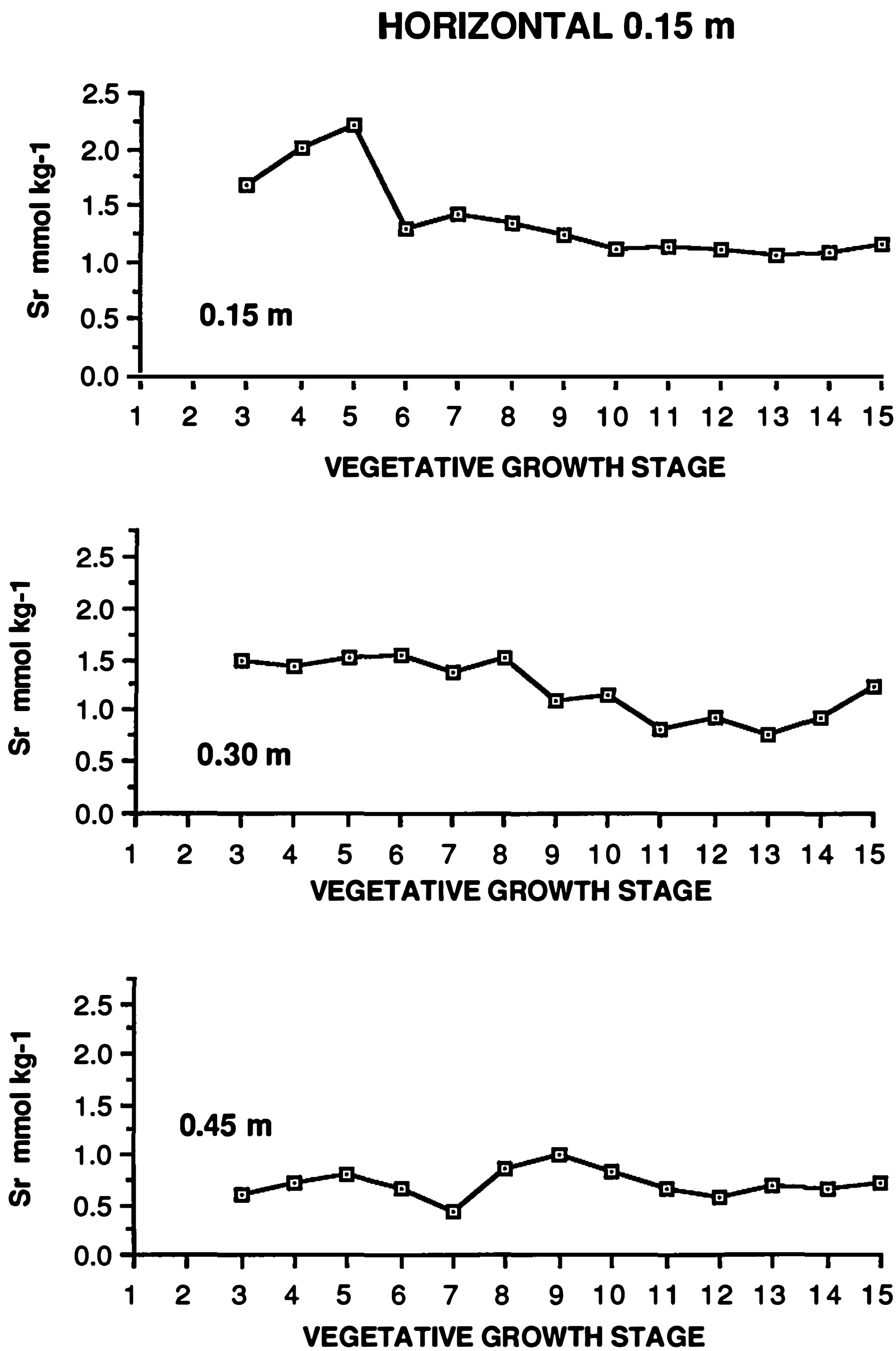

Figure 4. Strontium concentration in soybean leaves at different vegetative growth stages, for tracer placement at three depths and 0.15 m horizontal distance from the plant.

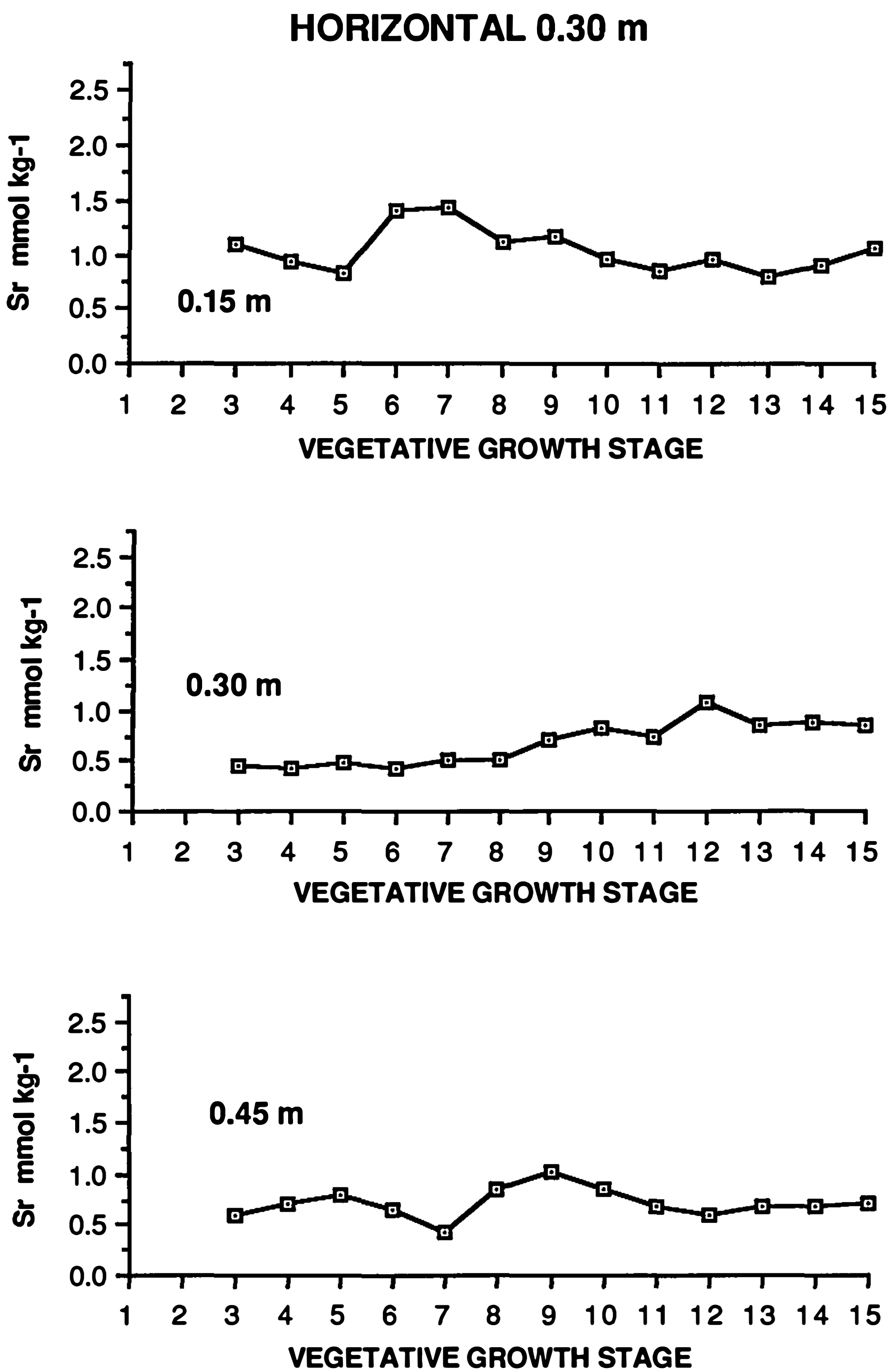

Figure 5. Strontium concentration in soybean leaves at different vegetative growth stages, for tracer placement at three depths and 0.30 m horizontal distance from the plant.

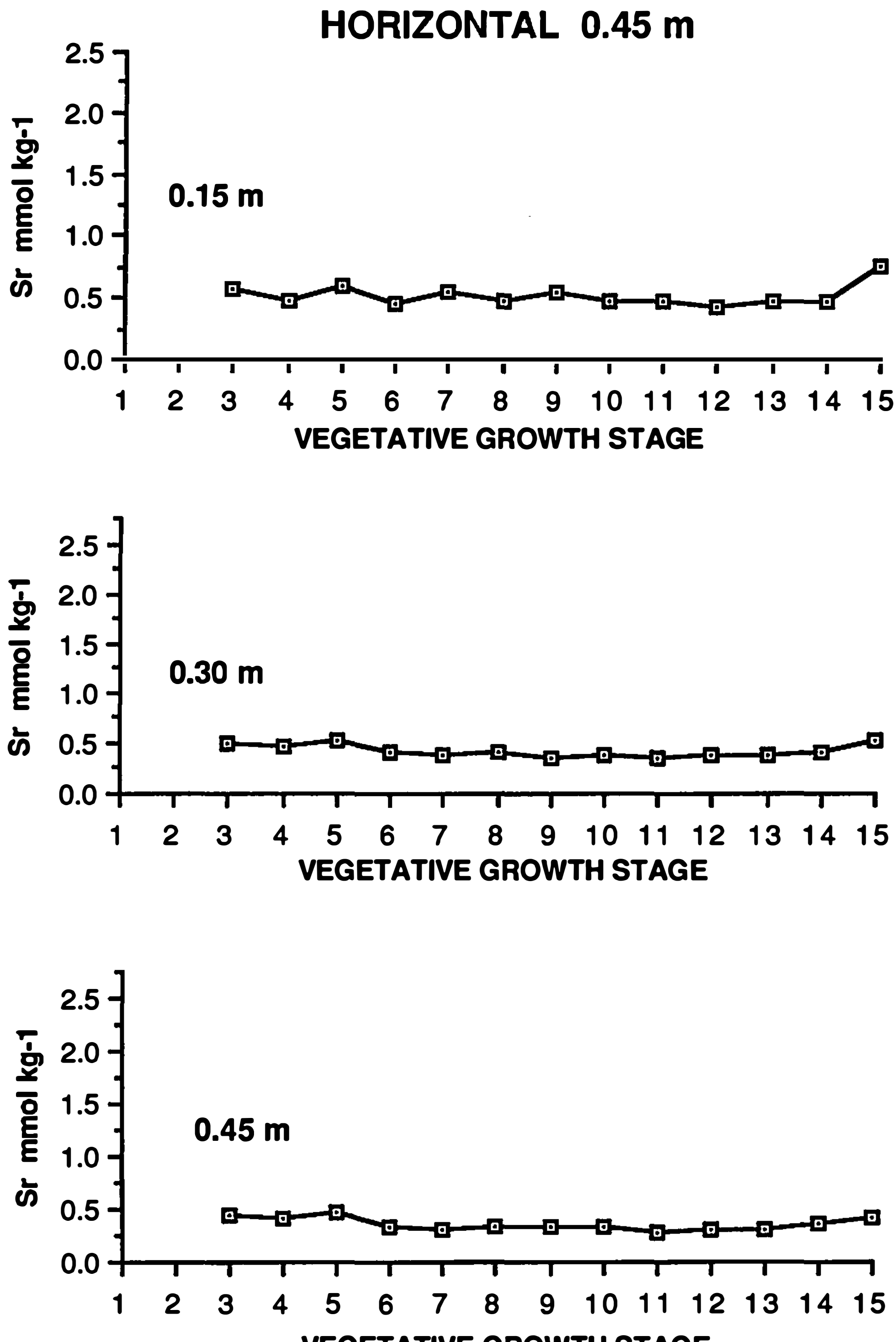

Figure 6. Strontium concentration in soybean leaves at different vegetative growth stages, for tracer placement at three depths and 0.45 m horizontal distance from the plant.

Root Channelling Study There were significantly higher levels of Sr in the trifoliates when the tracer was injected at 0.10 m as compared to the 0.30 m injection depth, or the check treatment, regardless of the needle size used. Strontium concentrations of 2.39 mmol kg^{-1} for the 1-mm needles and 2.66 mmol kg^{-1} for the 3.2-mm needles were not significantly different from one another, for the 0.10-m injection depth. Injection of the tracer at 0.30 m resulted in Sr concentrations of 2.27 mmol kg^{-1} for the 1-mm needles and 2.07 mmol kg^{-1} for the 3.2-mm needles, which were also not significantly different from one another. However, these were also significantly higher Sr levels than for the check.

The trench profile method provided some information as to existence of probe holes at the end of the growing season. The plow layer directly above the restrictive layer showed no presence of probe holes and therefore no signs of directionalized root growth. However, probe holes were very distinct in the restrictive layer. Root growth was observed to stop at the interface between the plow layer and the restrictive layer with the exception of single roots growing through these probe holes and into the restrictive layer. Thirty 3.2-mm probe holes were observed and eight of these showed definite signs of root growth. Eight 1-mm probe holes were also observed and three of these had root growth present.

CONCLUSIONS

Previous work had indicated the suitability of stable Sr for field use in root studies. This investigation provided additional information as to the use of the tracer technique in field studies, identifying possible beneficial modifications to the method, e.g., optimized subplot size, reduced needle size, and identified possible limitations to the method's effect on altering root growth in a soil containing a hardpan.

The comparison of row lengths, or number of injection points and plants harvested and analyzed per subplot, indicated that an optimum subplot size might be between 0.45 and 0.90 m. The two primary criteria for this estimation were the degree of variability between replication and the effectiveness in identifying Sr concentration differences between growth stages. It is important to consider from a practical standpoint that part of the method's suitability for field studies is the potential to minimize the number of tracer injections necessary to provide reliable data identifying root growth.

The use of 1-mm needles (as compared to 3.2-mm needles used in previous studies) reduced soil disturbance and minimized effects on root growth. The 1-mm needles were relatively durable, even when inserted to a depth of 0.45 m.

The injection of Sr in a grid pattern (three depths and five horizontal distances) established the method's effectiveness in characterizing root growth. Injecting Sr at different points within the effective rooting area of the plant, allowed for the identification of specific zones within the soil profile when root activity began and when root activity was highest and lowest. The zone corresponding to tracer injection at 0.15-m depth and 0.15-m horizontal distance from the plant had the highest level of root activity, averaged over the entire growing season. The pattern for the other zones illustrated a decreasing level of root activity with increasing depth and horizontal distance. The ability to monitor these activity levels throughout the growing season, by analysis of individual vegetative growth stages, permitted determination of root activity levels at specific growth stages within specific soil zones.

Application of the technique to a soil containing a shallow restrictive layer indicated some limitation to the method's use. It was evident that in a dense soil, probe holes created by the needle during tracer injection could remain in the soil throughout the growing season. These holes then provided a path of least resistance for roots to grow downward, thus altering normal root growth for this kind of soil and biasing results. It was noted at the study site, that probe holes created in the plow layer were not evident at the end of the growing season. Therefore, it would seem that application of this method to a well-aggregrated soil of moderate bulk density would not result in any effects on normal root growth due to placement of the tracer using a needle.

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V. SUMMARY

The objectives of this research were to test and refine the use of stable Sr as a tracer for characterizing root growth or root activity in field studies. The premises underlying the suitability of Sr as an effective tracer in plant studies are 1) its chemical similarity to Ca, 2) its nontoxic effect on plants, even at relatively high concentrations in the soil, 3) its suitability for analysis using atomic absorption spectrophotometry, and 4) the strong correlation between the amount of Sr absorbed and the total root length and weight in the zone of tracer influence.

The stable Sr tracer aqueous solution was a 0.138 mole ratio of $Sr(OOCCH_3)_2 \cdot 0.5H_2O$ to $SrCl_2 \cdot 6H_2O$. This ratio of strontium acetate to strontium chloride provided a tracer solution that minimized pH change in the soil at the point of tracer placement. The solubility of these compounds in water allowed for a relatively enriched Sr solution containing 0.068 g Sr ml^{-1}. Incorporation of these Sr compounds into an aqueous solution provided a tracer that could be injected into the soil using a syringe and needle. The use of a syringe and needle allowed for different amounts of tracer to be injected at different depths within the soil. The use of a 3.2-mm needle, and in the later stages of research a 1-mm needle, resulted in minimal soil disturbance at the point of tracer injection.

A very important consideration in the development of this method was the amount of time necessary for tracer injection and subsequent plant tissue analysis. Needles could be inserted into the soil by hand to a depth of about 0.20 m, but greater depths required the use of a powered hand drill. Therefore, the amount of time required for tracer injection was dependent on the depth of injection. An approximate average of 200-250 injection points per day was achieved in these studies. Tissue sampling was relatively efficient due primarily to the growth characteristics of soybeans. Vegetative growth stages were identified based on the sequential development of primariy trifoliates. Sampling and analysis of individual primary trifoliates defined the period of root development. A simple dry ashing of the tissue and Sr analysis using atomic absorption spectrophotometry completes the technique from tracer injection to analysis.

One of the initial parameters established in this research was the amount of tracer necessary for injection to provide an sufficient quantity of Sr in the soil for absorption and subsequent detection in the trifoliates. Strontium concentrations of 0.136, 0.204 and 0.272 g per injection point all resulted in significantly higher levels of Sr in the trifoliates than the check treatment. The Sr concentrations in the trifoliates were linearly related to the amount of Sr injected. Based on these findings, the amount of tracer injected in subsequent studies was 0.136 g Sr per injection point.

The stable tracer technique was used successfully to characterize root growth differences at 0.15 and 0.40 m. Significantly higher levels of Sr in the trifoliates were noted for soybeans receiving Sr injections at 0.15 m. Nearly twice the amount of Sr was absorbed from 0.15 m than from 0.40 m indicating greater root activity at a depth of0.15 m.

The Sr concentration in trifoliates differed significantly between vegetative growth stages. The 0.15-m injections resulted in Sr concentrations that were highest during the early vegetative growth stages, followed by a decline in Sr levels throughout the growing season. In some studies, an increased level of Sr in trifoliates during the later stages of growth could be detected as a result of tracer injection at 0.40 m.

The capability to determine differences in Sr concentration among breeding lines using the stable tracer was evident. Certain lines were consistently higher in Sr concentration, while other lines were consistently lower. However, significant differences in Sr levels were limited to few occurrences, which may be a reflection on the selection of breeding lines or a lack of refinement in the technique.

Differences in Sr concentration were observed for soybeans grown in a conventional till system and a no-till system. Injection of Sr at 0.15 m resulted in significantly higher levels of Sr in no-till soybeans during the early stages of growth as compared to conventional till soybeans. Differences in root growth among soybean lines were also observed, depending on the type of tillage system. TN82-281 at PES contained a higher concentration of Sr than most of the other lines for both tillage systems. However, 'Forrest', which also had a higher concentration of Sr in conventional till, showed significant reduction in Sr concentration in no-till relative to the other lines. Comparison of the two tillage systems indicated that certain lines may have greater root activity under one system than another.

Injecting Sr at three depth and five horizontal distances from the plant provided a vertical and horizontal characterization of soybean root growth. The most root activity occurred near the plant's stem, as indicated by Sr concentration in trifoliates for the 0.15-m vertical and 0.15-m horizontal injection treatment. Monitoring Sr concentrations in trifoliates at individual vegetative growth stages provided a clear illustration of the root growth pattern throughout the growing season at different depths and horizontal distances. The pattern depicted was a high root activity level near the base of the plant during the early growth stages, followed by a decline in activity level with increasing depth, horizontal distance and growth stage.

The size of subplot or soybean row necessary to provide good statistical data while minimizing the number of injection points was tested. The criterion for evaluating statistical effectiveness was the coefficient of variation (CV). All five subplot sizes resulted in CV values in excess of 32, with a maximum CV of 74.2 for the 0.05 m subplot. Strontium concentration differences among vegetative growth stages were evident only for the 0.45-m and 0.90-m subplots. Evaluation of the five subplot sizes indicated that row lengths of 0.45 m and 0.90 m, containing 10 and 20 injection points respectively, were the best tested.

The reduction in needle size from 3.2 mm to 1 mm was determined to further reduce the degree of soil disturbance due to tracer injection. Results from a study of soybean root growth in a field containing a restrictive layer at 0.15 m indicated that holes created by a needle, regardless of size, provided a path for roots to grow downward into the subsoil. There was indication that in a well-aggregated soil with moderate bulk density, minimum root channelling would occur.

In summary, the use of stable strontium as a tracer for determining root growth can provide a qualitative characterization of a root system. The technique still requires some modifications necessary to make it practical for large-scale field studies, such as a more automated means for tracer injection. It also needs a certain amount of "fine-tuning," e.g., type of injection pattern to maximize sensitivity. The overall analysis of the technique is that it works and possesses a tremendous potential for root growth studies.

APPENDIX

DATA

LEGEND

PLANTS:

REP = REPLICATION
VGS = VEGETATIVE GROWTH STAGE
SR = STRONTIUM CONCENTRATION mmol kg^{-1}
CA = CALCIUM CONCENTRATION mmol kg^{-1}

LINES:

FORREST = 200
TN82-230 = 230
TN82-232 = 232
TN82-238 = 238
TN82-264 = 264
TN82-269 = 269
TN82-271 = 271
TN82-277 = 277
TN82-183 = 183
TN82-193 = 193
TN82-281 = 281
TN82-294 = 294

SOILS:

STATION (1=PES 2=KPS)
TILL = TILLAGE SYSTEM (1=CONVENTIONAL TILL 2=NO-TILL)
OC = ORGANIC CARBON (%)
H20 = MOISTURE CONTENT OF SOIL SAMPLE
MMCA = MILLIMOLES OF CALCIUM
MMMG = MILLIMOLES OF MAGNESIUM
MMK = MILLIMOLES OF POTASSIUM
MMNA = MILLIMOLES OF SODIUM
MMSR = MILLIMOLES OF STRONTIUM
MMEA = EXCHANGEABLE ACIDITY
MMCEC = CATION EXCHANGE CAPACITY

```
LEGEND FOR SECTION II PES

IF REP=1 AND PLOT=2001 THEN LINE=FORREST
IF REP=1 AND PLOT=2003 THEN LINE=230
IF REP=1 AND PLOT=2005 THEN LINE=232
IF REP=1 AND PLOT=2011 THEN LINE=235
IF REP=1 AND PLOT=2037 THEN LINE=264;
IF REP=1 AND PLOT=2042 THEN LINE=269;
IF REP=1 AND PLOT=2044 THEN LINE=271;
IF REP=1 AND PLOT=2050 THEN LINE=277;
IF REP=2 AND PLOT=2063 THEN LINE=FORREST
IF REP=2 AND PLOT=2053 THEN LINE=230;
IF REP=2 AND PLOT=2061 THEN LINE=232;
IF REP=2 AND PLOT=2072 THEN LINE=238;
IF REP=2 AND PLOT=2081 THEN LINE=264;
IF REP=2 AND PLOT=2060 THEN LINE=269;
IF REP=2 AND PLOT=2075 THEN LINE=271;
IF REP=2 AND PLOT=2051 THEN LINE=277;
IF REP=3 AND PLOT=2114 THEN LINE=FORREST
IF REP=3 AND PLOT=2134 THEN LINE=230;
IF REP=3 AND PLOT=2139 THEN LINE=232;
IF REP=3 AND PLOT=2137 THEN LINE=238;
IF REP=3 AND PLOT=2143 THEN LINE=264;
IF REP=3 AND PLOT=2115 THEN LINE=269;
IF REP=3 AND PLOT=2104 THEN LINE=271;
IF REP=3 AND PLOT=2101 THEN LINE=277;
IF LINE=200 AND SUBPLOT=1 OR LINE=230 AND SUBPLOT=1 OR LINE=232
   AND SUBPLOT=1 OR LINE=238 AND SUBPLOT=1 OR
   LINE=264 AND SUBPLOT=2 OR LINE=269 AND SUBPLOT=2 OR LINE=271
   AND SUBPLOT=2 OR LINE=277 AND SUBPLOT=2 THEN TRTMT=2;
IF LINE=200 AND SUBPLOT=2 OR LINE=230 AND SUBPLOT=2 OR LINE=232
   AND SUBPLOT=2 OR LINE=238 AND SUBPLOT=2 THEN TRTMT=3;
IF LINE=264 AND SUBPLOT=1 OR LINE=269 AND SUBPLOT=1 OR LINE=271
   AND SUBPLOT=1 OR LINE=277 AND SUBPLOT=1 THEN TRTMT=4;
IF SUBPLOT=3 THEN TRTMT=1;

TRTMT 1 = CHECK
TRTMT 2 = 0.136 G SR @ 0.40 M
TRTMT 3 = 0.204 G SR @ 0.40 M
TRTMT 4 = 0.272 G SR @ 0.40 M

LINE TN82-230 = 230
     TN82-232 = 232
     TN82-238 = 238
     TN82-264 = 264
     TN82-269 = 269
     TN82-271 = 271
     TN82-277 = 277
```

SECTION II PES RAW DATA
2:56 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
1	1	2001	1	1	0.99635	570.574
2	1	2001	1	3	2.15019	652.868
3	1	2001	1	4	1.44373	596.010
4	1	2001	1	5	0.99977	430.923
5	1	2001	1	6	0.67336	378.554
6	1	2001	2	1	1.83862	455.362
7	1	2001	2	3	3.13285	671.820
8	1	2001	2	4	1.89226	637.905
9	1	2001	2	5	0.74184	373.067
10	1	2001	2	6	0.69733	420.449
11	1	2001	3	1	0.30358	367.581
12	1	2003	1	1	1.01803	437.905
13	1	2003	1	3	2.21182	692.269
14	1	2003	1	4	1.75645	594.015
15	1	2003	1	5	0.79890	478.304
16	1	2003	1	6	0.40173	403.491
17	1	2003	2	1	1.54987	434.414
18	1	2003	2	4	1.11504	634.913
19	1	2003	2	5	0.47820	447.382
20	1	2003	2	6	0.47135	471.322
21	1	2003	3	1	0.26478	417.955
22	1	2005	1	1	1.37868	531.172
23	1	2005	1	3	1.40835	732.170
24	1	2005	1	4	2.27916	784.040
25	1	2005	1	5	0.76467	470.324
26	1	2005	1	6	0.79320	471.820
27	1	2005	2	1	2.10797	726.185
28	1	2005	2	5	0.52043	451.372
29	1	2005	2	6	0.39032	451.372
30	1	2005	3	1	0.27619	386.035
31	1	2011	1	1	1.49738	537.157
32	1	2011	1	3	0.94385	644.888
33	1	2011	1	4	1.29879	636.409
34	1	2011	1	5	0.52043	445.387
35	1	2011	1	6	0.39032	337.157
36	1	2011	2	1	4.91098	536.658
37	1	2011	2	4	1.19493	550.125
38	1	2011	2	5	0.68363	409.975
39	1	2011	2	6	0.59347	356.110
40	1	2011	3	1	0.27962	464.339
41	1	2037	1	1	1.94020	367.581
42	1	2037	1	3	5.22940	507.731
43	1	2037	1	4	4.69413	496.758
44	1	2037	1	5	1.51792	377.057
45	1	2037	1	6	1.52477	417.456
46	1	2037	2	1	0.80689	542.145
47	1	2037	2	3	1.02374	516.209
48	1	2037	2	4	0.87879	519.202
49	1	2037	2	5	0.59575	522.195
50	1	2037	2	6	0.49646	559.601
51	1	2037	3	1	0.21799	319.202
52	1	2042	1	1	1.13330	333.167
53	1	2042	1	3	3.67039	440.399
54	1	2042	1	4	3.75485	431.421
55	1	2042	1	5	0.74070	486.783

SECTION II PES RAW DATA
2:56 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
56	1	2042	1	6	2.37845	466.334
57	1	2042	2	1	1.50194	373.067
58	1	2042	2	3	1.57270	504.239
59	1	2042	2	4	1.42205	539.152
60	1	2042	2	6	1.05455	630.923
61	1	2042	3	1	0.29902	433.915
62	1	2044	1	1	4.31294	316.708
63	1	2044	1	3	3.02442	531.671
64	1	2044	1	4	2.98676	456.853
65	1	2044	1	5	2.26889	424.439
66	1	2044	1	6	0.75097	352.616
67	1	2044	2	1	0.80461	415.960
68	1	2044	2	3	2.00639	471.820
69	1	2044	2	4	1.38553	543.142
70	1	2044	2	5	0.64141	499.252
71	1	2044	2	6	0.55923	483.292
72	1	2044	3	1	0.26706	324.190
73	1	2050	1	1	0.21456	319.701
74	1	2050	1	3	2.88519	507.232
75	1	2050	1	4	3.60877	495.761
76	1	2050	1	5	1.56471	365.037
77	1	2050	1	6	0.98603	283.292
78	1	2050	2	1	0.55581	356.608
79	1	2050	2	3	0.98493	501.746
80	1	2050	2	4	1.03515	484.768
81	1	2050	2	5	0.37320	400.000
82	1	2050	2	6	0.28646	340.150
83	2	2051	1	1	0.55923	552.120
84	2	2051	1	3	1.42205	595.511
85	2	2051	1	4	0.88222	582.544
86	2	2051	1	5	0.68820	470.324
87	2	2051	1	6	0.47592	410.474
88	2	2051	2	1	0.62315	425.436
89	2	2051	2	3	1.22803	582.544
90	2	2051	2	4	0.64597	476.304
91	2	2051	2	5	0.34353	342.145
92	2	2051	2	6	0.26820	339.152
93	2	2051	3	1	0.24994	332.170
94	2	2053	1	1	1.20977	594.015
95	2	2053	1	4	1.04656	677.307
96	2	2053	1	5	0.48163	407.481
97	2	2053	1	6	0.35494	408.978
98	2	2053	2	1	1.16069	406.963
99	2	2053	2	3	2.08400	407.481
100	2	2053	2	4	1.39922	506.733
101	2	2053	2	5	0.61516	367.581
102	2	2053	2	6	0.36407	345.137
103	2	2053	3	1	0.30701	470.324
104	2	2060	1	1	1.35928	471.820
105	2	2060	1	3	1.75417	542.145
106	2	2060	1	4	1.44259	494.763
107	2	2060	1	5	0.92102	451.870
108	2	2060	1	6	0.83450	621.945
109	2	2060	2	1	0.57179	470.823
110	2	2060	2	3	0.56836	495.761

