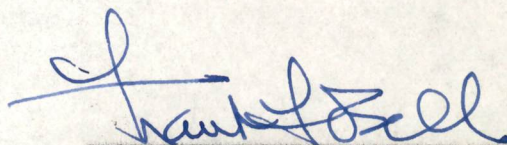


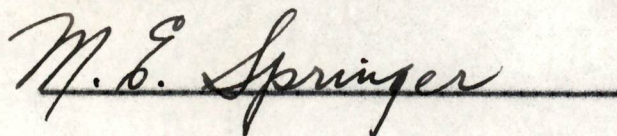
December 8, 1958

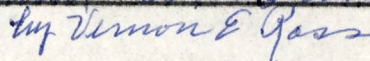
To the Graduate Council:

I am submitting herewith a thesis written by Joseph H. Vaden entitled "Relationships of Soils and Management to Establishment and Yield of Alfalfa in Putnam County, Tennessee." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agronomy.

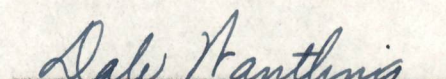
  
Major Professor

We have read this thesis and  
recommend its acceptance:



Accepted for the Council:

  
Dean of the Graduate School



RELATIONSHIPS OF SOILS AND MANAGEMENT TO ESTABLISHMENT AND  
YIELD OF ALFALFA IN PUTNAM COUNTY, TENNESSEE

---

A THESIS

Submitted to  
The Graduate Council  
of  
The University of Tennessee  
in  
Partial Fulfillment of the Requirements  
for the degree of  
Master of Science

---

by

Joseph H. Vaden

December 1958



22.  
33

#### ACKNOWLEDGEMENTS

The writer wishes to express his gratitude and appreciation to:

Dr. Frank F. Bell for directing the study,

Dr. David W. Brown and Dr. Maxwell E. Springer for serving  
on the author's graduate committee,

The Soil Conservation Service, the Tennessee Valley Authority  
and the University of Tennessee Agricultural Experiment Station for  
making this study possible,

Other members of the University staff for their cooperation and  
helpful suggestions, and

The professional agricultural workers and farmers of Putnam  
County who cooperated in this study.

Joseph H. Vaden



# TABLE OF CONTENTS

| CHAPTER                                                                                             | PAGE |
|-----------------------------------------------------------------------------------------------------|------|
| I. INTRODUCTION . . . . .                                                                           | 1    |
| II. SELECTED LITERATURE REVIEW . . . . .                                                            | 3    |
| Soil productivity. . . . .                                                                          | 3    |
| Comparison of alfalfa recommendations for Tennessee<br>with those of neighboring states . . . . .   | 4    |
| Establishment of alfalfa . . . . .                                                                  | 5    |
| Heaving. . . . .                                                                                    | 6    |
| Fertilization. . . . .                                                                              | 6    |
| Grass and alfalfa mixtures . . . . .                                                                | 7    |
| Root development as related to soil types. . . . .                                                  | 8    |
| III. METHODS AND PROCEDURE. . . . .                                                                 | 9    |
| Establishment of farmer cooperation. . . . .                                                        | 9    |
| Selection of stands for study. . . . .                                                              | 9    |
| Location and acreage of stands . . . . .                                                            | 10   |
| History, environmental and management factors affecting<br>alfalfa establishment and yield. . . . . | 11   |
| Past alfalfa production in Putnam County . . . . .                                                  | 11   |
| Climatic conditions influencing establishment. . . . .                                              | 11   |
| Identification of mapping units and description<br>of soil types. . . . .                           | 12   |
| Stand records. . . . .                                                                              | 12   |
| Collection of soil samples and laboratory analysis . .                                              | 13   |



## III. (continued)

|                                                          |    |
|----------------------------------------------------------|----|
| Obtaining yields and other measurements for              |    |
| stand evaluation . . . . .                               | 13 |
| Obtaining yield data . . . . .                           | 13 |
| Estimate of per cent full cover. . . . .                 | 14 |
| Stand density. . . . .                                   | 15 |
| Estimate of alfalfa in first cutting . . . . .           | 15 |
| Establishment of management levels . . . . .             | 16 |
| IV. THE AREA STUDIED . . . . .                           | 17 |
| Soils of the area. . . . .                               | 17 |
| Series descriptions. . . . .                             | 19 |
| Climatic conditions affecting establishment and          |    |
| yield of stands. . . . .                                 | 23 |
| V. FINDINGS AND DISCUSSION. . . . .                      | 25 |
| Alfalfa production in Putnam County. . . . .             | 25 |
| Individual management practices of alfalfa production. . | 26 |
| Seeding data . . . . .                                   | 27 |
| Land preparation . . . . .                               | 27 |
| Use of cultipacker . . . . .                             | 27 |
| Soil tests . . . . .                                     | 28 |
| Lime application . . . . .                               | 28 |
| Fertilization. . . . .                                   | 28 |
| Top dressing . . . . .                                   | 31 |
| Varieties used . . . . .                                 | 32 |
| Seeding rates. . . . .                                   | 32 |



## V. (continued)

|                                                              |    |
|--------------------------------------------------------------|----|
| Seeding methods. . . . .                                     | 33 |
| Inoculation. . . . .                                         | 33 |
| Crops grown in combination with alfalfa. . . . .             | 33 |
| Measured and observed factors affecting alfalfa              |    |
| establishment and yield. . . . .                             | 35 |
| Soil tests . . . . .                                         | 35 |
| Harvesting . . . . .                                         | 37 |
| Modulation . . . . .                                         | 37 |
| Volunteer plants . . . . .                                   | 38 |
| Diseases and insects . . . . .                               | 38 |
| Data from measurements of stands and yields. . . . .         | 39 |
| Factors relating to success of establishment . . . . .       | 42 |
| Relationship of management levels to yield . . . . .         | 50 |
| Yield and stands as related to specific soil types . . . . . | 52 |
| VI. SUMMARY AND CONCLUSIONS. . . . .                         | 60 |
| BIBLIOGRAPHY. . . . .                                        | 63 |
| APPENDIX. . . . .                                            | 65 |



# LIST OF TABLES

| TABLE                                                                                                                                           | PAGE |
|-------------------------------------------------------------------------------------------------------------------------------------------------|------|
| I. Soil Mapping Units of Sixty Alfalfa Stands Studied<br>in Putnam County, Tennessee. . . . .                                                   | 18   |
| II. Amounts and Analyses of Fertilizer Used in Initial<br>Applications on Sixty Alfalfa Stands in Putnam<br>County, Tennessee. . . . .          | 29   |
| III. Quantities of Nutrients Used in Initial Applications<br>on Sixty Alfalfa Stands in Putnam County, Tennessee. . .                           | 30   |
| IV. Summary of Soil Test Results of Surface and B <sub>2</sub><br>Horizon Samples from Alfalfa Stands in Putnam<br>County, Tennessee. . . . .   | 36   |
| V. Alfalfa Yields and Stand Evaluation Measurements of<br>Sixty Alfalfa Stands in Putnam County, Tennessee . . . .                              | 40   |
| VI. Relationship of Yields to Plants per Square Foot and Per<br>Cent Full Cover of Sixty Alfalfa Stands in Putnam<br>County, Tennessee. . . . . | 49   |
| VII. Adjusted Yields, Management Levels and Soil Mapping Units<br>of Sixty Alfalfa Stands in Putnam County, Tennessee. . .                      | 53   |
| VIII. Summary of Stand Evaluation Measurements on Mountview<br>and Waynesboro Soils in Putnam County, Tennessee . . . .                         | 57   |



# LIST OF FIGURES

| FIGURE |                                                                                                      | PAGE |
|--------|------------------------------------------------------------------------------------------------------|------|
| 1.     | Regression of Per Cent Alfalfa at First Cutting on<br>Per Cent Full Cover. . . . .                   | 44   |
| 2.     | Regression of Plants Per Square Foot on Per Cent Full<br>Cover. . . . .                              | 45   |
| 3.     | Regression of Plants Per Square Foot on Yield. . . . .                                               | 46   |
| 4.     | Regression of Per Cent Full Cover on Yield . . . . .                                                 | 47   |
| 5.     | Relationship of Yield to Three Levels of Management. . . .                                           | 55   |
| 6.     | Yields of Waynesboro Silt Loam and Mountview Silt Loam<br>Under Three Levels of Management . . . . . | 59   |



# LIST OF APPENDICES

| APPENDIX                                                                                                                   | PAGE |
|----------------------------------------------------------------------------------------------------------------------------|------|
| A. Recommended Practices for Production of Alfalfa in<br>Tennessee and Adjoining States . . . . .                          | 65   |
| B. Climatological Data at Cookeville, Tennessee,<br>July 1957 through May 1958 . . . . .                                   | 67   |
| C. Questionnaire to Experienced Alfalfa Growers in<br>Putnam County. . . . .                                               | 68   |
| D. Record of 1957 (Fall) Seeded Alfalfa Stands in Putnam<br>County . . . . .                                               | 70   |
| E. Soil Association Map of Putnam County Showing Locations<br>of Stands. . . . .                                           | 75   |
| F. Profile Description of Waynesboro Silt Loam. . . . .                                                                    | 76   |
| G. Profile Description of Mountview Silt Loam . . . . .                                                                    | 77   |
| H. Profile Description of Baxter Cherty Silt Loam . . . . .                                                                | 78   |
| I. Profile Description of Hermitage Cherty Silt Loam. . . . .                                                              | 79   |
| J. Profile Description of Huntington Silt Loam. . . . .                                                                    | 80   |
| K. Profile Description of Sequatchie Loam . . . . .                                                                        | 81   |
| L. Profile Description of Wellston Silt Loam. . . . .                                                                      | 82   |
| M. Profile Description of Emory Silt Loam . . . . .                                                                        | 83   |
| N. Profile Description of Holston Silt Loam . . . . .                                                                      | 84   |
| O. Numerical Rating of Management Practices . . . . .                                                                      | 85   |
| P. Summary of Management Practices and Stand Evaluations for<br>Sixty Alfalfa Stands in Putnam County, Tennessee . . . . . | 88   |
| Q. Results of Tests of Soil Samples for Sixty Alfalfa Stands<br>in Putnam County, Tennessee. . . . .                       | 91   |



## CHAPTER I

### INTRODUCTION

One of the considerations of the Joint Land Use and Economic Study of Putnam County is the possibility of increasing alfalfa production in this area. While efficient alfalfa production is dependent upon many factors, the primary consideration is the potential productivity of the soils of the county for this crop.

In Tennessee, as in a number of other states, soil productivity studies have proven to be long and complex undertakings. Field data, gathered over a long period of time under varying conditions, and from controlled experiments are necessary for accurate predictions. Such studies, however, are valuable for agricultural planning, not only from the standpoint of yield predictions but for the soil management problems they reveal. Soil productivity studies have also proven to be a vehicle for the exchange of information between farmers and experiment stations.

Intensive soil productivity studies in relation to alfalfa on different soil types under field conditions have been very limited. Therefore, this investigation has been an effort to explore the possibilities of such a study in Putnam County, to establish sites, and to develop valid methods for obtaining yield data over a period of time necessary to determine accurate soil productivity predictions.

As a part of this study, all farmers in Putnam County known to have seeded alfalfa in the fall of 1957, were contacted. Farmers, on whose farms these stands that were located, have cooperated in furnishing management and yield information as well as additional information about their past experiences in alfalfa production.



Contacting farmers and observing sites revealed conditions and management problems that are basic and important to productivity studies of soils of the county. Foremost among these was establishment of stands.

The winter of 1957-58 presented unusually adverse weather conditions. The very wet fall season resulted in a number of late seedings. Extremely cold winter that followed, with intermittent warm spells, caused considerable heaving, and many of the poor stands can probably be attributed to these weather conditions. On the other hand, a number of sites came through the winter with good stands, indicating that both management and soil conditions were contributing factors.

Although the objective of this study has been to study yields under all levels of management, the ultimate goal is to help determine what yields the farmers of Putnam County can expect on specific soil types under good management procedures. Except for comparison there would be little value in determining yields of alfalfa on any soil type under poor management.

For the above reasons, this study was directed at the following: (1) establishing sites for continuing study, (2) developing methods of obtaining yield data, (3) evaluating management practices affecting establishment of alfalfa, (4) attempting to evaluate the adequacy of stands by stand count, percentage of full cover at the time of second cutting, and yield (5) relating the yield to different levels of management on all stands and to the major soil types on which they were grown, insofar as possible.



## CHAPTER II

### SELECTED LITERATURE REVIEW

#### Soil Productivity

Soil productivity studies not only bring out local and regional differences in soils but they measure environmental influences within a given area. Sprague (26) stated that physiological and ecological behavior of plants furnishes a basis for integrating new information into a coherent concept of natural laws and the uses which man may make of natural resources to best meet his needs. Physiological and ecological problems must therefore be taken into account in recommending management practices so that they may be in harmony with local conditions.

The value of soil productivity rating as a necessary part of soil type characterization has long been recognized. In 1937 Ableiter (1) presented a method of rating that was used by the Soil Survey Division of the U. S. Department of Agriculture. The method was an index system based on the relationship of any given soil type to what the most productive soils in the country would produce of a certain crop under (a) usual practices of better than average farmers, and (b) the inherent ability of the soil to produce without amendments. He further stated that productivity ratings are derived by deductive and inductive means. The use of inductive or subjective means involves weighing the characteristics of the soil profile in relation to their effect on production of a particular crop as determined by values attached to physical, chemical, and biological characteristics of a soil. Deductive means refer to



ratings assigned to a soil as a result of yield data (representative of a particular crop on a particular soil). This rating represents the integration of the influences of all factors of environment. The values of inductive and deductive processes serve to check each other, as data are frequently lacking or inadequate.

Much of the pioneer work in soil productivity has been done in Illinois. Studies made by Smith and Smith (24) indicate that with sufficient yield data at a given management level the productivity of a given soil can be predicted with a reasonable degree of accuracy. Odell and Smith (20) report a distinct tendency for long-time average farm yields to cluster about the mean of the soil type and management group to which each belongs. Odell (19) later found that crop yields on farms (when obtained in sufficient numbers) tend to be from 75 per cent to 95 per cent of yields on experimental plots with similar soils and similar management. In cooperative studies between the Tennessee Agricultural Experiment Station and the Soil Conservation Service, Bell and Springer (4) reported that the results of experiments constituted not only a good source of crop yield information but knowledge as to the response to management that could be expected for the soils on which the experiments were conducted. They further pointed out the importance of preliminary investigations to develop reliable and economical methods of obtaining management and yield data before extensive studies are attempted.

#### Comparison of Alfalfa Recommendations for Tennessee with those of Neighboring States

Much information is available on research concerning management practices involved in establishment of alfalfa in Tennessee and in



neighboring states with similar soils and other environmental conditions. It was considered that the latest recommendations of these states would reflect the results of their research and serve as a standard of currently accepted management practices.

Recommended management practices for five states are included as Appendix A.

These recommendations are generally in accord, with the exception of initial fertilization rates which frequently vary. In terms of nitrogen per acre two states recommended 30 pounds, two states 20 pounds, and one state no nitrogen. All states recommend approximately 120 pounds of  $P_2O_5$  and  $K_2O$  except one which recommends 100 pounds of  $P_2O_5$  and 200 pounds of  $K_2O$ . Three states recommend following soil tests in initial application, while two states make no mention of soil tests as governing application. This is not thought to imply that the soil test is not desirable but indicates that the recommended amounts may be desirable even on soils of high fertility in these states.

Recommendations for annual maintenance application of fertilizer vary considerably both as to quantity and analysis. These may range from 500 to 1000 pounds in varying combinations of  $P_2O_5$  and  $K_2O$ . (In no case is the application of nitrogen recommended after the initial application.) Only one state mentions that top dressing is not necessary until after the first year's growth.

#### Establishment of Alfalfa

Grauman and Hanson (15) state that the soils of the southeastern United States with few exceptions are not naturally well suited to alfalfa



production. While this appears true of many of the soils of this area, experiments by Bishop and Turner (6), Woodhouse (30), and Blaser (8) show definitely that alfalfa can be produced profitably on a rather wide range of deep, well-drained, permeable soil types, if proper management practices are followed.

### Heaving

Frost heaving has apparently not been serious during normal seasons in Tennessee. The winter of 1957, which was unusually severe, resulted in consideration of this problem. Way (29) as a result of observations in Vermont, reports that heaving is caused by freezing of water to form ice crystals near the surface. The resulting expansion lifts the plants up and out of the soil. He considers any soil drainage conditions which cause water to be present in excess in the surface layer as especially conducive to this problem. Grasses seeded with alfalfa were found to afford some protection from heaving, and a firm seed bed proved to be a preventive measure. Way also found that heaving was 40 per cent greater on summer-worked land than on land that had been worked the previous year.

### Fertilization

Davis (9) reported that three tons of alfalfa can remove 200 lbs. of  $\text{CaO}$ , 30 lbs. of  $\text{P}_2\text{O}_5$  and 120 lbs. of  $\text{K}_2\text{O}$  which indicates the high fertility requirements of alfalfa. The fertility level must not only be adequate at seeding time but must be maintained by annual applications (7)(11).



The role of nitrogen in the establishment of alfalfa has received the attention of numerous investigators (13)(15)(18). Response to nitrogen has been observed by the author on young stands where plants were not well inoculated. Gerwig (13) reports some beneficial effects of 25 lbs. per acre of nitrogen applied during the year following seeding, but higher rates tended to reduce nitrogen fixation and to be of no value. After the first season, nitrogen was not beneficial but tended to increase weed competition which resulted in decreased yield and thinning of stands. MacGregor, Brownell, and Nelson (18) reported little value of nitrogen in alfalfa production on Port Byron silt loam in Michigan. Slight increases in yield were obtained but were not sufficient to be financially justified.

It is concluded from this literature that nitrogen applied in limited amounts, may have some beneficial effect on the establishment of alfalfa. The normal growth habit of alfalfa after establishment is such that the use of commercial nitrogen is not required. Its addition is often favorable to non-legume volunteer plants that are competitive with alfalfa.

#### Grass and Alfalfa Mixtures

Graber (14) reported that companion crops are competitive but their use may still be a good practice where managed properly. Sears and Blaser (23) have found orchard grass seeded at rates of 3 to 5 pounds per acre with alfalfa to be compatible, provided early spring cuttings are made and annual applications of at least 100 pounds of  $K_2O$  are made. They also pointed out that higher seeding rates of orchard grass were detrimental.



### Root Development as Related to Soil Types

Root development is known to be a factor affecting the longevity of alfalfa plants, but how much the physical characteristics of soils that affect root development are related to success of establishment is not fully known. However the results of experiments conducted by Long (17) do provide some insight into this question. He found that gray and yellow soils are associated with high bulk density and low porosity values and that rarely were alfalfa plants deep rooted in these soils. On Mountview silt loam, which is characteristic of the gray and yellow soils, roots penetrated 30 inches and oven dry weight of the roots was 5189 pounds. Seventy-eight per cent of the root system was in the upper 6 inches, and only ten per cent was found below 18 inches. In contrast to this the red soils, of which Cumberland loam is an example, are associated with lower bulk density and high porosity values. Experiments with this soil revealed that roots penetrated 34 inches and 58 per cent of the root system was in the top 6 inches. Total oven dry weight of roots was 6062 pounds.



## CHAPTER III

### METHODS AND PROCEDURE

Methods and procedures developed for this study take into account the many variables which may enter into such an attempt to collect field data and the ways in which these variables may effect the end results or the usefulness of such a study. Methods used here should lend themselves to use in areas where similar kinds of measurements may be desired.

#### Establishment of Farmer Cooperation

The success of a study of this type is primarily dependent on the interest and cooperation of individual farmers. The farmers of Putnam County were contacted through the aid of the professional agricultural workers of the county and the objectives of the study were explained. Without exception all farmers contacted were most cooperative in contributing the benefits of their past experiences in alfalfa production, and in aiding us in keeping complete records of their present stands. Insofar as farmer cooperation was concerned, the prospects for continuing alfalfa studies in Putnam County appear to be excellent.

#### Selection of Stands for Study

It was decided to concentrate in this study on alfalfa stands seeded in the fall of 1957 so that continuous management records could be kept. With the aid of professional agricultural workers and Agricultural Conservation Program records, all of the farmers known to



have seeded at this time were contacted. Fifty-five stands were located and arrangements were made with the farmers to study these stands. In addition to these, five farmers were contacted who had stands seeded in the fall of 1956 on which records were available.

The original plan was altered to include all soil types where alfalfa was seeded in the fall of 1957. This was done because only a limited number of stands occurred on any one soil type and it was soon recognized when visiting the stands that farmers were experiencing management problems in establishing alfalfa on all soil types. For these reasons, it was decided to concentrate this phase of the study on management problems involved in the establishment and yield of stands on all of the sixty sites, regardless of soil type. The selection of stands for a continuing study would necessarily need to be on well established stands of the same general age.

#### Location and Acreage of Stands

To establish a permanent record, the stands to be studied were first located on a county road map (included on soil association map as Appendix E.) The general area surrounding and including the stands was then delineated on aerial photographs (scale: one inch = 1320 feet). From this, reproductions were made of each site on a scale of one inch to 660 feet. On these reproductions, the stands were delineated in the field. Field boundaries in most cases could be sketched in free hand by obvious land marks, but in some instances it was necessary to ground measure and scale. By use of a grid scale measure and a planimeter,



acres to be used in all yield calculations were measured. The reproductions showing farmer's name, acreage of stand, and field boundaries were a part of the permanent record. Aerial photographs and reproductions were furnished by the Soil Conservation Service.

## History, Environmental and Management Factors Affecting Alfalfa Establishment and Yield

### Past Alfalfa Production in Putnam County

As part of the background for this study, it was considered desirable to investigate certain aspects of the history of alfalfa production in the county, which would include the experiences and the observations of some of the more experienced growers. Information for this phase of the study was obtained from (1) census records, (2) interviews with professional agricultural workers who have had long and varied experiences in the county, and (3) interviews with a number of the more experienced growers of the county. The results of interviews with experienced growers were assembled on a mimeographed questionnaire form, an example copy of which is included as Appendix C.

### Climatic Conditions Influencing Establishment

A record of climatic conditions is an essential part of any management or productivity study. Somewhat unusual weather conditions before and during the life of the stands studied have greatly influenced success of establishment and yield. The climatic record included as Appendix B was taken from U. S. Weather Bureau records that had been collected at Cookeville, Tennessee. In addition to this record, a number



of rain gauges were distributed to farmer cooperators. During the 1958 spring and summer growing season, records from these gauges were kept in enough places to give a generalized picture of rainfall over the area studied.

#### Identification of Mapping Units and Description of Soil Types

As previously stated, it was decided to study all stands seeded in the fall of 1957, regardless of soil type. The majority of fields were uniform enough with respect to soil mapping units to be acceptable. Individual fields were acceptable which included less than 15 per cent of other soil mapping units. In the analysis of results, an effort was made to relate soil types and groups of soil types to yield. Identification of mapping units on the individual sites was made by Jackson (15), Party Chief of the Progressive Soil Survey which was being conducted in the county. Descriptions of the soil types included as Appendix F, G, H, I, J, K, L, M, N were also obtained from members of the soil survey party (2)(15).

#### Stand Records

The validity of this study is based primarily on the accuracy of a complete and detailed management record that extends from previous use of the field throughout the period in which it was conducted. Much time and effort went into this phase of the study. Information was obtained through (1) interviews with the farmers, (2) checking seed and fertilizer purchase records, and (3) direct observations. The complete field record has been assembled on a mimeographed form which will become a part of a permanent record of the stand. A sample copy of this form is included as Appendix D.



### Collection of Soil Samples and Laboratory Analysis

As a part of the management record, soil samples were taken in the spring of 1958 on all of the sites. The surface samples were taken from the top 7 inches of soil. Samples were also taken from the B2 horizons on all of the major soil types involved. All samples were tested for pH, "available" phosphorus, and exchangeable potassium by the Soil Research Laboratory of the University of Tennessee.

### Obtaining Yields and Other Measurements for Stand Evaluation

#### Obtaining Yield Data

Most of the yield data were obtained by measurement of baled weight of each alfalfa cutting. This was a simple method that depended on farmer cooperation. Each farmer kept a record of the number of bales as indicated by baler counter. As most farmers paid for their baling by the bale, this was no problem. An average weight was obtained by weighing 10 per cent (or enough to get a representative sample) of the bales. Average weight multiplied by number of bales, divided by number of acres in the field equalled weight per acre. The main limiting factor in this method would be the variation in per cent moisture of cured hay. Since the variation under normal conditions is small, the method is considered satisfactory for this type of study.

In the case of a few farmers who did not bale their hay, a sampling method was used. At least five different representative areas of one square foot each were harvested by hand for each acre of the field. These clippings were cured in an electric hay drier and weighed. From these



samples the yield per acre of cured hay was calculated mathematically. This method, though satisfactory for plot measurements, has its limitations in a field study. It is difficult to obtain a representative sample over large fields, and hand clippings are not always representative of clippings made with a mower. They may be a closer measure of the actual growth but not of what the farmer harvests. In several weight comparisons the sampled weight was slightly higher than baled weight, probably because clipping by hand was lower than by a mower.

In a few cases (which are indicated) estimations were made of cuttings that were not baled. These estimates were made on the basis of cover before cutting, by comparison with a previous yield, and the farmer's estimate. This method definitely has its limitations, but as experience was gained in measuring yields over the county, it is considered to be acceptable in the few instances where it was used.

#### Estimate of Per Cent Full Cover

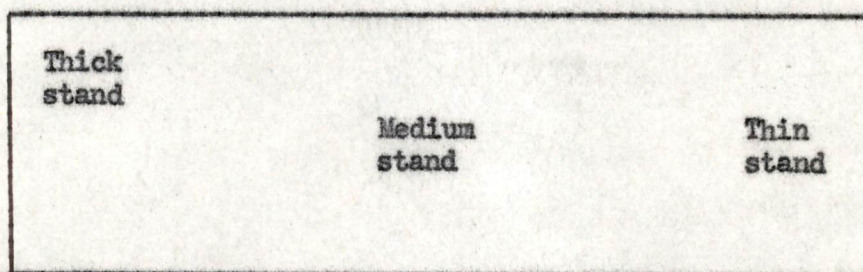
As a field evaluation of the degree of success of establishment, an estimate of per cent full cover was made. For purposes of this study, per cent full cover is defined as the per cent of ground cover at the time of the second cutting. It is not necessarily the same as might be considered an adequate stand, but is based on complete cover. This estimate considers both stand density and vigor of the plants. Therefore stands with equal numbers of plants per square foot did not always have the same per cent cover. A stand, considered to be adequate, did not necessarily have 100 per cent cover.



### Stand Density

On large fields, often with variable stands, any practical evaluation stand density is partly by estimate. Every effort was made to make this estimate as accurate as possible. While the number of plants reported per square foot for individual stands may not be exact, it is felt that the count is satisfactory for comparison of density among stands. To use random sampling over large fields on a scope that was practical might not give a true picture of stand count because of irregular stands. For this reason, the following steps were used:

1. Survey of the field was made in which an overall analysis of the stand was determined.
2. The field was then divided into sections each of which represented fairly uniform stand, example:



3. Within each of the uniform areas, a stand count was made by use of either a square foot or a three square foot open end quadrant (the three square foot quadrant on the thinner stands). Counts were made at randomly selected points within the uniform areas in sufficient number to give a consistent range.
4. Averages were made of all like sections. These were combined to give an average count for the field.

### Estimate of Alfalfa in First Cutting

Because of the heavy infestation of volunteer weeds, and in a few cases because of the presence of seeded annuals in stands, it was



considered necessary to make an estimate of the per cent alfalfa as compared with other plants present in the first cutting of hay. This estimate was used in determining an adjusted yield, which was more nearly a measure of actual alfalfa production. The estimate of plants was divided into percentages of (1) alfalfa, (2) small grain, (3) seeded grasses, (4) cheat, and (5) broadleaf weeds. Cuttings made after the first cutting consisted mainly of alfalfa and, in a few cases, included seeded perennial grasses.

#### Establishment of Management Levels

As a means of comparing management practices with yields, one of three management levels was assigned to each stand. This management level was determined by a numerical rating system in which all of the more important practices were given ratings based on their adequacy in relation to recommended practices. Certain adjustments were made to these ratings on the basis of personal knowledge of the stand.



## CHAPTER IV

### THE AREA STUDIED

#### Soils of the Area

Putnam County lies mainly within three physiographic provinces, the Cumberland Plateau, the Highland Rim, and the Outer Basin. With the exception of one site on the Brotherton Bench (a division of the Cumberland Plateau) all of the stands studied are located in the Highland Rim.

The soils of this area consist largely of transported cappings (described as either loess or stream laid material) that have been deposited on limestone residuum. The residuum consists of both high-grade Saint Louis and Warsaw limestone and Cherty limestone of the Fort Payne Chert. In general the high grade limestone is considered by some to underlie the more dissected area consisting mainly of red soils and the more resistant Fort Payne Chert formation to underlie the more level gray soil areas.