SECTION II PES RAW DATA
2:56 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VSS	SR	CA
111	2	2060	2	4	0.49646	556.608
112	2	2060	2	5	0.36065	557.606
113	2	2060	2	6	0.38804	624.439
114	2	2060	3	1	0.27163	460.349
115	2	2063	1	1	0.76352	462.843
116	2	2063	1	3	1.13444	496.259
117	2	2063	1	4	0.71901	572.070
118	2	2063	1	5	0.57635	450.374
119	2	2063	1	6	0.48505	470.324
120	2	2063	2	1	0.65624	502.743
121	2	2063	2	3	0.65282	417.955
122	2	2063	2	4	0.71217	515.711
123	2	2063	2	5	0.41429	448.379
124	2	2063	2	6	0.38804	430.923
125	2	2063	3	1	0.25907	387.531
126	2	2072	1	1	1.32390	414.963
127	2	2072	1	3	2.50514	606.983
128	2	2072	1	4	0.98950	568.060
129	2	2072	1	5	0.66880	465.337
130	2	2072	1	6	0.39146	331.671
131	2	2072	2	1	2.83839	426.933
132	2	2072	2	3	1.84205	633.915
133	2	2072	2	4	1.63319	605.985
134	2	2072	2	5	0.82630	450.374
135	2	2072	2	6	0.32527	319.202
136	2	2072	3	1	0.25907	376.559
137	2	2075	1	1	0.52728	456.858
138	2	2075	1	3	1.23944	467.830
139	2	2075	1	4	0.97595	556.110
140	2	2075	1	5	0.56266	464.838
141	2	2075	1	6	0.41885	370.574
142	2	2075	2	1	0.81831	461.347
143	2	2075	2	3	0.90504	484.289
144	2	2075	2	4	0.98265	492.768
145	2	2075	2	5	0.43027	374.065
146	2	2075	2	6	0.35494	304.239
147	2	2075	3	1	0.26820	387.032
148	2	2081	1	1	1.06939	444.888
149	2	2081	1	3	1.21319	562.594
150	2	2081	1	4	1.23944	484.788
151	2	2081	1	5	0.90619	596.010
152	2	2081	1	6	0.80347	591.521
153	2	2081	2	1	1.03173	462.344
154	2	2081	2	3	1.02945	523.691
155	2	2081	2	4	0.90619	488.279
156	2	2081	2	5	0.52271	494.763
157	2	2081	2	6	0.45994	466.833
158	2	2081	3	1	0.31500	493.766
159	3	2101	1	1	1.19151	369.077
160	3	2101	1	4	1.14015	451.372
161	3	2101	1	5	0.80233	413.466
162	3	2101	1	6	0.44739	275.312
163	3	2101	2	4	1.11961	455.362
164	3	2101	2	5	0.62543	339.152
165	3	2101	2	6	0.54896	344.633

SECTION II PES RAW DATA
2:56 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
166	3	2101	3	1	0.17918	352.618
167	3	2104	1	1	0.38690	272.319
168	3	2104	1	4	0.77722	504.239
169	3	2104	1	5	0.58434	432.419
170	3	2104	1	6	0.72814	490.773
171	3	2104	2	1	0.64255	373.566
172	3	2104	2	4	1.14814	526.678
173	3	2104	2	5	0.59804	377.556
174	3	2104	2	6	0.32755	301.247
175	3	2104	3	1	0.27049	355.112
176	3	2118	1	1	0.58434	462.344
177	3	2118	1	3	0.71445	665.835
178	3	2118	1	4	0.57978	597.506
179	3	2118	1	5	0.44625	585.037
180	3	2118	1	6	0.51701	646.384
181	3	2118	2	1	0.69048	381.546
182	3	2118	2	3	1.55216	557.107
183	3	2118	2	4	0.79776	514.713
184	3	2118	2	5	0.55809	357.107
185	3	2118	2	6	0.46565	441.397
186	3	2118	3	1	0.20657	395.511
187	3	2134	1	1	0.70646	389.027
188	3	2134	1	3	1.05570	599.501
189	3	2134	1	4	0.75211	629.426
190	3	2134	1	5	0.45652	544.638
191	3	2134	1	6	0.32983	426.434
192	3	2134	2	1	0.94499	311.222
193	3	2134	2	3	0.92216	561.596
194	3	2134	2	4	0.75782	608.479
195	3	2134	2	5	0.49076	517.207
196	3	2134	2	6	0.41429	361.097
197	3	2134	3	1	0.33896	481.297
198	3	2137	1	1	0.59804	340.648
199	3	2137	1	3	0.64597	523.192
200	3	2137	1	4	0.57978	560.100
201	3	2137	1	5	0.37434	413.965
202	3	2137	1	6	0.42913	374.065
203	3	2137	2	1	0.98608	312.718
204	3	2137	2	3	1.57612	461.845
205	3	2137	2	4	1.01118	517.207
206	3	2137	2	5	0.70646	355.611
207	3	2137	2	6	0.53412	318.204
208	3	2137	3	1	0.24994	348.628
209	3	2139	1	1	1.09336	416.459
210	3	2139	1	3	0.95412	492.768
211	3	2139	1	4	1.09792	559.601
212	3	2139	1	5	0.74184	541.646
213	3	2139	1	6	0.72472	556.608
214	3	2139	2	1	1.53276	386.534
215	3	2139	2	3	1.64346	603.990
216	3	2139	2	4	1.21319	477.307
217	3	2139	2	5	0.65282	506.234
218	3	2139	2	6	1.35814	513.217
219	3	2139	3	1	0.28418	358.105
220	3	2143	1	1	0.92102	375.561