No effort will be made to describe in any detail the soils of the area as the Progressive Survey now in progress in the county will afford a detailed description of the soils of the area. Table I lists the mapping units identified on the sites studied; a brief description of their general characteristics is also included; profile descriptions are included as Appendix F, G, H, I, J, K, L, M, N.



TABLE I  
SOIL MAPPING UNITS OF SIXTY ALFALFA STANDS STUDIED  
IN PUTNAM COUNTY, TENNESSEE

| Predominant Soil Type and Phase <sup>1</sup> |                              | Number of Sites |
|----------------------------------------------|------------------------------|-----------------|
| Waynesboro silt loam                         | B1                           | 3               |
| Waynesboro silt loam                         | B2                           | 6               |
| Waynesboro silt loam                         | C2                           | 6               |
| Waynesboro silt loam                         | C3                           | 5               |
| Waynesboro silt loam                         | C3 (and Emory silt loam)     | 1               |
| Mountview silt loam                          | B1                           | 14              |
| Mountview silt loam                          | C2                           | 1               |
| Holston silt loam                            | B1                           | 1               |
| Holston silt loam                            | B2                           | 1               |
| Holston silt loam                            | C2                           | 1               |
| Wellston silt loam                           | B1                           | 1               |
| Cookeville silt loam                         | C3                           | 1               |
| Bewleyville silt loam                        | B2 (and Mountview silt loam) | 1               |
| Bewleyville silt loam                        | C2                           | 1               |
| Cumberland silt loam                         | B1                           | 4               |
| Cumberland silt loam                         | B2                           | 1               |
| Cumberland silt loam                         | C2                           | 1               |
| Cumberland silt loam                         | C3                           | 1               |
| Hermitage Cherty silt loam                   | C1                           | 2               |
| Mixed Old Colluvium                          | B1                           | 1               |
| Baxter Cherty loam                           | C2                           | 4               |
| Emory                                        |                              | 1               |
| Huntington                                   |                              | 1               |
| Sequatchie                                   |                              | 1               |
|                                              |                              | <hr/> 60        |

<sup>1</sup>Phase designations are indicated by letter and number

B - indicates gently sloping phase - 2 to 5% slope

C - indicates sloping phase - 5 to 12%

1 - indicates uneroded or slightly eroded

2 - indicates moderately eroded

3 - indicates severely eroded



## Series Descriptions

The following descriptions were adapted from descriptions made by the Soil Conservation Service.

Waynesboro - The Waynesboro series consists of deep, well-drained Red-Yellow Podzolic soils developed in old alluvium on high stream terraces. The alluvium has washed from soil developed from sandstone and shale and an admixture of materials from limestone soils. These soils occupy gently to moderately steep slopes. They are medium to strongly acid and moderate in content of plant nutrients and organic matter. The Waynesboro series grade toward the Cumberland series on the one hand and toward the Holston series on the other. They are permeable soils, are generally cleared and used productively for a wide variety of crops.

Mountview - The Mountview series consists of well-drained Red-Yellow Podzolic soils that are developed in loess or loess-like silt over residuum from cherty limestone. These soils are on gently sloping to sloping uplands of the Highland Rim. They are dominantly associated with the Dickson soils but lack the characteristic fragipan. The Mountview soils are low in organic matter and natural fertility. They are medium to strongly acid. These soils are permeable to air, roots, and water, but they do not have as nearly optimum air and water relationships as the Waynesboro and Cumberland series. Numerous angular chert fragments occur in the lower portion of the profile. Most of the soils have been cleared and are used for general farm crops. They produce relatively low yields of corn, tobacco, lespedeza, small grains, and pasture.



Cumberland - The Cumberland series consists of Reddish-Brown Lateritic soils that intergrade toward Red-Yellow Podzolic soils. These soils occupy nearly level to sloping areas and are developed in old alluvium, washed chiefly from soils developed in limestone residuum that is mixed to some degree with materials washed from soils developed in sandstone and shale residuum. Typically they have dark brown silt loam to loam surface layers and dark red silty clay loam to silt clay B2 horizons. They are well-drained, permeable, highly productive soils that are widely distributed but of small total acreage. They are used for a wide variety of crops and are generally considered very desirable for the production of alfalfa.

Holston - The Holston series consists of well-drained Red-Yellow Podzolic soils developed in old alluvium on terrace positions. The alluvium is washed from soils developed in residuum predominately from acid sandstone and shales. They occupy nearly level to sloping topography in close association with the Waynesboro and Nolichucky series. Typically they have dark grayish brown to grayish brown silt loam to sandy loam surface horizons and yellowish brown sandy clay loam to silty clay loam B2 horizons. Though considered well-drained, as actually mapped some mottling may occur in the lower B horizon. The soils, which are permeable and moderately productive, are used for a wide variety of crops.

Hermitage - The Hermitage series includes Reddish-Brown soils developed in old local alluvium that has developed in limestone residuum. Parent material and position are similar to those of the Emory soils, but they have well defined B horizons and are considered older. In the sites studied in Putnam County they are cherty and are often defined locally as



"Crag Rock" land. The soils are well-drained, permeable, highly productive, and are used for a wide variety of crops. In Putnam County they are considered by many farmers to be highly desirable for alfalfa production.

Baxter - The Baxter soils are well-drained cherty red upland soils belonging to the Red-Yellow Podzolic great soil group. They occupy broad rolling to steep ridges of the Highland Rim in Putnam County. They are resider, have less chert and more highly developed B horizons than the Bodine soils with which they are associated. Baxter soils are permeable, moderately productive although considered somewhat droughty,

Cookeville - The Cookeville series, on which only one site is located, consists of Red-Yellow Podzolic soils. They are developed in residuum from slightly cherty, moderately high grade limestone on gently rolling to rolling and karst topography. In places, a small component of loess may occur irregularly on the surface. Where not eroded, the series is characterized by brown silt loam surfaces and red to dark red silty clay B horizons. The series does not appear to be extensive in Putnam County and, where observed, is eroded. It is well drained, permeable, and moderately productive.

Bewleyville - The Bewleyville series on which one site is located consists of well-drained polygenetic soils. The upper horizon developed in loess-like materials, is Gray-Brown Podzolic, and the lower sequence developed in residuum from moderately high grade limestones is Red-Yellow Podzolic. Bewleyville soils occupy gently to rolling slopes and are associated with Mountview, Cookeville, and Baxter soils. They are characterized by dark grayish-brown to grayish-brown silt loam surfaces



and strong brown to yellowish-red B horizons. The soils are moderately productive and are used for a wide variety of crops.

Emory - The Emory series on which one site is located is an Alluvial soil developed from recent alluvium washed from soils developed in high grade limestone residuum. They are well-drained, permeable, highly productive soils on nearly level to sloping topography and are characterized by brown to reddish-brown silt loam to loam surfaces, over weakly developed brown to reddish-brown silt loam, loam or silty clay loam, weakly developed B horizons.

Huntington - The Huntington series, on which one site is located, consists of well-drained Alluvial soils that are composed of young sediments, derived largely from uplands of limestone. They are on nearly level stream topography and are characterized by dark brown silt loam to loam surfaces and brown to dark brown silt loam to loam lower horizons. Huntington soils are permeable, slightly acid to mildly alkaline, have good moisture supplying capacity, and are highly productive.

Sequatchie - The Sequatchie series, on which one site is located, consists of young Gray-Brown Podzolic-Alluvial intergrades. These soils occupy low stream terraces and are developed from mixed alluvium washed chiefly from soils underlain by sandstones and shales but, in places, from limestones and mixtures of other materials. They are characterized by dark brown fine sandy loam to loam surfaces and dark brown to strong brown fine sandy clay loam to clay loam weakly developed B horizons. They are well-drained, permeable, and highly productive soils.



## Climatic Conditions Affecting Establishment and Yield of Stands

Climatological data that is included as Appendix B reflect a number of conditions that had a direct and, in some cases, unusual effect on establishment of the stands studied.

July and August, the two months prior to seeding, were dry months with a total of 2.47 inches rainfall. According to a number of farmers practicing summer fallow, this fact contributed to the volunteer weed problem. Summer fallow was less effective because moisture was not sufficient to sprout all of the small grain and weed seeds so that they could be killed by disking.

During seeding time rainfall was light, but seeding could be accomplished (where land was in fallow) within the preferred time of the last of August 15 to September 15. From this time until October 7, rainfall was unusually heavy for this season. Those farmers who did not seed before this period were generally delayed until a rather late date for seeding their alfalfa.

After seeding, the winter season was very severe for this section; the months of January (average 32.1°) and February (average 26.5°) were unusually cold. Stands that were seeded late suffered some winter killing, and a number of farmers reported good fall stands that were severely thinned by spring. Considerable heaving was reported. From reports of the farmers and the appearance of the stands, winter killing appeared to be more severe on the "gray" soils which included mainly the Mountview series.



March, April and May were months with high rainfall. The soils were never below field capacity. This moisture condition favored good yields of the first cutting on all establishes stands.

Following the first cutting, rainfall was relatively light over most of the area in June. Many of the stands made poor recovery; there was considerable yellowing (that to some degree was evidence of fertility deficiencies), and the alfalfa bloomed out short.

Some of the farmers cut this short crop at the early bloom stage while others waited because of the short growth or for other reasons. July was a month of high rainfall with from 4 to 7 inches over the county. In general, those stands from which the second cutting had been taken made an excellent recovery. Farmers who had not made the second cutting by early July were delayed because of rainy weather, and did not cut the second time until others were making their third cuttings.

The reduced yield due to the delayed second cutting is considered a result of management rather than potential yield of the stands.



## CHAPTER V

### FINDINGS AND DISCUSSION

#### Alfalfa Production in Putnam County

From interviews with professional agricultural workers and the more experienced growers it appears that alfalfa has been grown to some extent in Putnam County for about thirty years. Agricultural census records verify this as shown by the following data (27)

|                      |       |               |            |
|----------------------|-------|---------------|------------|
| 1929 - acres grown - | 71    | Yield in tons | not listed |
| 1934 - acres grown - | 260   | Yield in tons | 282        |
| 1949 - acres grown - | 1,323 | Yield in tons | 2,464      |
| 1954 - acres grown - | 1,128 | Yield in tons | 1,913      |

These figures indicate a slight decline in acreage during the early 1950's which has been attributed to disappointments in success of stands and poor stands resulting from a tendency of experienced growers to reduce the efficiency of their management practices. Although no current figures are available, production seems to have been on the increase during the last few years. Seedlings in the fall of 1957 amounting to approximately 300 acres would indicate this to be true.

As seen by the census figures, yields of alfalfa have been low through the years - at no time were as much as two tons per acre reported.

Management history indicates good cultural practices and liming but low fertilization. None of the experienced growers interviewed used more than 600 pounds of fertilizer at seeding which was mainly 6-12-12. Topdressing had been irregular if done at all. It is interesting to note that two of the most successful older growers had, through the years,



used 0-1-3 or 0-1-2 combinations of fertilizer at rates of 400 pounds at seeding and 200 pounds annually. These growers expected 5 to 6 years from any stand and believed that, with heavier annual fertilizer applications, stands would last up to 9 years. Many of the average growers expected no more than 3 to 4 years from a stand.

The growers interviewed were unanimous in the opinion that "red" soils (soils with red subsoils) were much superior to "gray" soils (soils with yellowish brown or brownish yellow subsoils). A favorite with several growers was "Crag Rock" land which consists of soils formed from old colluvium and would fall mostly into the Hermitage Series. No successful growth over a long period of years was located on the so-called "gray" soils which was mainly the Mountview and Dickson soils.

Growers had very little knowledge of past or expected yields. They generally expected 3 or 4 cuttings a year, with the first cutting amounting to about one-third of the total yield.

Fall seedings in general were preferred, and only in a few cases had the growers experienced failure in getting stands from seedings made at this time. Failures were usually attributed to late or poor seedbed preparation, late seedings, seed of unadapted varieties, or unusually severe winters as was the case in 1957-58.

#### Individual Management Practices of Alfalfa Production

A summary of each of the more important management practices follows. Of the sixty stands studied, five were seeded in 1956 and are treated separately in the seeding date analysis because they were influenced by different climatic conditions.



### Seeding Date

Seeding dates for the 1957 stands were influenced for the most part by an unusually wet fall season. Dates fell in three main groups, (1) seventy-one per cent of the stands were seeded from August 15 to September 15 (the recommended dates for Tennessee), (2) seven per cent were seeded from September 20 to September 30 (following heavy rainfall), and (3) the remaining twenty-two per cent were seeded from October 1 to October 30. Most of the farmers who did not seed early were delayed by rainfall until the third period.

Of the five 1956 stands studied four were seeded between August 15 and September 15. The fifth was seeded September 30.

### Land Preparation

There were three general methods of land preparation.

- (1) Forty-eight per cent practiced summer fallow, in which the land was turned by July 15 and disked regularly until seeded.
- (2) Twenty-five per cent followed a harvested summer crop, preparing the land either by turning and disking or by bogging and disking.
- (3) Twenty-seven per cent turned weeds, volunteer oats or lespedeza late, just prior to seeding.

This indicates that 73.0 per cent of the farmers followed methods considered more desirable. Disks, section drags and cultipackers were used in seed bed preparation.

### Use of Cultipacker

Use of the cultipacker both before and after seeding is considered a very desirable practice. Seventy-three per cent of the farmers used a cultipacker, and of this group fifty-five per cent used it only after seeding and eighteen per cent used it both before and after.



### Soil Tests

Only nineteen of the sixty farmers, or thirty-two per cent, had soil tests made prior to seeding. Of this group, thirteen per cent followed recommendations and nineteen per cent partially followed recommendations. Sixty-eight per cent did not have a soil test.

The group that partially followed recommendations met the lime requirements but all of this group used 6-12-12 fertilizer which does not supply the proportion of plant nutrients generally recommended by the Tennessee Agricultural Experiment Station.

### Lime Application

All stands except seven (7) received an application of lime during the season they were seeded. These fields had been limed in previous years.

#### Summary of Lime Application in Tons per Acre

|                   | <u>2 Tons</u> | <u>2 1/2 Tons</u> | <u>3 Tons</u> | <u>Over 3 Tons</u> |
|-------------------|---------------|-------------------|---------------|--------------------|
| Per cent of Total | 27            | 10                | 53            | 10                 |

Most of the applications were made while the seedbed was being prepared although a few were made before the land was turned.

### Fertilization

Initial fertilization was generally lower, and plant nutrients were not in the proportions recommended by the Tennessee Agricultural Experiment Station when no soil test is made.

A summary of the fertilizer practices used is shown in Tables II and III.