SECTION II PES RAW DATA
2:56 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
221	3	2143	1	3	0.77037	452.369
222	3	2143	1	4	0.82515	467.830
223	3	2143	1	5	0.47364	385.536
224	3	2143	1	6	0.42114	385.037
225	3	2143	2	1	1.19950	448.379
226	3	2143	2	3	1.03743	424.938
227	3	2143	2	4	0.96667	488.778
228	3	2143	2	5	1.55672	447.850
229	3	2143	2	6	1.58183	478.603
230	3	2143	3	1	0.25108	406.464

```
FILE: KPSLS1    SAS       A

LEGEND FOR SECTION II KPS

IF REP=1 AND PLOT=3001 THEN LINE=200;
IF REP=1 AND PLOT=3003 THEN LINE=230;
IF REP=1 AND PLOT=3005 THEN LINE=232;
IF REP=1 AND PLOT=3011 THEN LINE=238;
IF REP=1 AND PLOT=3037 THEN LINE=264;
IF REP=1 AND PLOT=3042 THEN LINE=269;
IF REP=1 AND PLOT=3044 THEN LINE=271;
IF REP=1 AND PLOT=3050 THEN LINE=277;
IF REP=2 AND PLOT=3056 THEN LINE=200;
IF REP=2 AND PLOT=3059 THEN LINE=230;
IF REP=2 AND PLOT=3083 THEN LINE=232;
IF REP=2 AND PLOT=3093 THEN LINE=238;
IF REP=2 AND PLOT=3095 THEN LINE=264;
IF REP=2 AND PLOT=3100 THEN LINE=269;
IF REP=2 AND PLOT=3074 THEN LINE=271;
IF REP=2 AND PLOT=3076 THEN LINE=277;
IF REP=3 AND PLOT=3116 THEN LINE=200;
IF REP=3 AND PLOT=3127 THEN LINE=230;
IF REP=3 AND PLOT=3124 THEN LINE=232;
IF REP=3 AND PLOT=3118 THEN LINE=238;
IF REP=3 AND PLOT=3133 THEN LINE=264;
IF REP=3 AND PLOT=3147 THEN LINE=269;
IF REP=3 AND PLOT=3135 THEN LINE=271;
IF REP=3 AND PLOT=3110 THEN LINE=277;

IF PLOT=3001 AND SUBPLOT=2   OR   PLOT=3056 AND SUBPLOT=1   OR
   PLOT=3116 AND SUBPLOT=2   OR   PLOT=3003 AND SUBPLOT=2   OR
   PLOT=3059 AND SUBPLOT=2   OR   PLOT=3127 AND SUBPLOT=1   OR
   PLOT=3005 AND SUBPLOT=5   OR   PLOT=3083 AND SUBPLOT=4   OR
   PLOT=3124 AND SUBPLOT=2   OR   PLOT=3011 AND SUBPLOT=1   OR
   PLOT=3093 AND SUBPLOT=3   OR   PLOT=3118 AND SUBPLOT=1   OR
   PLOT=3037 AND SUBPLOT=3   OR   PLOT=3095 AND SUBPLOT=2   OR
   PLOT=3133 AND SUBPLOT=1   OR   PLOT=3042 AND SUBPLOT=2   OR
   PLOT=3100 AND SUBPLOT=3   OR   PLOT=3147 AND SUBPLOT=2   OR
   PLOT=3044 AND SUBPLOT=2   OR   PLOT=3074 AND SUBPLOT=3   OR
   PLOT=3135 AND SUBPLOT=1   OR   PLOT=3050 AND SUBPLOT=1   OR
   PLOT=3076 AND SUBPLOT=1   OR   PLOT=3110 AND SUBPLOT=5
THEN TRTMT=1;

IF PLOT=3001 AND SUBPLOT=1   OR   PLOT=3056 AND SUBPLOT=6   OR
   PLOT=3116 AND SUBPLOT=3   OR   PLOT=3003 AND SUBPLOT=1   OR
   PLOT=3059 AND SUBPLOT=4   OR   PLOT=3127 AND SUBPLOT=4   OR
   PLOT=3005 AND SUBPLOT=2   OR   PLOT=3083 AND SUBPLOT=1   OR
   PLOT=3124 AND SUBPLOT=3   OR   PLOT=3011 AND SUBPLOT=5   OR
   PLOT=3093 AND SUBPLOT=1   OR   PLOT=3118 AND SUBPLOT=6   OR
   PLOT=3037 AND SUBPLOT=1   OR   PLOT=3095 AND SUBPLOT=5   OR
   PLOT=3133 AND SUBPLOT=4   OR   PLOT=3042 AND SUBPLOT=5   OR
   PLOT=3100 AND SUBPLOT=5   OR   PLOT=3147 AND SUBPLOT=3   OR
   PLOT=3044 AND SUBPLOT=3   OR   PLOT=3074 AND SUBPLOT=4   OR
   PLOT=3135 AND SUBPLOT=5   OR   PLOT=3050 AND SUBPLOT=4   OR
   PLOT=3076 AND SUBPLOT=2   OR   PLOT=3110 AND SUBPLOT=1
THEN TRTMT=2;
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FILE: KPSLS1    SAS       A

IF PLOT=3001 AND SUBPLOT=6     OR     PLOT=3056 AND SUBPLOT=4    OR
   PLOT=3116 AND SUBPLOT=4     OR     PLOT=3003 AND SUPPLOT=5    OR
   PLOT=3059 AND SUBPLOT=3     OR     PLOT=3127 AND SUBPLOT=6    OR
   PLOT=3005 AND SUBPLOT=3     OR     PLOT=3083 AND SUBPLOT=2    OR
   PLOT=3124 AND SUBPLOT=4     OR     PLOT=3011 AND SUBPLOT=3    OR
   PLOT=3093 AND SUBPLOT=5     OR     PLOT=3118 AND SUBPLOT=3    OR
   PLOT=3037 AND SUBPLOT=4     OR     PLOT=3095 AND SUBPLOT=1    OR
   PLOT=3133 AND SUBPLOT=5     OR     PLOT=3042 AND SUBPLOT=1    OR
   PLOT=3100 AND SUBPLOT=1     OR     PLOT=3147 AND SUBPLOT=4    OR
   PLOT=3044 AND SUBPLOT=1     OR     PLOT=3074 AND SUBPLOT=1    OR
   PLOT=3135 AND SUBPLOT=5     OR     PLOT=3050 AND SUBPLOT=5    OR
   PLOT=3076 AND SUBPLOT=4     OR     PLOT=3110 AND SUBPLOT=4
THEN TRTMT=3;

IF PLOT=3001 AND SUBPLOT=3     OR     PLOT=3056 AND SUBPLOT=3     OR
   PLOT=3116 AND SUBPLOT=5     OR     PLOT=3003 AND SUBPLOT=4     OR
   PLOT=3059 AND SUBPLOT=1     OR     PLOT=3127 AND SUBPLOT=2     OR
   PLOT=3005 AND SUBPLOT=4     OR     PLOT=3083 AND SUBPLOT=3     OR
   PLOT=3124 AND SUBPLOT=1     OR     PLOT=3011 AND SUBPLOT=4     OR
   PLOT=3093 AND SUBPLOT=2     OR     PLOT=3116 AND SUBPLOT=2
THEN TRTMT=4;

IF PLOT=3001 AND SUBPLOT=4     OR     PLOT=3056 AND SUBPLOT=2     OR
   PLOT=3116 AND SUBPLOT=1     OR     PLOT=3003 AND SUBPLOT=3     OR
   PLOT=3059 AND SUBPLOT=5     OR     PLOT=3127 AND SUBPLOT=3     OR
   PLOT=3005 AND SUBPLOT=1     OR     PLOT=3083 AND SUBPLOT=6     OR
   PLOT=3124 AND SUBPLOT=5     OR     PLOT=3011 AND SUBPLOT=2     OR
   PLOT=3093 AND SUBPLOT=4     OR     PLOT=3118 AND SUBPLOT=4
THEN TRTMT=5;

IF PLOT=3037 AND SUBPLOT=5     OR     PLOT=3095 AND SUBPLOT=4     OR
   PLOT=3133 AND SUBPLOT=6     OR     PLOT=3042 AND SUBPLOT=4     OR
   PLOT=3100 AND SUBPLOT=6     OR     PLOT=3147 AND SUBPLOT=1     OR
   PLOT=3044 AND SUBPLOT=4     OR     PLOT=3074 AND SUBPLOT=6     OR
   PLOT=3135 AND SUBPLOT=4     OR     PLOT=3050 AND SUBPLOT=2     OR
   PLOT=3076 AND SUBPLOT=6     OR     PLOT=3110 AND SUBPLOT=2
THEN TRTMT=6;

IF PLOT=3037 AND SUBPLOT=2     OR     PLOT=3095 AND SUBPLOT=3     OR
   PLOT=3133 AND SUBPLOT=3     OR     PLOT=3042 AND SUBPLOT=3     OR
   PLOT=3100 AND SUBPLOT=2     OR     PLOT=3147 AND SUBPLOT=6     OR
   PLOT=3044 AND SUBPLOT=5     OR     PLOT=3074 AND SUBPLOT=2     OR
   PLOT=3135 AND SUBPLOT=6     OR     PLOT=3050 AND SUBPLOT=6     OR
   PLOT=3076 AND SUBPLOT=3     OR     PLOT=3110 AND SUBPLOT=3
THEN TRTMT=7;

IF PLOT=3001 AND SUBPLOT=5     OR     PLOT=3056 AND SUBPLOT=5     OR
   PLOT=3116 AND SUBPLOT=6     OR     PLOT=3003 AND SUBPLOT=6     OR
   PLOT=3059 AND SUBPLOT=6     OR     PLOT=3127 AND SUBPLOT=5     OR
   PLOT=3005 AND SUBPLOT=6     OR     PLOT=3083 AND SUBPLOT=5     OR
   PLOT=3124 AND SUBPLOT=6     OR     PLOT=3011 AND SUBPLOT=6     OR
   PLOT=3093 AND SUBPLOT=6     OR     PLOT=3118 AND SUBPLOT=5     OR
   PLOT=3037 AND SUBPLOT=6     OR     PLOT=3095 AND SUBPLOT=6     OR
   PLOT=3133 AND SUBPLOT=2     OR     PLOT=3042 AND SUBPLOT=6     OR
   PLOT=3100 AND SUBPLOT=4     OR     PLOT=3147 AND SUBPLOT=5     OR
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FILE: KPSLS1 SAS A

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   PLOT=3044 AND SUBPLOT=6    OR    PLOT=3074 AND SUBPLOT=5    OR
   PLOT=3135 AND SUBPLOT=2    OR    PLOT=3050 AND SUBPLOT=3    OR
   PLOT=3076 AND SUBPLOT=5    OR    PLOT=3110 AND SUBPLOT=6
THEN TRTMT=1;
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SECTION II KPS RAW DATA
3:13 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
1	1	3001	1	1	3.5026	596.020
2	1	3001	1	3	0.3811	447.264
3	1	3001	1	4	0.5928	348.756
4	1	3001	1	5	0.6460	321.891
5	1	3001	1	6	0.7350	315.423
6	1	3001	2	1	0.3755	520.896
7	1	3001	2	3	0.4234	632.836
8	1	3001	2	4	0.4405	543.284
9	1	3001	2	5	0.3321	454.726
10	1	3001	2	6	0.3606	470.647
11	1	3001	3	1	0.5455	680.100
12	1	3001	3	3	1.4289	770.547
13	1	3001	3	4	1.1196	673.632
14	1	3001	3	5	1.3353	595.025
15	1	3001	3	6	0.9861	470.647
16	1	3001	4	1	1.7953	796.517
17	1	3001	4	3	0.9998	605.473
18	1	3001	4	4	0.9975	547.761
19	1	3001	4	5	1.0089	503.483
20	1	3001	4	6	1.0009	483.582
21	1	3001	5	1	0.5969	764.179
22	1	3001	5	3	0.3949	516.418
23	1	3001	5	4	0.3184	452.736
24	1	3001	5	5	0.2751	398.507
25	1	3001	5	6	0.3470	416.915
26	1	3001	6	1	0.5959	665.174
27	1	3001	6	3	0.4371	493.532
28	1	3001	6	4	0.2899	383.085
29	1	3001	6	5	0.2865	356.716
30	1	3001	6	6	0.3367	379.104
31	1	3003	1	3	1.2782	549.254
32	1	3003	1	4	0.6802	369.652
33	1	3003	1	5	1.1949	489.055
34	1	3003	2	1	0.4109	573.632
35	1	3003	2	3	0.4906	632.836
36	1	3003	2	5	0.3196	413.433
37	1	3003	2	6	0.2705	394.030
38	1	3003	2	6	0.3253	457.711
39	1	3003	3	1	0.6608	657.711
40	1	3003	3	3	0.7156	634.328
41	1	3003	3	4	0.6952	564.677
42	1	3003	3	5	0.8012	542.786
43	1	3003	3	6	0.6562	537.811
44	1	3003	4	1	11.4118	994.527
45	1	3003	4	3	1.2646	624.378
46	1	3003	4	4	1.7131	517.413
47	1	3003	4	5	1.6081	457.214
48	1	3003	4	6	1.7268	429.851
49	1	3003	5	1	0.9553	769.652
50	1	3003	5	3	0.7932	615.920
51	1	3003	5	4	0.6973	527.363
52	1	3003	5	5	0.5501	395.522
53	1	3003	5	6	0.4577	398.010
54	1	3003	6	1	0.6152	994.527
55	1	3003	6	2	0.5843	777.114

SECTION II KPS RAW DATA
3:13 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SK	CA
56	1	3003	6	3	0.29217	445.274
57	1	3003	6	4	0.22940	354.726
58	1	3003	6	5	0.32869	423.383
59	1	3003	6	6	0.24994	346.269
60	1	3005	1	1	0.78407	804.478
61	1	3005	1	3	0.48733	563.184
62	1	3005	1	4	0.83428	445.771
63	1	3005	1	5	0.73385	470.149
64	1	3005	1	6	1.04200	531.343
65	1	3005	2	1	4.29354	561.095
66	1	3005	2	3	1.74960	630.348
67	1	3005	2	4	2.10568	545.274
68	1	3005	2	5	2.46291	579.602
69	1	3005	2	6	2.51427	713.433
70	1	3005	3	1	0.68135	760.199
71	1	3005	3	3	0.58691	766.169
72	1	3005	3	4	0.49532	619.900
73	1	3005	3	5	0.57179	638.306
74	1	3005	3	6	0.47706	607.463
75	1	3005	4	1	6.63433	994.527
76	1	3005	4	3	2.49486	822.388
77	1	3005	4	4	2.69916	710.448
78	1	3005	4	5	2.26432	547.264
79	1	3005	4	6	2.81765	535.323
80	1	3005	5	1	0.55923	994.527
81	1	3005	5	3	0.39603	695.522
82	1	3005	5	4	0.36179	604.478
83	1	3005	5	5	0.36635	592.537
84	1	3005	5	6	0.30244	515.423
85	1	3005	6	1	0.65738	759.701
86	1	3005	6	3	0.37777	505.473
87	1	3005	6	4	0.18261	391.542
88	1	3005	6	5	0.31271	417.413
89	1	3011	1	3	0.27849	564.179
90	1	3011	1	4	0.28076	485.075
91	1	3011	1	5	0.24680	501.493
92	1	3011	1	6	0.32299	490.547
93	1	3011	2	1	0.52499	720.398
94	1	3011	2	3	0.89021	770.149
95	1	3011	2	4	0.65853	636.318
96	1	3011	2	5	0.63912	588.060
97	1	3011	2	6	0.33762	453.234
98	1	3011	3	1	0.60374	994.527
99	1	3011	3	3	0.98151	767.164
100	1	3011	3	4	0.73342	662.189
101	1	3011	3	5	0.91417	560.597
102	1	3011	3	6	0.64940	531.343
103	1	3011	4	1	4.78544	994.527
104	1	3011	4	3	4.00137	699.005
105	1	3011	4	4	3.19219	603.980
106	1	3011	4	5	2.72084	522.886
107	1	3011	4	6	2.41041	461.592
108	1	3011	5	1	1.05113	792.537
109	1	3011	5	3	2.03606	582.090
110	1	3011	5	4	3.23214	561.692

SECTION II KPS RAW DATA
3:13 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
111	1	3011	5	5	2.57475	517.910
112	1	3011	5	6	2.41840	369.154
113	1	3011	6	1	0.47249	994.527
114	1	3011	6	3	0.28190	607.960
115	1	3011	6	4	0.25337	492.040
116	1	3011	6	5	0.30016	564.677
117	1	3011	6	6	0.24766	400.000
118	1	3037	1	1	5.35494	803.980
119	1	3037	1	3	1.09678	605.970
120	1	3037	1	3	2.53709	740.299
121	1	3037	1	4	2.95937	576.119
122	1	3037	1	5	4.84136	704.478
123	1	3037	2	1	0.76467	696.020
124	1	3037	2	3	1.09678	695.522
125	1	3037	2	4	0.93814	592.537
126	1	3037	2	5	1.40379	757.214
127	1	3037	3	1	0.47478	710.945
128	1	3037	3	3	0.26478	532.338
129	1	3037	3	4	0.25679	469.652
130	1	3037	3	5	0.25907	533.333
131	1	3037	4	1	0.94499	724.676
132	1	3037	4	3	0.97124	674.627
133	1	3037	4	4	0.82858	573.632
134	1	3037	4	5	1.11961	710.945
135	1	3037	5	1	4.47729	800.498
136	1	3037	5	3	0.33896	678.109
137	1	3037	5	4	0.31956	540.796
138	1	3037	5	5	0.26478	624.378
139	1	3037	5	6	0.43141	689.055
140	1	3037	6	1	0.37434	591.045
141	1	3037	6	3	3.47409	696.517
142	1	3037	6	4	4.69299	629.353
143	1	3037	6	5	5.57407	654.229
144	1	3042	1	1	0.46565	634.826
145	1	3042	1	3	0.71217	609.453
146	1	3042	1	4	0.64255	649.751
147	1	3042	1	5	1.03059	817.413
148	1	3042	2	1	0.53983	994.527
149	1	3042	2	3	0.39032	741.791
150	1	3042	2	4	0.51358	727.363
151	1	3042	2	5	0.55695	994.527
152	1	3042	3	1	0.55124	994.527
153	1	3042	3	3	1.35814	752.736
154	1	3042	3	4	1.10363	643.284
155	1	3042	3	5	1.50765	763.682
156	1	3042	4	1	6.23374	788.060
157	1	3042	4	3	1.94819	680.100
158	1	3042	4	4	1.75417	661.692
159	1	3042	4	5	2.16389	994.527
160	1	3042	5	1	1.78042	800.000
161	1	3042	5	3	1.19265	724.378
162	1	3042	5	4	1.14015	724.378
163	1	3042	5	5	1.01233	771.642
164	1	3042	6	1	0.49190	765.672
165	1	3042	6	3	0.48505	783.582

SECTION II KPS RAW DATA
3:13 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
166	1	3042	6	4	0.50331	759.204
167	1	3042	6	5	0.57521	827.661
168	1	3044	1	1	0.49532	615.920
169	1	3044	1	2	0.52956	701.990
170	1	3044	1	3	0.69276	621.393
171	1	3044	1	4	0.59119	484.080
172	1	3044	1	5	0.59804	464.677
173	1	3044	1	6	0.65510	459.701
174	1	3044	2	1	0.38119	579.104
175	1	3044	2	2	0.48961	754.726
176	1	3044	2	3	0.35837	547.761
177	1	3044	2	4	0.30472	474.627
178	1	3044	2	5	0.28761	477.114
179	1	3044	2	6	0.24081	380.100
180	1	3044	3	1	1.85916	591.045
181	1	3044	3	2	1.47911	638.308
182	1	3044	3	3	0.86282	526.866
183	1	3044	3	4	0.71445	475.622
184	1	3044	3	5	0.81602	461.194
185	1	3044	3	6	0.57293	407.463
186	1	3044	4	1	4.63707	647.761
187	1	3044	4	2	1.26683	748.259
188	1	3044	4	3	1.15841	574.129
189	1	3044	4	4	0.93244	435.821
190	1	3044	4	5	0.80005	471.144
191	1	3044	4	6	0.79776	380.100
192	1	3044	4	6	1.06825	421.891
193	1	3044	5	1	1.18694	623.881
194	1	3044	5	2	1.15042	680.597
195	1	3044	5	3	1.27026	632.338
196	1	3044	5	4	0.90276	545.771
197	1	3044	5	5	0.97352	546.766
198	1	3044	5	6	0.77494	400.000
199	1	3044	6	1	0.39831	549.254
200	1	3044	6	2	0.38233	597.512
201	1	3044	6	3	0.41315	559.204
202	1	3044	6	4	0.31614	445.771
203	1	3044	6	5	0.32413	446.766
204	1	3044	6	6	0.32184	399.005
205	1	3050	1	1	0.42684	581.592
206	1	3050	1	2	0.46336	709.950
207	1	3050	1	3	0.31842	567.164
208	1	3050	1	4	0.26136	402.488
209	1	3050	1	5	0.38918	438.308
210	1	3050	1	6	0.23511	362.687
211	1	3050	1	6	0.34924	362.189
212	1	3050	2	1	2.98105	451.741
213	1	3050	2	2	1.28738	569.652
214	1	3050	2	3	0.89477	494.030
215	1	3050	2	4	1.40493	435.323
216	1	3050	2	5	0.83200	398.507
217	1	3050	2	6	1.47113	375.622
218	1	3050	3	1	0.38005	582.090
219	1	3050	3	2	0.32184	700.498
220	1	3050	3	3	0.27962	472.637

SECTION II KPS RAW DATA

3:13 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
221	1	3050	3	4	0.2693	428.358
222	1	3050	3	5	0.2146	377.114
223	1	3050	3	6	0.2123	300.995
224	1	3050	4	1	0.7852	596.517
225	1	3050	4	4	2.0292	792.537
226	1	3050	4	5	1.3444	561.692
227	1	3050	4	6	1.1755	383.085
228	1	3050	5	1	0.4383	570.647
229	1	3050	5	3	0.5056	664.677
230	1	3050	5	4	0.3264	563.184
231	1	3050	5	5	0.2591	477.612
232	1	3050	5	6	0.1883	403.483
233	1	3050	5	6	0.2773	414.925
234	1	3050	6	1	0.8080	692.040
235	1	3050	6	3	1.0546	994.527
236	1	3050	6	4	0.6528	531.343
237	1	3050	6	5	0.6140	447.264
238	1	3050	6	6	0.7008	411.443
239	2	3056	1	1	0.5090	994.527
240	2	3056	1	2	0.4850	733.333
241	2	3056	1	3	0.3196	542.289
242	2	3056	1	4	0.4223	512.935
243	2	3056	1	6	0.5193	629.353
244	2	3056	2	1	1.1459	816.418
245	2	3056	2	2	0.4793	625.373
246	2	3056	2	3	1.0192	624.378
247	2	3056	2	5	0.7567	542.786
248	2	3056	3	1	10.7030	994.527
249	2	3056	3	2	3.3942	673.134
250	2	3056	3	3	2.8167	556.219
251	2	3056	3	4	2.1856	444.776
252	2	3056	3	5	3.0769	439.801
253	2	3056	3	6	3.5163	569.154
254	2	3056	4	1	0.9769	994.527
255	2	3056	4	2	0.6425	713.930
256	2	3056	4	3	0.5387	505.473
257	2	3056	4	4	0.3333	463.184
258	2	3056	4	5	0.5307	444.776
259	2	3056	4	6	0.5318	393.532
260	2	3056	5	1	0.6996	994.527
261	2	3056	5	2	0.5090	813.433
262	2	3056	5	3	0.4782	703.483
263	2	3056	5	4	0.4417	556.716
264	2	3056	5	5	0.4280	552.239
265	2	3056	5	6	0.2751	419.403
266	2	3056	6	1	1.5259	994.527
267	2	3056	6	3	2.9160	632.836
268	2	3056	6	4	1.8557	531.841
269	2	3056	6	5	2.2232	489.552
270	2	3056	6	6	0.9153	362.189
271	2	3059	1	1	5.0114	770.647
272	2	3059	1	3	1.5510	667.164
273	2	3059	1	4	3.0358	542.786
274	2	3059	1	5	0.3618	549.254
275	2	3059	1	5	2.5964	546.269

SECTION II KPS RAW DATA
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OBS	REP	PLOT	SUBPLOT	VSS	SR	CA
276	2	3059	1	5	1.58998	472.139
277	2	3059	2	1	1.79753	304.478
278	2	3059	2	3	0.54782	727.363
279	2	3059	2	4	0.37206	551.244
280	2	3059	2	4	0.64711	475.124
281	2	3059	2	5	0.32641	486.060
282	2	3059	2	6	0.27962	429.851
283	2	3059	3	1	1.55736	994.527
284	2	3059	3	2	0.48733	701.493
285	2	3059	3	3	0.55923	615.423
286	2	3059	3	4	0.55010	515.423
287	2	3059	3	5	0.74755	493.532
288	2	3059	3	6	1.16868	503.483
289	2	3059	4	1	4.70555	572.139
290	2	3059	4	2	1.30336	514.925
291	2	3059	4	3	1.11504	517.910
292	2	3059	4	4	1.41520	479.104
293	2	3059	4	5	1.41178	490.547
294	2	3059	4	5	1.43118	433.333
295	2	3059	4	6	1.39238	435.323
296	2	3059	5	1	0.69276	739.801
297	2	3059	5	3	0.69505	541.791
298	2	3059	5	4	0.88564	618.905
299	2	3059	5	5	0.55353	506.468
300	2	3059	5	6	0.47592	462.189
301	2	3059	6	1	0.56608	596.020
302	2	3059	6	2	0.39945	570.647
303	2	3059	6	3	0.40173	527.363
304	2	3059	6	4	0.35951	483.085
305	2	3059	6	5	0.34125	470.647
306	2	3059	6	6	0.35494	470.149
307	2	3074	1	1	1.72107	500.498
308	2	3074	1	2	1.84889	764.677
309	2	3074	1	4	0.93700	546.269
310	2	3074	1	5	0.55483	552.736
311	2	3074	1	6	0.42684	472.637
312	2	3074	2	1	0.79434	613.433
313	2	3074	2	2	1.11048	724.378
314	2	3074	2	3	1.04542	674.129
315	2	3074	2	4	0.66880	532.338
316	2	3074	2	5	0.66651	530.846
317	2	3074	3	1	0.36065	487.065
318	2	3074	3	2	0.44168	632.338
319	2	3074	3	3	0.40059	589.055
320	2	3074	3	4	0.34467	423.881
321	2	3074	3	5	0.35152	442.786
322	2	3074	3	6	0.30472	375.124
323	2	3074	4	1	3.25382	506.965
324	2	3074	4	2	2.39101	531.841
325	2	3074	4	2	2.78818	589.055
326	2	3074	4	3	1.73134	574.627
327	2	3074	4	4	1.50243	432.338
328	2	3074	4	5	1.57498	407.463
329	2	3074	4	6	2.36590	358.706
330	2	3074	5	1	0.32983	492.040

SECTION II KPS RAW DATA
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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
331	2	3074	5	2	0.31728	579.104
332	2	3074	5	3	0.28875	500.495
333	2	3074	5	4	0.25565	427.651
334	2	3074	5	5	0.22255	396.517
335	2	3074	5	6	0.17690	296.517
336	2	3074	6	1	7.97307	562.587
337	2	3074	6	2	7.66263	720.398
338	2	3074	6	3	6.32961	608.458
339	2	3074	6	4	3.56540	463.184
340	2	3074	6	5	3.46154	484.090
341	2	3074	6	6	5.95070	451.244
342	2	3076	1	1	0.32983	467.562
343	2	3076	1	2	0.35038	604.478
344	2	3076	1	3	0.23168	485.572
345	2	3076	1	4	0.20772	409.453
346	2	3076	1	4	0.28959	404.478
347	2	3076	1	5	0.17918	375.622
348	2	3076	1	6	0.17462	365.174
349	2	3076	1	6	0.26478	380.597
350	2	3076	2	1	2.16557	460.199
351	2	3076	2	2	1.12531	550.746
352	2	3076	2	3	0.86907	447.761
353	2	3076	2	4	1.10135	417.910
354	2	3076	2	5	0.32299	558.209
355	2	3076	2	5	0.91075	353.234
356	2	3076	2	6	1.05227	432.836
357	2	3076	3	1	0.54211	420.398
358	2	3076	3	2	0.83200	545.771
359	2	3076	3	2	1.22232	414.925
360	2	3076	3	4	1.22461	357.214
361	2	3076	3	5	1.56471	384.577
362	2	3076	3	6	1.71879	379.602
363	2	3076	4	1	0.67564	502.488
364	2	3076	4	2	1.19836	596.517
365	2	3076	4	3	1.01233	594.030
366	2	3076	4	4	0.91417	491.045
367	2	3076	4	5	0.68478	399.502
368	2	3076	4	6	0.69276	386.567
369	2	3076	5	1	0.22826	372.139
370	2	3076	5	3	0.32413	550.249
371	2	3076	5	4	0.27277	442.289
372	2	3076	5	5	0.21570	379.602
373	2	3076	5	6	0.20772	371.642
374	2	3076	6	1	4.42707	493.035
375	2	3076	6	2	1.85346	597.015
376	2	3076	6	3	1.72906	500.498
377	2	3076	6	4	1.31933	393.532
378	2	3076	6	5	1.46085	323.383
379	2	3076	6	5	1.46314	374.627
330	2	3076	6	6	1.49395	351.741
381	2	3083	1	1	7.72883	632.338
382	2	3083	1	2	3.21958	524.378
383	2	3083	1	3	1.81123	437.811
384	2	3083	1	4	2.34650	430.348
385	2	3083	1	5	2.17302	440.299

SECTION II KPS RAW DATA
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OBS	REP	PLOT	SUBPLOT	VGS	SK	CA
386	2	3083	2	1	0.77265	548.259
387	2	3083	2	2	0.67793	507.463
388	2	3083	2	2	0.85711	535.821
389	2	3083	2	3	0.63570	450.746
390	2	3083	2	4	0.70304	445.274
391	2	3083	2	5	0.62543	502.485
392	2	3083	2	6	0.92787	475.124
393	2	3083	3	1	4.38598	654.378
394	2	3083	3	2	1.09336	536.316
395	2	3083	3	3	0.87309	494.527
396	2	3083	3	4	0.96067	447.264
397	2	3083	3	4	1.26912	435.323
398	2	3083	3	5	1.50879	527.363
399	2	3083	4	1	0.52043	640.299
400	2	3083	4	2	0.39717	499.005
401	2	3083	4	3	0.42456	548.259
402	2	3083	4	4	0.36293	420.896
403	2	3083	4	5	0.33896	416.915
404	2	3083	4	6	0.41429	528.356
405	2	3083	5	1	0.50559	564.677
406	2	3083	5	2	0.55239	654.229
407	2	3083	5	3	0.39489	527.861
408	2	3083	5	4	0.30244	390.050
409	2	3083	5	5	0.18717	352.736
410	2	3083	6	1	0.48048	612.438
411	2	3083	6	2	0.68934	531.841
412	2	3083	6	3	0.46451	502.488
413	2	3083	6	4	0.52385	460.697
414	2	3083	6	5	0.55467	570.149
415	2	3095	4	1	0.38005	531.343
416	2	3095	4	2	4.62451	564.179
417	2	3095	4	3	2.60100	604.975
418	2	3095	4	4	2.42753	430.346
419	2	3095	4	5	3.42159	502.985
420	2	3095	5	1	1.46199	537.811
421	2	3095	5	2	0.78064	467.164
422	2	3095	5	3	0.30016	406.965
423	2	3095	5	4	0.56722	384.080
424	2	3095	5	4	0.74298	406.965
425	2	3095	5	5	0.91956	480.100
426	2	3095	6	1	0.45994	641.791
427	2	3095	6	2	0.43369	674.129
428	2	3095	6	3	0.39032	581.095
429	2	3095	6	4	0.35722	501.493
430	2	3095	6	5	0.43826	551.741
431	2	3100	1	1	0.43711	542.289
432	2	3100	1	2	0.59005	539.303
433	2	3100	1	3	0.65738	503.483
434	2	3100	1	4	0.71217	445.771
435	2	3100	1	5	0.98379	484.577
436	2	3100	1	6	1.68569	595.025
437	2	3100	2	1	0.85597	525.871
438	2	3100	2	2	0.76238	589.055
439	2	3100	2	3	0.57293	496.020
440	2	3100	2	4	0.74755	556.209

SECTION II KPS RAW DATA

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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
441	2	3100	2	5	0.98722	625.871
442	2	3100	3	1	0.40858	519.403
443	2	3100	3	2	0.38913	628.358
444	2	3100	3	3	0.40972	583.085
445	2	3100	3	4	0.39603	512.935
446	2	3100	3	5	0.46579	639.303
447	2	3100	4	1	0.41543	486.567
448	2	3100	4	2	0.35380	604.478
449	2	3100	4	3	0.34924	512.935
450	2	3100	4	4	0.33326	476.109
451	2	3100	4	5	0.43141	611.443
452	2	3100	5	1	1.10021	431.343
453	2	3100	5	2	0.61744	521.393
454	2	3100	5	3	0.47476	458.209
455	2	3100	5	4	0.44396	460.199
456	2	3100	5	5	0.52771	536.816
457	2	3100	6	1	4.14860	436.318
458	2	3100	6	2	1.90596	479.602
459	2	3100	6	3	1.42547	499.502
460	2	3100	6	4	1.85802	499.502
461	2	3100	6	5	2.85095	689.552
462	3	3110	1	1	2.01324	519.900
463	3	3110	1	2	1.18124	571.144
464	3	3110	1	3	1.26569	560.697
465	3	3110	1	4	1.44944	468.657
466	3	3110	1	5	1.05570	390.050
467	3	3110	1	6	1.04999	326.368
468	3	3110	2	1	6.28852	536.816
469	3	3110	2	2	2.32709	486.070
470	3	3110	2	3	2.21639	511.940
471	3	3110	2	4	2.00525	443.781
472	3	3110	2	5	1.74732	345.771
473	3	3110	2	6	1.46199	326.866
474	3	3110	3	1	0.80347	559.204
475	3	3110	3	2	0.78064	656.219
476	3	3110	3	3	0.65282	500.000
477	3	3110	3	4	0.75097	443.284
478	3	3110	3	5	0.84341	351.244
479	3	3110	3	6	0.43027	309.950
480	3	3110	4	1	0.35266	395.522
481	3	3110	4	2	0.87537	508.458
482	3	3110	4	3	1.25656	425.871
483	3	3110	4	4	1.00320	346.269
484	3	3110	4	5	1.04086	326.368
485	3	3110	4	6	1.03629	289.552
486	3	3110	5	1	0.19630	362.189
487	3	3110	5	2	0.26478	452.239
488	3	3110	5	3	0.26706	435.323
489	3	3110	5	4	0.26136	377.612
490	3	3110	5	5	0.22141	293.035
491	3	3110	5	6	0.19973	349.254
492	3	3110	6	1	0.23054	432.836
493	3	3110	6	2	0.26364	477.612
494	3	3110	6	3	0.20201	391.542
495	3	3110	6	4	0.19858	343.284

SECTION II KPS RAW DATA
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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
496	3	3110	6	5	0.33696	344.279
497	3	3110	6	6	0.02511	292.040
498	3	3116	1	1	0.73157	584.577
499	3	3116	1	2	1.10021	575.124
500	3	3116	1	3	0.63543	456.209
501	3	3116	1	4	0.79206	440.796
502	3	3116	1	5	0.76581	506.468
503	3	3116	2	1	0.52385	994.527
504	3	3116	2	2	0.35265	689.552
505	3	3116	2	3	0.28304	524.676
506	3	3116	2	4	0.30815	466.169
507	3	3116	2	5	0.31728	536.816
508	3	3116	2	6	0.26820	517.910
509	3	3116	3	1	1.97101	757.711
510	3	3116	3	2	0.97010	548.756
511	3	3116	3	3	0.70646	471.144
512	3	3116	3	4	0.53641	423.681
513	3	3116	3	5	0.44625	442.786
514	3	3116	3	6	0.65510	503.483
515	3	3116	4	1	0.62429	607.463
516	3	3116	4	2	0.67450	596.517
517	3	3116	4	3	0.66380	518.905
518	3	3116	4	4	0.70075	440.796
519	3	3116	4	5	0.70646	436.308
520	3	3116	4	6	0.72244	480.100
521	3	3116	5	1	3.73545	697.512
522	3	3116	5	2	1.07738	600.995
523	3	3116	5	3	1.11390	567.164
524	3	3116	5	4	1.11618	437.313
525	3	3116	5	5	1.01689	532.338
526	3	3116	5	6	1.54074	443.781
527	3	3116	6	1	0.37092	580.100
528	3	3116	6	2	0.33326	646.766
529	3	3116	6	3	0.28304	577.114
530	3	3116	6	4	0.21799	426.866
531	3	3116	6	5	0.22940	485.075
532	3	3116	6	6	0.28761	571.144
533	3	3118	1	1	0.26761	455.224
534	3	3118	1	2	0.26934	532.836
535	3	3118	1	3	0.26136	482.090
536	3	3118	1	4	0.27505	432.338
537	3	3118	1	5	0.28761	411.443
538	3	3118	1	6	0.23282	480.100
539	3	3118	2	1	2.04748	468.657
540	3	3118	2	2	1.05455	486.567
541	3	3118	2	3	0.94727	480.100
542	3	3118	2	4	1.16640	430.348
543	3	3118	2	5	1.29308	447.761
544	3	3118	3	1	0.58891	489.552
545	3	3118	3	2	0.49190	557.711
546	3	3118	3	3	0.37663	477.114
547	3	3118	3	4	0.40402	412.935
548	3	3118	3	5	0.42456	415.920
549	3	3118	3	6	0.45652	442.786
550	3	3118	4	1	0.70532	471.642

SECTION II   KPS RAW DATA

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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
551	3	3118	4	3	0.67108	509.453
552	3	3118	4	4	0.56152	420.398
553	3	3118	4	5	0.63798	445.274
554	3	3118	4	6	1.20178	443.781
555	3	3118	5	1	0.26136	469.154
556	3	3118	5	2	0.33326	557.711
557	3	3118	5	3	0.27619	440.796
558	3	3118	5	4	0.21913	441.294
559	3	3118	5	5	0.26820	483.562
560	3	3118	5	6	0.32527	516.915
561	3	3118	6	1	3.72289	461.194
562	3	3118	6	2	1.74161	535.323
563	3	3118	6	3	1.60806	414.925
564	3	3118	6	4	1.36384	350.746
565	3	3118	6	5	1.26852	345.771
566	3	3124	1	1	4.30609	487.065
567	3	3124	1	2	1.56814	526.856
568	3	3124	1	3	1.12303	460.597
569	3	3124	1	4	0.70968	410.448
570	3	3124	1	5	0.55353	341.791
571	3	3124	2	1	0.48505	632.338
572	3	3124	2	2	0.64493	643.284
573	3	3124	2	3	0.44510	556.716
574	3	3124	2	4	0.31614	494.527
575	3	3124	2	5	0.42226	439.303
576	3	3124	2	6	0.32299	554.726
577	3	3124	3	1	4.93609	728.856
578	3	3124	3	3	1.96302	547.264
579	3	3124	3	4	1.81808	455.224
580	3	3124	3	5	1.49738	502.985
581	3	3124	3	6	2.01895	457.711
582	3	3124	4	1	1.42547	500.995
583	3	3124	4	2	1.25542	567.164
584	3	3124	4	4	1.06140	533.831
585	3	3124	4	5	1.25086	597.015
586	3	3124	5	1	0.81717	461.692
587	3	3124	5	2	1.23830	530.846
588	3	3124	5	3	1.12760	520.398
589	3	3124	5	4	1.04314	432.836
590	3	3124	5	5	0.58135	443.284
591	3	3124	6	1	0.53755	471.144
592	3	3124	6	3	0.31728	499.005
593	3	3124	6	4	0.22141	414.925
594	3	3124	6	5	0.17348	344.776
595	3	3127	1	1	0.40744	538.308
596	3	3127	1	3	0.30472	535.323
597	3	3127	1	4	0.60486	482.090
598	3	3127	1	5	0.52157	467.662
599	3	3127	1	6	0.44967	486.070
600	3	3127	2	1	4.71582	692.537
601	3	3127	2	3	0.28761	534.826
602	3	3127	2	4	0.30016	434.328
603	3	3127	2	5	0.29559	412.935
604	3	3127	2	6	0.31157	493.035
605	3	3127	3	1	0.92559	582.090

SECTION II KPS RAW DATA
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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
606	3	3127	3	3	0.91075	576.617
607	3	3127	3	4	0.78749	431.641
608	3	3127	3	5	1.02374	455.721
609	3	3127	4	1	2.05889	479.104
610	3	3127	5	1	0.60488	617.910
611	3	3127	6	1	1.03434	686.567
612	3	3133	1	1	0.53298	810.945
613	3	3133	1	2	0.40059	705.970
614	3	3133	1	3	0.35266	563.184
615	3	3133	1	4	0.31386	553.731
616	3	3133	1	5	0.42342	639.303
617	3	3133	2	1	0.37092	573.632
618	3	3133	2	2	0.40059	666.169
619	3	3133	2	3	0.35837	521.393
620	3	3133	2	4	0.38918	491.045
621	3	3133	2	5	0.56722	764.179
622	3	3133	3	1	0.81032	568.657
623	3	3133	3	2	0.64255	500.000
624	3	3133	3	3	0.59119	467.662
625	3	3133	3	4	0.55124	416.418
626	3	3133	3	5	0.85825	492.537
627	3	3133	4	1	1.88656	545.274
628	3	3133	4	2	1.19722	535.821
629	3	3133	4	3	1.07396	491.045