TABLE II

AMOUNTS AND ANALYSES OF FERTILIZER USED IN INITIAL APPLICATIONS ON  
SIXTY ALFALFA STANDS IN PUTNAM COUNTY, TENNESSEE

| Number of Stands | Lbs. of Mixed Fertilizer | Analysis |
|------------------|--------------------------|----------|
| 3                | 300-350                  | 6-12-12  |
| 25               | 400                      | 6-12-12  |
| 14               | 400-600                  | 6-12-12  |
| 1                | 750                      | 6-12-12  |
| 2                | 1000                     | 6-12-12  |
| <u>45</u>        |                          |          |
| 3                | 400                      | 3-12-12  |
| 1                | 1100                     | 3-12-12  |
| 1                | 600                      | 2-12-12  |
| <u>5</u>         |                          |          |
| 4                | 200-250                  | 0-9-27   |
| 2                | 300                      | 0-9-27   |
| 1                | 600                      | 0-9-27   |
| <u>7</u>         |                          |          |
| 1                | 300                      | 0-10-20  |
| 2                | 100-150                  | 0-0-60   |
| <u>3</u>         |                          |          |



TABLE III

QUANTITIES OF NUTRIENTS USED IN INITIAL FERTILIZER APPLICATIONS ON  
SIXTY ALFALFA STANDS IN PUTNAM COUNTY, TENNESSEE

| Number of Stands | N     | P <sub>2</sub> O <sub>5</sub> | K <sub>2</sub> O |
|------------------|-------|-------------------------------|------------------|
|                  | Lbs.  | Lbs.                          | Lbs.             |
| 3                | 18    | 36                            | 36               |
| 25               | 24    | 48                            | 48               |
| 14               | 24-36 | 48-72                         | 48-72            |
| 2                | 60    | 120                           | 120              |
| 1                | 45    | 90                            | 90               |
| 3                | 12    | 48                            | 48               |
| 1                | 33    | 132                           | 132              |
| 1                | 12    | 72                            | 72               |
| 7                | 0     | 18-27                         | 54-81            |
| 1                | 0     | 54                            | 162              |
| 2                | 0     | 0                             | 60-90            |



From Table II it can be seen that a large majority of the farmers (70 per cent) used 600 pounds or less of the 6-12-12 fertilizer. Forty-two per cent used 400 pounds of 6-12-12 which is the equivalent of the amount of nutrients on which an Agricultural Conservation Program cost-sharing allowance is made.

The general fertilizer recommendation of the Tennessee Experiment Station (when soil test is not used) is 15 pounds of N, 120 pounds of  $P_2O_5$  and 120 pounds of  $K_2O$ . Table III indicates that applications were close to these suggestions in three instances, but in each case these exceeded the recommended amount of N. Eight of the applications met the recommendations of the soil test. Although a number of other applications may have been adequate; without the soil test, we can consider that only eleven stands were fertilized adequately.

While the amounts of nitrogen applied at seeding are not unusually large, they are high in proportion to other nutrients used when the fertility requirements of alfalfa are considered.

Borax was included in the fertilizer mixture on all sites except two. Both of these stands were poor, and evidence of the deficiency was pronounced.

#### Top Dressing

Many investigators (7)(13)(18) agree that annual applications of  $P_2O_5$  and  $K_2O$  are essential to high yields and long life of alfalfa stands. Generally, top dressing is associated with maintenance rather than establishment of stands; however, where inadequate amounts of nutrients are used at time of seeding, top dressing becomes associated



with establishment as well as maintenance. Parks (21) has found that in the greater number of experiments conducted in Tennessee there has been little response to fertilization during the first year after seeding. These observations were made on stands receiving recommended rates of fertilization at seeding. This was not the case in most instances in this study and excellent responses were observed from top dressing. In some cases this practice appeared to result in the difference between establishment and failure of stands.

Number of Stands, Amounts Used and Time of  
Topdressing Fertilizer Applications

| <u>Before 1st Cut</u> | <u>After 1st Cut</u> | <u>After 2nd Cut</u> | <u>After 1st and<br/>3rd Cut</u> |
|-----------------------|----------------------|----------------------|----------------------------------|
| (3) 200# 0-9-27       | (4) 200# 0-9-27      | (2) 300# 0-9-27      | (1) 600# 0-9-27                  |
| (3) 350# 0-9-27       | (1) 250# 0-9-27      |                      | After 1st cut                    |
| (1) 400# 0-9-27       | (1) 300# 0-9-27      |                      | 400# 0-9-27                      |
| (1) 500# 0-9-27       | (1) 400# 0-9-27      |                      | After 2nd cut                    |
| (1) 300# 6-12-12      | (2) 250# 0-20-20     |                      |                                  |

( ) Represents number of stands.

Varieties Used

Mainly three varieties were used:

|                   | <u>Buffalo</u> | <u>Kansas Common</u> | <u>Oklahoma Common</u> | <u>Other</u> |
|-------------------|----------------|----------------------|------------------------|--------------|
| Per cent of total | 53             | 17                   | 23                     | 7            |

Included under other are two mixtures of Oklahoma and Kansas, one of Buffalo and Kansas, and one variety known only as Jumbo.

Seeding Rates

All of the farmers used as much or more seed as the recommended rate. It seemed to be the general opinion of many farmers that you "couldn't go



wrong" using plenty of seed. A few considered that thicker stands gave higher quality hay.

#### Summary of Seeding Rates

|                   | <u>Less than<br/>20 lbs.</u> | <u>20 lbs.</u> | <u>25 lbs.</u> | <u>30 lbs.</u> | <u>40 lbs.</u> | <u>50 lbs.</u> |
|-------------------|------------------------------|----------------|----------------|----------------|----------------|----------------|
| Per cent of total | 3                            | 37             | 40             | 12             | 5              | 3              |

The two instances of less than 20 pounds of seed were mixtures containing sweet clover, white clover and orchardgrass with 10 and 15 pounds of alfalfa seed.

#### Seeding Methods

Three methods of seeding were used:

|                   | <u>Cyclone</u> | <u>Grain Drill</u> | <u>Cultipacker-Seeder</u> |
|-------------------|----------------|--------------------|---------------------------|
| Per cent of total | 54             | 43                 | 3                         |

Although the cultipacker-seeder is the more desirable of these methods; any of them should be satisfactory if properly used.

#### Inoculation

All the farmers except one used inoculum. The complete failure of this one stand was due to a number of reasons.

#### Crops Grown in Combination with Alfalfa

Only two growers seeded small grain (oats) as a companion crop. One of these had a stand failure and attributed it partly to the oats. The other grower had used oats with his alfalfa for a number of years and liked the practice both from the standpoint of protection and additional yield.



Thirteen growers included from two to six pounds of orchardgrass with their alfalfa seed; nine of them were satisfied with the practice; four were not. Reasons given in favor of orchardgrass were (1) it added to the total yield, (2) it was an aid in curing, (3) it prevented alfalfa from lodging, and therefore was an aid in escaping fungous diseases, and (4) it served as erosion control. Reasons given against the use of orchardgrass were (1) it crowded out the alfalfa, and (2) mixed hay would not demand as high price as pure alfalfa.

Of the other growers who did not use orchardgrass, practically all felt that it was too competitive when used with alfalfa. It is thought that much of the aversion to a mixture of orchardgrass (which in most cases is a result of either their observations or experience) is due largely to improper fertilization and heavy seeding rates of the grass.

One grower (two sites) used a mixture of 10 pounds of alfalfa, 5 pounds of sweet clover, 3 pounds of orchardgrass and 1/2 pound of white clover. He used a cropping system in which the mixture was used for hay three years, followed by pasture for 3 or 4 years. The field was then planted to corn for 2 years, and back to the alfalfa mixture. While this system would not be desirable in all cases, a mixture of this type is worthy of consideration where the longevity of alfalfa stands is questionable because of the physical properties of the soil.



Measured and Observed Factors Affecting Alfalfa  
Establishment and Yield

Soil Tests

The results of tests of soil samples taken on all sites are included in Appendix Q. Table IV is a summary of these results.

The soil test summary indicates that the pH and fertility level of the stands was definitely not optimum, but considering field conditions and the small amounts of fertilizer applied, they are not as low in some instances as might be expected. All but 10 of the surface samples showed definite results of liming, with about one-half of the sites being within the optimum range. The pH of the B<sub>2</sub> horizon is generally low. Phosphorus in the surface layer was low or very low in one-half of the sites. All but one of B<sub>2</sub> horizons tested were very low in phosphorus. Of particular interest is the generally high level of potassium in most of the sites, especially in the surface layer.

Several possibilities should be considered when interpreting these results, (1) because of the period at which the soil samples were taken (the spring after fertilizer application) the results could not be expected in all instances to give an accurate measurement of the field; (2) the level of phosphorus may have been a limiting factor in establishment; (3) the level of potassium, which may have been a limiting factor in alfalfa establishment in some cases, appears to be high in many instances despite low applications of this nutrient at seeding. The fertility status of the soil could be the result of previous treatment or cropping history or other factors. It could suggest that the inherent fertility of these soils be further investigated on the possibility that this factor would influence fertilizer recommendations for the area.



TABLE IV

SUMMARY OF SOIL TEST RESULTS OF SURFACE AND B<sub>2</sub> HORIZON SAMPLES  
FROM ALFALFA STANDS IN PUTNAM COUNTY, TENNESSEE

| Soil Tests                                | Soil Test Rating |            |            |      |
|-------------------------------------------|------------------|------------|------------|------|
|                                           | Below 6.0        | 6.0 to 6.5 | 6.5 to 7.1 |      |
| pH of surface - 60 samples                |                  |            |            |      |
| Number                                    | 10               | 21         | 29         |      |
| Per cent of total                         | 17               | 35         | 48         |      |
| pH of B <sub>2</sub> horizon - 38 samples |                  |            |            |      |
| Number                                    | 19               | 14         | 5          |      |
| Per cent of total                         | 50               | 37         | 13         |      |
| P of surface - 60 samples                 | Very Low         | Low        | Medium     | High |
| Number                                    | 9                | 21         | 13         | 17   |
| Per cent of total                         | 15               | 35         | 22         | 28   |
| P of B <sub>2</sub> horizon - 36 samples  | Very Low         | Low        | Medium     | High |
| Number                                    | 35               | 1          |            |      |
| Per cent of total                         | 97               | 3          |            |      |
| K of surface - 60 samples                 | Very Low         | Low        | Medium     | High |
| Number                                    | 3                | 13         | 11         | 33   |
| Per cent of total                         | 5                | 22         | 18         | 55   |
| K of B <sub>2</sub> horizon - 36 samples  | Very Low         | Low        | Medium     | High |
| Number                                    | 3                | 15         | 10         | 8    |
| Per cent of total                         | 8                | 42         | 28         | 22   |



### Harvesting

The yield results of this study are based on the amount of hay harvested through August 10.

#### Date, Number and Order of Cuttings for 56 Stands\*

|             | <u>May 22 to June 10</u> | <u>June 28 to July 7</u> | <u>July 19 to Aug. 10</u> |
|-------------|--------------------------|--------------------------|---------------------------|
| 1st cutting | 56                       |                          |                           |
| 2nd cutting |                          | 26                       | 26                        |
| 3rd cutting |                          |                          | 26                        |

\* 4 seedings were failures and no yields were harvested.

The first, second, and third cuttings were generally harvested in the early bloom stage, with exception of 26 second cuttings that were harvested late and were in late bloom stage. In this instance part of the yield was from new growth. The yield of these stands was generally decreased by delay of the second cutting, but since all successful stands were harvested within the same period of July 19 to August 10 it is not believed that the last cutting would greatly affect the relative yields. Yield through August 10 is used as one measure of success of establishment.

### Nodulation

From observations made in Tennessee it appears that inoculation is one of the more serious problems in establishment of alfalfa. Although time or facilities did not permit a study of this phase of management, a few observations were made. The roots from plants carefully dug from twenty different stands were examined for the presence of nodules. In only two instances were nodules found. While this observation is not sufficient to draw any conclusions, it is of some interest to note



that the two stands where a few nodules were observed were older stands. One was three years old and the other four. These were two of the few stands in the county that have received only  $P_2O_5$  and  $K_2O$  (no nitrogen) both at seeding and in annual applications.

### Volunteer Plants

Many of the alfalfa stands were heavily infested with volunteer plants (weeds). These plants included mainly oats, ryegrass, cheat, turnips, cress, and cool-season broadleaf weeds, mainly chickweed, winter mint, sour dock, fennel and wild mustard. Although this infestation was worse in stands where the land was prepared late, it was also a problem in a number of stands where preferable cultural methods had been used.

The growth of these plants was undoubtedly stimulated by extra nitrogen as a result of the wide use of 6-12-12 fertilizer. Although they added greatly to the yield of the first cutting, they were competitive with the alfalfa plants. While alfalfa recovered very well in some stands, the competition of these volunteer plants greatly thinned or crowded out some weaker stands. The serious effects of this problem were no doubt closely related to fertility level of the soils (high level of nitrogen in proportion to phosphorus and potash) and whether the stands were thick enough to bear losing some plants and still have an adequate stand.

### Diseases and Insects

Disease and insect problems were not of a serious nature during the period in which the stands were observed except for several stands that were heavily infested with green aphids. A few stands were thinned by Crown Rot, Sclerotinia trifoliorum, and Black Stem, Ascochyta imperfecta,



mainly during the cool wet period prior to the first cutting. Damage by these diseases appeared to be more serious on thick, vigorous growing, pure stands of alfalfa. The presence of orchardgrass in stands seemed to be an aid in escaping damage from these diseases. Two farmers expressed the opinion that grass mixtures prevented lodging of alfalfa thus affording better aeration. Only one stand was seriously affected by Leaf Spot.

#### Data From Measurements of Stands and Yields

Table V lists yield results, both total and adjusted, and other measurements directed at determining success of establishment. All total yields were computed on the basis of total baled weight except where otherwise indicated. Adjusted weight was computed by subtracting the estimated weight of volunteer or annual plants from the total yields of the first cutting. Average total yield for fifty-five, 1957 stands was 4230 lbs. per acre; adjusted average yield was 3620 pounds per acre. This included 22 stands that were cut three times, 25 that were cut twice, four that were cut once and four stands that were not harvested.

Percentage of alfalfa at first cutting was estimated within three weeks prior to first cutting.

Percentage of full cover was estimated at time of second cutting.

Stand count of plants per square foot was made within two weeks following first cutting.

All unadjusted yields are listed to nearest 10 pounds per acre, and adjusted yields are listed to the nearest one hundred pounds.