630	3	3133	4	4	1.21776	415.920
631	3	3133	4	5	1.48710	541.791
632	3	3133	5	1	0.60831	543.284
633	3	3133	5	2	0.53412	611.443
634	3	3133	5	3	0.47021	577.114
635	3	3133	5	4	0.39489	539.303
636	3	3133	5	5	0.45994	558.706
637	3	3133	5	6	0.42570	566.169
638	3	3133	6	1	7.79160	590.547
639	3	3133	6	2	5.30929	608.955
640	3	3133	6	3	5.04908	522.388
641	3	3133	6	4	5.58548	474.129
642	3	3133	6	5	6.97329	536.318
643	3	3135	1	1	0.35837	636.318
644	3	3135	1	2	0.25907	499.502
645	3	3135	1	3	0.25108	500.498
646	3	3135	1	4	0.20856	426.866
647	3	3135	1	6	0.21685	405.473
648	3	3135	2	1	0.33762	494.030
649	3	3135	2	2	0.30130	540.796
650	3	3135	2	3	0.32869	461.692
651	3	3135	2	4	0.27962	409.950
652	3	3135	2	5	0.30016	343.781
653	3	3135	2	6	0.25565	372.139
654	3	3135	3	1	2.13764	495.025
655	3	3135	3	2	0.89021	604.478
656	3	3135	3	4	0.78749	473.134
657	3	3135	3	5	0.76923	488.557
658	3	3135	3	6	0.64141	351.741
659	3	3135	4	1	3.04611	490.547
660	3	3135	4	2	1.60922	571.642

SECTION II KPS RAW DATA
3:13 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VSS	SR	CA
661	3	3135	4	3	1.48590	428.358
662	3	3135	4	4	1.11961	358.706
663	3	3135	4	5	1.36727	374.627
664	3	3135	4	6	1.29423	371.144
665	3	3135	5	1	0.71102	604.478
666	3	3135	5	2	0.52271	474.627
667	3	3135	5	3	0.55010	484.577
668	3	3135	5	4	0.64141	476.617
669	3	3135	5	5	0.68249	436.816
670	3	3135	5	6	1.05227	395.572
671	3	3135	6	1	1.84651	727.363
672	3	3135	6	3	0.85026	564.677
673	3	3135	6	3	1.13444	585.075
674	3	3135	6	4	1.18010	499.502
675	3	3135	6	5	0.97695	507.463
676	3	3135	6	6	0.33440	384.080
677	3	3147	1	1	7.92627	733.631
678	3	3147	1	5	0.96439	463.184
679	3	3147	1	6	1.41520	506.468
680	3	3147	2	1	0.44510	607.960
681	3	3147	2	3	0.34809	644.279
682	3	3147	2	4	0.34467	506.965
683	3	3147	2	5	0.42228	634.826
684	3	3147	3	1	3.67154	593.532
685	3	3147	3	2	1.85688	712.935
686	3	3147	3	3	1.95503	611.940
687	3	3147	3	4	1.42205	610.945
688	3	3147	3	5	1.75302	632.338
689	3	3147	3	6	1.58754	673.632
690	3	3147	4	1	0.76581	480.100
691	3	3147	4	2	0.55353	594.030
692	3	3147	4	3	0.45309	517.413
693	3	3147	4	4	0.49304	530.846
694	3	3147	4	5	0.58592	695.025
695	3	3147	5	1	0.35038	507.960
696	3	3147	5	2	0.35266	548.259
697	3	3147	5	3	0.35494	533.333
698	3	3147	5	4	0.44967	664.179
699	3	3147	5	5	0.56152	725.871
700	3	3147	5	6	0.64483	725.871
701	3	3147	6	1	0.56266	466.567
702	3	3147	6	2	0.39489	472.637
703	3	3147	6	3	0.60374	542.786
704	3	3147	6	4	0.79662	507.960
705	3	3147	6	5	0.56836	514.925
706	3	3147	6	6	0.45994	441.294

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FILE: PESCT7   SAS   A

LEGEND SECTION III RES CONVENTIONAL TILL

IF REP=1 AND PLOT=7001 THEN LINE=200;
IF REP=1 AND PLOT=7013 THEN LINE=281;
IF REP=1 AND PLOT=7031 THEN LINE=183;
IF REP=1 AND PLOT=7047 THEN LINE=193;
IF REP=1 AND PLOT=7052 THEN LINE=294;
IF REP=2 AND PLOT=7099 THEN LINE=200;
IF REP=2 AND PLOT=7088 THEN LINE=281;
IF REP=2 AND PLOT=7073 THEN LINE=183;
IF REP=2 AND PLOT=7069 THEN LINE=193;
IF REP=2 AND PLOT=7065 THEN LINE=294;
IF REP=3 AND PLOT=7136 THEN LINE=200;
IF REP=3 AND PLOT=7144 THEN LINE=281;
IF REP=3 AND PLOT=7118 THEN LINE=183;
IF REP=3 AND PLOT=7141 THEN LINE=193;
IF REP=3 AND PLOT=7105 THEN LINE=294;

IF PLOT=7001 AND SUBPLOT=1    OR     PLOT=7013 AND SUBPLOT=1    OR
   PLOT=7031 AND SUBPLOT=1    OR     PLOT=7047 AND SUBPLOT=1    OR
   PLOT=7052 AND SUBPLOT=1    OR     PLOT=7099 AND SUBPLOT=1    OR
   PLOT=7088 AND SUBPLOT=1    OR     PLOT=7073 AND SUBPLOT=1    OR
   PLOT=7069 AND SUBPLOT=1    OR     PLOT=7065 AND SUBPLOT=1    OR
   PLOT=7136 AND SUBPLOT=1    OR     PLOT=7144 AND SUBPLOT=1    OR
   PLOT=7118 AND SUBPLOT=1    OR     PLOT=7141 AND SUBPLOT=1    OR
   PLOT=7105 AND SUBPLOT=1   THEN TRTMT=2;



IF PLOT=7001 AND SUBPLOT=2    OR     PLOT=7013 AND SUBPLOT=2    OR
   PLOT=7031 AND SUBPLOT=2    OR     PLOT=7047 AND SUBPLOT=2    OR
   PLOT=7052 AND SUBPLOT=2    OR     PLOT=7099 AND SUBPLOT=2    OR
   PLOT=7088 AND SUBPLOT=2    OR     PLOT=7073 AND SUBPLOT=2    OR
   PLOT=7069 AND SUBPLOT=2    OR     PLOT=7065 AND SUBPLOT=2    OR
   PLOT=7136 AND SUBPLOT=2    OR     PLOT=7144 AND SUBPLOT=2    OR
   PLOT=7118 AND SUBPLOT=2    OR     PLOT=7141 AND SUBPLOT=2    OR
   PLOT=7105 AND SUBPLOT=2   THEN TRTMT=1;


IF PLOT=7001 AND SUBPLOT=3    OR     PLOT=7013 AND SUBPLOT=3    OR
   PLOT=7031 AND SUBPLOT=3    OR     PLOT=7047 AND SUBPLOT=3    OR
   PLOT=7052 AND SUBPLOT=3    OR     PLOT=7099 AND SUBPLOT=3    OR
   PLOT=7088 AND SUBPLOT=3    OR     PLOT=7073 AND SUBPLOT=3    OR
   PLOT=7069 AND SUBPLOT=3    OR     PLOT=7065 AND SUBPLOT=3    OR
   PLOT=7136 AND SUBPLOT=3    OR     PLOT=7144 AND SUBPLOT=3    OR
   PLOT=7118 AND SUBPLOT=3    OR     PLOT=7141 AND SUBPLOT=3    OR
   PLOT=7105 AND SUBPLOT=3   THEN TRTMT=2;


IF PLOT=7001 AND SUBPLOT=4    OR     PLOT=7013 AND SUBPLOT=4    OR
   PLOT=7031 AND SUBPLOT=4    OR     PLOT=7047 AND SUBPLOT=4    OR
   PLOT=7052 AND SUBPLOT=4    OR     PLOT=7099 AND SUBPLOT=4    OR
   PLOT=7088 AND SUBPLOT=4    OR     PLOT=7073 AND SUBPLOT=4    OR
   PLOT=7069 AND SUBPLOT=4    OR     PLOT=7065 AND SUBPLOT=4    OR
   PLOT=7136 AND SUBPLOT=4    OR     PLOT=7144 AND SUBPLOT=4    OR
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FILE: PESCT2    SAS       A

     PLOT=7118 AND SUBPLOT=4     OR      PLOT=7141 AND SUBPLOT=4     OR
     PLOT=7105 AND SUBPLOT=4   THEN  TRTMT=3;

IF   PLOT=7001 AND SUBPLOT=5     OR      PLOT=7013 AND SUBPLOT=5     OR
     PLOT=7031 AND SUBPLOT=5     OR      PLOT=7047 AND SUBPLOT=5     OR
     PLOT=7052 AND SUBPLOT=5     OR      PLOT=7099 AND SUBPLOT=5     OR
     PLOT=7083 AND SUBPLOT=5     OR      PLOT=7073 AND SUBPLOT=5     OR
     PLOT=7069 AND SUBPLOT=5     OR      PLOT=7065 AND SUBPLOT=5     OR
     PLOT=7136 AND SUBPLOT=5     OR      PLOT=7144 AND SUBPLOT=5     OR
     PLOT=7118 AND SUBPLOT=5     OR      PLOT=7141 AND SUBPLOT=5     OR
     PLOT=7105 AND SUBPLOT=5   THEN  TRTMT=1;

IF   PLOT=7001 AND SUBPLOT=6     OR      PLOT=7013 AND SUBPLOT=6     OR
     PLOT=7031 AND SUBPLOT=6     OR      PLOT=7047 AND SUBPLOT=6     OR
     PLOT=7052 AND SUBPLOT=6     OR      PLOT=7099 AND SUBPLOT=6     OR
     PLOT=7083 AND SUBPLOT=6     OR      PLOT=7073 AND SUBPLOT=6     OR
     PLOT=7069 AND SUBPLOT=6     OR      PLOT=7065 AND SUBPLOT=6     OR
     PLOT=7136 AND SUBPLOT=6     OR      PLOT=7144 AND SUBPLOT=6     OR
     PLOT=7118 AND SUBPLOT=6     OR      PLOT=7141 AND SUBPLOT=6     OR
     PLOT=7105 AND SUBPLOT=6   THEN  TRTMT=3;

IF   PLOT=7001 AND SUBPLOT=3     OR      PLOT=7013 AND SUBPLOT=3     OR
     PLOT=7031 AND SUBPLOT=3     OR      PLOT=7047 AND SUBPLOT=3     OR
     PLOT=7052 AND SUBPLOT=3     OR      PLOT=7001 AND SUBPLOT=5     OR
     PLOT=7013 AND SUBPLOT=5     OR      PLOT=7031 AND SUBPLOT=5     OR
     PLOT=7047 AND SUBPLOT=5     OR      PLOT=7052 AND SUBPLOT=5     OR
     PLOT=7001 AND SUBPLOT=6     OR      PLOT=7013 AND SUBPLOT=6     OR
     PLOT=7031 AND SUBPLOT=6     OR      PLOT=7047 AND SUBPLOT=6     OR
     PLOT=7052 AND SUBPLOT=6   THEN  REP=4;

IF   PLOT=7099 AND SUBPLOT=3     OR      PLOT=7083 AND SUBPLOT=3     OR
     PLOT=7073 AND SUBPLOT=3     OR      PLOT=7069 AND SUBPLOT=3     OR
     PLOT=7065 AND SUBPLOT=3     OR      PLOT=7099 AND SUBPLOT=5     OR
     PLOT=7083 AND SUBPLOT=5     OR      PLOT=7073 AND SUBPLOT=5     OR
     PLOT=7069 AND SUBPLOT=5     OR      PLOT=7065 AND SUBPLOT=5     OR
     PLOT=7099 AND SUBPLOT=6     OR      PLOT=7083 AND SUBPLOT=6     OR
     PLOT=7073 AND SUBPLOT=6     OR      PLOT=7069 AND SUBPLOT=6     OR
     PLOT=7065 AND SUBPLOT=6   THEN  REP=5;

IF   PLOT=7136 AND SUBPLOT=3     OR      PLOT=7144 AND SUBPLOT=3     OR
     PLOT=7118 AND SUBPLOT=3     OR      PLOT=7141 AND SUBPLOT=3     OR
     PLOT=7105 AND SUBPLOT=3     OR      PLOT=7136 AND SUBPLOT=5     OR
     PLOT=7144 AND SUBPLOT=5     OR      PLOT=7118 AND SUBPLOT=5     OR
     PLOT=7141 AND SUBPLOT=5     OR      PLOT=7105 AND SUBPLOT=5     OR
     PLOT=7136 AND SUBPLOT=6     OR      PLOT=7144 AND SUBPLOT=6     OR
     PLOT=7118 AND SUBPLOT=6     OR      PLOT=7141 AND SUBPLOT=6     OR
     PLOT=7105 AND SUBPLOT=6   THEN  REP=6;
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SECTION III PCS CONVENTIONAL TILL; 13:35 MONDAY, MAY 25, 1987

OBS	ID	REP	PLOT	SUBPLOT	VSS	SR	CA
1	1[illegible]	1	7001	1	1	1.73819	537.31
2	130	1	7001	1	2	1.76101	626.87
3	131	1	7001	1	3	2.03721	633.08
4	132	1	7001	1	4	1.74960	565.92
5	133	1	7001	1	5	1.80145	609.45
6	134	1	7001	1	6	1.81009	624.38
7	40	1	7001	2	1	0.49418	694.03
8	135	1	7001	2	3	0.38690	675.37
9	136	1	7001	2	4	0.39717	696.52
10	137	1	7001	2	5	0.35266	674.13
11	138	1	7001	2	6	0.30130	634.33
12	64	1	7001	3	1	0.84456	645.52
13	139	1	7001	3	2	1.30221	669.15
14	140	1	7001	3	3	1.52362	716.42
15	141	1	7001	3	4	1.57761	679.10
16	142	1	7001	3	5	1.39466	689.05
17	143	1	7001	3	6	1.31363	554.73
18	48	1	7001	4	1	0.81488	547.26
19	144	1	7001	4	2	0.70760	681.59
20	145	1	7001	4	3	0.83200	696.52
21	146	1	7001	4	4	0.82401	716.42
22	147	1	7001	4	5	0.66423	694.03
23	148	1	7001	4	6	0.68934	633.08
24	7[illegible]	1	7001	5	1	0.35722	546.51
25	149	1	7001	5	3	0.28419	634.33
26	150	1	7001	5	4	0.35266	549.75
27	151	1	7001	5	5	0.32527	649.25
28	152	1	7001	5	6	0.31271	655.47
29	115	1	7001	6	1	1.02482	449.00
30	77	1	7001	6	1	1.03401	470.15
31	153	1	7001	6	2	1.57498	600.75
32	154	1	7001	6	3	1.34216	604.48
33	155	1	7001	6	4	1.20749	606.97
34	156	1	7001	6	5	0.97124	604.48
35	157	1	7001	6	6	0.92445	572.14
36	76	1	7013	1	1	1.32646	534.83
37	10[illegible]	1	7013	1	2	[illegible].57907	544.78
38	11[illegible]5	1	7013	1	3	0.81260	519.90
39	1071	1	7013	1	4	1.30221	628.11
40	1115	1	7013	1	5	0.94499	510.17
41	1084	1	7013	1	6	1.02486	506.22
42	25	1	7013	2	1	0.36978	532.34
43	2074	1	7013	2	2	0.27277	605.72
44	2067	1	7013	2	3	0.27049	619.40
45	2009	1	7013	2	4	0.30358	634.33
46	1047	1	7013	2	5	0.29217	604.48
47	1109	1	7013	2	6	0.23168	488.81
48	118	1	7013	3	1	1.51221	563.43
49	17	1	7013	3	1	1.53618	580.85
50	1055	1	7013	3	2	0.80401	1022.39
51	1111	1	7013	3	3	1.12760	599.50
52	2004	1	7013	3	4	1.13352	619.40
53	101[illegible]	1	7013	3	5	0.71102	546.02
54	1074	1	7013	3	5	1.21319	577.11
55	1065	1	7013	3	6	0.94613	597.01

SECTION III PGS CONVENTIONAL TILL; 13:35 MONDAY, MAY 25, 1967

OBS	ID	REF	PLOT	SUBPLOT	VGS	SR	CA
56	51	1	7013	4	1	0.50722	404.229
57	38	1	7013	4	1	0.57864	528.607
58	1091	1	7013	4	2	0.52728	549.751
59	2001	1	7013	4	3	0.47478	447.761
60	1067	1	7013	4	4	0.46451	592.090
61	1076	1	7013	4	5	0.47249	590.796
62	1058	1	7013	4	6	0.47706	575.671
63	19	1	7013	5	1	0.38090	522.388
64	44	1	7013	5	1	0.40402	542.239
65	1037	1	7013	5	2	0.28646	523.632
66	2055	1	7013	5	3	0.28418	614.428
67	1075	1	7013	5	4	0.35494	694.030
68	2066	1	7013	5	5	0.29902	643.035
69	1119	1	7013	5	6	0.23532	562.189
70	50	1	7013	6	1	0.34456	447.761
71	2072	1	7013	6	2	0.70189	565.821
72	1063	1	7013	6	3	0.69162	582.090
73	2065	1	7013	6	4	0.61630	603.234
74	2076	1	7013	6	5	0.49190	557.214
75	1087	1	7013	6	6	0.50445	584.577
76	111	1	7031	1	1	1.63205	476.368
77	1112	1	7031	1	2	0.81468	579.602
78	1050	1	7031	1	3	0.92355	569.652
79	2045	1	7031	1	4	1.13444	656.716
80	2051	1	7031	1	5	1.04771	589.552
81	2044	1	7031	1	6	1.01689	580.846
82	1053	1	7031	2	2	0.35951	526.119
83	2050	1	7031	2	3	0.27648	570.896
84	1077	1	7031	2	4	0.36521	643.035
85	1096	1	7031	2	5	0.27962	605.721
86	2011	1	7031	2	6	0.23282	419.154
87	55	1	7031	3	1	1.50194	491.343
88	1063	1	7031	3	2	0.78863	538.557
89	2066	1	7031	3	3	0.63113	538.557
90	1049	1	7031	3	4	0.80119	575.371
91	1093	1	7031	3	6	0.46679	405.473
92	2052	1	7031	4	2	0.53641	451.493
93	2060	1	7031	4	3	0.49418	486.318
94	1103	1	7031	4	4	0.50331	562.189
95	1064	1	7031	4	5	0.92559	451.493
96	2071	1	7031	4	6	0.25907	391.791
97	1090	1	7031	5	2	0.30356	585.821
98	2061	1	7031	5	3	0.31366	574.627
99	1089	1	7031	5	4	0.34809	633.085
100	1102	1	7031	5	5	0.30130	546.020
101	1073	1	7031	5	6	0.28076	543.532
102	85	1	7031	6	1	0.44054	492.587
103	1035	1	7031	6	2	0.37434	523.632
104	1028	1	7031	6	3	0.33896	546.507
105	1023	1	7031	6	4	0.45538	614.428
106	1025	1	7031	6	5	0.41315	558.458
107	4014	1	7031	6	6	0.36293	466.418
108	105	1	7047	1	1	0.87994	437.811
109	1024	1	7047	1	2	0.91760	522.388
110	6058	1	7047	1	3	0.84706	546.507

SECTION III P&S CONVENTIONAL TILL: 13:35 MONDAY, MAY 25, 1987

OBS	ID	REP	PLOT	SUBPLOT	VGS	SR	CA
111	2111	1	7047	1	4	1.19379	570.696
112	4049	1	7047	1	5	0.93129	567.164
113	3107	1	7047	1	6	0.79320	440.299
114	20	1	7047	2	1	0.31614	460.199
115	3097	1	7047	2	2	0.23511	502.485
116	4036	1	7047	2	3	0.22141	512.438
117	2036	1	7047	2	4	0.22712	514.925
118	3115	1	7047	2	5	0.22712	517.413
119	4025	1	7047	2	6	0.16777	379.353
120	69	1	7047	3	1	0.81146	402.985
121	4029	1	7047	3	2	0.55609	429.104
122	1005	1	7047	3	3	0.78635	435.323
123	4020	1	7047	3	4	1.10591	503.731
124	1019	1	7047	3	5	1.48482	503.731
125	4035	1	7047	3	6	1.08651	391.791
126	46	1	7047	4	1	0.43141	450.249
127	4022	1	7047	4	2	0.25679	470.149
128	4030	1	7047	4	3	0.43369	439.055
129	4037	1	7047	4	4	0.40173	507.463
130	4061	1	7047	4	5	0.31642	541.045
131	4019	1	7047	4	6	0.23511	386.816
132	71	1	7047	5	1	0.28646	375.622
133	1095	1	7047	5	2	0.21114	507.463
134	1106	1	7047	5	3	0.18717	458.955
135	4032	1	7047	5	4	0.19973	467.662
136	3076	1	7047	5	5	0.20315	506.706
137	3099	1	7047	5	6	0.20201	450.249
138	39	1	7047	6	1	0.95070	452.736
139	4027	1	7047	6	3	0.60260	455.224
140	1011	1	7047	6	4	0.72929	507.463
141	3106	1	7047	6	5	0.65054	501.244
142	4054	1	7047	6	6	0.49418	437.811
143	102	1	7052	1	1	1.62292	577.114
144	2012	1	7052	1	2	0.89706	788.557
145	2015	1	7052	1	3	0.83428	726.368
146	3093	1	7052	1	4	0.99977	674.129
147	1025	1	7052	1	5	0.97010	555.970
148	2091	1	7052	1	6	0.65054	410.448
149	33	1	7052	2	1	0.35722	564.677
150	2020	1	7052	2	2	0.42684	980.100
151	3096	1	7052	2	3	0.29902	699.005
152	2047	1	7052	2	4	0.26592	638.060
153	3051	1	7052	2	5	0.24538	565.920
154	2049	1	7052	2	6	0.20772	485.075
155	63	1	7052	3	1	0.89820	516.169
156	1083	1	7052	3	2	0.84456	716.418
157	2041	1	7052	3	3	0.83428	606.965
158	2089	1	7052	3	4	0.90048	645.522
159	4001	1	7052	3	5	0.84570	537.313
160	3033	1	7052	3	6	0.83657	500.000
161	65	1	7052	4	1	0.84912	444.030
162	2088	1	7052	4	2	1.21890	487.562
163	2033	1	7052	4	3	0.79890	603.234
164	2017	1	7052	4	4	0.61858	516.169
165	2013	1	7052	4	5	0.55239	495.025

SECTION III PES CONVENTIONAL TILL; 13:35 MONDAY, MAY 25, 1987

OBS	ID	REP	PLOT	SUBPLOT	VGS	SR	CA
166	2075	1	7052	4	6	0.45652	427.86
167	13	1	7052	5	1	0.42000	585.82
168	2042	1	7052	5	2	0.29788	655.47
169	2015	1	7052	5	3	0.27277	643.03
170	2003	1	7052	5	4	0.27391	626.11
171	2021	1	7052	5	5	0.26364	604.48
172	2023	1	7052	5	6	0.21625	498.76
173	67	1	7052	6	1	0.68473	507.46
174	2035	1	7052	6	2	1.00562	601.99
175	4045	1	7052	6	3	0.57407	584.58
176	2044	1	7052	6	4	0.51744	548.51
177	2031	1	7052	6	5	0.54440	547.26
178	2025	1	7052	6	6	0.98037	440.30
179	72	2	7065	1	1	0.99407	559.70
180	4006	2	7065	1	2	0.68620	491.29
181	3087	2	7065	1	3	0.55957	522.39
182	3064	2	7065	1	4	0.83771	600.75
183	3007	2	7065	1	5	0.70760	478.86
184	4043	2	7065	1	6	0.51929	350.75
185	32	2	7065	2	1	0.35608	427.66
186	1082	2	7065	2	2	0.32983	638.06
187	4009	2	7065	2	3	0.25565	560.95
188	2003	2	7065	2	4	0.27391	564.66
189	2026	2	7065	2	5	0.23739	456.47
190	2005	2	7065	2	6	0.18231	393.03
191	62	2	7065	3	1	1.[illegible]7199	575.87
192	2027	2	7065	3	2	0.96896	645.52
193	3045	2	7065	3	3	0.75010	594.53
194	3091	2	7065	3	4	0.75608	573.38
195	2110	2	7065	3	5	0.71787	506.22
196	3043	2	7065	3	6	0.59918	410.45
197	12	2	7065	4	1	0.72016	517.41
198	3034	2	7065	4	2	0.56548	463.83
199	2022	2	7065	4	3	0.44054	522.39
200	3035	2	7065	4	4	0.46336	518.66
201	4004	2	7065	4	5	0.33752	424.13
202	3001	2	7065	4	6	0.27505	368.16
203	34	2	7065	5	1	0.37206	529.85
204	2037	2	7065	5	2	0.25451	549.75
205	2023	2	7065	5	3	0.23625	524.88
206	4011	2	7065	5	4	0.29217	567.16
207	2007	2	7065	5	5	0.26364	514.93
208	2091	2	7065	5	6	0.18603	359.45
209	35	2	7065	6	1	0.59575	610.70
210	4044	2	7065	6	2	0.37549	496.27
211	3099	2	7065	6	3	0.42114	568.41
212	2032	2	7065	6	4	0.30179	524.88
213	4041	2	7065	6	5	0.34695	516.17
214	4007	2	7065	6	6	0.25793	371.89
215	54	2	7069	1	1	1.11847	437.81
216	1043	2	7069	1	2	1.30107	439.05
217	1056	2	7069	1	3	1.15754	422.89
218	1107	2	7069	1	4	1.58640	480.10
219	1046	2	7069	1	5	1.59761	9452.74
220	1094	2	7069	1	6	1.51721	467.6[illegible]

SECTION III PES CONVENTIONAL TILL; 13:35 MONDAY, MAY 25, 1987

OBS	ID	REP	PLOT	SUBPLOT	VGS	SR	CA
221	24	2	7069	2	1	0.27163	396.01
222	3098	2	7069	2	2	0.22369	488.91
223	1059	2	7069	2	3	0.23967	497.51
224	1086	2	7069	2	4	0.26934	527.36
225	1103	2	7069	2	5	0.24195	465.17
226	1034	2	7069	2	6	0.22712	411.69
227	105	2	7069	3	1	1.76444	519.90
228	1075	2	7069	3	3	0.87309	597.01
229	2070	2	7069	3	4	0.55364	631.84
230	2057	2	7069	3	5	0.79548	599.50
231	4013	2	7069	3	6	0.64026	427.86
232	16	2	7069	4	1	0.61287	477.61
233	1101	2	7069	4	2	0.33326	419.15
234	2015	2	7069	4	3	0.25451	425.37
235	1042	2	7069	4	4	0.35951	491.29
236	1001	2	7069	4	5	0.31386	467.66
237	1032	2	7069	4	6	0.27391	361.84
238	53	2	7069	5	1	0.30815	401.74
239	2099	2	7069	5	3	0.18603	394.28
240	1037	2	7069	5	4	0.22712	457.71
241	1010	2	7069	5	5	0.24680	444.03
242	2045	2	7069	5	6	0.20657	398.01
243	110	2	7069	6	1	0.44853	465.17
244	1021	2	7069	6	2	0.26364	390.55
245	1045	2	7069	6	3	0.28989	445.27
246	1052	2	7069	6	4	0.40350	553.48
247	3028	2	7069	6	5	0.39146	517.41
248	1051	2	7069	6	6	0.38347	465.17
249	23	2	7073	1	1	1.79183	445.27
250	1035	2	7073	1	2	1.26341	402.99
251	1043	2	7073	1	3	1.65630	563.43
252	2096	2	7073	1	4	1.57270	544.78
253	2059	2	7073	1	5	1.63091	509.95
254	1104	2	7073	1	6	1.13330	460.20
255	75	2	7073	2	1	0.28304	351.99
256	1061	2	7073	2	2	0.24766	441.54
257	1054	2	7073	2	3	0.29217	504.98
258	2069	2	7073	2	4	0.22826	3109.45
259	2045	2	7073	2	5	0.23625	472.64
260	1069	2	7073	2	6	0.24310	426.62
261	22	2	7073	3	1	0.86852	470.15
262	1044	2	7073	3	2	0.53641	511.19
263	1031	2	7073	3	3	0.84912	544.78
264	1100	2	7073	3	4	1.09450	601.99
265	3094	2	7073	3	5	0.94271	490.05
266	2113	2	7073	3	6	0.82515	446.52
267	56	2	7073	4	1	0.61858	376.87
268	1002	2	7073	4	2	0.35722	518.66
269	1003	2	7073	4	3	0.40858	579.60
270	1012	2	7073	4	4	0.47706	603.23
271	1033	2	7073	4	5	0.37891	543.53
272	1041	2	7073	4	6	0.33063	426.62
273	49	2	7073	5	1	0.27505	419.15
274	3059	2	7073	5	2	0.29217	533.33
275	2035	2	7073	5	3	0.27962	529.85

SECTION III PES CONVENTIONAL TILL; 13:35 MONDAY, MAY 25, 1987

OBS	ID	REP	PLOT	SUBPLOT	VGS	SR	CA
276	2019	2	7073	5	4	0.26136	493.781
277	1007	2	7073	5	5	0.27733	405.473
278	1051	2	7073	5	6	0.29902	595.771
279	47	2	7073	6	1	0.33326	394.279
280	1062	2	7073	6	2	0.28532	416.657
281	1017	2	7073	6	3	0.41429	425.373
282	1004	2	7073	6	4	0.28761	440.299
283	3036	2	7073	6	5	0.40516	477.612
284	1060	2	7073	6	6	0.34125	446.517
285	70	2	7088	1	1	1.12631	500.000
286	4031	2	7088	1	2	0.91303	552.239
287	4017	2	7088	1	3	0.99749	562.189
288	3019	2	7088	1	4	1.28738	609.453
289	3112	2	7088	1	5	1.32276	554.726
290	4033	2	7088	1	6	1.46596	534.826
291	74	2	7088	2	1	0.41315	541.045
292	1026	2	7088	2	2	0.29902	534.826
293	3054	2	7088	2	3	0.25108	568.408
294	3075	2	7088	2	4	0.30016	654.229
295	3077	2	7088	2	5	0.24195	562.189
296	1013	2	7088	2	6	0.24081	496.269
297	41	2	7088	3	1	1.91052	593.259
298	1014	2	7088	3	2	1.81123	615.672
299	2098	2	7088	3	3	1.79297	579.602
300	3005	2	7088	3	4	2.28715	611.940
301	2102	2	7088	3	5	1.77699	528.607
302	3103	2	7088	3	6	1.64116	532.338
303	43	2	7088	4	1	0.58548	532.338
304	2114	2	7088	4	2	0.64369	657.960
305	4012	2	7088	4	3	0.54440	579.602
306	4028	2	7088	4	4	0.44054	610.697
307	3035	2	7088	4	5	0.35360	609.453
308	3114	2	7088	4	6	0.33097	503.731
309	57	2	7088	5	1	0.43255	573.383
310	3081	2	7088	5	2	0.33097	642.010
311	3013	2	7088	5	3	0.30929	603.234
312	1020	2	7088	5	4	0.39717	710.199
313	3024	2	7088	5	5	0.29674	650.498
314	3022	2	7088	5	6	0.26620	574.627
315	73	2	7088	6	1	1.01347	522.388
316	2085	2	7088	6	2	0.45309	512.438
317	4016	2	7088	6	3	0.83200	548.507
318	4026	2	7088	6	4	0.70760	578.358
319	4057	2	7088	6	5	0.61630	553.483
320	4023	2	7088	6	6	0.58206	557.214
321	114	2	7099	1	1	1.13787	449.005
322	68	2	7099	1	1	1.27711	466.418
323	3111	2	7099	1	2	0.98493	516.169
324	2062	2	7099	1	3	1.00890	514.925
325	4052	2	7099	1	4	0.97352	504.975
326	4054	2	7099	1	5	0.87081	452.736
327	3115	2	7099	1	6	0.95070	493.781
328	14	2	7099	2	1	0.39260	486.806
329	4050	2	7099	2	2	0.25451	506.219
330	4042	2	7099	2	3	0.24195	541.045

SECTION III PES CONVENTIONAL TILL; 13:35 MONDAY, MAY 25, 1987

OBS	ID	REP	PLOT	SUBPLOT	VGS	SR	CA
331	4093	2	7099	2	4	0.24652	572.139
332	3031	2	7099	2	5	0.25451	519.900
333	2104	2	7099	2	6	0.23396	471.393
334	67	2	7099	3	1	1.72677	444.030
335	3110	2	7099	3	2	1.15385	544.776
336	4062	2	7099	3	3	1.57042	593.284
337	3034	2	7099	3	4	1.56928	635.572
338	4056	2	7099	3	5	1.32961	538.557
339	3117	2	7099	3	6	1.16868	506.219
340	112	2	7099	4	1	0.51566	570.896
341	3014	2	7099	4	2	0.58206	660.448
342	4055	2	7099	4	3	0.54325	606.965
343	2103	2	7099	4	4	0.63228	715.174
344	2107	2	7099	4	5	0.31500	430.348
345	3032	2	7099	4	6	0.29559	416.667
346	108	2	7099	5	1	0.36976	462.587
347	3056	2	7099	5	2	0.23282	490.050
348	3105	2	7099	5	3	0.27962	572.139
349	4019	2	7099	5	4	0.31728	606.209
350	4008	2	7099	5	5	0.30130	618.159
351	1006	2	7099	5	6	0.35152	682.836
352	107	2	7099	6	1	0.50636	497.512
353	4050	2	7099	6	2	1.03091	424.129
354	2097	2	7099	6	3	1.05711	478.856
355	3073	2	7099	6	4	0.90733	475.124
356	3023	2	7099	6	5	0.61030	498.756
357	3065	2	7099	6	6	0.63428	523.632
358	61	3	7105	1	1	0.95164	430.348
359	3072	3	7105	1	2	0.94613	508.706
360	3092	3	7105	1	3	0.74412	483.831
361	4003	3	7105	1	4	1.04200	441.542
362	4048	3	7105	1	5	0.68478	426.617
363	4005	3	7105	1	6	0.59619	391.791
364	103	3	7105	2	1	0.31043	426.617
365	2024	3	7105	2	2	0.34467	676.617
366	3045	3	7105	2	3	0.26136	511.194
367	2064	3	7105	2	4	0.20657	455.224
368	3005	3	7105	2	5	0.19060	414.179
369	3002	3	7105	2	6	0.17918	368.159
370	31	3	7105	3	1	1.80210	475.124
371	3042	3	7105	3	2	1.85689	675.373
372	2107	3	7105	3	3	1.15727	580.846
373	3006	3	7105	3	4	1.03972	493.781
374	4002	3	7105	3	5	0.99172	462.687
375	3009	3	7105	3	6	0.84912	348.259
376	37	3	7105	4	1	1.09678	431.592
377	3096	3	7105	4	2	1.35325	546.020
378	3090	3	7105	4	3	0.58336	457.711
379	4046	3	7105	4	4	0.68592	446.517
380	2092	3	7105	4	5	0.64483	409.204
381	2093	3	7105	4	5	0.64711	421.642
382	4010	3	7105	4	6	0.51815	320.896
383	36	3	7105	5	1	0.29445	440.299
384	3004	3	7105	5	2	0.26250	466.318
385	2043	3	7105	5	3	0.25793	487.562

SECTION III PES CONVENTIONAL TILL: 13:35 MONDAY, MAY 25, 1987

OBS	TJ	REP	PLOT	SUBPLOT	VGS	SR	CA
386	3047	3	7105	5	4	0.19956	388.060
387	3044	3	7105	5	5	0.19973	361.940
388	3003	3	7105	5	6	0.17119	324.627
389	50	3	7105	6	1	0.96151	445.274
390	3046	3	7105	6	2	1.36499	409.204
391	2066	3	7105	6	3	1.35471	389.303
392	2083	3	7105	6	4	0.79548	404.229
393	2031	3	7105	6	5	0.54325	365.672
394	3010	3	7105	6	5	0.65994	378.109
395	30	3	7118	1	1	1.57341	462.687
396	4015	3	7118	1	2	1.41520	334.328
397	1022	3	7118	1	3	1.33503	496.269
398	3012	3	7118	1	4	1.35585	470.149
399	3026	3	7118	1	5	1.14814	450.249
400	4033	3	7118	1	6	1.09564	451.493
401	33	3	7118	2	1	0.26820	451.493
402	3061	3	7118	2	3	0.23739	565.920
403	2109	3	7118	2	4	0.22598	527.363
404	3021	3	7118	2	5	0.24538	529.851
405	3067	3	7118	2	6	0.20657	449.005
406	116	3	7118	3	1	1.53390	380.597
407	23	3	7118	3	1	1.04346	402.985
408	4024	3	7118	3	2	0.62429	486.318
409	2064	3	7118	3	3	1.27711	519.900
410	3109	3	7118	3	4	1.04200	444.030
411	1029	3	7118	3	5	1.03629	439.055
412	3034	3	7118	3	6	0.38804	409.204
413	27	3	7118	4	1	0.62543	376.866
414	3103	3	7118	4	2	0.53953	442.786
415	3104	3	7118	4	3	0.48048	449.005
416	3015	3	7118	4	4	0.47592	452.736
417	3055	3	7118	4	5	0.39489	460.199
418	3063	3	7118	4	6	0.36521	465.174
419	15	3	7118	5	1	0.26476	415.423
420	1030	3	7118	5	3	0.25337	511.194
421	2053	3	7118	5	4	0.23396	471.393
422	4051	3	7118	5	5	0.21913	471.393
423	3113	3	7118	5	5	0.21570	421.642
424	104	3	7118	6	1	0.64825	407.960
425	3053	3	7118	6	2	0.53184	461.443
426	3057	3	7118	6	3	0.74640	544.776
427	2099	3	7118	6	4	0.51016	482.587
428	2115	3	7118	6	5	0.57293	512.438
429	2100	3	7118	6	6	0.48733	437.811
430	26	3	7136	1	1	0.97466	595.771
431	117	3	7136	1	1	0.98493	629.353
432	1015	3	7136	1	2	0.65396	539.801
433	2077	3	7136	1	3	0.53070	669.154
434	1008	3	7136	1	4	0.61972	664.179
435	2010	3	7136	1	5	0.53070	615.672
436	1116	3	7136	1	6	0.55239	669.154
437	109	3	7136	2	1	0.31614	523.632
438	2037	3	7136	2	2	0.29674	330.846
439	2034	3	7136	2	3	0.27277	667.910
440	1098	3	7136	2	4	0.30587	691.542

OBS	ID	REP	PLOT	SUBPLOT	VGS	SR	CA
441	1113	3	7136	2	5	0.28076	636.816
442	1016	3	7136	2	6	0.25532	584.577
443	75	3	7136	3	1	1.33189	507.463
444	1092	3	7136	3	2	1.09879	652.985
445	2054	3	7136	3	3	1.21319	751.244
446	2073	3	7136	3	4	1.00320	769.900
447	1077	3	7136	3	5	0.80803	651.741
448	1055	3	7136	3	6	0.80913	644.279
449	66	3	7136	4	1	0.73499	487.562
450	1117	3	7136	4	2	0.78521	667.910
451	1069	3	7136	4	3	0.79776	743.781
452	2038	3	7136	4	4	0.69505	656.716
453	2056	3	7136	4	5	0.50217	620.647
454	12	3	7136	5	1	0.30130	496.269
455	2075	3	7136	5	2	0.23511	588.308
456	1114	3	7136	5	3	0.27049	634.328
457	2082	3	7136	5	4	0.27391	665.423
458	2063	3	7136	5	5	0.28989	677.861
459	1027	3	7136	5	6	0.25565	594.527
460	45	3	7136	6	1	0.66081	554.726
461	2065	3	7136	6	2	0.45538	604.179
462	1072	3	7136	6	3	0.52157	589.552
463	2014	3	7136	6	4	0.45195	680.348
464	3017	3	7136	6	5	0.39945	550.995
465	2002	3	7136	6	6	0.36750	514.925
466	80	3	7141	1	1	0.23739	342.040
467	2105	3	7141	2	3	0.13810	368.159
468	3016	3	7141	2	4	0.13717	450.249
469	3025	3	7141	2	5	0.19630	467.662
470	3029	3	7141	2	6	0.16663	396.766
471	101	3	7141	4	1	0.25337	434.080
472	3030	3	7141	4	3	0.16092	455.224
473	3011	3	7141	4	4	0.18945	460.199
474	3027	3	7141	4	5	0.18375	436.567
475	3049	3	7141	4	6	0.18261	395.522
476	91	3	7144	1	1	1.11618	592.040
477	113	3	7144	1	1	1.16184	534.826
478	3050	3	7144	1	2	0.40972	470.149
479	3020	3	7144	1	3	0.73157	572.139
480	4047	3	7144	1	4	0.79206	560.945
481	2112	3	7144	1	5	0.60423	516.169
482	2101	3	7144	1	6	0.81032	553.483
483	42	3	7144	2	1	0.24766	421.642
484	2116	3	7144	2	2	0.20543	529.851
485	3101	3	7144	2	3	0.22598	593.284
486	3074	3	7144	2	4	0.19630	516.169
487	3095	3	7144	2	5	0.13810	400.498
488	3058	3	7144	2	6	0.12212	347.015
489	95	3	7144	3	1	1.34672	529.851
490	3052	3	7144	3	2	0.81260	524.876
491	3071	3	7144	3	3	0.81486	564.677
492	[illegible]	3	7144	3	4	0.91532	595.771
493	3102	3	7144	3	5	0.82059	516.169
494	3070	3	7144	3	6	0.72586	490.050
495	52	3	7144	4	1	2.32595	518.657

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OBS	ID	REP	PLOT	SUBPLOT	VGS	SR	CA
496	3037	3	7144	4	2	1.30727	455.224
497	3069	3	7144	4	3	1.43569	564.677
498	4021	3	7144	4	4	1.31819	541.045
499	2117	3	7144	4	5	0.87423	526.119
500	2108	3	7144	4	6	0.55168	436.567
501	21	3	7144	5	1	0.33212	516.169
502	3013	3	7144	5	2	0.20856	500.000
503	4063	3	7144	5	3	0.23054	552.239
504	3055	3	7144	5	4	0.26706	639.303
505	3041	3	7144	5	5	0.21913	563.433
506	3033	3	7144	5	6	0.20429	498.756
507	84	3	7144	6	1	0.65168	542.289
508	3066	3	7144	6	2	0.54554	507.463
509	3062	3	7144	6	3	0.54606	563.433
510	4034	3	7144	6	4	0.64433	593.284
511	3072	3	7144	6	5	0.37563	569.652
512	3052	3	7144	6	6	0.32527	482.587

```
FILE: PCSMTZ    SAS       A

LEGEND FOR SECTION III PCS NO-TILL

IF REP=1 AND PLOT=8001 THEN LINE=200;
IF REP=1 AND PLOT=8013 THEN LINE=281;
IF REP=1 AND PLOT=8031 THEN LINE=183;
IF REP=1 AND PLOT=8047 THEN LINE=193;
IF REP=1 AND PLOT=8052 THEN LINE=294;
IF REP=2 AND PLOT=8075 THEN LINE=200;
IF REP=2 AND PLOT=8089 THEN LINE=281;
IF REP=2 AND PLOT=8084 THEN LINE=183;
IF REP=2 AND PLOT=8062 THEN LINE=193;
IF REP=2 AND PLOT=8093 THEN LINE=294;
IF REP=3 AND PLOT=8134 THEN LINE=200;
IF REP=3 AND PLOT=8145 THEN LINE=281;
IF REP=3 AND PLOT=8107 THEN LINE=183;
IF REP=3 AND PLOT=8118 THEN LINE=193;
IF REP=3 AND PLOT=8150 THEN LINE=294;

IF PLOT=8001 AND SUBPLOT=1    OR     PLOT=8013 AND SUBPLOT=2    OR
   PLOT=8031 AND SUBPLOT=3    OR     PLOT=8047 AND SUBPLOT=2    OR
   PLOT=8052 AND SUBPLOT=1    OR     PLOT=8075 AND SUBPLOT=3    OR
   PLOT=8089 AND SUBPLOT=1    OR     PLOT=8084 AND SUBPLOT=2    OR
   PLOT=8062 AND SUBPLOT=3    OR     PLOT=8093 AND SUBPLOT=1    OR
   PLOT=8134 AND SUBPLOT=2    OR     PLOT=8145 AND SUBPLOT=1    OR
   PLOT=8107 AND SUBPLOT=1    OR     PLOT=8118 AND SUBPLOT=1    OR
   PLOT=8150 AND SUBPLOT=1   THEN TRTMT=1;

IF PLOT=8001 AND SUBPLOT=2    OR     PLOT=8013 AND SUBPLOT=3    OR
   PLOT=8031 AND SUBPLOT=1    OR     PLOT=8047 AND SUBPLOT=1    OR
   PLOT=8052 AND SUBPLOT=2    OR     PLOT=8075 AND SUBPLOT=1    OR
   PLOT=8089 AND SUBPLOT=2    OR     PLOT=8084 AND SUBPLOT=1    OR
   PLOT=8062 AND SUBPLOT=2    OR     PLOT=8093 AND SUBPLOT=3    OR
   PLOT=8134 AND SUBPLOT=1    OR     PLOT=8145 AND SUBPLOT=3    OR
   PLOT=8107 AND SUBPLOT=3    OR     PLOT=8118 AND SUBPLOT=3    OR
   PLOT=8150 AND SUBPLOT=2   THEN TRTMT=2;

IF PLOT=8001 AND SUBPLOT=3    OR     PLOT=8013 AND SUBPLOT=1    OR
   PLOT=8031 AND SUBPLOT=2    OR     PLOT=8047 AND SUBPLOT=3    OR
   PLOT=8052 AND SUBPLOT=3    OR     PLOT=8075 AND SUBPLOT=2    OR
   PLOT=8089 AND SUBPLOT=3    OR     PLOT=8084 AND SUBPLOT=3    OR
   PLOT=8062 AND SUBPLOT=1    OR     PLOT=8093 AND SUBPLOT=2    OR
   PLOT=8134 AND SUBPLOT=3    OR     PLOT=8145 AND SUBPLOT=2    OR
   PLOT=8107 AND SUBPLOT=2    OR     PLOT=8118 AND SUBPLOT=2    OR
   PLOT=8150 AND SUBPLOT=3   THEN TRTMT=3;