TABLE V

ALFALFA YIELDS AND STAND EVALUATION MEASUREMENTS OF SIXTY ALFALFA  
STANDS IN PUTNAM COUNTY, TENNESSEE

| No. of<br>1957<br>Seeded<br>Stands | Total<br>Yield<br>Lbs. | No.<br>Cuts | Yield<br>1st<br>Cut<br>Lbs. | Yield<br>2nd<br>Cut<br>Lbs. | Yield<br>3rd<br>Cut<br>Lbs. | Per Cent<br>Alfalfa<br>1st Cut | Adjusted<br>Yield<br>Lbs. | Per Cent<br>Full<br>Cover | Plants<br>Per<br>Sq. Ft |
|------------------------------------|------------------------|-------------|-----------------------------|-----------------------------|-----------------------------|--------------------------------|---------------------------|---------------------------|-------------------------|
| 39                                 | 12160                  | 3           | 6050                        | 3710                        | 2400                        | 50                             | 9100                      | 85                        | 18                      |
| 54                                 | 9020 <sup>1</sup>      | 3           | 4340                        | 2780                        | 2000                        | 95                             | 8800                      | 100                       | 35                      |
| 59                                 | 7590                   | 2           | 4780                        | 2810                        | —                           | 70                             | 6200                      | 85                        | 18                      |
| 27                                 | 7150                   | 3           | 3150                        | 1400                        | 2600                        | 90                             | 6800                      | 95                        | 25                      |
| 46                                 | 7020                   | 3           | 4350                        | 690                         | 1980                        | 60                             | 5300                      | 90                        | 18                      |
| 11                                 | 6870                   | 2           | 4680                        | 2190                        | —                           | 70                             | 5500                      | 80                        | 16                      |
| 51                                 | 6810                   | 3           | 3360                        | 2430                        | 1020                        | 80                             | 6500                      | 80                        | 16                      |
| 49                                 | 6500                   | 3           | 2200                        | 1500 <sup>2</sup>           | 2800                        | 95                             | 6400                      | 95                        | 22                      |
| 34                                 | 6450                   | 3           | 3280                        | 470                         | 2700                        | 70                             | 5500                      | 85                        | 18                      |
| 25                                 | 6310                   | 3           | 2570                        | 1450                        | 2290                        | 95                             | 6200                      | 100                       | 35                      |
| 8                                  | 6190                   | 3           | 2980                        | 900                         | 2310                        | 60                             | 5000                      | 80                        | 15                      |
| 26                                 | 6150                   | 3           | 2720                        | 1260                        | 2170                        | 70                             | 5300                      | 90                        | 18                      |
| 45                                 | 5710                   | 3           | 3060                        | 940                         | 1710                        | 95                             | 5600                      | 95                        | 20                      |
| 7                                  | 5490                   | 3           | 2070                        | 2140                        | 1280                        | 95                             | 5400                      | 100                       | 35                      |
| 32                                 | 5410                   | 2           | 3130                        | 2280                        | —                           | 80                             | 4800                      | 90                        | 20                      |
| 58                                 | 5380                   | 3           | 2320                        | 910                         | 2150                        | 95                             | 5800                      | 95                        | 25                      |
| 60                                 | 5240                   | 2           | 2910                        | 2330                        | —                           | 92                             | 5000                      | 95                        | 30                      |
| 2                                  | 5140                   | 3           | 3740                        | 790                         | 610                         | 60                             | 3600                      | 75                        | 16                      |
| 20                                 | 5050                   | 2           | 2970                        | 2080                        | —                           | 70                             | 4200                      | 85                        | 16                      |
| 36                                 | 4870                   | 2           | 3280                        | 1590                        | —                           | 80                             | 4200                      | 85                        | 22                      |
| 3                                  | 4840                   | 3           | 2400                        | 1300                        | 1140                        | 40                             | 3400                      | 70                        | 16                      |
| 42                                 | 4700                   | 3           | 2100                        | 1100 <sup>2</sup>           | 1500 <sup>2</sup>           | 75                             | 4200                      | 85                        | 14                      |
| 47                                 | 4700                   | 3           | 1990                        | 730                         | 1980                        | 95                             | 4600                      | 95                        | 25                      |
| 1                                  | 4580                   | 3           | 2890                        | 1130                        | 560                         | 40                             | 2800                      | 60                        | 12                      |
| 31                                 | 4500                   | 2           | 2100                        | 2400                        | —                           | 90                             | 4300                      | 85                        | 14                      |
| 52                                 | 4320                   | 2           | 2760                        | 1560                        | —                           | 85                             | 3900                      | 80                        | 14                      |
| 9                                  | 4270                   | 3           | 2140                        | 710                         | 1420                        | 60                             | 3400                      | 85                        | 15                      |
| 33                                 | 4160                   | 2           | 2160                        | 2000                        | —                           | 80                             | 3700                      | 75                        | 18                      |
| 38                                 | 3850                   | 2           | 2100                        | 1750                        | —                           | 85                             | 3500                      | 85                        | 14                      |
| 30                                 | 3800                   | 2           | 2180                        | 1620                        | —                           | 85                             | 3500                      | 90                        | 28                      |
| 55                                 | 3780                   | 2           | 1890                        | 1890                        | —                           | 95                             | 3700                      | 85                        | 14                      |
| 53                                 | 3760                   | 3           | 2230                        | 290                         | 1240                        | 50                             | 2600                      | 70                        | 14                      |
| 48                                 | 3750                   | 3           | 1290                        | 690                         | 1770                        | 65                             | 3300                      | 80                        | 17                      |
| 15                                 | 3590                   | 2           | 2160                        | 4430                        | —                           | 75                             | 3100                      | 80                        | 14                      |
| 21                                 | 3450                   | 2           | 2340                        | 1110                        | —                           | 90                             | 3200                      | 85                        | 16                      |
| 28                                 | 3440                   | 2           | 2090                        | 1350                        | —                           | 95                             | 3300                      | 95                        | 23                      |
| 22                                 | 3400                   | 2           | 2100                        | 1300 <sup>2</sup>           | —                           | 65                             | 2700                      | 60                        | 12                      |



TABLE V

ALFALFA YIELDS AND STAND EVALUATION MEASUREMENTS OF SIXTY ALFALFA  
STANDS IN PUTNAM COUNTY, TENNESSEE (continued)

| No. of<br>1957<br>Seeded<br>Stands | Total<br>Yield<br>Lbs. | No.<br>Cuts | Yield<br>1st<br>Cut<br>Lbs. | Yield<br>2nd<br>Cut<br>Lbs. | Yield<br>3rd<br>Cut<br>Lbs. | Per Cent<br>Alfalfa<br>1st Cut | Adjusted<br>Yield<br>Lbs. | Per Cent<br>Full<br>Cover | Plants<br>Per<br>Sq. Ft |
|------------------------------------|------------------------|-------------|-----------------------------|-----------------------------|-----------------------------|--------------------------------|---------------------------|---------------------------|-------------------------|
| 23                                 | 3280                   | 2           | 2020                        | 1260                        | --                          | 70                             | 2700                      | 85                        | 17                      |
| 14                                 | 3230                   | 2           | 2380                        | 850                         | --                          | 90                             | 3000                      | 90                        | 16                      |
| 41                                 | 3210                   | 2           | 1010                        | 2200                        | --                          | 90                             | 3100                      | 74                        | 17                      |
| 13                                 | 2980                   | 2           | 2060                        | 920                         | --                          | 90                             | 2800                      | 90                        | 18                      |
| 37                                 | 2950                   | 2           | 2050                        | 900                         | --                          | 50                             | 1900                      | 60                        | 15                      |
| 50                                 | 2920                   | 3           | 1190                        | 590                         | 1140                        | 98                             | 2900                      | 90                        | 20                      |
| 10                                 | 2600                   | 1           | 2600                        | --                          | --                          | 10                             | 300                       | 20                        | 6                       |
| 4                                  | 2280                   | 1           | 2280                        | --                          | --                          | 15                             | 300                       | --                        | --                      |
| 40                                 | 2170                   | 2           | 1380                        | 790                         | --                          | 85                             | 2000                      | 90                        | 14                      |
| 35                                 | 2140                   | 2           | 940                         | 1200                        | --                          | 65                             | 1800                      | 60                        | 14                      |
| 6                                  | 1860                   | 2           | 1210                        | 650                         | --                          | 65                             | 1400                      | 60                        | 11                      |
| 29                                 | 1700                   | 2           | 800                         | 900 <sup>2</sup>            | --                          | 90                             | 1600                      | 65                        | 15                      |
| 5                                  | 1210                   | 1           | 1210                        | --                          | --                          | 30                             | 400                       | 20                        | 7                       |
| 16                                 | 960                    | 1           | 960                         | --                          | --                          | 60                             | 600                       | 50                        | 11                      |
| 12                                 | 0                      | --          | --                          | --                          | --                          | --                             | --                        | --                        | --                      |
| 24                                 | 0                      | --          | --                          | --                          | --                          | --                             | --                        | --                        | --                      |
| 44                                 | 0                      | --          | --                          | --                          | --                          | --                             | --                        | --                        | --                      |
| 56                                 | --                     | --          | --                          | --                          | --                          | --                             | --                        | --                        | --                      |
| <hr/>                              |                        |             |                             |                             |                             |                                |                           |                           |                         |
| No. of<br>1956<br>Seeded<br>Stands |                        |             |                             |                             |                             |                                |                           |                           |                         |
| 57                                 | 11830 <sup>1</sup>     | 3           | 5990                        | 3140                        | 2700                        | 95                             | 11500                     | 100                       | 20                      |
| 43                                 | 7420                   | 2           | 3870                        | 3550                        | --                          | 85                             | 6800                      | 85                        | 10                      |
| 17                                 | 7340                   | 3           | 3980                        | 660                         | 2700                        | 75                             | 6400                      | 90                        | 12                      |
| 18                                 | 6100                   | 3           | 3530                        | 1470                        | 1100                        | 85                             | 5400                      | 90                        | 12                      |
| 19                                 | 4800                   | 3           | 2150                        | 900                         | 1750                        | 85                             | 4500                      | 80                        | 7                       |

<sup>1</sup>Indicates yield obtained by sampling method.

<sup>2</sup>Indicates estimated yield.



### Factors Relating to Success of Establishment

Establishment is a difficult factor to measure in quantitative terms. As defined in this study it is the combination of both number of plants and vigor of plants. These are variable factors. To get at the necessary combination of the factors for establishment, two measurements were made: (1) plants per square foot and (2) per cent full cover. The latter was an attempt to measure vigor necessary to give complete coverage with any number of plants at the time of the second cutting of alfalfa. While 100 per cent cover of alfalfa may be considered as perfect establishment, this was rarely achieved and it does not mean that anything less than this is not a successful stand. Age at the time of this study is a relatively constant factor but vigor is influenced by a number of variables, mainly productivity of the soil, therefore the same plant population would not always result in the same cover.

The combination of plant population and amount and vigor of growth is expressed quantitatively in yield. As yield can vary within a definite per cent of cover, it cannot be considered as an exact measure of establishment. On the other hand, yield is dependent upon cover. In this respect, per cent full cover as a measure of establishment is related to yield.

Under the field conditions which this study was made interest was directed toward determining a range of plants per square foot that was necessary to give complete cover for the stands and yields resulting from varying combinations of these factors. In the effort to get at



this information the degree of influence of (1) per cent alfalfa at first cutting on per cent full cover (2) plants per square foot on per cent full cover (3) plants per square foot on yield and (4) per cent full cover on yield was determined by regression analysis (25).

The results of these analyses as shown in Figures 1, 2, 3, and 4 indicate that there is a high degree of correlation between all of the measurement factors used. (1) The regression of per cent alfalfa at the first cutting on per cent full cover resulted in a correlation coefficient of .94 which is highly significant at the 1 per cent level of probability. This seems to indicate that per cent full cover, as a measure of establishment was highly dependent on the per cent of alfalfa at the first cutting. It may suggest that volunteer plants or seeded annuals have had a serious affect on stand establishment. (2) The regression of plants per square foot on per cent full cover resulted in a correlation coefficient of .87 which is highly significant at the 1 per cent level of probability. This does not mean that the same number of plants resulted in a like degree of cover in all instances. The deviation from perfect correlation is indicated by the scatter of points on the graph which may reflect the influence of vigor. The regression would seem to indicate, however, that per cent full cover is highly dependent on plants per square foot and that, in general, the greater plant populations resulted in the higher percentage of full cover. (3) The regression of plants per square foot on yield resulted in a correlation coefficient of .78 which is significant at the 1 per cent level of probability. Scattering of points on the graph indicates that vigor has had much effect on yield along with plant population. This is illustrated



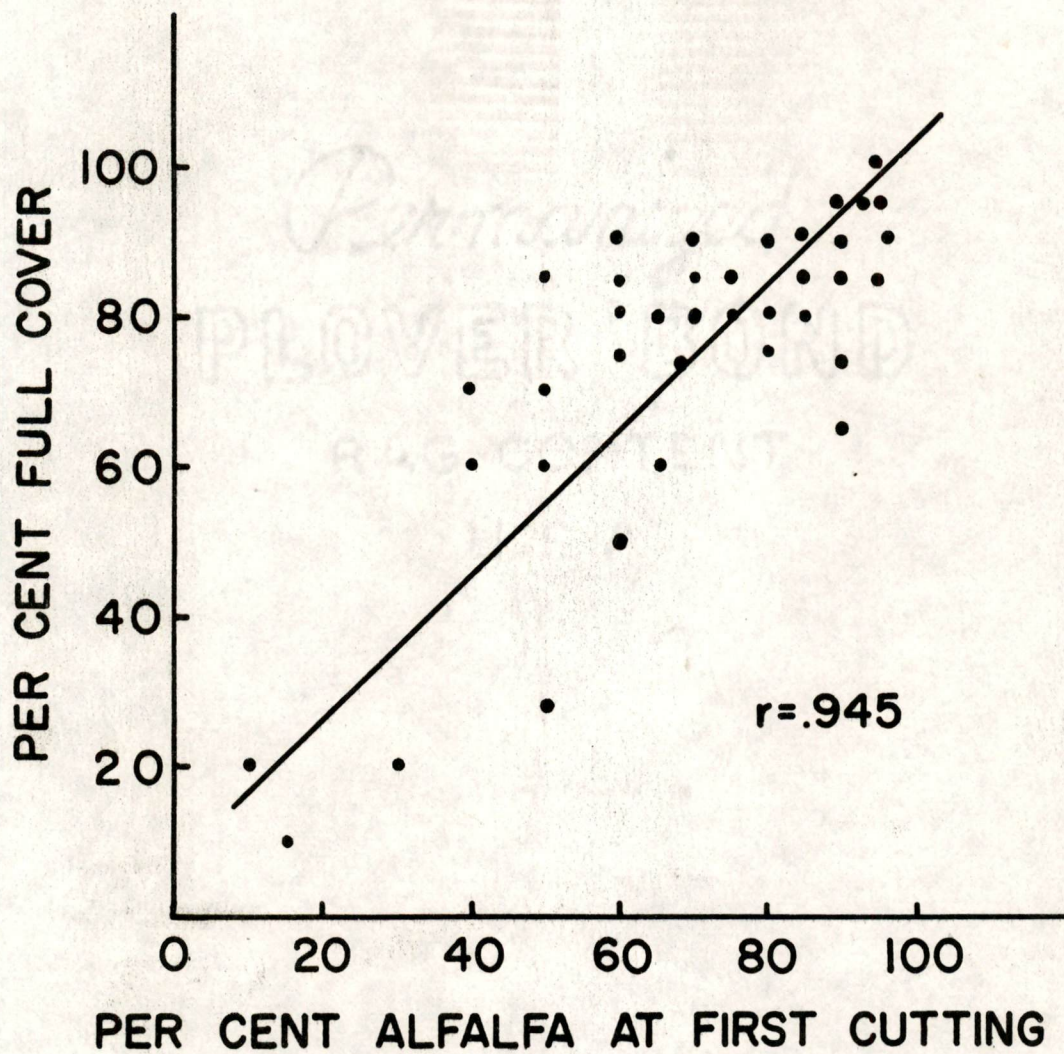


Figure 1. Regression of Per Cent Alfalfa at First Cutting on  
Per Cent Full Cover