SR=STRONTIUM*10/87.62;
CA=CALCIUM*5000/40.02;
OR=(SR/CA)*1000;
```

SECTION III PES NO-TILL
3:04 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
1	1	8001	1	1	0.49418	792.289
2	1	8001	1	2	0.37549	553.483
3	1	8001	1	3	0.32413	508.706
4	1	8001	1	4	0.30472	549.751
5	1	8001	2	1	1.69710	889.303
6	1	8001	2	2	1.08993	685.323
7	1	8001	2	3	0.84113	586.308
8	1	8001	2	4	0.79206	601.990
9	1	8001	3	1	0.84227	922.886
10	1	8001	3	2	0.80461	720.149
11	1	8001	3	3	0.66309	593.284
12	1	8001	3	4	0.61744	604.478
13	1	8013	1	1	1.08537	384.328
14	1	8013	1	2	0.93244	665.423
15	1	8013	1	3	0.90504	633.085
16	1	8013	1	4	0.67907	504.975
17	1	8013	1	5	0.79776	606.965
18	1	8013	2	1	0.79662	840.796
19	1	8013	2	2	0.61972	705.224
20	1	8013	2	3	0.53869	4.975
21	1	8013	2	4	0.46336	549.751
22	1	8013	2	5	0.54658	672.886
23	1	8013	3	1	2.14449	804.726
24	1	8013	3	2	1.71536	685.323
25	1	8013	3	3	1.43004	649.254
26	1	8013	3	4	1.27595	584.577
27	1	8013	3	5	0.93265	532.338
28	1	8031	1	1	1.83862	722.637
29	1	8031	1	2	1.28738	625.622
30	1	8031	1	3	1.10705	656.716
31	1	8031	1	4	1.05227	583.333
32	1	8031	1	5	1.52477	947.761
33	1	8031	2	1	0.92901	793.532
34	1	8031	2	2	0.56605	705.224
35	1	8031	2	3	0.27391	426.617
36	1	8031	2	4	0.29217	456.468
37	1	8031	2	5	0.34125	641.791
38	1	8031	3	1	0.40630	766.070
39	1	8031	3	2	0.30244	584.577
40	1	8031	3	3	0.16663	427.861
41	1	8031	3	4	0.17576	444.030
42	1	8031	3	5	0.25565	661.692
43	1	8047	1	1	0.80233	666.667
44	1	8047	1	2	0.74184	549.751
45	1	8047	1	3	0.91303	507.463
46	1	8047	1	4	0.79662	465.174
47	1	8047	1	5	0.90276	538.557
48	1	8047	2	1	0.29559	636.060
49	1	8047	2	2	0.22712	572.139
50	1	8047	2	3	0.22826	560.945
51	1	8047	2	4	0.18603	460.199
52	1	8047	2	5	0.20657	538.557
53	1	8047	3	1	0.77836	792.289
54	1	8047	3	2	0.57864	634.328
55	1	8047	3	3	0.46336	501.244

SECTION III PES NO-TILL
3:04 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
56	1	8047	3	4	0.45680	488.806
57	1	8047	3	5	0.40059	495.025
58	1	8052	1	1	0.41201	762.438
59	1	8052	1	2	0.34467	604.476
60	1	8052	1	3	0.22712	473.881
61	1	8052	1	4	0.20315	415.423
62	1	8052	1	5	0.17916	371.891
63	1	8052	2	2	0.66994	498.756
64	1	8052	2	3	0.61059	462.687
65	1	8052	2	4	0.53641	402.935
66	1	8052	2	5	0.36804	342.040
67	1	8052	3	1	0.47820	667.910
68	1	8052	3	2	0.35266	495.025
69	1	8052	3	3	0.34924	482.587
70	1	8052	3	4	0.27391	385.572
71	1	8052	3	5	0.22940	354.478
72	2	8075	1	1	1.00548	711.443
73	2	8075	1	2	1.19607	616.915
74	2	8075	1	3	0.83086	526.119
75	2	8075	1	4	0.66309	415.423
76	2	8075	1	5	0.52271	348.259
77	2	8075	2	1	2.27459	722.637
78	2	8075	2	2	0.88678	641.791
79	2	8075	2	3	0.84570	539.801
80	2	8075	2	4	0.74184	466.418
81	2	8075	2	5	0.55010	528.607
82	2	8075	3	1	0.33440	705.224
83	2	8075	3	2	0.28375	680.348
84	2	8075	3	3	0.17348	411.692
85	2	8075	3	4	0.12326	384.328
86	2	8075	3	5	0.18831	495.025
87	2	8082	1	1	0.51929	541.045
88	2	8082	1	2	0.43255	506.219
89	2	8082	1	3	0.40972	477.612
90	2	8082	1	4	0.49874	507.463
91	2	8082	1	5	0.42913	470.149
92	2	8082	2	1	1.79183	497.512
93	2	8082	2	2	0.86738	514.925
94	2	8082	2	3	0.68021	450.249
95	2	8082	2	4	0.50331	373.134
96	2	8082	2	5	0.67907	368.159
97	2	8082	3	1	0.27049	562.189
98	2	8082	3	2	0.22712	514.925
99	2	8082	3	3	0.20087	471.393
100	2	8082	3	4	0.18147	400.498
101	2	8082	3	5	0.24424	569.652
102	2	8084	1	1	1.22004	748.756
103	2	8084	1	2	1.01917	633.085
104	2	8084	1	3	0.61402	491.294
105	2	8084	1	4	0.25451	645.522
106	2	8084	1	4	0.68592	533.582
107	2	8084	2	1	0.28989	568.408
108	2	8084	2	2	0.24424	546.020
109	2	8084	2	3	0.18147	470.149
110	2	8084	2	4	1.24401	518.657

SECTION III   PES   NO-TILL
3:04 MONDAY, MAY 25

GES	REP	PLOT	SUBPLOT	VGS	SR	CA
111	2	8084	3	1	0.39375	507.463
112	2	8084	3	2	0.42684	511.194
113	2	8084	3	3	0.22483	347.015
114	2	8084	3	4	0.23158	364.426
115	2	8084	3	5	0.43369	516.169
116	2	8089	1	1	0.30929	519.900
117	2	8089	1	2	0.31956	526.119
118	2	8089	1	3	0.24994	468.905
119	2	8089	1	4	0.23967	478.856
120	2	8089	1	5	0.27049	419.154
121	2	8089	2	1	2.03378	674.129
122	2	8089	2	2	1.65145	575.871
123	2	8089	2	3	1.43232	538.557
124	2	8089	3	1	2.25748	699.005
125	2	8089	3	2	0.81831	723.681
126	2	8089	3	3	0.63113	630.597
127	2	8089	3	4	0.43369	450.249
128	2	8089	3	5	0.56336	600.746
129	2	8098	1	1	0.32755	699.005
130	2	8098	1	2	0.24652	562.189
131	2	8098	1	3	0.16663	424.129
132	2	8098	1	4	0.11185	307.214
133	2	8098	1	5	0.08902	257.463
134	2	8098	2	2	0.53070	473.881
135	2	8098	2	2	0.65168	594.527
136	2	8098	2	3	0.48619	374.378
137	2	8098	2	4	0.42228	283.582
138	2	8098	2	5	0.43597	298.507
139	2	8098	3	1	1.16184	595.771
140	2	8098	3	2	0.93129	495.025
141	2	8098	3	3	0.73365	420.398
142	2	8098	3	4	0.69162	384.328
143	2	8098	3	5	0.66309	425.373
144	3	8107	1	1	0.38462	742.537
145	3	8107	1	2	0.32299	643.035
146	3	8107	1	3	0.25223	562.189
147	3	8107	1	4	0.25793	586.308
148	3	8107	1	5	0.30815	756.219
149	3	8107	2	1	0.71331	798.507
150	3	8107	2	2	0.52043	682.836
151	3	8107	2	3	0.16320	360.697
152	3	8107	2	4	0.28761	636.060
153	3	8107	2	5	0.22826	374.378
154	3	8107	3	1	1.19836	680.345
155	3	8107	3	2	1.07167	550.995
156	3	8107	3	3	0.64825	450.249
157	3	8107	3	4	0.58092	396.766
158	3	8107	3	5	0.54097	480.100
159	3	8118	1	1	0.47820	548.507
160	3	8118	1	2	0.31043	460.199
161	3	8118	1	3	0.31614	411.692
162	3	8118	1	4	0.27277	368.159
163	3	8118	1	5	0.35038	460.199
164	3	8118	2	1	0.47478	495.025
165	3	8118	2	2	0.42114	385.572

SECTION III PES NO-TILL
3:04 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
166	3	8118	2	3	0.49304	334.577
167	3	8118	2	4	0.55923	330.846
168	3	8118	2	5	0.78178	416.667
169	3	8118	3	1	3.54599	478.856
170	3	8118	3	2	2.42296	351.990
171	3	8118	3	3	2.29171	374.378
172	3	8118	3	4	2.18329	319.652
173	3	8118	3	5	2.86921	376.866
174	3	8134	1	1	2.08058	574.627
175	3	8134	1	2	1.30678	570.896
176	3	8134	1	3	0.74526	416.667
177	3	8134	1	4	0.31614	303.483
178	3	8134	1	5	0.38918	274.876
179	3	8134	2	1	0.55809	580.846
180	3	8134	2	2	0.45766	594.527
181	3	8134	2	3	0.28989	513.682
182	3	8134	2	4	0.22141	409.204
183	3	8134	2	5	0.24195	447.761
184	3	8134	3	1	0.75325	926.617
185	3	8134	3	2	0.56152	640.547
186	3	8134	3	3	0.33668	442.786
187	3	8134	3	4	0.32184	400.498
188	3	8134	3	5	0.37663	544.776
189	3	8145	1	1	0.66423	727.612
190	3	8145	1	2	0.56380	656.716
191	3	8145	1	3	0.49418	564.577
192	3	8145	1	4	0.42570	497.512
193	3	8145	1	5	0.53412	616.915
194	3	8145	3	1	2.81557	773.632
195	3	8145	3	2	1.89340	660.448
196	3	8145	3	3	1.52819	649.254
197	3	8145	3	4	1.42433	577.114
198	3	8145	3	5	1.05570	587.065
199	3	8150	1	1	0.46793	656.716
200	3	8150	1	2	0.35608	526.119
201	3	8150	1	3	0.29788	398.010
202	3	8150	1	4	0.24310	291.045
203	3	8150	1	5	0.30472	394.279
204	3	8150	2	1	0.51701	555.970
205	3	8150	2	2	0.86852	522.388
206	3	8150	2	3	0.80005	415.423
207	3	8150	2	4	0.85597	398.010
208	3	8150	2	5	0.80461	381.841
209	3	8150	3	1	1.06939	672.886
210	3	8150	3	2	0.78407	534.826
211	3	8150	3	3	0.67108	267.313
212	3	8150	3	4	0.50331	385.572
213	3	8150	3	5	0.64369	458.955

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FILE: KPSCT2   SAS     A

LEGEND FOR SECTION III KPS CONVENTIONAL TILL

IF REP=1 AND PLOT=9001 THEN LINE=200;
IF REP=1 AND PLOT=9013 THEN LINE=201;
IF REP=1 AND PLOT=9031 THEN LINE=183;
IF REP=1 AND PLOT=9047 THEN LINE=193;
IF REP=1 AND PLOT=9052 THEN LINE=294;
IF REP=2 AND PLOT=9094 THEN LINE=200;
IF REP=2 AND PLOT=9077 THEN LINE=201;
IF REP=2 AND PLOT=9085 THEN LINE=183;
IF REP=2 AND PLOT=9061 THEN LINE=193;
IF REP=2 AND PLOT=9057 THEN LINE=294;
IF REP=3 AND PLOT=9114 THEN LINE=200;
IF REP=3 AND PLOT=9115 THEN LINE=201;
IF REP=3 AND PLOT=9149 THEN LINE=183;
IF REP=3 AND PLOT=9146 THEN LINE=193;
IF REP=3 AND PLOT=9121 THEN LINE=294;

IF PLOT=9001 AND SUBPLOT=1    OR    PLOT=9094 AND SUBPLOT=1    OR
   PLOT=9114 AND SUBPLOT=1    OR    PLOT=9013 AND SUBPLOT=2    OR
   PLOT=9077 AND SUBPLOT=2    OR    PLOT=9115 AND SUBPLOT=2    OR
   PLOT=9031 AND SUBPLOT=2    OR    PLOT=9085 AND SUBPLOT=3    OR
   PLOT=9149 AND SUBPLOT=5    OR    PLOT=9047 AND SUBPLOT=2    OR
   PLOT=9061 AND SUBPLOT=3    OR    PLOT=9146 AND SUBPLOT=3    OR
   PLOT=9052 AND SUBPLOT=1    OR    PLOT=9057 AND SUBPLOT=1    OR
   PLOT=9121 AND SUBPLOT=1   THEN TRTMT=1;

IF PLOT=9001 AND SUBPLOT=6    OR    PLOT=9094 AND SUBPLOT=3    OR
   PLOT=9114 AND SUBPLOT=4    OR    PLOT=9013 AND SUBPLOT=3    OR
   PLOT=9077 AND SUBPLOT=3    OR    PLOT=9115 AND SUBPLOT=3    OR
   PLOT=9031 AND SUBPLOT=6    OR    PLOT=9085 AND SUBPLOT=4    OR
   PLOT=9149 AND SUBPLOT=6    OR    PLOT=9047 AND SUBPLOT=4    OR
   PLOT=9061 AND SUBPLOT=5    OR    PLOT=9146 AND SUBPLOT=5    OR
   PLOT=9052 AND SUBPLOT=3    OR    PLOT=9057 AND SUBPLOT=5    OR
   PLOT=9121 AND SUBPLOT=5   THEN TRTMT=1;

IF PLOT=9001 AND SUBPLOT=3    OR    PLOT=9094 AND SUBPLOT=4    OR
   PLOT=9114 AND SUBPLOT=6    OR    PLOT=9013 AND SUBPLOT=1    OR
   PLOT=9077 AND SUBPLOT=4    OR    PLOT=9115 AND SUBPLOT=4    OR
   PLOT=9031 AND SUBPLOT=4    OR    PLOT=9085 AND SUBPLOT=6    OR
   PLOT=9149 AND SUBPLOT=3    OR    PLOT=9047 AND SUBPLOT=1    OR
   PLOT=9061 AND SUBPLOT=6    OR    PLOT=9146 AND SUBPLOT=6    OR
   PLOT=9052 AND SUBPLOT=6    OR    PLOT=9057 AND SUBPLOT=2    OR
   PLOT=9121 AND SUBPLOT=3   THEN TRTMT=2;

IF PLOT=9001 AND SUBPLOT=2    OR    PLOT=9094 AND SUBPLOT=2    OR
   PLOT=9114 AND SUBPLOT=5    OR    PLOT=9013 AND SUBPLOT=5    OR
   PLOT=9077 AND SUBPLOT=1    OR    PLOT=9115 AND SUBPLOT=6    OR
   PLOT=9031 AND SUBPLOT=1    OR    PLOT=9085 AND SUBPLOT=2    OR
   PLOT=9149 AND SUBPLOT=2    OR    PLOT=9047 AND SUBPLOT=5    OR
   PLOT=9061 AND SUBPLOT=1    OR    PLOT=9146 AND SUBPLOT=2    OR
   PLOT=9052 AND SUBPLOT=4    OR    PLOT=9057 AND SUBPLOT=4    OR
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FILE: KPSCTZ SAS A

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   PLOT=9121 AND SUBPLOT=4   THEN TRTMT=3;

IF PLOT=9001 AND SUBPLOT=5    OR     PLOT=9094 AND SUBPLOT=6   OR
   PLOT=9114 AND SUBPLOT=2    OR     PLOT=9013 AND SUBPLOT=6   OR
   PLOT=9077 AND SUBPLOT=6    OR     PLOT=9115 AND SUBPLOT=5   OR
   PLOT=9031 AND SUBPLOT=3    OR     PLOT=9065 AND SUBPLOT=5   OR
   PLOT=9149 AND SUBPLOT=1    OR     PLOT=9047 AND SUBPLOT=3   OR
   PLOT=9061 AND SUBPLOT=4    OR     PLOT=9146 AND SUBPLOT=4   OR
   PLOT=9052 AND SUBPLOT=5    OR     PLOT=9057 AND SUBPLOT=6   OR
   PLOT=9121 AND SUBPLOT=2   THEN TRTMT=4;

IF PLOT=9001 AND SUBPLOT=4    OR     PLOT=9094 AND SUBPLOT=5   OR
   PLOT=9114 AND SUBPLOT=3    OR     PLOT=9013 AND SUBPLOT=4   OR
   PLOT=9077 AND SUBPLOT=5    OR     PLOT=9115 AND SUBPLOT=1   OR
   PLOT=9031 AND SUBPLOT=5    OR     PLOT=9065 AND SUBPLOT=1   OR
   PLOT=9149 AND SUBPLOT=4    OR     PLOT=9047 AND SUBPLOT=6   OR
   PLOT=9061 AND SUBPLOT=2    OR     PLOT=9146 AND SUBPLOT=1   OR
   PLOT=9052 AND SUBPLOT=2    OR     PLOT=9057 AND SUBPLOT=3   OR
   PLOT=9121 AND SUBPLOT=6   THEN TRTMT=5;
```

SECTION III KPS CONVENTIONAL TILL
3:06 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
1	1	9001	1	1	0.39489	588.306
2	1	9001	1	2	0.33608	524.876
3	1	9001	1	3	0.37320	554.726
4	1	9001	1	4	0.34695	533.582
5	1	9001	1	5	0.39945	600.746
6	1	9001	2	1	2.96508	498.756
7	1	9001	2	2	1.01004	611.940
8	1	9001	2	3	0.92445	487.562
9	1	9001	2	4	1.03629	676.617
10	1	9001	2	5	1.43004	853.234
11	1	9001	3	1	1.01461	585.821
12	1	9001	3	2	0.76923	544.776
13	1	9001	3	3	0.76238	447.761
14	1	9001	3	4	0.91532	555.970
15	1	9001	3	5	1.18238	577.114
16	1	9001	4	1	0.75782	497.512
17	1	9001	4	2	0.79548	565.920
18	1	9001	4	3	0.79662	618.159
19	1	9001	4	4	0.75325	593.284
20	1	9001	4	5	0.66852	616.915
21	1	9001	5	1	1.77014	631.841
22	1	9001	5	2	1.69254	614.428
23	1	9001	5	3	1.56585	442.786
24	1	9001	5	4	1.37163	543.532
25	1	9001	5	5	1.78270	644.279
26	1	9001	6	1	0.41087	452.587
27	1	9001	6	2	0.36407	317.164
28	1	9001	6	3	0.32869	504.975
29	1	9001	6	4	0.20592	404.229
30	1	9001	6	5	0.37891	563.433
31	1	9013	1	2	0.35380	587.065
32	1	9013	1	2	1.42661	593.284
33	1	9013	1	3	1.73476	504.677
34	1	9013	1	4	1.29651	506.706
35	1	9013	1	5	1.74618	580.846
36	3	9013	1	1	2.17987	584.577
37	1	9013	2	1	0.33440	466.905
38	1	9013	2	3	0.39945	657.960
39	1	9013	2	4	0.39146	166.667
40	1	9013	2	5	0.40744	625.622
41	1	9013	3	1	0.43027	613.184
42	1	9013	3	2	0.53298	662.935
43	1	9013	3	2	1.46770	711.443
44	1	9013	3	3	0.40972	500.000
45	1	9013	3	4	0.39945	563.433
46	1	9013	3	5	0.56494	743.781
47	1	9013	4	1	0.44739	569.652
48	1	9013	4	2	0.73043	608.209
49	1	9013	4	3	0.91075	639.060
50	1	9013	4	4	0.69162	512.438
51	1	9013	4	5	0.63798	517.413
52	1	9013	5	1	0.51701	560.945
53	1	9013	5	2	0.47021	330.846
54	1	9013	5	3	0.57521	641.791
55	1	9013	5	4	0.50217	593.264

SECTION III KPS CONVENTIONAL TILL

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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
56	1	9013	5	5	0.70532	493.781
57	1	9013	6	1	2.73454	572.139
58	1	9013	6	2	1.94819	584.577
59	1	9013	6	3	1.95617	507.463
60	1	9013	6	4	2.77220	620.647
61	1	9013	6	5	2.34650	636.816
62	1	9025	3	1	0.33554	485.075
63	1	9031	1	1	0.55353	654.229
64	1	9031	1	2	0.51701	587.065
65	1	9031	1	3	0.42664	531.095
66	1	9031	1	4	0.43027	527.363
67	1	9031	1	5	0.32070	518.657
68	1	9031	2	1	0.25565	379.353
69	1	9031	2	2	0.33212	595.771
70	1	9031	2	3	0.36407	497.512
71	1	9031	2	4	0.43940	786.557
72	1	9031	3	1	1.68683	720.149
73	1	9031	3	3	1.99726	613.184
74	1	9031	3	4	1.88656	758.706
75	1	9031	3	5	2.19470	827.114
76	1	9031	4	1	0.76236	522.388
77	1	9031	4	2	0.89477	521.144
78	1	9031	4	4	0.97580	598.259
79	1	9031	4	5	0.77494	552.239
80	1	9031	5	1	0.44853	527.363
81	1	9031	5	2	0.57293	620.647
82	1	9031	5	3	0.74869	660.448
83	1	9031	5	4	0.76635	593.284
84	1	9031	5	5	0.91189	643.035
85	1	9031	6	1	0.33896	570.896
86	1	9031	6	2	0.30701	604.478
87	1	9031	6	3	0.30815	507.463
88	1	9031	6	4	0.29331	618.159
89	1	9031	6	5	0.27733	541.045
90	1	9047	1	1	1.10934	365.672
91	1	9047	1	2	0.99521	563.433
92	1	9047	1	3	1.06254	424.129
93	1	9047	1	4	0.97238	415.423
94	1	9047	1	5	1.12189	383.085
95	1	9047	2	1	0.11984	246.756
96	1	9047	2	2	0.22369	379.353
97	1	9047	2	3	0.24880	434.080
98	1	9047	2	4	0.22483	370.647
99	1	9047	2	5	0.24310	402.985
100	1	9047	3	1	1.09678	434.080
101	1	9047	3	2	0.93244	439.055
102	1	9047	3	3	1.12874	395.522
103	1	9047	3	4	1.10363	486.318
104	1	9047	3	5	0.95298	420.398
105	1	9047	4	1	0.27848	529.851
106	1	9047	4	2	0.33554	563.433
107	1	9047	4	3	0.32070	559.701
108	1	9047	4	4	0.23168	466.199
109	1	9047	4	5	0.26478	470.149
110	1	9047	5	1	0.50673	402.985

SECTION III KPS CONVENTIONAL TILL
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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
111	1	9047	5	2	0.50103	512.44
112	1	9047	5	3	0.55923	303.48
113	1	9047	5	4	0.59461	473.88
114	1	9047	5	5	0.46679	383.08
115	1	9047	6	1	0.27391	466.42
116	1	9047	6	2	0.47135	536.07
117	1	9047	6	3	0.36065	496.27
118	1	9047	6	4	0.29217	437.81
119	1	9047	6	5	0.29103	383.05
120	1	9052	1	1	0.32963	570.90
121	1	9052	1	2	0.23853	419.15
122	1	9052	1	4	0.23282	431.59
123	1	9052	1	5	0.17690	349.50
124	1	9052	2	2	0.59916	541.04
125	1	9052	2	3	0.55124	512.44
126	1	9052	2	4	0.42684	440.30
127	1	9052	2	5	0.98608	363.18
128	1	9052	3	2	0.30359	455.22
129	1	9052	3	3	0.24536	409.20
130	1	9052	3	4	0.21228	441.54
131	1	9052	3	5	0.23739	410.45
132	1	9052	4	2	0.47021	498.76
133	1	9052	4	3	0.39032	342.04
134	1	9052	4	4	0.42342	452.74
135	1	9052	4	5	0.47934	519.90
136	1	9052	5	1	0.73727	1057.21
137	1	9052	5	2	0.65624	553.48
138	1	9052	5	3	1.24857	476.37
139	1	9052	5	4	1.01118	436.57
140	1	9052	5	5	0.86282	358.21
141	1	9052	6	1	0.92331	625.62
142	1	9052	6	2	0.79320	547.26
143	1	9052	6	3	0.27277	480.10
144	1	9052	6	4	0.67108	419.15
145	1	9052	6	5	0.51130	388.06
146	2	9057	1	1	0.37434	657.96
147	2	9057	1	2	0.28989	415.42
148	2	9057	1	3	0.28645	447.76
149	2	9057	1	4	0.24766	445.27
150	2	9057	1	5	0.22712	407.96
151	2	9057	2	1	1.33874	493.78
152	2	9057	2	2	1.13787	599.50
153	2	9057	2	3	0.91189	492.54
154	2	9057	2	4	0.69733	384.33
155	2	9057	2	5	0.44396	293.53
156	2	9057	3	1	0.86282	497.51
157	2	9057	3	2	0.57749	165.42
158	2	9057	3	3	0.61358	393.03
159	2	9057	3	4	0.59119	491.29
160	2	9057	3	5	0.42000	361.94
161	2	9057	4	1	0.36864	568.41
162	2	9057	4	2	0.55124	522.39
163	2	9057	4	3	0.73613	480.10
164	2	9057	4	4	0.66537	419.15
165	2	9057	4	5	0.69733	446.52

SECTION III KPS CONVENTIONAL TILL
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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
166	2	9057	5	1	0.28875	460.199
167	2	9057	5	2	0.30244	503.731
168	2	9057	5	3	0.27163	490.050
169	2	9057	5	4	0.24310	486.318
170	2	9057	5	5	0.21114	374.378
171	2	9057	6	1	1.50536	369.403
172	2	9057	6	2	1.41406	501.244
173	2	9057	6	3	1.60237	462.687
174	2	9057	6	4	1.44373	555.970
175	2	9057	6	5	1.90025	450.249
176	2	9061	1	1	0.27962	470.368
177	2	9061	1	2	0.29103	550.995
178	2	9061	1	3	0.24765	447.761
179	2	9061	1	4	0.25108	455.174
180	2	9061	1	5	0.21114	409.204
181	2	9061	2	1	0.48619	555.970
182	2	9061	2	2	0.41087	582.090
183	2	9061	2	3	0.49190	665.423
184	2	9061	2	4	0.40173	478.856
185	2	9061	2	5	0.44625	476.368
186	2	9061	3	1	0.25679	500.000
187	2	9061	3	2	0.22598	517.413
188	2	9061	3	3	0.20592	534.826
189	2	9061	3	5	0.17005	355.721
190	2	9061	4	1	1.32732	456.468
191	2	9061	4	2	1.23509	522.388
192	2	9061	4	3	1.17439	553.483
193	2	9061	4	4	1.06597	330.846
194	2	9061	4	5	0.80119	378.109
195	2	9061	5	1	0.19973	419.154
196	2	9061	5	2	0.24538	353.234
197	2	9061	5	3	0.23625	344.527
198	2	9061	5	4	0.23168	465.174
199	2	9061	5	5	0.17918	380.597
200	2	9061	6	1	0.77380	305.970
201	2	9061	6	2	0.69961	419.154
202	2	9061	6	3	0.59005	419.154
203	2	9061	6	4	0.49760	370.647
204	2	9061	6	5	0.44282	278.607
205	2	9077	1	1	0.71787	565.920
206	2	9077	1	2	0.60374	492.537
207	2	9077	1	3	0.46679	426.617
208	2	9077	1	4	0.43826	383.085
209	2	9077	1	5	0.50673	435.323
210	2	9077	2	1	0.31386	569.652
211	2	9077	2	2	0.29331	560.945
212	2	9077	2	3	0.25793	450.249
213	2	9077	2	4	0.32184	471.393
214	2	9077	2	5	0.26364	480.100
215	2	9077	3	1	0.29902	552.239
216	2	9077	3	2	0.26705	542.289
217	2	9077	3	3	0.28532	508.706
218	2	9077	3	4	0.26076	542.239
219	2	9077	3	5	0.22578	427.861
220	2	9077	4	1	0.88675	579.602

SECTION III KPS CONVENTIONAL TILL
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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
221	2	9077	4	2	0.90040	466.418
222	2	9077	4	3	0.94499	575.871
223	2	9077	4	4	0.66195	298.507
224	2	9077	4	5	0.79549	468.905
225	2	9077	5	1	0.65282	472.637
226	2	9077	5	2	0.57978	536.070
227	2	9077	5	3	0.63798	541.045
228	2	9077	5	4	0.49070	553.483
229	2	9077	5	5	0.47592	485.075
230	2	9077	6	1	1.10477	441.542
231	2	9077	6	2	0.93928	490.050
232	2	9077	6	3	0.86053	476.366
233	2	9077	6	4	0.87651	463.930
234	2	9077	6	5	0.89591	471.393
235	2	9085	1	1	0.51244	737.562
236	2	9085	1	2	0.49190	597.015
237	2	9085	1	3	0.68706	751.244
238	2	9085	1	4	0.64026	695.274
239	2	9085	1	5	0.54666	498.756
240	2	9085	2	1	0.64255	618.159
241	2	9085	2	2	0.78178	537.313
242	2	9085	2	3	0.74755	616.915
243	2	9085	2	4	0.78635	609.453
244	2	9085	2	5	1.05684	654.229
245	2	9085	3	1	0.35606	590.796
246	2	9085	3	2	0.30587	600.746
247	2	9085	3	3	0.38804	213.930
248	2	9085	3	4	0.35038	563.433
249	2	9085	3	5	0.29902	537.313
250	2	9085	4	1	0.39489	720.149
251	2	9085	4	2	0.43711	679.104
252	2	9085	4	3	0.33212	671.642
253	2	9085	4	4	0.30701	583.333
254	2	9085	4	5	0.41429	753.731
255	2	9085	5	1	0.39375	526.119
256	2	9085	5	2	0.80803	552.239
257	2	9085	5	3	0.84684	611.940
258	2	9085	5	4	0.60603	557.214
259	2	9085	5	5	0.65168	710.199
260	2	9085	6	2	1.10021	486.318
261	2	9085	6	3	1.63091	731.343
262	2	9085	6	4	1.05455	445.274
263	2	9085	6	5	1.08679	527.363
264	2	9094	1	1	0.35152	635.572
265	2	9094	1	2	0.28875	549.751
266	2	9094	1	3	0.35038	537.313
267	2	9094	1	4	0.30244	623.134
268	2	9094	1	5	0.35206	650.498
269	2	9094	2	1	1.25200	541.045
270	2	9094	2	2	0.90390	553.483
271	2	9094	2	3	0.53755	485.075
272	2	9094	2	4	0.49532	486.318
273	2	9094	2	5	0.45423	400.498
274	2	9094	3	1	0.34924	655.473
275	2	9094	3	2	0.33554	665.423

SECTION III KPS CONVENTIONAL TILL
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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
276	2	9094	3	3	0.28304	569.652
277	2	9094	3	4	0.21913	473.831
278	2	9094	3	5	0.29445	490.050
279	2	9094	4	1	1.53390	453.980
280	2	9094	4	2	1.10619	677.861
281	2	9094	4	3	1.01004	603.234
282	2	9094	4	4	1.06140	610.697
283	2	9094	5	1	0.76238	573.383
284	2	9094	5	2	0.99064	657.960
285	2	9094	5	3	0.62657	620.647
286	2	9094	5	4	0.49418	555.970
287	2	9094	5	5	0.42228	523.632
288	3	9114	1	1	0.30130	623.134
289	3	9114	1	2	0.32641	583.333
290	3	9114	1	3	0.27619	502.488
291	3	9114	1	4	0.26706	472.637
292	3	9114	1	5	0.34809	613.184
293	3	9114	2	1	1.15042	537.313
294	3	9114	2	2	1.08993	649.254
295	3	9114	2	3	0.80233	536.070
296	3	9114	2	4	0.65510	315.920
297	3	9114	2	5	0.80347	552.239
298	3	9114	3	2	1.35514	630.597
299	3	9114	3	3	0.59119	345.771
300	3	9114	3	4	0.60374	460.100
301	3	9114	3	5	0.65282	553.483
302	3	9114	4	2	0.35722	621.891
303	3	9114	4	3	0.22940	434.080
304	3	9114	4	4	0.25451	476.368
305	3	9114	5	1	0.49646	609.453
306	3	9114	5	2	0.66651	624.378
307	3	9114	5	3	0.66766	401.741
308	3	9114	5	4	0.70189	575.871
309	3	9114	5	5	0.28532	164.179
310	3	9114	6	1	0.99064	557.214
311	3	9114	6	2	1.14700	593.284
312	3	9114	6	3	1.20863	568.408
313	3	9114	6	4	1.15156	589.552
314	3	9115	4	2	0.07418	620.647
315	3	9115	4	3	0.92331	548.507
316	3	9115	4	4	0.92331	559.701
317	3	9115	4	5	1.07053	613.184
318	3	9115	5	2	1.86601	425.373
319	3	9115	5	3	1.43232	694.030
320	3	9115	5	4	1.31933	575.871
321	3	9115	5	5	1.50536	631.841
322	3	9115	6	1	0.48277	599.502
323	3	9115	6	2	0.46222	544.776
324	3	9115	6	3	0.50331	554.726
325	3	9115	6	4	0.42456	531.095
326	3	9115	6	5	0.48505	536.070
327	3	9121	1	1	0.40853	672.886
328	3	9121	1	2	0.40516	675.373
329	3	9121	1	3	0.33668	569.652
330	3	9121	1	4	0.29217	451.493

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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
331	3	9121	1	5	0.26250	396.77
332	3	9121	2	1	1.20406	508.71
333	3	9121	2	2	1.28738	563.43
334	3	9121	2	3	1.14472	567.16
335	3	9121	2	4	0.92673	431.59
336	3	9121	2	5	0.70532	363.18
337	3	9121	3	2	0.60918	587.06
338	3	9121	3	3	0.72130	470.15
339	3	9121	3	4	0.56836	431.59
340	3	9121	3	5	0.32184	261.09
341	3	9121	4	1	0.67793	665.32
342	3	9121	4	2	0.76467	726.37
343	3	9121	4	3	0.68592	594.53
344	3	9121	4	4	0.67222	569.65
345	3	9121	4	5	0.52157	412.94
346	3	9121	5	2	0.36293	606.97
347	3	9121	5	3	0.35951	340.80
348	3	9121	5	4	0.28418	452.74
349	3	9121	5	5	0.27505	478.86
350	3	9121	6	1	1.92536	594.53
351	3	9121	6	2	1.20292	604.48
352	3	9121	6	3	1.00662	470.15
353	3	9121	6	4	1.01004	466.42
354	3	9121	6	5	0.75663	394.28
355	3	9146	1	3	0.53184	477.61
356	3	9146	1	4	0.43255	441.54
357	3	9146	1	5	0.38690	420.40
358	3	9146	2	2	0.97695	478.86
359	3	9146	2	3	0.66423	481.34
360	3	9146	2	4	0.51244	466.42
361	3	9146	2	5	0.34125	313.43
362	3	9146	3	2	0.15065	334.58
363	3	9146	3	3	0.34353	528.61
364	3	9146	3	4	0.28076	457.71
365	3	9146	3	5	0.19630	314.68
366	3	9146	4	2	1.01461	473.86
367	3	9146	4	3	1.14357	577.11
368	3	9146	4	4	0.84912	411.69
369	3	9146	4	5	0.91674	245.02
370	3	9146	5	1	0.24195	468.91
371	3	9146	5	2	0.31336	536.56
372	3	9146	5	3	0.34467	589.55
373	3	9146	5	4	0.34924	600.75
374	3	9146	5	5	0.26250	461.44
375	3	9146	6	1	1.18923	528.61
376	3	9146	6	3	1.34330	643.03
377	3	9146	6	4	1.20635	526.12
378	3	9146	6	5	0.99635	330.85
379	3	9146	6	6	1.20178	477.61
380	3	9149	1	1	3.46496	763.68
381	3	9149	1	2	2.04684	699.00
382	3	9149	1	3	1.45172	569.55
383	3	9149	1	4	1.16640	559.70
384	3	9149	1	5	2.34307	677.85
385	3	9149	2	1	0.59451	1225.12

SECTION III KPS CONVENTIONAL TILL
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OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
386	3	9149	2	2	0.68135	639.303
387	3	9149	2	3	0.64711	661.692
388	3	9149	2	4	0.71102	665.423
389	3	9149	2	5	0.63570	730.100
390	3	9149	3	1	1.10477	626.866
391	3	9149	3	2	1.01004	485.075
392	3	9149	3	3	0.99863	548.507
393	3	9149	3	4	0.86738	475.124
394	3	9149	3	5	0.84684	466.418
395	3	9149	4	1	0.55353	680.348
396	3	9149	4	3	0.66765	491.294
397	3	9149	4	4	0.65510	554.726
398	3	9149	4	5	0.92559	598.259
399	3	9149	5	1	0.38304	552.239
400	3	9149	5	2	0.25793	575.871
401	3	9149	5	3	0.35606	370.647
402	3	9149	5	4	0.46793	624.378
403	3	9149	5	5	0.41885	631.841
404	3	9149	6	1	0.31043	495.025
405	3	9149	6	2	1.13901	502.488
406	3	9149	6	3	0.36179	534.326
407	3	9149	6	4	0.36635	562.189
408	3	9149	6	5	0.38005	527.363

```
FILE: KPSNTZ   SAS      A


LEGEND OF SECTION III KPS NO-TILL

IF REP=1 AND PLOT=6001 THEN LINE=200;
IF REP=1 AND PLOT=6013 THEN LINE=281;
IF REP=1 AND PLOT=6031 THEN LINE=183;
IF REP=1 AND PLOT=6047 THEN LINE=193;
IF REP=1 AND PLOT=6052 THEN LINE=294;
IF REP=2 AND PLOT=6059 THEN LINE=200;
IF REP=2 AND PLOT=6097 THEN LINE=281;
IF REP=2 AND PLOT=6084 THEN LINE=183;
IF REP=2 AND PLOT=6100 THEN LINE=193;
IF REP=2 AND PLOT=6075 THEN LINE=294;
IF REP=3 AND PLOT=6107 THEN LINE=200;
IF REP=3 AND PLOT=6154 THEN LINE=281;
IF REP=3 AND PLOT=6115 THEN LINE=183;
IF REP=3 AND PLOT=6109 THEN LINE=193;
IF REP=3 AND PLOT=6135 THEN LINE=294;

IF PLOT=6001 AND SUBPLOT=1    OR     PLOT=6059 AND SUBPLOT=1    OR
   PLOT=6107 AND SUBPLOT=1    OR     PLOT=6013 AND SUBPLOT=3    OR
   PLOT=6097 AND SUBPLOT=2    OR     PLOT=6154 AND SUBPLOT=1    OR
   PLOT=6031 AND SUBPLOT=1    OR     PLOT=6084 AND SUBPLOT=1    OR
   PLOT=6115 AND SUBPLOT=1    OR     PLOT=6047 AND SUBPLOT=2    OR
   PLOT=6100 AND SUBPLOT=3    OR     PLOT=6109 AND SUBPLOT=1    OR
   PLOT=6052 AND SUBPLOT=3    OR     PLOT=6075 AND SUBPLOT=2    OR
   PLOT=6135 AND SUBPLOT=2   THEN TRTMT=1;


IF PLOT=6001 AND SUBPLOT=2    OR     PLOT=6059 AND SUBPLOT=2    OR
   PLOT=6107 AND SUBPLOT=3    OR     PLOT=6013 AND SUBPLOT=1    OR
   PLOT=6097 AND SUBPLOT=3    OR     PLOT=6154 AND SUBPLOT=2    OR
   PLOT=6031 AND SUBPLOT=3    OR     PLOT=6084 AND SUBPLOT=2    OR
   PLOT=6115 AND SUBPLOT=2    OR     PLOT=6047 AND SUBPLOT=3    OR
   PLOT=6100 AND SUBPLOT=2    OR     PLOT=6109 AND SUBPLOT=2    OR
   PLOT=6052 AND SUBPLOT=2    OR     PLOT=6075 AND SUBPLOT=1    OR
   PLOT=6135 AND SUBPLOT=1   THEN TRTMT=2;


IF PLOT=6001 AND SUBPLOT=3    OR     PLOT=6059 AND SUBPLOT=3    OR
   PLOT=6107 AND SUBPLOT=2    OR     PLOT=6013 AND SUBPLOT=2    OR
   PLOT=6097 AND SUBPLOT=1    OR     PLOT=6154 AND SUBPLOT=3    OR
   PLOT=6031 AND SUBPLOT=2    OR     PLOT=6084 AND SUBPLOT=3    OR
   PLOT=6115 AND SUBPLOT=3    OR     PLOT=6047 AND SUBPLOT=1    OR
   PLOT=6100 AND SUBPLOT=1    OR     PLOT=6109 AND SUBPLOT=3    OR
   PLOT=6052 AND SUBPLOT=1    OR     PLOT=6109 AND SUBPLOT=3    OR
   PLOT=6135 AND SUBPLOT=3   THEN TRTMT=3;
```

SECTION III KPS NO-TILL
3:10 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
1	1	6015	1	4	1.67834	898.01
2	1	6015	2	4	1.13901	759.95
3	1	6015	2	5	1.63319	1026.12
4	1	6015	3	3	1.57042	646.77
5	1	6023	1	4	1.49395	741.29
6	1	6023	3	5	2.13307	610.70
7	1	6052	1	4	1.42205	763.68
8	1	6052	2	4	0.93358	762.44
9	2	6062	1	5	1.08879	551.00
10	2	6062	2	3	0.90733	789.80
11	2	6082	2	1	1.72335	447.76
12	2	6082	3	3	1.45857	623.11
13	2	6082	3	5	1.86541	838.31
14	2	6083	1	5	2.11367	630.60
15	2	6084	1	2	0.52271	634.33
16	2	6084	1	3	0.46793	614.43
17	2	6084	1	4	0.61173	393.03
18	2	6084	2	1	0.55923	420.40
19	2	6084	2	2	0.69048	424.13
20	2	6084	2	3	1.31134	507.46
21	2	6084	2	4	1.54987	511.19
22	2	6084	3	1	1.67313	497.51
23	2	6084	3	2	1.09678	676.62
24	2	6084	3	3	0.97010	628.11
25	2	6084	3	4	1.12760	684.08
26	2	6097	1	1	1.57841	621.89
27	2	6097	1	2	2.06802	427.86
28	2	6097	1	3	1.83862	694.03
29	2	6097	1	4	1.75302	796.02
30	2	6097	1	5	2.14677	830.85
31	2	6097	2	1	0.28989	441.54
32	2	6097	2	2	0.38005	549.75
33	2	6097	2	3	0.33554	369.40
34	2	6097	2	4	0.34924	570.90
35	2	6097	2	5	0.55467	833.33
36	2	6097	3	1	1.12189	580.85
37	2	6097	3	2	0.93586	557.21
38	2	6097	3	3	0.94727	624.38
39	2	6097	3	4	1.37526	703.98
40	2	6100	1	2	0.38462	314.66
41	2	6100	1	3	0.46108	511.19
42	2	6100	1	4	0.44625	354.48
43	2	6100	1	5	0.35606	315.92
44	2	6100	2	1	7.49829	629.35
45	2	6100	2	2	1.58982	598.26
46	2	6100	2	3	1.45743	625.62
47	2	6100	2	4	1.04771	511.19
48	2	6100	2	5	1.02374	457.71
49	2	6100	3	2	0.30016	329.60
50	2	6100	3	3	0.27163	503.73
51	2	6100	3	4	0.27049	449.00
52	2	6100	3	5	0.32299	456.96
53	3	6107	1	1	0.39375	507.46
54	3	6107	1	2	0.41543	539.80
55	3	6107	1	3	0.31271	532.34

SECTION III KPS NO-TILL

3:10 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
56	3	6107	1	4	0.37434	261.19
57	3	6107	1	5	0.57749	618.41
58	3	6107	2	2	1.34787	500.00
59	3	6107	2	3	2.25063	616.92
60	3	6107	2	4	1.67400	544.76
61	3	6107	3	2	6.26569	565.92
62	3	6107	3	3	2.04862	590.80
63	3	6107	3	4	2.02693	692.79
64	3	6109	1	2	0.26532	483.83
65	3	6109	1	3	0.28304	529.85
66	3	6109	1	4	0.52157	803.48
67	3	6109	1	5	0.19973	318.41
68	3	6109	2	2	0.74755	444.03
69	3	6109	2	3	0.59233	434.08
70	3	6109	2	4	0.50331	354.48
71	3	6109	2	5	0.66592	294.78
72	3	6109	3	2	0.99749	468.91
73	3	6109	3	3	1.35585	468.91
74	3	6109	3	4	1.28167	430.35
75	3	6109	3	5	1.27368	503.73
76	3	6115	1	3	0.59804	697.76
77	3	6115	1	3	2.10112	1925.37
78	3	6115	1	4	0.68363	764.93
79	3	6115	2	2	6.27366	508.71
80	3	6115	2	3	2.63068	563.43
81	3	6115	2	4	2.46802	624.35
82	3	6115	3	1	0.63620	579.60
83	3	6115	3	2	0.94727	555.97
84	3	6115	3	3	2.61927	675.37
85	3	6115	3	4	2.78133	723.68
86	3	6115	3	5	0.76467	601.99
87	3	6123	1	2	1.45857	667.81
88	3	6127	1	1	7.28373	434.08
89	3	6127	1	4	1.14586	805.97
90	3	6127	1	5	2.47432	853.23
91	3	6127	2	2	1.89454	569.65
92	3	6127	2	3	1.43460	592.04
93	3	6127	2	4	1.55558	720.15
94	3	6127	2	5	1.95732	758.71
95	3	6127	2	5	2.20498	603.23
96	3	6127	3	1	1.95161	559.70
97	3	6127	3	2	2.48003	715.17
98	3	6127	3	4	1.79247	625.62
99	3	6135	1	1	0.64026	470.15
100	3	6135	1	2	1.41292	476.37
101	3	6135	1	3	0.99292	148.01
102	3	6135	1	4	1.17097	452.74
103	3	6135	1	5	1.25200	504.98
104	3	6152	1	3	1.69824	629.35
105	3	6152	1	5	1.61607	879.35
106	3	6154	1	2	0.43483	544.78
107	3	6154	1	3	0.42456	548.51
108	3	6154	1	4	0.43463	529.85
109	3	6154	1	5	0.53412	633.08
110	3	6154	2	2	1.62292	384.33

SECTION III KPS NO-TILL
3:10 MONDAY, MAY 25

OBS	REP	PLOT	SUBPLOT	VGS	SR	CA
111	3	6154	2	4	1.97101	630.597
112	3	6154	3	1	0.63912	347.015
113	3	6154	3	2	2.31796	509.950
114	3	6154	3	3	3.45583	365.672
115	3	6154	3	4	3.01643	240.050
116	3	6154	3	5	1.97329	628.109

```
FILE: PLTZ      SAS     A

LEGEND FOR SECTION IV PLOTSIZE STUDY

IF PLOT=1 THEN TRTMT=1;
IF PLOT=5 THEN TRTMT=1;
IF PLOT=13 THEN TRTMT=1;
IF PLOT=4 THEN TRTMT=2;
IF PLOT=6 THEN TRTMT=2;
IF PLOT=14 THEN TRTMT=2;
IF PLOT=2 THEN TRTMT=3;
IF PLOT=7 THEN TRTMT=3;
IF PLOT=8 THEN TRTMT=3;
IF PLOT=10 THEN TRTMT=4;
IF PLOT=12 THEN TRTMT=4;
IF PLOT=15 THEN TRTMT=4;
IF PLOT=3 THEN TRTMT=5;
IF PLOT=9 THEN TRTMT=5;
IF PLOT=11 THEN TRTMT=5;
```

SECTION IV PLOTSIZE STUDY
2:36 MONDAY, MAY 25

OBS	PLOT	VOS	SR	TRTMT
1	1	5	0.75097	1
2	1	6	0.83200	1
3	1	8	0.56950	1
4	1	9	0.63912	1
5	1	11	0.47820	1
6	5	9	0.42027	1
7	5	10	0.45660	1
8	5	11	0.36521	1
9	5	13	0.60831	1
10	13	4	2.06802	1
11	13	5	1.46140	1
12	13	6	1.52362	1
13	13	7	1.89340	1
14	13	8	2.70307	1
15	13	9	2.23465	1
16	13	10	1.76553	1
17	13	11	2.37503	1
18	13	12	2.36476	1
19	13	13	1.27140	1
20	4	4	2.59302	2
21	4	5	2.20498	2
22	4	6	1.56585	2
23	4	7	2.29171	2
24	4	8	1.23031	2
25	4	9	1.37412	2
26	4	11	1.09222	2
27	4	12	1.20178	2
28	4	13	1.32390	2
29	6	4	1.29423	2
30	6	5	1.20977	2
31	6	7	0.66081	2
32	6	8	0.64597	2
33	6	9	0.59604	2
34	6	10	0.63228	2
35	6	11	0.57065	2
36	6	12	0.67336	2
37	6	13	0.82287	2
38	14	4	1.17553	2
39	14	5	1.38553	2
40	14	6	1.44602	2
41	14	7	1.19151	2
42	14	8	0.96667	2
43	14	9	0.99635	2
44	14	10	0.99863	2
45	14	11	0.96553	2
46	14	12	1.12531	2
47	14	13	1.18694	2
48	2	4	0.44396	3
49	2	5	6.14814	3
50	2	6	2.19927	3
51	2	7	1.59438	3
52	2	8	1.65257	3
53	2	9	1.23374	3
54	2	10	1.27711	3
55	2	11	1.40379	3

SECTION IV PLOTSIZE STUDY
2:36 MONDAY, MAY 25

OBS	PLOT	VGS	SS	TRTMT
56	2	12	1.54303	3
57	2	13	1.14243	3
58	7	4	2.66720	3
59	7	5	3.91463	3
60	7	6	2.23123	3
61	7	7	2.11139	3
62	7	8	1.87971	3
63	7	9	1.71650	3
64	7	10	1.81009	3
65	7	11	1.45058	3
66	7	12	1.60466	3
67	7	13	1.81009	3
68	8	4	1.02031	3
69	8	5	1.60580	3
70	8	8	0.97809	3
71	8	9	1.07624	3
72	8	10	0.88564	3
73	8	11	0.92901	3
74	8	12	0.83771	3
75	8	13	1.01233	3
76	10	4	2.16161	4
77	10	5	2.02808	4
78	10	6	2.13307	4
79	10	7	1.56585	4
80	10	8	1.42433	4
81	10	9	1.33759	4
82	10	10	1.22689	4
83	10	11	1.30221	4
84	10	12	1.31933	4
85	10	13	1.37754	4
86	12	4	2.29286	4
87	12	5	4.11550	4
88	12	6	2.29856	4
89	12	7	1.72449	4
90	12	8	1.33531	4
91	12	9	1.25999	4
92	12	10	1.04086	4
93	12	11	1.15042	4
94	12	12	1.21546	4
95	12	13	1.13787	4
96	15	4	1.48368	4
97	15	5	1.40493	4
98	15	6	1.35700	4
99	15	7	1.38210	4
100	15	8	1.45857	4
101	15	9	1.28738	4
102	15	10	1.30221	4
103	15	11	1.25542	4
104	15	12	1.32162	4
105	15	13	1.27140	4
106	3	4	1.30221	5
107	3	5	2.56448	5
108	3	6	1.73591	5
109	3	7	1.59324	5
110	3	8	1.22232	5

SECTION IV PLOTSIZE STUDY
2:36 MONDAY, MAY 25

OBS	PLOT	VGS	SR	TRTMT
111	3	9	0.86852	5
112	3	10	0.82401	5
113	3	11	0.98151	5
114	3	12	0.91874	5
115	3	13	0.85255	5
116	9	4	0.79890	5
117	9	5	0.70988	5
118	9	8	0.58548	5
119	11	4	2.52497	5
120	11	5	2.66720	5
121	11	6	2.42525	5
122	11	7	2.18786	5
123	11	8	1.63319	5
124	11	9	1.44259	5
125	11	10	1.54460	5
126	11	11	1.56243	5
127	11	12	1.52134	5
128	11	13	1.37754	5