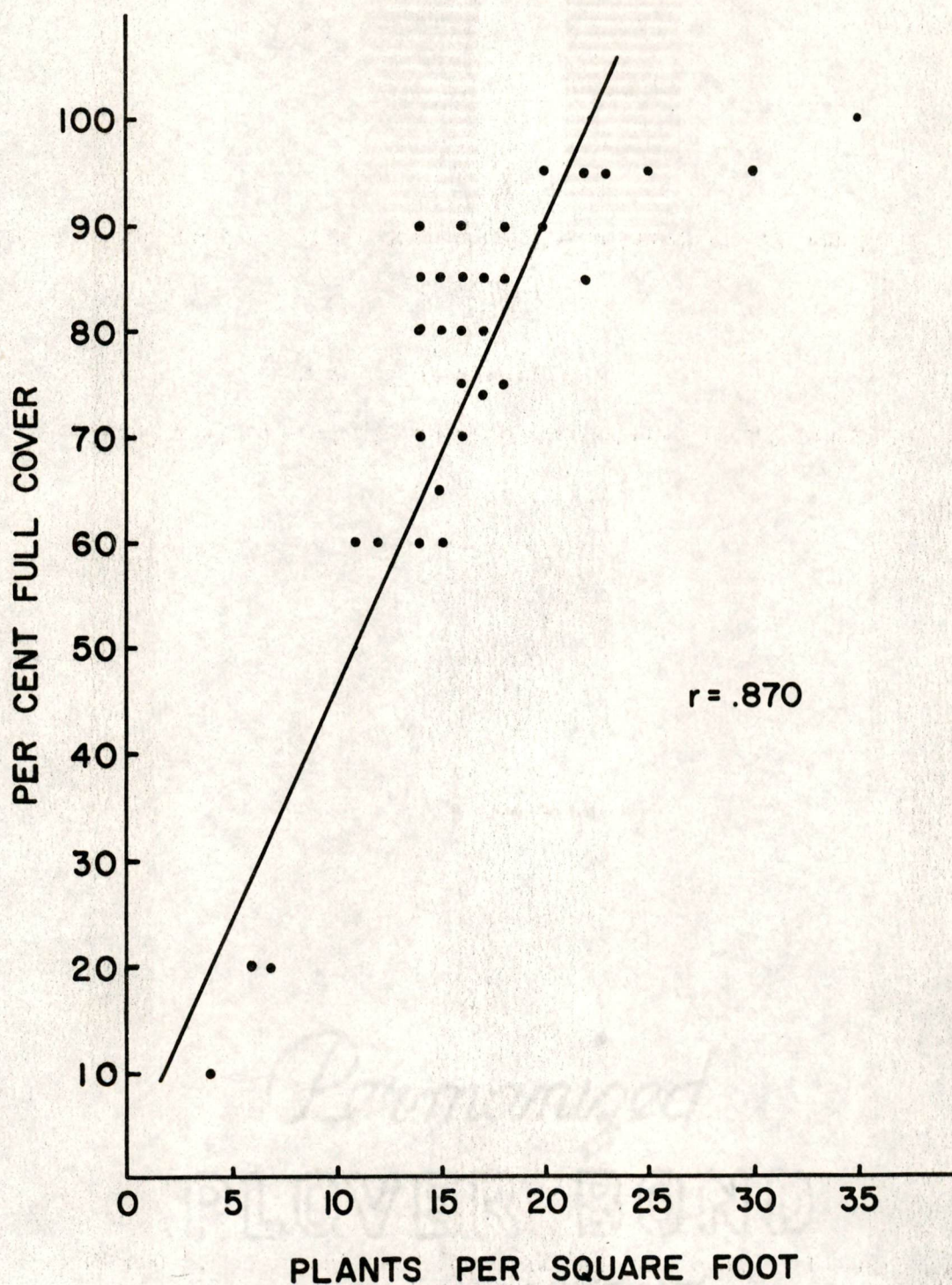


Figure 2. Regression of Plants Per Square Foot on Per Cent Full Cover



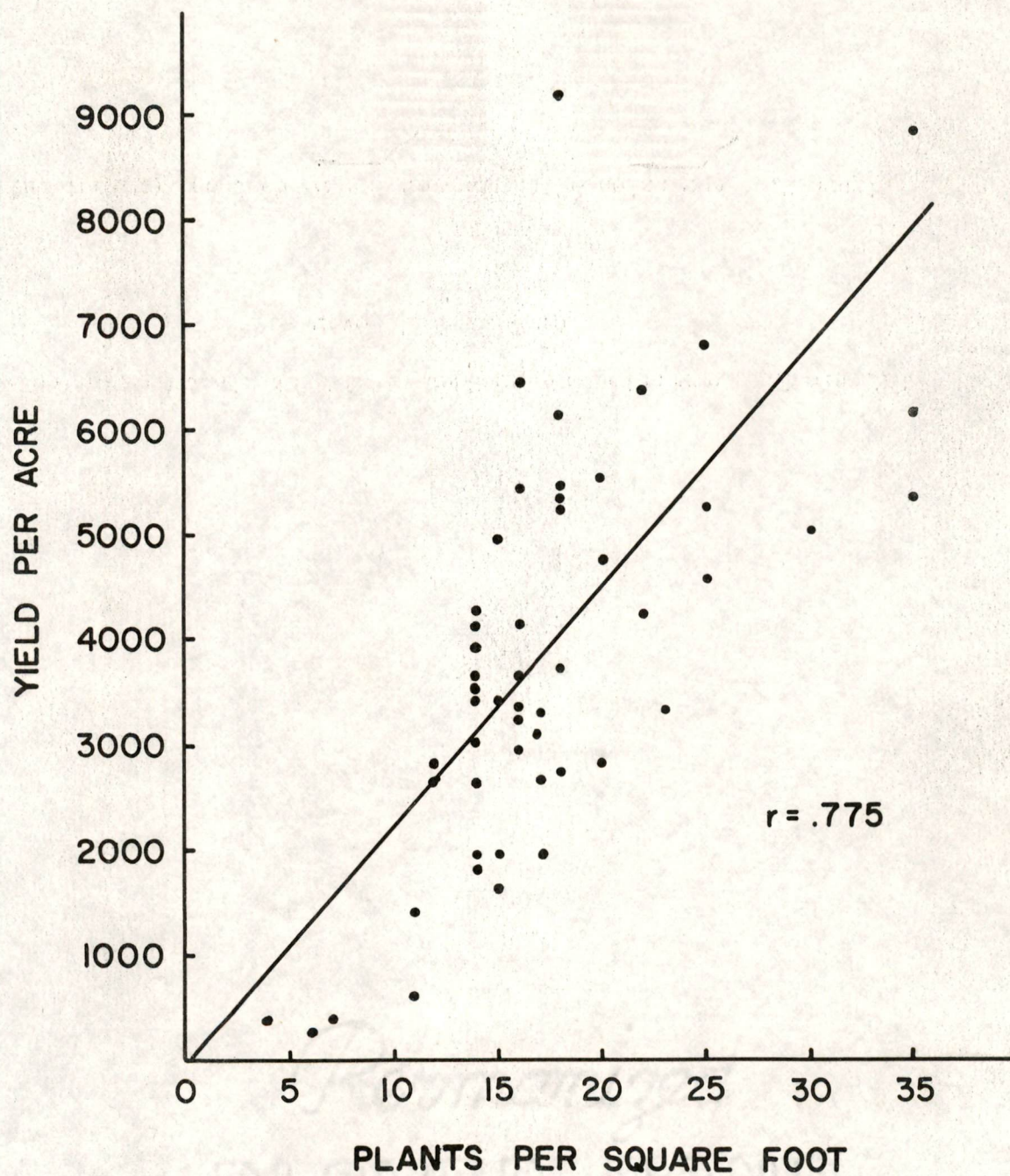


Figure 3. Regression of Plants Per Square Foot on Yield Per Acre



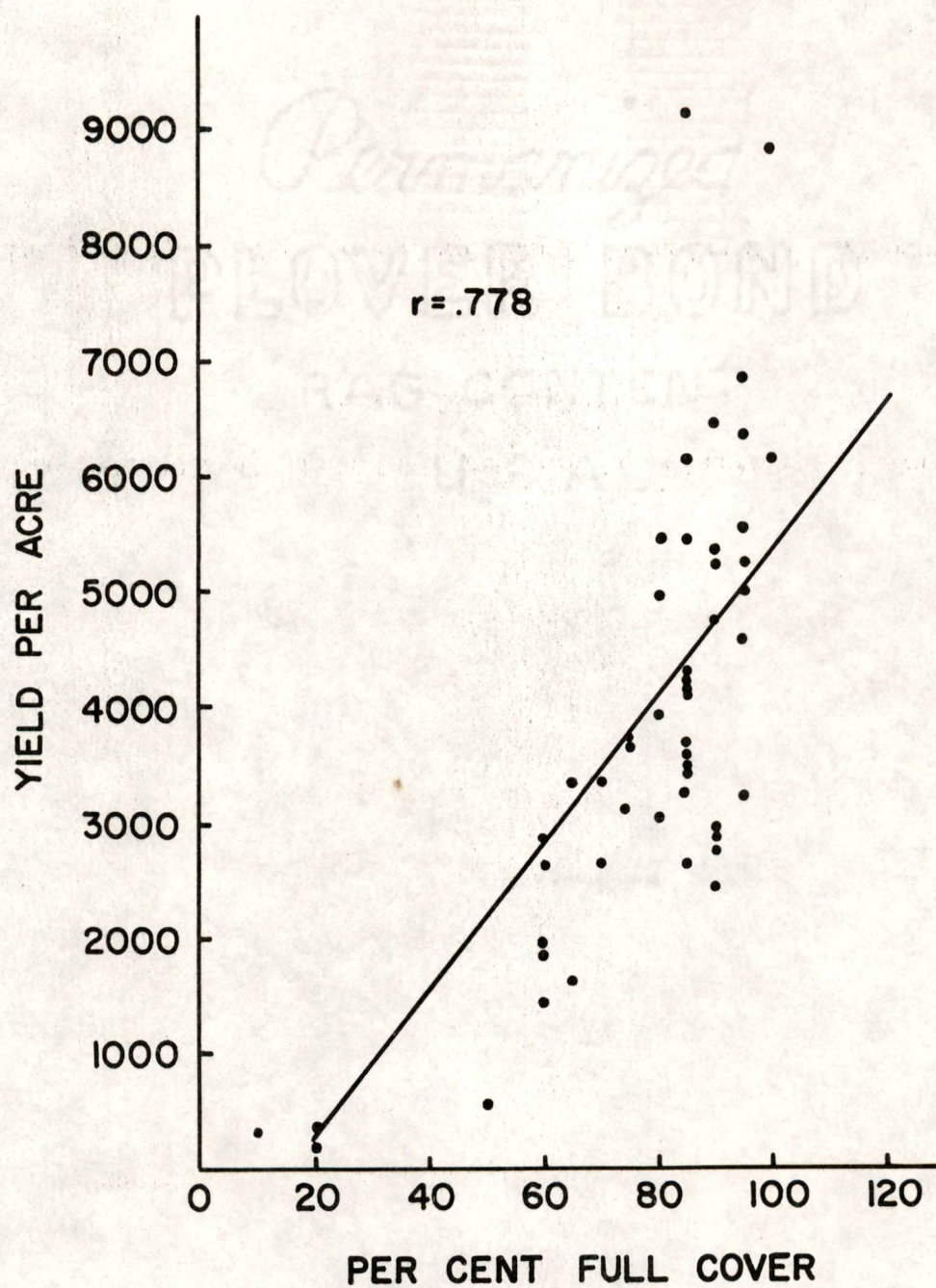


Figure 4. Regression of Per Cent Full Cover on Yield Per Acre



by the example that 15 plants per square foot yielded a low of 1620 pounds per acre on one stand as compared with a high of 4990 pounds on another stand. Despite the wide ranges between the yield of like plant populations in some instances, it appears that the higher yields were obtained from the greater plant populations (above 15 plants per square foot). (4) Regression of per cent full cover on yield resulted in a correlation coefficient of .78 which is significant at the 1 per cent level of probability. The degree of correlation here is similar to that of plant population on yield. It will also be noted from the graph that, with few exceptions, the points cluster more nearly about the mean. Differences in yields within the same degrees of cover are again indicative of the element of vigor. An example of this is a low yield of 5380 pounds per acre versus a high yield of 8800 pounds per acre with 100 per cent cover. It is significant, however, that all of the higher yields (5000 pounds and above) had a per cent full cover of 80 per cent or above. The fact that there is close correlation between these factors does not necessarily mean that this would be true under all conditions. It is also recognized that varying yields can be expected within what could be considered a definite degree of establishment.

Table VI summarizes some of the relationships between the three measurements by comparing ranges of yield with averages of plant population and percentage of full cover. A close relationship exists between yield of plants per square foot and per cent of full cover (2) The more productive 1957 stands (22) have an average of 18 plants or more (the lowest number of plants per square foot was 14 in one instance, high was 35 plants in



TABLE VI

RELATIONSHIP OF YIELDS TO PLANTS PER SQUARE FOOT AND PER CENT  
FULL COVER OF SIXTY ALFALFA STANDS IN  
PUTNAM COUNTY, TENNESSEE

| Fifty-five 1957 Seeded Stands     |                       |                        |
|-----------------------------------|-----------------------|------------------------|
| Yield                             | Plants per<br>Sq. Ft. | Per Cent<br>Full Cover |
| 5000 lbs. or<br>over<br>15 stands | Av. 22.6              | 80 to 100% av. 91.3%   |
| 4000 to 5000 lbs.<br>7 stands     | Av. 18.0              | 80 to 95% av. 86.4%    |
| 3000 to 4000 lbs.<br>12 stands    | Av. 16.2              | 70 - 95% av. 81.7%     |
| Under 3000 lbs.<br>17 stands      | Av. 12.9              | 20 - 90% av. 61.7%     |
| Complete<br>failure<br>4 stands   | 4 failures            |                        |
| -----                             |                       |                        |
| Five 1956 Seeded Stands           |                       |                        |
| -----                             |                       |                        |
| 11,500 lbs.<br>1 stand            | 20.0                  | 100%                   |
| 5300 to 6850 lbs.<br>3 stands     | 11.3                  | 85% to 90% av. 88.3    |
| 4500 lbs.<br>1 stand              | 7.0                   | 80%                    |



three instances), and an average of 94 per cent full cover (ranging from 80 to 100 per cent). (4) The summary of the five 1956 stands indicates that a lower number of plants per square foot and per cent full cover produced a higher yield than the newer stands. Average yield (ranging from 4,500 pounds to 11,500 pounds per acre) was 6920 pounds per acre which was produced from an average plant population of 12.2 plants per square foot and a cover of 87 per cent.

#### Relationship of Management Levels to Yield

Alfalfa is a rather exacting crop in its management requirements, and its failure could result from poor methods in any one practice. Selecting the particular cause is difficult to determine under field conditions. To evaluate single entities, one must have controlled conditions in which all other factors are kept nearly constant and/or non-limiting. Since this was not possible under the conditions studied, it was felt that evaluations determined by combining all of the more important management factors was the only practical approach. With the use of this method it is also recognized that there is interaction between the many factors that contribute to alfalfa establishment and growth.

Management levels were determined by the combination of values assigned to each of the more important management practices. This was accomplished by a numerical rating system in which the individual practices were rated as to their adequacy in relation to recommended methods.

The following ratings were assigned to the practices that were through to be most relevant to establishment and yield.



|                                                                                                        | <u>Rating</u> |
|--------------------------------------------------------------------------------------------------------|---------------|
| 1. Seeding date                                                                                        |               |
| August 15 to September 15                                                                              | 3             |
| September 20 to September 30                                                                           | 2             |
| October 1 to October 30                                                                                | 1             |
| 2. Land preparation                                                                                    |               |
| Summer fallow                                                                                          | 3             |
| Following a summer crop                                                                                | 2             |
| Turned late                                                                                            | 1             |
| 3. Fertilization                                                                                       |               |
| Followed soil test or used over 750#<br>fertilizer at seeding                                          | 4             |
| 300 to 600# 0-9-27, 2-12-12 or 3-12-12                                                                 | 3             |
| 400 to 600# 6-12-12                                                                                    | 2             |
| Less than 400# 6-12-12                                                                                 | 1             |
| 4. Lime requirement (based on pH)                                                                      |               |
| 6.5 - 7.1                                                                                              | 3             |
| 6.0 - 6.5                                                                                              | 2             |
| below 6.0                                                                                              | 1             |
| 5. Use of cultipacker                                                                                  |               |
| Before and after seeding                                                                               | 3             |
| After seeding                                                                                          | 2             |
| Not used                                                                                               | 1             |
| 6. Topdressing                                                                                         |               |
| One point was added to each stand that was topdressed<br>with 200 pounds or more of 0-9-27 or 0-20-20  |               |
| 7. Inoculation and use of borax                                                                        |               |
| Two points were subtracted from the total score of any<br>farmer who failed to inoculate or use borax. |               |



With the use of values designated above, it was possible for stands to have a high rating of 17 or a low rating of 1. After rating each stand, the following levels of management with assigned values were established: (1) A - above average - 13 to 17 points (2) B - average - 10 through 13 points (3) C - below average - 1-9 points.

When working with the growers and observing stands over several months, it is only natural that one would form opinions as to the general efficiency of individual farmer methods. These opinions are of value, as they are the result of close and interested observations. They have limitations, however, in evaluating management levels because they are not always consistent and are apt to be influenced by good or poor results. It seemed desirable that the knowledge obtained from personal observation be considered, if for no other reason than to judge the method of evaluation used. In six cases it was felt that the numerical system did not present the true picture of management level. All of these were border-line cases, and knowledge of certain factors, not reflected in the system were used, shifting them one level of management. Summary of numerical rating is included as Appendix O.

Figure 5 shows the comparative average yield of all soils under the three levels of management. In this study higher average yields were directly related to higher levels of management (Table VII).

#### Yield and Stands as Related to Specific Soil Types

The most widely used soil types for 1957 stands of alfalfa in Putnam County were Waynesboro silt loam and Mountview silt loam. These



TABLE VII

ADJUSTED YIELDS, MANAGEMENT LEVELS AND SOIL MAPPING UNITS OF SIXTY  
ALFALFA STANDS IN PUTNAM COUNTY, TENNESSEE

Fifty-Five 1957 Stands

| Stand No.<br>of 1957<br>Seeded Stands | Adjusted<br>Yield | Management<br>Level | Soil Mapping Unit        |
|---------------------------------------|-------------------|---------------------|--------------------------|
| 39                                    | 9100              | A                   | Waynesboro B1            |
| 54                                    | 8800              | A                   | Baxter B2                |
| 27                                    | 6800              | A                   | Waynesboro B2            |
| 51                                    | 6500              | B                   | Hermitage C1             |
| 49                                    | 6400              | A                   | Cumberland B2            |
| 25                                    | 6200              | A                   | Waynesboro B1            |
| 59                                    | 6200              | A                   | Sequatchie A1            |
| 45                                    | 5600              | A                   | Cumberland C3            |
| 34                                    | 5500              | B                   | Waynesboro B2            |
| 11                                    | 5500              | A                   | Mountview B1             |
| 7                                     | 5400              | A                   | Mountview B1             |
| 26                                    | 5300              | A                   | Waynesboro C2            |
| 46                                    | 5300              | A                   | Cumberland B2            |
| 58                                    | 5300              | A                   | Emory A1                 |
| 60                                    | 5000              | B                   | Huntington A1            |
| 8                                     | 5000              | B                   | Mountview B1             |
| 32                                    | 4800              | A                   | Waynesboro C3            |
| 47                                    | 4600              | A                   | Cumberland B1            |
| 31                                    | 4300              | B                   | Waynesboro B2            |
| 36                                    | 4200              | B                   | Waynesboro C2            |
| 42                                    | 4200              | B                   | Cookeville C3            |
| 20                                    | 4200              | B                   | Bewleyville B2           |
| 52                                    | 3900              | B                   | Hermitage C1             |
| 33                                    | 3700              | A                   | Waynesboro C3            |
| 55                                    | 3700              | A                   | Baxter C2                |
| 2                                     | 3600              | A                   | Mountview B1             |
| 38                                    | 3500              | A                   | Waynesboro B1            |
| 30                                    | 3500              | B                   | Waynesboro C3            |
| 9                                     | 3400              | B                   | Mountview B2             |
| 3                                     | 3400              | A                   | Mountview B1             |
| 28                                    | 3300              | B                   | Waynesboro B2            |
| 48                                    | 3300              | C                   | Cumberland B1            |
| 21                                    | 3200              | B                   | Bewleyville B2           |
| 41                                    | 3100              | B                   | Waynesboro C3 & Emory A1 |
| 15                                    | 3100              | B                   | Holston B1               |



TABLE VII (continued)

ADJUSTED YIELDS, MANAGEMENT LEVELS AND SOIL MAPPING UNITS OF SIXTY  
ALFALFA STANDS IN PUTNAM COUNTY, TENNESSEE

## Fifty-Five 1957 Stands

| Stand No.<br>of 1957<br>Seeded Stands | Adjusted<br>Yield | Management<br>Level | Soil Mapping Unit  |
|---------------------------------------|-------------------|---------------------|--------------------|
| 14                                    | 3000              | B                   | Holston B2         |
| 50                                    | 2900              | B                   | Cumberland C3      |
| 1                                     | 2800              | B                   | Mountview B1       |
| 13                                    | 2800              | B                   | Holston C2         |
| 23                                    | 2700              | C                   | Waynesboro B2      |
| 22                                    | 2700              | C                   | Waynesboro C3      |
| 53                                    | 2600              | B                   | Mixed Colluvium C1 |
| 40                                    | 2000              | B                   | Waynesboro C2      |
| 37                                    | 1900              | B                   | Waynesboro C2      |
| 35                                    | 1800              | B                   | Waynesboro C3      |
| 29                                    | 1600              | C                   | Waynesboro B2      |
| 6                                     | 1400              | B                   | Mountview B1       |
| 16                                    | 600               | C                   | Wellston A1        |
| 5                                     | 400               | C                   | Mountview B1       |
| 4                                     | 300               | C                   | Mountview B1       |
| 10                                    | 300               | C                   | Mountview B1       |
| 12                                    | —                 | C                   | Mountview B1       |
| 24                                    | —                 | C                   | Waynesboro C3      |
| 44                                    | —                 | B                   | Cumberland B1      |
| 56                                    | —                 | B                   | Baxter C2          |

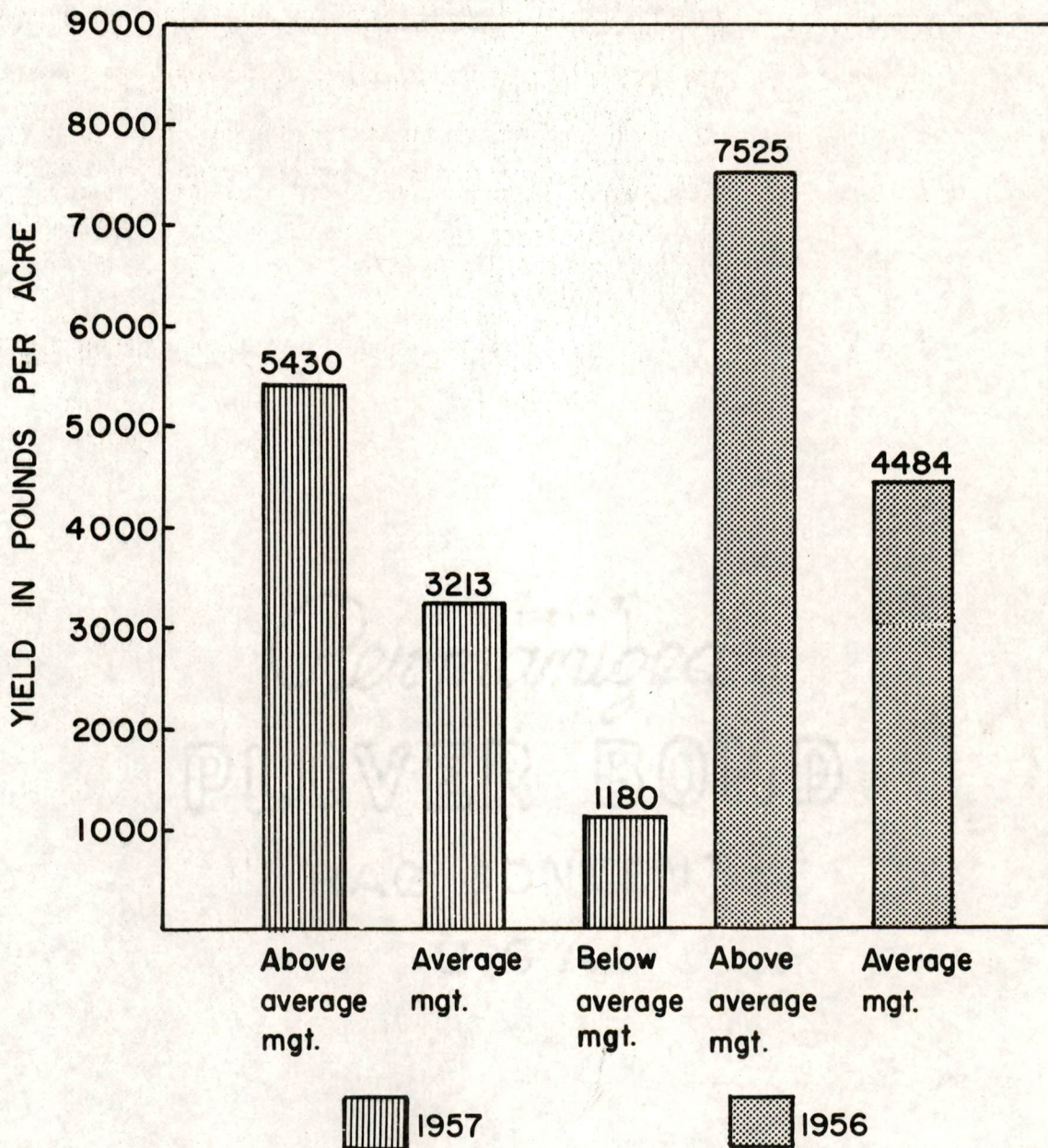
## Stand of 1956 Seeded Stands

|    |       |   |               |
|----|-------|---|---------------|
| 57 | 11500 | A | Baxter B2     |
| 43 | 6800  | A | Waynesboro C2 |
| 17 | 6300  | A | Mountview B1  |
| 18 | 5400  | A | Mountview B1  |
| 19 | 4500  | B | Mountview B1  |



Figure 5. RELATIONSHIP OF ALFALFA YIELD TO THREE  
LEVELS OF MANAGEMENT ON 60 STANDS.

55





two soil types represent a contrast in physical characteristics; Waynesboro has what is generally considered as desirable characteristics for alfalfa production whereas Mountview has marginal or questionable characteristics.

The red, well-drained, permeable B horizons of the Waynesboro soils indicate adequate aeration and water movement which are considered necessary for good root development (17) and longevity of alfalfa stands. They are on gently sloping to rolling topography and are underlain by high-grade limestone.

Mountview soils on the other hand, though considered as well-drained have yellowish-brown to brownish-yellow B horizons that do not indicate adequate aeration and water movement. They are on more level topography than Waynesboro and are underlain by cherty limestone. Physical characteristics are not considered ideal for root development (17) and longevity of alfalfa stands.