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FILE: KPSX2     SAS     A

LEGEND FOR SECTION IV ROOT CHARACTERIZATION STUDY

IF PLOT=1 AND SUBPLOT=1 THEN TRTMT=14;
IF PLOT=1 AND SUBPLOT=2 THEN TRTMT=5;
IF PLOT=1 AND SUBPLOT=3 THEN TRTMT=14;
IF PLOT=2 AND SUBPLOT=1 THEN TRTMT=11;
IF PLOT=2 AND SUBPLOT=2 THEN TRTMT=1;
IF PLOT=2 AND SUBPLOT=3 THEN TRTMT=11;
IF PLOT=3 AND SUBPLOT=1 THEN TRTMT=15;
IF PLOT=3 AND SUBPLOT=2 THEN TRTMT=7;
IF PLOT=3 AND SUBPLOT=3 THEN TRTMT=15;
IF PLOT=4 AND SUBPLOT=1 THEN TRTMT=16;
IF PLOT=4 AND SUBPLOT=2 THEN TRTMT=8;
IF PLOT=4 AND SUBPLOT=3 THEN TRTMT=16;
IF PLOT=5 AND SUBPLOT=1 THEN TRTMT=12;
IF PLOT=5 AND SUBPLOT=2 THEN TRTMT=2;
IF PLOT=5 AND SUBPLOT=3 THEN TRTMT=12;
IF PLOT=6 AND SUBPLOT=1 THEN TRTMT=10;
IF PLOT=6 AND SUBPLOT=2 THEN TRTMT=10;
IF PLOT=6 AND SUBPLOT=3 THEN TRTMT=10;
IF PLOT=7 AND SUBPLOT=1 THEN TRTMT=9;
IF PLOT=7 AND SUBPLOT=2 THEN TRTMT=9;
IF PLOT=7 AND SUBPLOT=3 THEN TRTMT=9;
IF PLOT=8 AND SUBPLOT=1 THEN TRTMT=3;
IF PLOT=8 AND SUBPLOT=2 THEN TRTMT=3;
IF PLOT=8 AND SUBPLOT=3 THEN TRTMT=3;
IF PLOT=9 AND SUBPLOT=1 THEN TRTMT=13;
IF PLOT=9 AND SUBPLOT=2 THEN TRTMT=4;
IF PLOT=9 AND SUBPLOT=3 THEN TRTMT=13;
IF PLOT=10 AND SUBPLOT=1 THEN TRTMT=6;
IF PLOT=10 AND SUBPLOT=2 THEN TRTMT=6;
IF PLOT=10 AND SUBPLOT=3 THEN TRTMT=6;
IF PLOT=11 AND SUBPLOT=1 THEN TRTMT=13;
IF PLOT=11 AND SUBPLOT=2 THEN TRTMT=4;
IF PLOT=11 AND SUBPLOT=3 THEN TRTMT=13;
IF PLOT=12 AND SUBPLOT=1 THEN TRTMT=3;
IF PLOT=12 AND SUBPLOT=2 THEN TRTMT=3;
IF PLOT=12 AND SUBPLOT=3 THEN TRTMT=3;
IF PLOT=13 AND SUBPLOT=1 THEN TRTMT=6;
IF PLOT=13 AND SUBPLOT=2 THEN TRTMT=6;
IF PLOT=13 AND SUBPLOT=3 THEN TRTMT=6;
IF PLOT=14 AND SUBPLOT=1 THEN TRTMT=10;
IF PLOT=14 AND SUBPLOT=2 THEN TRTMT=10;
IF PLOT=14 AND SUBPLOT=3 THEN TRTMT=10;
IF PLOT=15 AND SUBPLOT=1 THEN TRTMT=15;
IF PLOT=15 AND SUBPLOT=2 THEN TRTMT=7;
IF PLOT=15 AND SUBPLOT=3 THEN TRTMT=15;
IF PLOT=16 AND SUBPLOT=1 THEN TRTMT=9;
IF PLOT=16 AND SUBPLOT=2 THEN TRTMT=9;
IF PLOT=16 AND SUBPLOT=3 THEN TRTMT=9;
IF PLOT=17 AND SUBPLOT=1 THEN TRTMT=11;
IF PLOT=17 AND SUBPLOT=2 THEN TRTMT=1;
IF PLOT=17 AND SUBPLOT=3 THEN TRTMT=11;
IF PLOT=18 AND SUBPLOT=1 THEN TRTMT=12;
IF PLOT=18 AND SUBPLOT=2 THEN TRTMT=2;
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IF PLOT=18 AND SUBPLOT=3 THEN TRTMT=12;
IF PLOT=19 AND SUBPLOT=1 THEN TRTMT=14;
IF PLOT=19 AND SUBPLOT=2 THEN TRTMT=5;
IF PLOT=19 AND SUBPLOT=3 THEN TRTMT=14;
IF PLOT=20 AND SUBPLOT=1 THEN TRTMT=16;
IF PLOT=20 AND SUBPLOT=2 THEN TRTMT=8;
IF PLOT=20 AND SUBPLOT=3 THEN TRTMT=16;
IF PLOT=21 AND SUBPLOT=1 THEN TRTMT=14;
IF PLOT=21 AND SUBPLOT=2 THEN TRTMT=5;
IF PLOT=21 AND SUBPLOT=3 THEN TRTMT=14;
IF PLOT=22 AND SUBPLOT=1 THEN TRTMT=9;
IF PLOT=22 AND SUBPLOT=2 THEN TRTMT=9;
IF PLOT=22 AND SUBPLOT=3 THEN TRTMT=9;
IF PLOT=23 AND SUBPLOT=1 THEN TRTMT=10;
IF PLOT=23 AND SUBPLOT=2 THEN TRTMT=10;
IF PLOT=23 AND SUBPLOT=3 THEN TRTMT=10;
IF PLOT=24 AND SUBPLOT=1 THEN TRTMT=6;
IF PLOT=24 AND SUBPLOT=2 THEN TRTMT=6;
IF PLOT=24 AND SUBPLOT=3 THEN TRTMT=6;
IF PLOT=25 AND SUBPLOT=1 THEN TRTMT=16;
IF PLOT=25 AND SUBPLOT=2 THEN TRTMT=6;
IF PLOT=25 AND SUBPLOT=3 THEN TRTMT=16;
IF PLOT=26 AND SUBPLOT=1 THEN TRTMT=12;
IF PLOT=26 AND SUBPLOT=2 THEN TRTMT=2;
IF PLOT=26 AND SUBPLOT=3 THEN TRTMT=12;
IF PLOT=27 AND SUBPLOT=1 THEN TRTMT=15;
IF PLOT=27 AND SUBPLOT=2 THEN TRTMT=7;
IF PLOT=27 AND SUBPLOT=3 THEN TRTMT=15;
IF PLOT=28 AND SUBPLOT=1 THEN TRTMT=13;
IF PLOT=28 AND SUBPLOT=2 THEN TRTMT=4;
IF PLOT=28 AND SUBPLOT=3 THEN TRTMT=13;
IF PLOT=29 AND SUBPLOT=1 THEN TRTMT=11;
IF PLOT=29 AND SUBPLOT=2 THEN TRTMT=1;
IF PLOT=29 AND SUBPLOT=3 THEN TRTMT=11;
IF PLOT=30 AND SUBPLOT=1 THEN TRTMT=3;
IF PLOT=30 AND SUBPLOT=2 THEN TRTMT=3;
IF PLOT=30 AND SUBPLOT=3 THEN TRTMT=3;
```

SECTION IV ROOT CHARACTERIZATION STUDY
2:38 MONDAY, MAY 25

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
1	2	2	1	1.92992	1
2	2	2	2	2.94567	1
3	2	2	3	3.73659	1
4	2	2	4	2.24036	1
5	2	2	5	2.60872	1
6	2	2	6	2.11139	1
7	2	2	7	2.04063	1
8	2	2	8	1.63319	1
9	2	2	9	1.73020	1
10	2	2	10	1.47341	1
11	2	2	11	1.57612	1
12	2	2	12	1.46656	1
13	2	2	13	1.74161	1
14	17	2	1	2.66948	1
15	17	2	2	2.59073	1
16	17	2	3	2.50265	1
17	17	2	4	1.28167	1
18	17	2	5	1.09222	1
19	17	2	6	1.25542	1
20	17	2	7	0.99407	1
21	17	2	8	1.14357	1
22	17	2	9	1.17211	1
23	17	2	10	1.13444	1
24	17	2	11	0.97010	1
25	17	2	12	1.10819	1
26	17	2	13	0.97580	1
27	29	2	1	0.48505	1
28	29	2	2	0.54211	1
29	29	2	3	0.48619	1
30	29	2	4	0.43141	1
31	29	2	5	0.42342	1
32	29	2	6	0.64940	1
33	29	2	7	0.69505	1
34	29	2	8	0.60032	1
35	29	2	9	0.55695	1
36	29	2	10	0.71797	1
37	29	2	11	0.68592	1
38	29	2	12	0.71217	1
39	29	2	13	0.75663	1
40	5	2	1	0.64825	2
41	5	2	2	0.45766	2
42	5	2	3	0.33771	2
43	5	2	4	0.47820	2
44	5	2	5	0.70532	2
45	5	2	6	0.69046	2
46	5	2	7	0.59461	2
47	5	2	8	0.59918	2
48	5	2	9	0.37320	2
49	5	2	10	0.47135	2
50	5	2	11	0.40744	2
51	5	2	12	0.41201	2
52	5	2	13	0.62543	2
53	18	2	1	0.55608	2
54	18	2	2	0.65967	2
55	18	2	4	0.91417	2

SECTION IV ROOT CHARACTERIZATION STUDY
2:38 MONDAY, MAY 25

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
56	18	2	5	1.32732	2
57	18	2	6	1.49395	2
58	18	2	7	1.11162	2
59	18	2	8	1.06254	2
60	18	2	9	1.02031	2
61	18	2	10	1.48026	2
62	18	2	11	1.02146	2
63	18	2	12	1.09564	2
64	18	2	13	1.22346	2
65	26	2	1	2.06574	2
66	26	2	2	1.71879	2
67	26	2	4	2.85437	2
68	26	2	5	2.33737	2
69	26	2	7	1.82493	2
70	26	2	8	1.24173	2
71	26	2	9	1.10819	2
72	26	2	10	0.95640	2
73	26	2	11	0.91760	2
74	26	2	12	1.20520	2
75	26	2	13	1.35129	2
76	8	1	1	0.94042	3
77	8	1	2	0.41315	3
78	8	1	3	0.41657	3
79	8	1	4	0.34467	3
80	8	1	5	0.31842	3
81	8	1	6	0.31614	3
82	8	1	7	0.26136	3
83	8	1	8	0.30701	3
84	8	1	9	0.31728	3
85	8	1	10	0.27843	3
86	8	1	11	0.45538	3
87	8	1	12	0.38804	3
88	8	1	13	0.79662	3
89	8	2	1	0.47934	3
90	8	2	2	0.40516	3
91	8	2	3	0.87081	3
92	8	2	4	0.45081	3
93	8	2	5	1.36841	3
94	8	2	6	0.69391	3
95	8	2	7	1.14357	3
96	8	2	8	0.91646	3
97	8	2	9	1.02716	3
98	8	2	10	0.71445	3
99	8	2	11	1.11732	3
100	8	2	12	0.90803	3
101	8	2	13	1.44031	3
102	8	3	1	0.43027	3
103	8	3	2	0.40516	3
104	8	3	3	0.45195	3
105	8	3	4	0.34695	3
106	8	3	5	0.33212	3
107	8	3	6	0.26820	3
108	8	3	7	0.24830	3
109	8	3	8	0.20201	3
110	8	3	9	0.19060	3

SECTION IV ROOT CHARACTERIZATION STUDY
2:36 MONDAY, MAY 25

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
111	8	3	10	0.17918	3
112	8	3	11	0.17576	3
113	8	3	12	0.22027	3
114	8	3	13	0.36293	3
115	12	1	1	0.43711	3
116	12	1	2	0.48391	3
117	12	1	4	0.33668	3
118	12	1	5	0.29331	3
119	12	1	6	0.23168	3
120	12	1	7	0.24424	3
121	12	1	8	0.31842	3
122	12	1	9	0.30929	3
123	12	1	10	0.29331	3
124	12	1	11	0.26592	3
125	12	1	12	0.30472	3
126	12	1	13	0.42456	3
127	12	2	1	0.56266	3
128	12	2	2	0.47135	3
129	12	2	3	0.51586	3
130	12	2	4	0.35494	3
131	12	2	5	0.41771	3
132	12	2	6	0.28418	3
133	12	2	7	0.37320	3
134	12	2	8	0.35152	3
135	12	2	9	0.41429	3
136	12	2	10	0.26021	3
137	12	2	11	0.42228	3
138	12	2	12	0.34924	3
139	12	2	13	0.53296	3
140	12	3	1	0.71673	3
141	12	3	2	0.80918	3
142	12	3	3	0.92331	3
143	12	3	4	0.91874	3
144	12	3	5	1.02716	3
145	12	3	6	0.89706	3
146	12	3	7	1.24053	3
147	12	3	8	0.79434	3
148	12	3	9	0.78749	3
149	12	3	10	0.83314	3
150	12	3	11	0.58546	3
151	12	3	12	0.70189	3
152	12	3	13	1.10477	3
153	30	1	1	0.54325	3
154	30	1	2	0.47478	3
155	30	1	4	0.45309	3
156	30	1	5	0.37320	3
157	30	1	6	0.54554	3
158	30	1	7	0.49190	3
159	30	1	8	0.59461	3
160	30	1	9	0.47706	3
161	30	1	10	0.52614	3
162	30	1	11	0.50673	3
163	30	1	12	0.48277	3
164	30	1	13	0.69733	3
165	30	2	1	0.48505	3

SECTION IV ROOT CHARACTERIZATION STUDY
2:38 MONDAY, MAY 25

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
166	30	2	2	0.49969	3
167	30	2	3	0.50559	3
168	30	2	4	0.40744	3
169	30	2	5	0.40516	3
170	30	2	6	0.45061	3
171	30	2	7	0.42342	3
172	30	2	8	0.44967	3
173	30	2	9	0.37206	3
174	30	2	10	0.41201	3
175	30	2	11	0.41657	3
176	30	2	12	0.50331	3
177	30	2	13	0.62315	3
178	30	3	3	0.59005	3
179	30	3	4	0.48647	3
180	30	3	5	0.54554	3
181	30	3	6	0.40173	3
182	30	3	7	0.34809	3
183	30	3	8	0.23418	3
184	30	3	9	0.25706	3
185	30	3	10	0.28076	3
186	30	3	11	0.34809	3
187	9	2	1	1.66400	4
188	9	2	2	1.35129	4
189	9	2	3	1.94819	4
190	9	2	4	1.66971	4
191	9	2	5	1.54074	4
192	9	2	6	1.66514	4
193	9	2	7	1.16526	4
194	9	2	8	1.36841	4
195	9	2	9	0.93129	4
196	9	2	10	1.14814	4
197	9	2	11	0.92787	4
198	9	2	12	1.01689	4
199	9	2	13	1.42091	4
200	11	2	1	1.95960	4
201	11	2	2	2.14449	4
202	11	2	3	1.12075	4
203	11	2	4	2.12166	4
204	11	2	5	1.77813	4
205	11	2	6	1.77927	4
206	11	2	7	1.31933	4
207	11	2	8	1.28966	4
208	11	2	9	0.89706	4
209	11	2	10	1.06254	4
210	11	2	11	0.78407	4
211	11	2	12	1.19037	4
212	11	2	13	1.44145	4
213	28	2	1	0.81331	4
214	28	2	2	0.78635	4
215	28	2	3	1.49167	4
216	28	2	4	0.86852	4
217	28	2	5	0.85140	4
218	28	2	6	1.04771	4
219	28	2	7	0.75668	4
220	28	2	8	0.76467	4

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
221	28	2	9	0.58434	4
222	28	2	10	0.54211	4
223	28	2	11	0.55124	4
224	28	2	12	0.57749	4
225	28	2	13	0.79776	4
226	1	2	1	0.53298	5
227	1	2	2	0.48505	5
228	1	2	3	0.49304	5
229	1	2	4	0.63226	5
230	1	2	5	0.46108	5
231	1	2	6	0.55581	5
232	1	2	7	0.43027	5
233	1	2	8	0.60603	5
234	1	2	9	0.56536	5
235	1	2	10	0.79434	5
236	1	2	11	0.60717	5
237	1	2	12	0.76352	5
238	1	2	13	0.91674	5
239	19	2	1	0.50673	5
240	19	2	2	0.37891	5
241	19	2	4	0.27391	5
242	19	2	5	0.69048	5
243	19	2	6	0.58320	5
244	19	2	7	1.28053	5
245	19	2	8	1.54417	5
246	19	2	9	1.30336	5
247	19	2	10	2.12394	5
248	19	2	11	1.50466	5
249	19	2	12	1.53504	5
250	19	2	13	1.30107	5
251	21	2	1	0.37320	5
252	21	2	2	0.42000	5
253	21	2	4	0.38005	5
254	21	2	5	0.36978	5
255	21	2	6	0.30016	5
256	21	2	7	0.33326	5
257	21	2	8	0.28989	5
258	21	2	9	0.24652	5
259	21	2	10	0.28076	5
260	21	2	11	0.24310	5
261	21	2	12	0.23967	5
262	21	2	13	0.29331	5
263	10	1	1	0.39717	6
264	10	1	2	0.35407	6
265	10	1	3	0.63455	6
266	10	1	4	0.32299	6
267	10	1	5	0.27733	6
268	10	1	7	0.23739	6
269	10	1	8	0.28190	6
270	10	1	9	0.26021	6
271	10	1	10	0.27277	6
272	10	1	11	0.28761	6
273	10	1	12	0.28304	6
274	10	1	13	0.34353	6
275	10	2	1	0.44054	6

SECTION IV   ROOT CHARACTERIZATION STUDY
2:38 MONDAY, MAY 25

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
276	10	2	2	0.381192	6
277	10	2	3	0.419995	6
278	10	2	4	0.505592	6
279	10	2	5	0.431408	6
280	10	2	6	0.296736	6
281	10	2	7	0.406300	6
282	10	2	8	0.307005	6
283	10	2	9	0.494179	6
284	10	2	10	0.389181	6
285	10	2	12	0.470212	6
286	10	2	13	0.789774	6
287	10	3	1	0.380050	6
288	10	3	2	0.386896	6
289	10	3	3	0.401735	6
290	10	3	4	0.336651	6
291	10	3	5	0.328692	6
292	10	3	6	0.302442	6
293	10	3	7	0.285323	6
294	10	3	8	0.271627	6
295	10	3	9	0.295595	6
296	10	3	10	0.221411	6
297	10	3	11	0.244236	6
298	10	3	12	0.385757	6
299	10	3	13	0.473636	6
300	13	1	1	0.505592	6
301	13	1	2	0.438473	6
302	13	1	4	0.416572	6
303	13	1	5	0.365898	6
304	13	1	6	0.376909	6
305	13	1	7	0.402876	6
306	13	1	8	0.386039	6
307	13	1	9	0.362931	6
308	13	1	10	0.369779	6
309	13	1	11	0.413148	6
310	13	1	12	0.413148	6
311	13	1	13	0.571767	6
312	13	2	1	0.764666	6
313	13	2	2	0.595754	6
314	13	2	4	0.427984	6
315	13	2	5	0.333257	6
316	13	2	6	0.486190	6
317	13	2	7	0.369779	6
318	13	2	8	0.338964	6
319	13	2	9	0.345811	6
320	13	2	10	0.389181	6
321	13	2	11	0.368637	6
322	13	2	12	0.357224	6
323	13	2	13	0.417713	6
324	13	3	1	0.651673	6
325	13	3	2	0.512440	6
326	13	3	3	0.691623	6
327	13	3	4	0.377768	6
328	13	3	5	0.295595	6
329	13	3	6	0.481625	6
330	13	3	7	0.370920	6

SECTION IV ROOT CHARACTERIZATION STUDY
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OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
331	13	3	8	0.460484	6
332	13	3	9	0.392604	6
333	13	3	10	0.519288	6
334	13	3	11	0.497603	6
335	13	3	12	0.608309	6
336	13	3	13	0.738416	6
337	24	1	1	0.501027	6
338	24	1	2	0.510157	6
339	24	1	4	0.424561	6
340	24	1	5	0.380050	6
341	24	1	6	0.394837	6
342	24	1	7	0.358366	6
343	24	1	8	0.327551	6
344	24	1	9	0.289885	6
345	24	1	10	0.317279	6
346	24	1	11	0.296736	6
347	24	1	12	0.317279	6
348	24	1	13	0.414289	6
349	24	2	1	0.481625	6
350	24	2	2	0.560918	6
351	24	2	4	0.512440	6
352	24	2	5	0.439397	6
353	24	2	6	0.431408	6
354	24	2	7	0.464506	6
355	24	2	8	0.402876	6
356	24	2	9	0.346094	6
357	24	2	10	0.348094	6
358	24	2	11	0.318420	6
359	24	2	12	0.345811	6
360	24	2	13	0.341246	6
361	24	3	1	0.501027	6
362	24	3	2	0.449669	6
363	24	3	4	0.488473	6
364	24	3	5	0.610591	6
365	24	3	6	0.493038	6
366	24	3	7	0.278475	6
367	24	3	8	0.458799	6
368	24	3	9	0.421137	6
369	24	3	10	0.416572	6
370	24	3	11	0.427984	6
371	24	3	12	0.434832	6
372	24	3	13	0.539831	6
373	3	2	1	0.446245	7
374	3	2	2	0.321844	7
375	3	2	3	0.316138	7
376	3	2	4	0.260215	7
377	3	2	5	0.237389	7
378	3	2	6	0.273910	7
379	3	2	7	0.297877	7
380	3	2	8	0.303584	7
381	3	2	9	0.414289	7
382	3	2	10	0.335540	7
383	3	2	11	0.419995	7
384	3	2	12	0.466788	7
385	3	2	13	0.958685	7

SECTION IV ROOT CHARACTERIZATION STUDY
2:38 MONDAY, MAY 25

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
386	15	2	1	0.76581	7
387	15	2	2	0.98722	7
388	15	2	3	0.59233	7
389	15	2	4	1.09450	7
390	15	2	6	1.41863	7
391	15	2	7	1.90710	7
392	15	2	8	1.30107	7
393	15	2	9	1.03529	7
394	15	2	10	0.79320	7
395	15	2	11	1.01347	7
396	15	2	12	0.86168	7
397	15	2	13	0.61972	7
398	27	2	1	0.63113	7
399	27	2	2	0.81831	7
400	27	2	3	1.55102	7
401	27	2	4	0.63456	7
402	27	2	5	0.63456	7
403	27	2	6	0.84227	7
404	27	2	7	0.82858	7
405	27	2	8	0.89135	7
406	27	2	9	0.54440	7
407	27	2	10	0.61059	7
408	27	2	11	0.58434	7
409	27	2	12	0.66423	7
410	27	2	13	0.57521	7
411	4	2	1	0.39032	8
412	4	2	2	0.36521	8
413	4	2	3	0.33896	8
414	4	2	4	0.29559	8
415	4	2	5	0.23739	8
416	4	2	6	0.29788	8
417	4	2	7	0.25108	8
418	4	2	8	0.28646	8
419	4	2	9	0.29217	8
420	4	2	10	0.23625	8
421	4	2	11	0.24424	8
422	4	2	12	0.26706	8
423	4	2	13	0.35951	8
424	20	2	1	0.54440	8
425	20	2	2	0.55010	8
426	20	2	4	0.64711	8
427	20	2	5	0.35951	8
428	20	2	6	0.61488	8
429	20	2	7	1.08309	8
430	20	2	8	1.08080	8
431	20	2	9	1.11732	8
432	20	2	10	0.61602	8
433	20	2	11	0.60233	8
434	20	2	12	0.74070	8
435	20	2	13	1.13673	8
436	25	2	1	0.48163	8
437	25	2	2	0.49989	8
438	25	2	4	0.41087	8
439	25	2	5	0.41429	8
440	25	2	6	0.44967	8

SECTION IV ROOT CHARACTERIZATION STUDY
2:38 MONDAY, MAY 25

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
441	25	2	7	0.407441	8
442	25	2	8	0.406300	8
443	25	2	9	0.381192	8
444	25	2	10	0.412006	8
445	25	2	11	0.575211	8
446	25	2	12	0.509016	8
447	25	2	13	0.914175	8
448	7	1	1	0.418854	9
449	7	1	2	0.377768	9
450	7	1	3	0.376909	9
451	7	1	4	0.300160	9
452	7	1	5	0.117553	9
453	7	1	6	0.246519	9
454	7	1	7	0.309290	9
455	7	1	8	0.236247	9
456	7	1	9	0.296736	9
457	7	1	10	0.308149	9
458	7	1	11	0.329833	9
459	7	1	12	0.358366	9
460	7	1	13	0.437115	9
461	7	2	1	0.400593	9
462	7	2	2	0.324127	9
463	7	2	3	0.370920	9
464	7	2	4	0.287606	9
465	7	2	5	0.295595	9
466	7	2	6	0.269345	9
467	7	2	7	0.311573	9
468	7	2	8	0.227117	9
469	7	2	9	0.207715	9
470	7	2	10	0.189454	9
471	7	2	11	0.244236	9
472	7	2	12	0.222552	9
473	7	2	13	0.354942	9
474	7	3	1	0.383474	9
475	7	3	2	0.326409	9
476	7	3	3	0.316138	9
477	7	3	4	0.281899	9
478	7	3	5	0.228258	9
479	7	3	6	0.223693	9
480	7	3	7	0.228258	9
481	7	3	8	0.208856	9
482	7	3	9	0.149366	9
483	7	3	10	0.151792	9
484	7	3	11	0.128966	9
485	7	3	12	0.188313	9
486	7	3	13	0.310431	9
487	16	1	1	0.376626	9
488	16	1	2	0.380898	9
489	16	1	4	0.311573	9
490	16	1	5	0.284162	9
491	16	1	6	0.276193	9
492	16	1	6	0.446528	9
493	16	1	7	0.293312	9
494	16	1	8	0.269345	9
495	16	1	9	0.235106	9

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
496	16	1	10	0.273910	9
497	16	1	11	0.254508	9
498	16	1	12	0.343529	9
499	16	2	1	0.368637	9
500	16	2	2	0.502166	9
501	16	2	4	0.270486	9
502	16	2	5	0.270436	9
503	16	2	6	0.302442	9
504	16	2	7	0.291029	9
505	16	2	8	0.294453	9
506	16	2	9	0.254508	9
507	16	2	10	0.261356	9
508	16	2	11	0.309290	9
509	16	2	12	0.362931	9
510	16	2	13	0.423419	9
511	16	3	1	0.410865	9
512	16	3	2	0.353801	9
513	16	3	3	0.524994	9
514	16	3	4	0.283040	9
515	16	3	5	0.287606	9
516	16	3	6	0.283040	9
517	16	3	7	0.310431	9
518	16	3	8	0.284182	9
519	16	3	9	0.235106	9
520	16	3	10	0.257932	9
521	16	3	11	0.166629	9
522	16	3	12	0.267062	9
523	16	3	13	0.329833	9
524	22	1	1	0.572929	9
525	22	1	2	0.512440	9
526	22	1	3	0.625852	9
527	22	1	4	0.482706	9
528	22	1	5	0.453093	9
529	22	1	6	0.477060	9
530	22	1	7	0.463365	9
531	22	1	8	0.443963	9
532	22	1	9	0.410865	9
533	22	1	10	0.384615	9
534	22	1	11	0.458799	9
535	22	1	12	0.432765	9
536	22	1	13	0.496462	9
537	22	2	1	0.631134	9
538	22	2	2	0.547820	9
539	22	2	4	0.445104	9
540	22	2	5	0.470212	9
541	22	2	7	0.404017	9
542	22	2	8	0.421137	9
543	22	2	9	0.346953	9
544	22	2	10	0.398311	9
545	22	2	11	0.342388	9
546	22	2	11	0.431408	9
547	22	2	12	0.556950	9
548	22	3	1	0.447386	9
549	22	3	2	0.568363	9
550	22	3	3	0.746405	9

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
551	22	3	4	0.515864	9
552	22	3	5	0.443963	9
553	22	3	6	0.392604	9
554	22	3	7	0.407441	9
555	22	3	8	0.394687	9
556	22	3	9	0.377768	9
557	22	3	10	0.374344	9
558	22	3	12	0.336598	9
559	22	3	13	0.590048	9
560	6	1	1	0.313855	10
561	6	1	2	0.294453	10
562	6	1	3	0.330975	10
563	6	1	4	0.252226	10
564	6	1	5	0.229400	10
565	6	1	6	0.195161	10
566	6	1	7	0.241954	10
567	6	1	8	0.262497	10
568	6	1	9	0.191737	10
569	6	1	10	0.165487	10
570	6	1	11	0.186031	10
571	6	1	12	0.206574	10
572	6	1	13	0.249943	10
573	6	2	1	0.319562	10
574	6	2	2	0.311573	10
575	6	2	3	0.344670	10
576	6	2	4	0.259073	10
577	6	2	5	0.260215	10
578	6	2	6	0.208856	10
579	6	2	7	0.156357	10
580	6	2	8	0.233965	10
581	6	2	9	0.168911	10
582	6	2	10	0.208856	10
583	6	2	11	0.182607	10
584	6	2	12	0.187172	10
585	6	2	13	0.303584	10
586	6	3	1	0.289883	10
587	6	3	1	0.364072	10
588	6	3	2	0.317279	10
589	6	3	3	0.294453	10
590	6	3	4	0.243095	10
591	6	3	5	0.208856	10
592	6	3	5	0.393746	10
593	6	3	6	0.189454	10
594	6	3	7	0.156357	10
595	6	3	8	0.149509	10
596	6	3	9	0.186031	10
597	6	3	10	0.275051	10
598	6	3	11	0.188313	10
599	6	3	12	0.200867	10
600	6	3	13	0.264780	10
601	14	1	1	0.396028	10
602	14	1	2	0.413148	10
603	14	1	3	0.427984	10
604	14	1	4	0.307008	10
605	14	1	5	0.303584	10

SECTION IV   ROOT CHARACTERIZATION STUDY
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OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
606	14	1	6	0.329333	10
607	14	1	7	0.301301	10
608	14	1	8	0.259073	10
609	14	1	9	0.251064	10
610	14	1	10	0.296736	10
611	14	1	11	0.309290	10
612	14	1	12	0.352659	10
613	14	1	13	0.364072	10
614	14	2	1	0.393746	10
615	14	2	2	0.402876	10
616	14	2	3	0.459941	10
617	14	2	4	0.338964	10
618	14	2	5	0.201301	10
619	14	2	6	0.342388	10
620	14	2	7	0.313855	10
621	14	2	8	0.325268	10
622	14	2	9	0.204291	10
623	14	2	10	0.292171	10
624	14	2	11	0.225976	10
625	14	2	12	0.388039	10
626	14	2	13	0.301301	10
627	14	3	2	0.399452	10
628	14	3	3	0.410865	10
629	14	3	4	0.340105	10
630	14	3	5	0.359507	10
631	14	3	6	0.486190	10
632	14	3	7	0.264780	10
633	14	3	8	0.253367	10
634	14	3	9	0.267062	10
635	14	3	10	0.244236	10
636	14	3	11	0.285323	10
637	14	3	12	0.288747	10
638	14	3	13	0.340105	10
639	23	1	1	0.510157	10
640	23	1	2	0.456517	10
641	23	1	3	0.810317	10
642	23	1	4	0.447386	10
643	23	1	6	0.535266	10
644	23	1	7	0.369779	10
645	23	1	8	0.353801	10
646	23	1	9	0.360648	10
647	23	1	10	0.341246	10
648	23	1	11	0.385757	10
649	23	1	12	0.414289	10
650	23	2	1	0.579776	10
651	23	2	2	0.617439	10
652	23	2	3	0.879936	10
653	23	2	4	0.544396	10
654	23	2	5	0.479343	10
655	23	2	6	0.462223	10
656	23	2	7	0.434832	10
657	23	2	8	0.453093	10
658	23	2	9	0.454234	10
659	23	2	10	0.396028	10
660	23	2	11	0.451952	10

SECTION IV ROOT CHARACTERIZATION STUDY
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OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
661	23	2	12	0.461062	10
662	23	2	13	0.486190	10
663	23	3	1	0.473636	10
664	23	3	2	0.540972	10
665	23	3	4	0.502168	10
666	23	3	5	0.558092	10
667	23	3	6	0.451952	10
668	23	3	7	0.426643	10
669	23	3	8	0.412006	10
670	23	3	9	0.396028	10
671	23	3	10	0.333474	10
672	23	3	12	0.406300	10
673	23	3	13	0.518147	10
674	2	1	1	0.477060	11
675	2	1	2	0.396028	11
676	2	1	3	0.368637	11
677	2	1	4	0.292171	11
678	2	1	5	0.264780	11
679	2	1	6	0.291029	11
680	2	1	7	0.248802	11
681	2	1	8	0.192878	11
682	2	1	9	0.164346	11
683	2	1	10	0.194020	11
684	2	1	11	0.224835	11
685	2	1	12	0.257932	11
686	2	1	13	0.401735	11
687	2	3	1	0.469614	11
688	2	3	2	0.412006	11
689	2	3	3	0.302442	11
690	2	3	4	0.297877	11
691	2	3	5	0.224835	11
692	2	3	7	0.227117	11
693	2	3	8	0.232824	11
694	2	3	9	0.240813	11
695	2	3	10	0.216845	11
696	2	3	11	0.259073	11
697	2	3	12	0.329833	11
698	2	3	13	0.384615	11
699	17	1	1	0.456517	11
700	17	1	2	0.352659	11
701	17	1	3	0.372061	11
702	17	1	4	0.313855	11
703	17	1	5	0.284182	11
704	17	1	6	0.337822	11
705	17	1	7	0.301301	11
706	17	1	8	0.183748	11
707	17	1	9	0.359507	11
708	17	1	10	0.327551	11
709	17	1	11	0.314997	11
710	17	1	12	0.339964	11
711	17	1	13	0.361790	11
712	17	3	2	0.394687	11
713	17	3	3	0.431408	11
714	17	3	4	0.309290	11
715	17	3	5	0.284182	11

SECTION IV   ROOT CHARACTERIZATION STUDY
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OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
716	17	3	6	0.314997	11
717	17	3	7	0.307006	11
718	17	3	8	0.224835	11
719	17	3	9	0.292171	11
720	17	3	10	0.235323	11
721	17	3	11	0.275051	11
722	17	3	12	0.269345	11
723	17	3	13	0.305860	11
724	29	1	1	0.527277	11
725	29	1	2	0.522712	11
726	29	1	3	0.540972	11
727	29	1	4	0.394887	11
728	29	1	5	0.328692	11
729	29	1	6	0.326409	11
730	29	1	7	0.324127	11
731	29	1	8	0.280758	11
732	29	1	9	0.263638	11
733	29	1	10	0.237389	11
734	29	1	11	0.288747	11
735	29	1	12	0.333257	11
736	29	1	13	0.278475	11
737	29	3	1	0.450810	11
738	29	3	2	0.394857	11
739	29	3	4	0.419995	11
740	29	3	5	0.373202	11
741	29	3	6	0.408563	11
742	29	3	7	0.406300	11
743	29	3	8	0.365213	11
744	29	3	9	0.340105	11
745	29	3	10	0.333257	11
746	29	3	11	0.304725	11
747	29	3	12	0.343529	11
748	29	3	13	0.445104	11
749	5	1	1	0.374344	12
750	5	1	2	0.328692	12
751	5	1	3	0.349235	12
752	5	1	4	0.272769	12
753	5	1	5	0.238530	12
754	5	1	6	0.211139	12
755	5	1	7	0.199726	12
756	5	1	8	0.241954	12
757	5	1	9	0.179183	12
758	5	1	10	0.192878	12
759	5	1	11	0.245378	12
760	5	1	12	0.222552	12
761	5	1	13	0.257932	12
762	5	3	2	0.318420	12
763	5	3	3	0.343529	12
764	5	3	4	0.279617	12
765	5	3	5	0.223693	12
766	5	3	6	0.214563	12
767	5	3	7	0.162063	12
768	5	3	8	0.146085	12
769	5	3	9	0.17[illegible]052	12
770	5	3	10	0.192876	12

SECTION IV ROOT CHARACTERIZATION STUDY
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OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
771	5	3	11	0.133531	12
772	5	3	12	0.171194	12
773	5	3	13	0.249943	12
774	18	1	1	0.368637	12
775	18	1	2	0.342388	12
776	18	1	3	0.393746	12
777	18	1	4	0.265921	12
778	18	1	5	0.259073	12
779	18	1	6	0.238747	12
780	18	1	7	0.287606	12
781	18	1	8	0.271627	12
782	18	1	9	0.271627	12
783	18	1	10	0.267062	12
784	18	1	11	0.254508	12
785	18	1	12	0.293312	12
786	18	1	13	0.359507	12
787	18	3	1	0.311573	12
788	18	3	2	0.289888	12
789	18	3	3	0.232324	12
790	18	3	4	0.253367	12
791	18	3	5	0.214563	12
792	18	3	6	0.286464	12
793	18	3	7	0.228255	12
794	18	3	8	0.215704	12
795	18	3	9	0.235136	12
796	18	3	10	0.202009	12
797	18	3	11	0.313855	12
798	18	3	12	0.230541	12
799	18	3	13	0.369779	12
800	26	1	1	0.620863	12
801	26	1	2	0.489614	12
802	26	1	4	0.438256	12
803	26	1	5	0.446245	12
804	26	1	6	0.391463	12
805	26	1	7	0.372061	12
806	26	1	8	0.344670	12
807	26	1	9	0.332116	12
808	26	1	10	0.243095	12
809	26	1	11	0.289888	12
810	26	1	12	0.294453	12
811	26	1	13	0.376626	12
812	26	3	1	0.466788	12
813	26	3	2	0.479343	12
814	26	3	4	0.369779	12
815	26	3	5	0.412006	12
816	26	3	6	0.458799	12
817	26	3	7	0.362931	12
818	26	3	8	0.335540	12
819	26	3	9	0.342388	12
820	26	3	10	0.319562	12
821	26	3	11	0.319562	12
822	26	3	12	0.359507	12
823	26	3	13	0.342388	12
824	9	1	1	0.477060	13
825	9	1	2	0.556950	13

SECTION IV ROOT CHARACTERIZATION STUDY
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OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
826	9	1	3	0.44625	13
827	9	1	4	0.37891	13
828	9	1	5	0.33782	13
829	9	1	6	0.37320	13
830	9	1	7	0.35036	13
831	9	1	8	0.27733	13
832	9	1	9	0.33782	13
833	9	1	10	0.34467	13
834	9	1	11	0.32184	13
835	9	1	12	0.38918	13
836	9	1	13	0.49415	13
837	9	3	1	0.54069	13
838	9	3	2	0.46679	13
839	9	3	3	0.45195	13
840	9	3	4	0.40288	13
841	9	3	6	0.37549	13
842	9	3	7	0.35152	13
843	9	3	8	0.43597	13
844	9	3	9	0.40289	13
845	9	3	11	0.27848	13
846	9	3	12	0.32299	13
847	9	3	13	0.56266	13
848	11	1	1	0.50445	13
849	11	1	2	0.37777	13
850	11	1	3	0.38576	13
851	11	1	4	0.31500	13
852	11	1	5	0.27277	13
853	11	1	6	0.22483	13
854	11	1	7	0.19516	13
855	11	1	8	0.23967	13
856	11	1	9	0.16549	13
857	11	1	10	0.18147	13
858	11	1	12	0.18717	13
859	11	1	13	0.28675	13
860	11	3	1	0.47592	13
861	11	3	2	0.41885	13
862	11	3	3	0.44967	13
863	11	3	4	0.31500	13
864	11	3	5	0.32641	13
865	11	3	6	0.27848	13
866	11	3	7	0.31157	13
867	11	3	8	0.30587	13
868	11	3	9	0.24994	13
869	11	3	10	0.29445	13
870	11	3	11	0.30701	13
871	11	3	12	0.24538	13
872	11	3	13	0.44510	13
873	28	1	2	0.42228	13
874	28	1	3	1.12988	13
875	28	1	4	0.36179	13
876	28	1	5	0.35837	13
877	28	1	6	0.42342	13
878	28	1	7	0.35608	13
879	28	1	8	0.36293	13
880	28	1	9	0.36978	13

SECTION IV   ROOT CHARACTERIZATION STUDY
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OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
881	28	1	10	0.360546	13
882	28	1	11	0.325265	13
883	28	1	12	0.378909	13
884	28	1	13	0.410865	13
885	28	3	1	0.472495	13
886	28	3	2	0.463365	13
887	28	3	3	0.429126	13
888	28	3	4	0.538690	13
889	28	3	5	0.394837	13
890	28	3	6	0.400593	13
891	28	3	7	0.370920	13
892	28	3	8	0.348094	13
893	28	3	9	0.349235	13
894	28	3	10	0.320703	13
895	28	3	11	0.318420	13
896	28	3	12	0.307006	13
897	28	3	13	0.363474	13
898	1	1	1	0.527277	14
899	1	1	2	0.451952	14
900	1	1	3	0.408583	14
901	1	1	4	0.385757	14
902	1	1	5	0.328692	14
903	1	1	6	0.338954	14
904	1	1	7	0.334399	14
905	1	1	8	0.337822	14
906	1	1	9	0.319552	14
907	1	1	10	0.293312	14
908	1	1	11	0.259073	14
909	1	1	12	0.319552	14
910	1	1	13	0.364072	14
911	1	3	1	0.493036	14
912	1	3	2	0.391463	14
913	1	3	3	0.408583	14
914	1	3	4	0.334399	14
915	1	3	5	0.285747	14
916	1	3	6	0.278475	14
917	1	3	7	0.264780	14
918	1	3	8	0.186031	14
919	1	3	9	0.158640	14
920	1	3	10	0.162607	14
921	1	3	11	0.148368	14
922	1	3	12	0.123260	14
923	1	3	13	0.254760	14
924	19	1	1	0.397170	14
925	19	1	2	0.380050	14
926	19	1	4	0.312714	14
927	19	1	5	0.327551	14
928	19	1	6	0.303584	14
929	19	1	7	0.514723	14
930	19	1	8	0.278475	14
931	19	1	9	0.247650	14
932	19	1	10	0.280758	14
933	19	1	11	0.241954	14
934	19	1	12	0.272769	14
935	19	1	13	0.337822	14

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
936	19	3	1	0.402876	14
937	19	3	2	0.398311	14
938	19	3	3	0.563798	14
939	19	3	4	0.392604	14
940	19	3	5	0.346953	14
941	19	3	6	0.230541	14
942	19	3	7	0.248602	14
943	19	3	8	0.249943	14
944	19	3	9	0.211139	14
945	19	3	10	0.193585	14
946	19	3	11	0.192878	14
947	19	3	12	0.243095	14
948	19	3	13	0.275051	14
949	21	1	1	0.349235	14
950	21	1	2	0.346953	14
951	21	1	4	0.396028	14
952	21	1	5	0.307008	14
953	21	1	6	0.281899	14
954	21	1	7	0.278475	14
955	21	1	8	0.246519	14
956	21	1	9	0.230541	14
957	21	1	10	0.194020	14
958	21	1	11	0.205433	14
959	21	1	12	0.220269	14
960	21	1	13	0.267606	14
961	21	3	1	0.394837	14
962	21	3	2	0.385757	14
963	21	3	3	0.393746	14
964	21	3	4	0.324127	14
965	21	3	5	0.317279	14
966	21	3	6	0.342388	14
967	21	3	7	0.295595	14
968	21	3	8	0.261356	14
969	21	3	9	0.245378	14
970	21	3	10	0.233965	14
971	21	3	11	0.237389	14
972	21	3	12	0.241954	14
973	3	1	1	0.429126	15
974	3	1	2	0.361790	15
975	3	1	3	0.384615	15
976	3	1	4	0.293312	15
977	3	1	5	0.279617	15
978	3	1	6	0.261899	15
979	3	1	7	0.260215	15
980	3	1	8	0.239571	15
981	3	1	9	0.220269	15
982	3	1	10	0.224835	15
983	3	1	11	0.256791	15
984	3	1	12	0.263636	15
985	3	1	13	0.356365	15
986	3	3	1	0.373202	15
987	3	3	2	0.386898	15
988	3	3	3	0.350377	15
989	3	3	4	0.300160	15
990	3	3	5	0.247660	15

SECTION IV ROOT CHARACTERIZATION STUDY
2:38 MONDAY, MAY 25

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
991	3	3	6	0.311573	15
992	3	3	7	0.276193	15
993	3	3	8	0.181465	15
994	3	3	9	0.197444	15
995	3	3	10	0.191737	15
996	3	3	11	0.230541	15
997	3	3	12	0.225976	15
998	3	3	13	0.303584	15
999	15	1	1	0.417713	15
1000	15	1	2	0.419995	15
1001	15	1	4	0.309290	15
1002	15	1	5	0.356083	15
1003	15	1	6	0.354942	15
1004	15	1	7	0.362931	15
1005	15	1	8	0.346953	15
1006	15	1	9	0.316138	15
1007	15	1	10	0.328692	15
1008	15	1	11	0.289388	15
1009	15	1	12	0.317279	15
1010	15	1	13	0.400593	15
1011	15	3	1	0.490756	15
1012	15	3	2	0.381192	15
1013	15	3	3	0.406300	15
1014	15	3	4	0.370920	15
1015	15	3	5	0.244236	15
1016	15	3	6	0.277334	15
1017	15	3	7	0.244236	15
1018	15	3	8	0.310431	15
1019	15	3	9	0.272769	15
1020	15	3	10	0.163205	15
1021	15	3	11	0.203150	15
1022	15	3	12	0.173476	15
1023	15	3	13	0.327551	15
1024	27	1	1	0.504451	15
1025	27	1	2	0.362931	15
1026	27	1	3	0.496462	15
1027	27	1	4	0.336681	15
1028	27	1	5	0.329833	15
1029	27	1	6	0.374344	15
1030	27	1	7	0.318420	15
1031	27	1	8	0.302442	15
1032	27	1	9	0.273910	15
1033	27	1	10	0.211139	15
1034	27	1	11	0.249943	15
1035	27	1	12	0.288747	15
1036	27	1	13	0.343529	15
1037	27	3	1	0.507675	15
1038	27	3	2	0.450810	15
1039	27	3	3	0.426843	15
1040	27	3	4	0.414239	15
1041	27	3	5	0.419995	15
1042	27	3	6	0.332116	15
1043	27	3	7	0.372061	15
1044	27	3	8	0.325268	15
1045	27	3	9	0.278475	15

SECTION IV ROOT CHARACTERIZATION STUDY
2:36 MONDAY, MAY 25

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
1046	27	3	10	0.265921	15
1047	27	3	11	0.233965	15
1048	27	3	12	0.244236	15
1049	27	3	13	0.289888	15
1050	4	1	1	0.393746	16
1051	4	1	2	0.353801	16
1052	4	1	3	0.330975	16
1053	4	1	4	0.273910	16
1054	4	1	5	0.239671	16
1055	4	1	6	0.216845	16
1056	4	1	7	0.221411	16
1057	4	1	8	0.169454	16
1058	4	1	9	0.272769	16
1059	4	1	10	0.224835	16
1060	4	1	11	0.236247	16
1061	4	1	12	0.240613	16
1062	4	1	13	0.349235	16
1063	4	3	1	0.354942	16
1064	4	3	2	0.317279	16
1065	4	3	3	0.322986	16
1066	4	3	4	0.276193	16
1067	4	3	5	0.240613	16
1068	4	3	6	0.216845	16
1069	4	3	7	0.235106	16
1070	4	3	8	0.165487	16
1071	4	3	9	0.149509	16
1072	4	3	11	0.206574	16
1073	4	3	12	0.220269	16
1074	4	3	13	0.301301	16
1075	20	1	1	0.499886	16
1076	20	1	2	0.443528	16
1077	20	1	3	0.591189	16
1078	20	1	4	0.368637	16
1079	20	1	5	0.330975	16
1080	20	1	6	0.324127	16
1081	20	1	7	0.317279	16
1082	20	1	8	0.338964	16
1083	20	1	9	0.238530	16
1084	20	1	10	0.235106	16
1085	20	1	11	0.261899	16
1086	20	1	12	0.311573	16
1087	20	3	1	0.365213	16
1088	20	3	2	0.359507	16
1089	20	3	3	0.805752	16
1090	20	3	4	0.455375	16
1091	20	3	5	0.299018	16
1092	20	3	6	0.267062	16
1093	20	3	7	0.265921	16
1094	20	3	8	0.265921	16
1095	20	3	9	0.224835	16
1096	20	3	10	0.285323	16
1097	20	3	11	0.191737	16
1098	20	3	12	0.279617	16
1099	20	3	13	0.311573	16
1100	25	1	1	0.592331	16

SECTION IV   ROOT CHARACTERIZATION STUDY
2:38 MONDAY, MAY 25

OBS	PLOT	SUBPLOT	VGS	SR	TRTMT
1101	25	1	2	0.434832	16
1102	25	1	4	0.400593	16
1103	25	1	5	0.357224	16
1104	25	1	6	0.366355	16
1105	25	1	7	0.351518	16
1106	25	1	8	0.344670	16
1107	25	1	9	0.337622	16
1108	25	1	10	0.308149	16
1109	25	1	11	0.312714	16
1110	25	1	12	0.322986	16
1111	25	1	13	0.400593	16
1112	25	3	1	0.505592	16
1113	25	3	2	0.461082	16
1114	25	3	3	0.551244	16
1115	25	3	4	0.366355	16
1116	25	3	5	0.406300	16
1117	25	3	6	0.389181	16
1118	25	3	7	0.342388	16
1119	25	3	8	0.326409	16
1120	25	3	9	0.333257	16
1121	25	3	10	0.314997	16
1122	25	3	11	0.319562	16
1123	25	3	12	0.346953	16
1124	25	3	13	0.372061	16

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FILE: JACKZ    SAS    A

LEGEND FOR SECTION IV ROOT CHANNELLING STUDY.

IF ROW=1 AND PLOT=1 THEN TRTMT=5;
IF ROW=1 AND PLOT=2 THEN TRTMT=1;
IF ROW=1 AND PLOT=3 THEN TRTMT=4;
IF ROW=1 AND PLOT=4 THEN TRTMT=2;
IF ROW=1 AND PLOT=5 THEN TRTMT=1;
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IF ROW=2 AND PLOT=2 THEN TRTMT=5;
IF ROW=2 AND PLOT=3 THEN TRTMT=4;
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IF ROW=4 AND PLOT=5 THEN TRTMT=2;
IF ROW=5 AND PLOT=1 THEN TRTMT=2;
IF ROW=5 AND PLOT=2 THEN TRTMT=4;
IF ROW=5 AND PLOT=3 THEN TRTMT=1;
IF ROW=5 AND PLOT=4 THEN TRTMT=2;
IF ROW=5 AND PLOT=5 THEN TRTMT=3;
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SECTION IV ROOT CHANNELLING STUDY
2:41 MONDAY, MAY 25

OBS	ROW	PLOT	VGS	SR	TRTMT
1	5	3	1	0.96782	1
2	5	3	2	1.21433	1
3	1	2	3	6.50651	1
4	3	3	3	1.51107	1
5	5	3	3	1.35243	1
6	1	2	4	4.83565	1
7	2	5	4	2.32938	1
8	3	3	4	1.15613	1
9	1	2	5	0.84456	1
10	1	5	5	0.77037	1
11	2	5	5	0.70418	1
12	3	3	5	1.17667	1
13	5	3	5	0.89135	1
14	1	2	6	0.80918	1
15	1	5	6	0.84227	1
16	2	5	6	1.00890	1
17	3	3	6	0.96439	1
18	5	3	6	0.76467	1
19	1	2	7	4.81511	1
20	1	5	7	1.48824	1
21	2	5	7	4.15038	1
22	3	3	7	1.72335	1
23	5	3	7	1.61607	1
24	1	2	8	2.73225	1
25	1	5	8	1.36270	1
26	2	5	8	4.07099	1
27	3	3	8	1.39238	1
28	5	3	8	1.29306	1
29	1	2	10	2.91436	1
30	1	5	10	1.47455	1
31	2	5	10	5.86733	1
32	5	3	10	1.88056	1
33	1	2	12	3.03926	1
34	1	5	12	1.68864	1
35	2	5	12	3.96827	1
36	3	3	12	1.51564	1
37	5	3	12	1.33075	1
38	5	1	2	5.20201	2
39	3	1	3	1.39009	2
40	4	5	3	1.03743	2
41	5	1	3	4.41680	2
42	5	4	3	1.74960	2
43	1	4	4	1.02716	2
44	3	1	4	1.20406	2
45	4	5	4	0.74184	2
46	5	1	4	3.10774	2
47	5	4	4	1.62178	2
48	1	4	5	3.60877	2
49	3	1	5	2.09884	2
50	4	5	5	2.22666	2
51	5	1	5	4.52066	2
52	5	4	5	4.30724	2
53	1	4	6	2.69345	2
54	3	1	6	2.51997	2
55	4	5	6	2.72084	2

SECTION IV   ROOT CHANNELLING STUDY
2:41 MONDAY, MAY 25

OBS	ROW	PLOT	VGS	SR	TRTMT
56	5	1	6	3.91349	2
57	5	4	6	2.17416	2
58	1	4	7	1.19950	2
59	3	1	7	1.61721	2
60	5	1	7	3.69779	2
61	5	4	7	1.91166	2
62	1	4	8	1.33645	2
63	3	1	8	1.75612	2
64	4	5	8	2.02806	2
65	5	1	8	4.00137	2
66	5	4	8	1.94362	2
67	1	4	10	1.88199	2
68	1	4	12	1.70966	2
69	3	1	12	1.42661	2
70	4	5	12	2.00297	2
71	5	1	12	2.95165	2
72	5	4	12	2.02806	2
73	2	1	2	1.36042	3
74	2	1	3	1.04771	3
75	2	4	3	1.53194	3
76	4	2	3	2.99133	3
77	4	4	3	3.53572	3
78	2	1	4	0.97010	3
79	2	4	4	1.68226	3
80	4	2	4	2.15248	3
81	4	4	4	2.94453	3
82	5	5	4	3.90892	3
83	2	1	5	1.86601	3
84	2	4	5	2.43894	3
85	4	2	5	3.13969	3
86	4	4	5	2.04063	3
87	5	5	5	3.14882	3
88	2	1	6	2.04634	3
89	2	4	6	2.40128	3
90	4	2	6	2.90231	3
91	4	4	6	1.82949	3
92	5	5	6	3.14426	3
93	2	1	7	1.44031	3
94	2	4	7	2.52796	3
95	4	4	7	5.99863	3
96	2	1	8	1.34558	3
97	2	4	8	0.87309	3
98	4	2	8	4.88131	3
99	4	4	8	4.60968	3
100	5	5	8	4.01849	3
101	2	1	10	1.80595	3
102	2	4	10	2.56905	3
103	4	4	10	4.20566	3
104	2	1	12	1.81580	3
105	2	4	12	2.12394	3
106	4	2	12	3.18078	3
107	4	4	12	3.27551	3
108	5	5	12	4.21023	3
109	2	3	2	1.44259	4
110	5	2	2	2.75736	4

SECTION IV ROOT CHANNELLING STUDY
2:41 MONDAY, MAY 25

OBS	ROW	PLOT	VGS	SR	TRTMT
111	2	3	3	1.20292	4
112	3	5	3	3.27779	4
113	4	1	3	3.43072	4
114	5	2	3	5.00799	4
115	2	3	4	1.02374	4
116	3	5	4	2.60899	4
117	4	1	4	2.86975	4
118	5	2	4	4.80484	4
119	1	3	5	1.00434	4
120	2	3	5	1.10477	4
121	3	5	5	0.97695	4
122	4	1	5	0.85597	4
123	5	2	5	1.20520	4
124	1	3	6	0.76809	4
125	2	3	6	0.83885	4
126	3	5	6	1.13787	4
127	4	1	6	0.94955	4
128	5	2	6	1.10591	4
129	3	5	7	4.15088	4
130	4	1	7	3.39991	4
131	3	5	8	3.30632	4
132	4	1	8	3.38621	4
133	5	2	8	2.76079	4
134	2	3	12	1.14357	4
135	3	5	12	2.07519	4
136	4	1	12	2.70307	4
137	5	2	12	4.16115	4
138	1	1	2	1.18694	5
139	1	1	3	1.10249	5
140	3	2	3	1.71879	5
141	3	4	3	1.59210	5
142	4	3	3	1.57841	5
143	1	1	4	0.97809	5
144	2	2	4	2.51084	5
145	3	2	4	1.09222	5
146	3	4	4	1.18808	5
147	4	3	4	1.28053	5
148	1	1	5	1.16069	5
149	2	2	5	1.27711	5
150	3	2	5	1.50993	5
151	3	4	5	0.97238	5
152	4	3	5	1.37183	5
153	1	1	6	0.93700	5
154	2	2	6	1.74161	5
155	3	2	6	1.54074	5
156	3	4	6	1.58059	5
157	4	3	6	1.31705	5
158	3	2	7	1.38439	5
159	3	4	7	2.10682	5
160	1	1	8	1.45629	5
161	2	2	8	4.27642	5
162	3	4	8	2.05661	5
163	4	3	8	1.47455	5
164	1	1	10	1.76215	5
165	3	4	10	2.32595	5

SECTION IV   ROOT CHANNELLING STUDY
2:41 MONDAY, MAY 25

OBS	ROW	PLOT	VGS	SR	TRTMT
166	4	3	10	1.85802	5
167	1	1	12	1.76558	5
168	2	2	12	4.18398	5
169	3	2	12	1.87971	5
170	3	4	12	1.59667	5
171	4	3	12	1.92308	5

SOILS DATA FOR PES AND KPS

16:43 MONDAY, MAY 25, 1987

OBS	STATION	TILL	DEPTH	REP	OC	PH	H2O	MMCA	MMMG
1	1	1	1	1	1.21	6.49	0.0140	27.2312	2.89652
2	1	1	1	2	1.00	6.43	0.0140	21.7039	2.96330
3	1	1	1	3	1.15	5.97	0.0140	19.3458	6.74046
4	1	1	1	4	1.23	6.08	0.0140	21.6024	2.55845
5	1	1	2	1	1.66	6.61	0.0135	27.3188	2.86168
6	1	1	2	2	0.96	6.33	0.0135	21.6168	2.89088
7	1	1	2	3	1.17	5.87	0.0135	18.1956	2.62807
8	1	1	3	1	0.61	6.54	0.0115	22.9894	2.06490
9	1	1	3	2	0.93	6.23	0.0115	21.5731	6.66096
10	1	1	3	3	0.65	6.05	0.0115	15.9838	2.24391
11	1	1	3	4	0.88	5.93	0.0115	20.3591	2.43125
12	1	1	4	1	0.21	5.55	0.0090	15.9183	0.92603
13	1	1	4	2	0.19	5.40	0.0090	11.7558	1.07137
14	1	1	4	3	0.16	5.54	0.0090	9.3340	1.34544
15	1	1	4	4	0.33	5.29	0.0090	12.9919	1.33714
16	1	2	1	1	2.01	6.40	0.0235	33.5125	2.03127
17	1	2	1	2	1.43	6.52	0.0235	32.7445	2.62127
18	1	2	1	3	1.75	5.96	0.0235	23.9631	2.57913
19	1	2	1	4	1.86	5.53	0.0235	17.2811	2.33470
20	1	2	2	1	1.78	6.72	0.0220	36.9632	1.78831
21	1	2	2	2	1.75	6.68	0.0220	32.4131	2.56255
22	1	2	2	3	1.79	6.41	0.0220	26.7638	2.42369
23	1	2	2	4	1.40	5.70	0.0220	18.8139	2.54993
24	1	2	3	1	1.07	6.28	0.0240	29.6107	1.87209
25	1	2	3	2	0.71	5.50	0.0240	17.8023	1.91847
26	1	2	3	3	1.07	6.41	0.0240	25.7684	2.23049

OBS	MMK	MMNA	MMSR	MMEA	MMCEC	GOC
1	6.72069	0.211659	0.0324173	0.243	37.3355	12.1
2	6.85297	0.165202	0.0254707	0.158	31.8988	10.0
3	6.96854	0.167563	0.0219975	0.290	33.4344	11.5
4	7.51182	0.163154	0.0243130	0.402	32.2622	12.3
5	5.81757	0.277661	0.0243007	0.047	36.3471	16.6
6	6.05878	0.392252	0.0219863	0.131	31.1117	9.6
7	5.69532	0.215959	0.0219863	0.523	27.2805	11.7
8	4.78909	0.285897	0.0277160	0.065	30.2220	6.1
9	5.33760	0.255697	0.0219418	0.178	34.0575	9.3
10	4.72958	0.343076	0.0184773	0.635	23.9539	8.5
11	5.99477	0.347474	0.0238708	0.524	29.6855	8.8
12	2.16785	0.083359	0.0172786	1.272	20.3848	2.1
13	2.25043	0.184267	0.0184307	5.406	20.6863	1.9
14	2.41560	-0.075972	0.0092154	2.731	15.7563	1.6
15	2.95433	0.153556	0.0138230	6.116	23.4668	3.3
16	4.97628	0.311672	0.0303946	0.122	40.9842	20.1
17	6.75464	0.293862	0.0339017	0.066	42.5142	14.3
18	5.66772	0.195908	0.0268876	0.505	32.9378	17.5
19	3.30268	0.405174	0.0151973	3.919	27.2579	18.6
20	2.73014	0.408998	0.0373514	0.150	42.0780	17.8
21	5.29553	0.297857	0.0326825	0.009	40.6107	17.5
22	4.54961	0.395661	0.0338497	0.131	34.3976	17.9
23	3.25316	0.365997	0.0245119	2.553	27.5635	14.0
24	3.09997	0.788489	0.0339191	0.131	35.5361	10.7
25	3.57427	0.383108	0.0187140	4.835	28.5318	7.1
26	4.33158	0.329651	0.0315798	0.056	32.7477	10.7

SOILS DATA FOR PES AND KPS

16:43 MONDAY, MAY 25, 1987

OBS	STATION	TILL	DEPTH	REP	OC	PH	H2O	MMCA
27	1	2	3	4	0.65	5.16	0.0240	10.9887
28	1	2	4	1	0.25	5.38	0.0225	19.3095
29	1	2	4	2	0.25	4.98	0.0225	8.0563
30	1	2	4	3	0.28	6.18	0.0225	17.1355
31	1	2	4	4	0.21	4.92	0.0225	4.1944
32	2	1	1	1	0.77	6.70	0.0130	15.6282
33	2	1	1	2	0.76	6.98	0.0130	17.7558
34	2	1	1	3	0.80	6.90	0.0130	17.7305
35	2	1	1	4	0.64	6.97	0.0130	15.6535
36	2	1	2	1	0.66	6.56	0.0120	15.5617
37	2	1	2	2	0.80	6.98	0.0120	18.2186
38	2	1	2	3	0.72	6.83	0.0120	18.0921
39	2	1	2	4	0.60	6.94	0.0120	15.1822
40	2	1	3	1	0.69	5.84	0.0165	14.0569
41	2	1	3	2	0.64	6.00	0.0165	13.2435
42	2	1	3	3	0.81	5.89	0.0165	16.2938
43	2	1	3	4	0.44	5.99	0.0165	13.2944
44	2	1	4	1	0.62	5.71	0.0160	13.2622
45	2	1	4	2	0.37	5.75	0.0160	10.6961
46	2	1	4	3	0.81	5.67	0.0160	14.8120
47	2	1	4	4	0.24	5.67	0.0160	13.4146
48	2	2	1	1	0.69	6.29	0.0120	11.8674
49	2	2	1	2	0.64	7.13	0.0120	16.7763
50	2	2	1	3	0.79	6.74	0.0120	15.6883
51	2	2	1	4	0.80	6.24	0.0120	13.9423
52	2	2	2	1	0.68	6.20	0.0125	13.8987

OBS	MMMG	MMK	MMNA	MMSR	MMEA	MMCEC	GOC
27	2.32745	2.38198	0.31629	0.0116962	16.732	32.7582	6.5
28	1.43930	1.51490	0.26243	0.0221887	9.746	32.2948	2.5
29	0.87567	1.76870	0.18681	0.0058391	17.471	28.3643	2.5
30	0.90093	1.96231	0.23129	0.0210209	0.608	20.8591	2.8
31	1.30929	1.12767	0.17347	0.0035035	24.588	31.3963	2.1
32	4.97406	3.61995	0.13656	0.0161922	0.065	24.3399	7.7
33	6.27499	4.04750	0.03965	0.0161922	0.112	28.2462	7.6
34	6.29167	5.34571	0.19382	0.0161922	0.075	29.6529	8.0
35	5.60788	2.70764	0.15858	0.0138791	0.075	24.2167	6.4
36	4.66087	3.70125	0.23763	0.0138650	0.149	24.3844	6.8
37	6.28113	3.13739	0.11442	0.0184867	0.000	27.7701	8.0
38	6.16534	2.98725	0.25964	0.0184867	0.047	27.5898	7.2
39	5.26066	2.58661	0.07481	0.0150204	0.056	23.1773	6.0
40	8.14258	2.94891	0.03095	0.0185713	0.337	25.5350	6.9
41	4.29724	1.90353	0.08399	0.0139284	0.281	19.8232	6.4
42	5.04204	2.68627	0.03979	0.0197320	0.533	24.6147	8.1
43	4.88722	2.03355	0.11052	0.0232141	0.234	20.5829	4.4
44	3.69701	2.11309	0.12372	0.0197219	0.467	19.6827	6.2
45	3.88521	1.35675	0.21209	0.0220422	1.048	17.2202	3.7
46	4.41634	2.00133	0.35348	0.0255225	1.291	22.8997	8.1
47	5.07712	1.49450	0.15907	0.0301630	0.954	21.1295	2.4
48	3.11974	4.17542	0.29044	0.0173313	0.187	19.6573	6.9
49	5.76881	3.03385	0.13202	0.0231084	0.000	25.7341	6.4
50	5.88127	4.14695	0.16722	0.0207975	0.037	25.9415	7.9
51	3.91946	4.90024	0.18483	0.0196421	0.243	23.2095	8.0
52	5.47586	2.33611	0.12768	0.0184960	0.177	22.0339	6.8

SOILS DATA FOR PES AND KPS

16:43 MONDAY, MAY 25, 1987

OBS	STATION	TILL	DEPTH	REP	OC	PH	H2O	MMCA
53	2	2	2	2	0.59	7.03	0.0125	16.9620
54	2	2	2	3	0.73	6.46	0.0125	12.1519
55	2	2	2	4	0.74	6.05	0.0125	12.5316
56	2	2	3	1	0.40	5.50	0.0185	13.1177
57	2	2	3	2	0.21	5.80	0.0185	11.0800
58	2	2	3	3	0.40	5.37	0.0185	8.0489
59	2	2	3	4	0.70	5.21	0.0185	10.6470
60	2	2	4	1	0.28	5.35	0.0200	12.1684
61	2	2	4	2	0.13	5.45	0.0200	14.8469
62	2	2	4	3	0.21	5.38	0.0200	12.9082
63	2	2	4	4	0.37	5.28	0.0200	7.7551

OBS	MMMG	MMK	MMNA	MMSR	MMEA	MMCEC	GOC
53	5.67172	2.12632	-0.00440	0.0231201	0.056	24.8348	5.9
54	3.36719	1.95798	0.23335	0.0231201	0.131	17.8645	7.3
55	3.71308	3.05905	0.10567	0.0196520	0.505	19.9441	7.4
56	4.95169	1.57648	0.07974	0.0348921	3.030	22.7905	4.0
57	4.12990	1.56345	0.17276	0.0255875	1.029	18.0007	2.1
58	2.34377	1.86572	1.04986	0.0127938	3.189	16.5100	4.0
59	3.78190	1.65726	0.33666	0.0197722	5.854	22.2966	7.0
60	4.48056	1.13263	0.23070	0.0291212	4.050	22.0914	2.8
61	5.55975	1.27355	0.16415	0.0512534	2.450	24.3457	1.3
62	4.40917	1.42492	0.35049	0.0337806	3.563	22.6895	2.1
63	2.38095	1.30746	-0.01331	0.0139782	5.892	17.3362	3.7

SOILS DATA FOR PES AND KPS

16:28 MONDAY, MAY 25, 1987

OBS	STATION	LOCATION	DEPTH	OC	PH	EA	H2O	MMCA
1	1	1	1	0.995	5.97	0.00	0.0140	15.6719
2	1	2	1	1.128	5.84	0.14	0.0140	19.9772
3	1	3	1	1.303	5.30	0.92	0.0140	10.6339
4	1	4	1	1.156	5.80	0.10	0.0140	15.0254
5	1	1	2	0.752	5.56	0.22	0.0140	17.7130
6	1	2	2	0.950	5.48	0.49	0.0140	18.8463
7	1	3	2	0.693	5.06	1.83	0.0140	8.9376
8	1	4	2	0.802	5.62	0.55	0.0140	20.1369
9	1	1	3	0.166	4.70	3.14	0.0140	5.1648
10	1	2	3	0.233	4.72	4.33	0.0140	5.9863
11	1	3	3	0.204	4.89	3.10	0.0140	1.8889
12	1	4	3	0.531	4.80	3.77	0.0140	9.7388
13	2	1	1	0.719	6.34	0.03	0.0076	11.9986
14	2	2	1	0.612	6.77	0.00	0.0078	14.5737
15	2	3	1	0.596	6.35	0.01	0.0078	11.9684
16	2	4	1	0.617	6.35	0.02	0.0078	10.2298
17	2	1	2	0.826	6.24	0.00	0.0075	12.1259
18	2	2	2	0.610	6.60	0.01	0.0075	13.4987
19	2	3	2	0.719	6.28	0.01	0.0075	11.6045
20	2	4	2	0.511	6.40	0.01	0.0075	9.5214
21	2	1	3	0.541	6.32	0.03	0.0095	12.0268
22	2	2	3	0.550	6.65	0.00	0.0095	15.1085
23	2	3	3	0.579	6.39	0.01	0.0095	13.7633
24	2	4	3	0.302	6.00	0.00	0.0095	10.7572
25	2	1	4	0.418	6.19	0.04	0.0105	13.9237
26	2	2	4	0.390	6.77	0.01	0.0105	13.2996

OBS	MMMG	MMK	MMNA	MMSR	MMEA	MMCEC	GOC
1	1.77380	2.32410	0.38363	0.0289440	0.0	20.1824	9.95
2	1.44409	3.00369	0.48064	0.0208397	1.4	26.3264	11.28
3	1.08932	2.12956	0.49387	0.0150509	9.2	23.5617	13.03
4	1.24375	2.46157	-0.21166	0.0115776	1.0	19.5306	11.56
5	2.04092	1.76382	0.43655	0.0173664	2.2	24.1716	7.52
6	1.46495	2.07249	0.00000	0.0208397	4.9	27.3046	9.50
7	1.08515	1.62376	0.32190	0.0138931	18.3	30.2823	6.98
8	1.77380	2.25406	0.14993	0.0173664	5.5	29.8321	8.02
9	0.72204	0.78335	-0.09260	0.0081043	31.4	37.9857	1.68
10	0.77213	1.15427	0.32190	0.0439949	43.3	51.5786	2.38
11	0.56762	1.22430	0.05732	-0.0034733	31.0	34.7347	2.04
12	1.02672	1.24246	0.26457	0.0092621	37.7	49.9819	5.31
13	3.55447	2.02861	-0.29798	0.0126558	0.3	17.5964	7.19
14	5.13470	0.86094	0.37665	0.0092042	0.0	20.9554	6.12
15	3.73282	1.17025	0.11831	0.0103547	0.1	17.1001	5.96
16	3.30977	1.26047	-0.11831	0.0057526	0.2	14.8875	6.17
17	3.69437	1.56674	-0.00438	0.0138021	0.0	17.3965	8.26
18	4.41169	1.31420	-0.24094	0.0115018	0.1	19.0952	6.10
19	3.64047	1.13382	0.26722	0.0115018	0.1	16.7576	7.19
20	3.29218	1.20082	-0.12266	0.0069011	0.1	13.9987	5.11
21	5.14351	1.27554	0.02195	0.0172875	0.3	18.7850	5.41
22	5.69609	0.94176	0.21070	0.0115250	0.0	21.8686	5.50
23	5.19752	0.85725	0.03951	0.0092200	0.1	19.9667	5.79
24	4.79036	1.01992	0.23264	0.0126775	0.0	16.8128	3.02
25	5.90147	1.08815	0.22849	0.0173050	0.4	21.5591	4.18
26	6.00960	0.56168	0.08788	0.0161513	0.1	20.1750	3.90

SOILS DATA FOR PES AND KPS

16:28 MONDAY, MAY 25, 1987

OBS	STATION	LOCATION	DEPTH	OC	PH	EA	H2O	MMCA
27	2	3	4	0.411	6.34	0.01	0.0105	12.2663
28	2	4	4	0.385	5.69	0.00	0.0105	11.5184

OBS	MMMG	MMK	MMNA	MMSR	MMEA	MMCEC	GOC
27	5.49390	0.586723	0.320759	0.0149977	0.1	18.7827	4.11
28	5.50638	0.814175	0.259244	0.0207660	0.0	18.1190	3.85

YIELD PES

17:17 MONDAY, MAY 25

OBS	PLOT	LINE	YLD1
1	2001	200	691.25
2	2003	230	651.50
3	2005	232	731.78
4	2011	235	1051.45
5	2037	264	677.53
6	2042	269	733.56
7	2044	271	502.25
8	2050	277	431.31
9	2051	277	445.95
10	2053	230	956.23
11	2060	269	1051.29
12	2061	232	939.82
13	2063	200	709.53
14	2072	235	1178.69
15	2075	271	374.57
16	2081	264	733.19
17	2101	277	359.15
18	2104	271	333.12
19	2114	200	755.56
20	2118	269	722.16
21	2134	230	1065.07
22	2137	235	914.80
23	2139	232	936.74
24	2143	264	1006.77

YIELD KPS

17:14 MONDAY, MAY 25

OBS	PLOT	LINE	YLD1
1	3001	200	778.87
2	3003	230	664.73
3	3005	232	775.45
4	3011	238	538.01
5	3037	264	585.14
6	3042	269	560.95
7	3044	271	750.00
8	3050	277	432.34
9	3056	200	740.35
10	3059	230	564.41
11	3074	271	605.38
12	3076	277	741.16
13	3083	232	953.38
14	3093	238	709.52
15	3095	264	853.11
16	3100	269	589.10
17	3110	277	760.40
18	3116	200	772.47
19	3118	238	1063.22
20	3124	232	1152.02
21	3127	230	818.82
22	3133	264	821.55
23	3135	271	952.72
24	3147	269	792.25

VITA

Michael Aaron Krstich was born in Akron, Ohio on May 10, 1952. He attended elementary school in that city and was graduated from Ellet High School in June 1970. The following September he entered Valencia Community College and in May 1972 he received an Associate of Arts degree. The following January he entered Arizona State University, and in December 1975 he received a Bachelor of Science degree in Natural Resource Management. The following January he enter graduate program at Arizona State University and in June 1982 he was awarded a Master's degree in Natural Resource Management. In the fall of 1982 he accepted a research assistantship at the University of Tennessee and in June 1987 he received the Doctor of Philosophy degree with a major in Plant and Soil Science.

The author is a member of the American Society of Agronomy and is currently employed by the University of Tennessee.