It was considered at the beginning of this study that Mountview soils were not so desirable for alfalfa production as the Waynesboro soils from the standpoint of longevity of stands. What was not considered, however, was that there was a difference in the problem of establishment on the two soils. From observations it appeared that establishment was much better on the Waynesboro than on the Mountview. Measurements relating to establishment as listed in Table VIII appear to support this observation. These measurements are averages of nineteen Waynesboro sites and sixteen Mountview sites.<sup>1</sup> They do not take into account management levels.

---

<sup>1</sup>The 16 stands considered as Mountview included 3 sites identified as Holston silt loam and 1 site identified as Wellston silt loam. As the characteristics of these soils are similar to Mountview, they are grouped with this soil type.



TABLE VIII

SUMMARY OF STAND EVALUATION MEASUREMENTS ON MOUNTVIEW AND  
WAYNESBORO SOILS IN PUTNAM COUNTY, TENNESSEE

|                                     | Average<br>% Alfalfa<br>at 1st<br>Cut | Average<br>% Full<br>Cover | Average<br>Number<br>Plants<br>Sq. Ft. |
|-------------------------------------|---------------------------------------|----------------------------|----------------------------------------|
| Mountview<br>Silt Loam<br>16 Sites  | 54                                    | 60                         | 13                                     |
| Waynesboro<br>Silt Loam<br>19 Sites | 74                                    | 78                         | 18                                     |



Figure 6 shows the yield of the two soils under three management levels. Considering yield as related to establishment, this is further evidence that establishment problems were greater on Mountview than on Waynesboro soils.

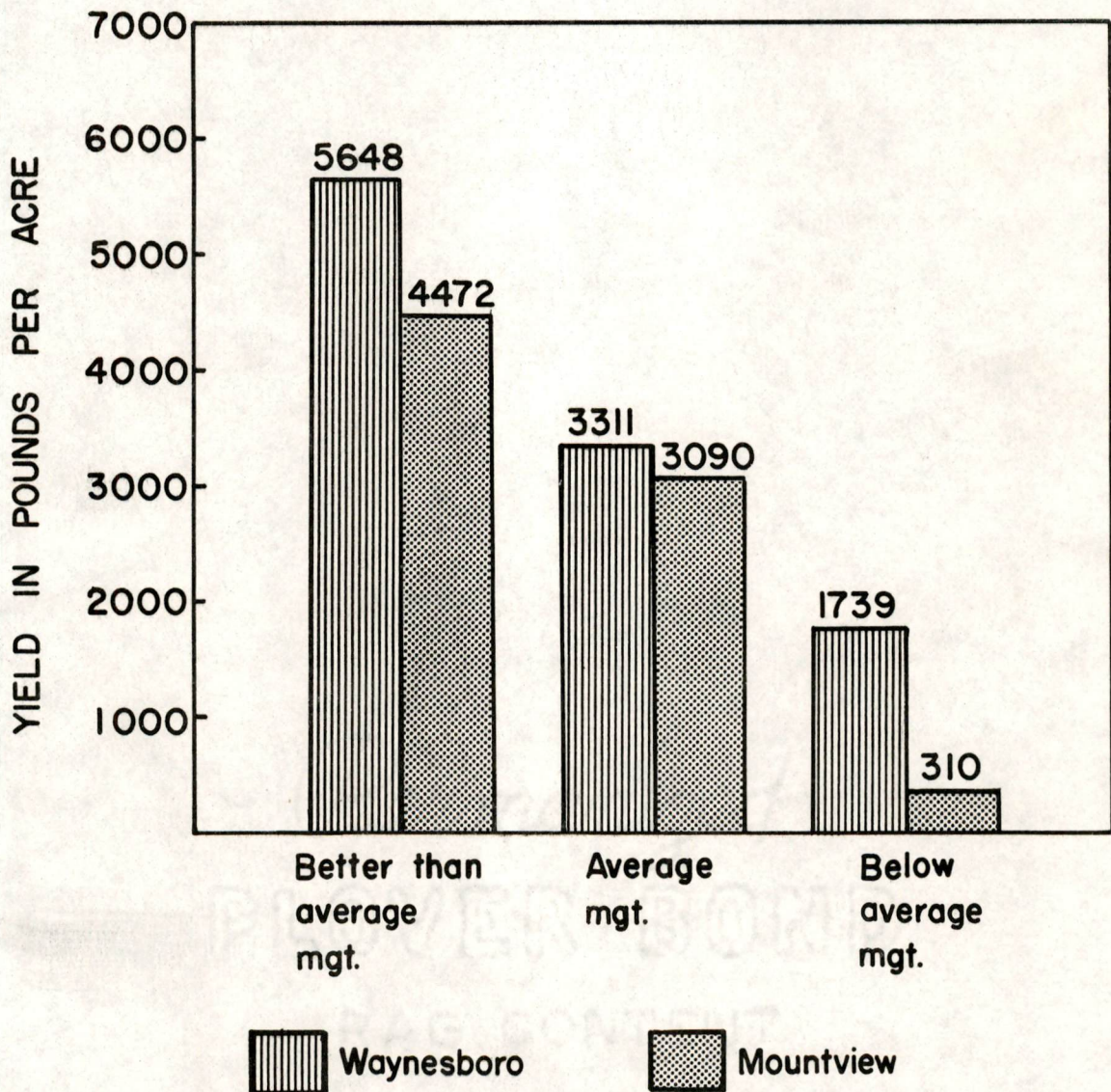
It is well to consider that these results represent only a limited number of 1957 stands. The fact that the winter of 1957 was unusually severe undoubtedly affected the results.

Mountview and Waynesboro were the only two soils on which it was considered that stands were in sufficient number to give a meaningful comparison of yields under different levels of management.



Figure 6

ALFALFA YIELDS ON WAYNESBORO SILT LOAM AND MOUNTVIEW SILT LOAM UNDER 3 LEVELS OF MANAGEMENT.





## CHAPTER VI

### SUMMARY AND CONCLUSIONS

This study was initiated to explore the possibilities of determining the productivity of certain soil types for alfalfa in Putnam County, Tennessee.

Complete management records and yields were gathered through August 10 on fifty-five stands seeded in the fall of 1957 and five stands seeded in the fall of 1958.

At an early stage of the study, a serious problem in alfalfa establishment was recognized. This problem was aggravated by the severe winter following seeding, by current management practices, and by the productive capacity of the soils. Since an important phase of any productivity study is the recognition and evaluation of management problems, it seemed desirable to attempt to relate management and soils to establishment and yield.

It was necessary to first determine what constituted establishment and to then evaluate stands as to their degree of success of establishment; therefore measurements were made of per cent alfalfa at the first cutting, plant population after the first cutting, and per cent full cover at the time of the second cutting.

Regression analysis revealed a high degree of correlation between the various stand-evaluation measurements and between these and yield. Yield was used as one measure of success of establishment. The twenty-two highest yielding 1957 stands (4,000 pounds per acre and above) had



plant populations averaging 22 plants per square foot and an average of 94 per cent full cover. The five 1956 stands averaged 12.2 plants per square foot and 87 per cent full cover; and produced yields ranging upward from 4500 pounds per acre. In this instance a smaller plant population and per cent full cover produced higher yields in the second year's growth than in the first.

Certain management problems were recognized as being more serious within the county. Principal among these was initial fertilization which was generally below standard, in both quantity and proportions of nutrients. The wide use of 6-12-12 fertilizer is not in keeping with recommendations. This practice has affected establishment and yield by favoring competition from volunteer plants and possibly by delaying nodulation.

The heavy infestation of volunteer plants was favored in a few cases by poor land preparation, but, on the whole, farmers appeared to follow good methods in this practice. The very dry summer that preceded seeding may have been responsible for much of this problem. Since all small grain and weed seeds did not sprout, disking was not effective.

The degree with which farmers adhered to recommendations of the more important management practices was used as a basis for determining a management level assigned to each stand. Three management levels were used to evaluate the stands. These levels were determined by means of a numerical rating system in which relative values were assigned to each selected management practice. Adjustments were made to this rating from personal knowledge of the stands.



Comparison was made of yields from all soils with the three management levels. Higher yields were directly proportional to higher levels of management.

Complete records were kept on nineteen 1957 stands on Waynesboro silt loam, and sixteen 1957 stands on Mountview silt loam. Degree of success in stand establishment and yields were lower on Mountview than on Waynesboro at all levels of management.

A number of factors appear to favor both increased and more efficient alfalfa production in the county. The first of these is that farmers appear to be interested in using better methods. Except for fertilization they generally do a good job of basic practices, especially liming, preparing land and seeding. There is no history of serious disease or insect problems in the county. Furthermore, there is considerable acreage of soils in the county with the physical characteristics considered desirable for alfalfa production. The crop fits well into the system of general farming and is probably the most profitable hay crop that can be grown, on the red well-drained soils of the county.

The future use of Mountview and related soils for alfalfa cannot be predicted from this study. Establishment was more of a problem on Mountview than Waynesboro for 1957 seedings. The reader should bear in mind that these observations were based on a season that followed a severe winter. The need for more knowledge concerning establishment, yield, and longevity of alfalfa on Mountview and related soils should act as an incentive for further research in Putnam County and much of the southeastern U. S. where similar soil conditions exist.



## BIBLIOGRAPHY



## BIBLIOGRAPHY

1. Ableiter, J. K. Productivity Ratings in the Soil Survey Report. Soil Sci. Soc. Amer. Proc. 2: 415-422. 1937.
2. Bacon, S. R. U. S. Dept. of Agri. Soil Conservation Service. Descriptions of Soil Profiles. Communication. 1958.
3. Alabama Agricultural Experiment Station. Alfalfa Production in Alabama. Bul. 300. 1956.
4. Bell, F. F. and Springer, D. K. Cooperative Studies in Soil Productivity and Management in Tennessee. Journ. of Soil & Water Cons. 13: 156-157. 1958.
5. Bishop, William D. and Burns, Joe D. Alfalfa Production in Tennessee. Tenn. Agr. Ext. Ser. Leaflet 103 rev. 1958.
6. Bishop, William D. and Turner, J. K. Alfalfa Regains Favor with Tennessee Farmers. Better Crops with Plant Foods. February 1954.
7. Blaser, R. E. Establishing and Maintaining Alfalfa. Better Crops with Plant Foods. December 1945.
8. Blaser, R. E. Why More Alfalfa. Better Crops with Plant Foods. December 1955.
9. Davis, J. F. 10 Rules for Establishment of Alfalfa. Hoards Dairyman. March 1958.
10. S. H. Dobson and R. L. Lovvorn. Alfalfa Production in North Carolina. N. C. Agri. Ext. Ser. Circ. 307. 1958.
11. Doll, E. C. and Miller, H. F. Fertilizing Alfalfa in Kentucky. Better Crops with Plant Foods. December 1956.
12. Fergus, E. N., Henson, Lawrence, and Stroube, William. Growing Alfalfa in Kentucky. Agri. Ext. Serv. Circ. 312 Rev. 1956.
13. Gerwig, J. L. Potash, Key to Alfalfa Yields. Better Crops with Plant Foods. April 1958.
14. Graber, L. F. Sow Enough Seed. Hoards Dairyman. April 1957.
15. Graumann, H. O. and Hanson, C. H. Growing Alfalfa. U. S. Dept. of Agri. Farmers Bul. 1722 Rev. 1954.
16. Jackson, G. C. U. S. Dept. of Agri. Soil Conservation Service. Identification of Soils and Descriptions of Soil Profiles. Communication. 1958.



17. Long, O. H. Root Development of Farm Crops in Tennessee. Unpublished Ph.D. Thesis. Knoxville, Tennessee. University of Tennessee Library. 1958.
18. MacGregor, Brownell & Nelson. Phosphate-Potash Maintain Alfalfa Stands with Profitable Yield. Better Crops with Plant Foods. March 1958.
19. Odell, R. T. Soil Survey Interpretation-Yield Prediction. Soil Sci. Soc. Amer. Proc. 22: 157-160. 1940.
20. Odell, R. T. and Smith, Guy D. A Study of Crop Yield Records by Soil Types. Soil Sci. Soc. Amer. Proc. 5: 316-322. 1940.
21. Parks, W. L. Alfalfa Fertilization. Tennessee Farm and Home Science. 17:3-9. 1956.
22. Romminger, T. S. and Hess, A. C. Relationship between Stand and Yield in Alfalfa Comparison. Agron. Journ. 47: 92-93. 1955.
23. Sears, R. D. and Blaser, R. E. How to Grow Alfalfa, Orchard Grass Mixture. Better Crops with Plant Foods. December 1957.
24. Smith, G. D. and Smith, R. S. A Study of Crop Yield Records by Soil Types and Soil Ratings. Soil Sci. Soc. Amer. Proc. 4: 375-378. 1939.
25. Snedecor, George W. Statistical Methods. 5th ed. Ames, Iowa. Iowa State College Press. 1956.
26. Sprague, Howard B. Opportunities for Solving Agronomic Problems by Physiological and Ecological Approach. Agron. Journ. 50: 363-365. 1958.
27. U. S. Bureau of Census. United States Census of Agriculture. 1954. U. S. Govt. Ptg. Off., Washington, D. C., 1956.
28. Virginia Agricultural Extension Service. Circ. 374. July 1956.
29. Way, Winston A. Keeping Frost from Heaving Your Alfalfa. Hoards Dairyman. August 25, 1957.
30. Woodhouse, W. W. 40 Tons in 10 Years. N. C. Agri. Exp. Sta. Res. and Farming. Autumn 1957.





## APPENDICES



# APPENDIX A

## RECOMMENDED PRACTICES FOR PRODUCTION OF ALFALFA IN TENNESSEE AND ADJOINING STATES

| State               | Preferred Seeding Date                                        | Varieties                                                                 | Seeding Rate/A                                              | Seed Bed Preparation                                                                   | Requirement                                 | Fert. Req. at Seeding                                                                                                                 |
|---------------------|---------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Tennessee (5)       | August 15 to Sept. 15                                         | Buffalo<br>Atlantic<br>Narragansett<br>Williamsburg<br>DuPuits            | 20# alone<br>15-20 with 3-5 lbs.<br>Orchard-grass           | Summer fallow, w. plow. 4-6 wks. bef. seed. followed by wkly. disking and cultupacking | pH of 7.0 desirable                         | Acc. to soil test or 800-1000# 3-12-12<br>30#N, 120#P <sub>2</sub> O <sub>5</sub><br>120# K <sub>2</sub> O                            |
| Alabama (3)         | Sept. 1 to Sept. 15                                           | Kansas<br>Oklahoma<br>Williamsburg<br>Atlantic<br>Narragansett<br>Vernal  | 20 to 25 lbs. alone                                         | Fallow land 1-2 months before seed. foll. by disking and cultupacker                   | pH 6.5 to 7.5                               | 1000# 0-12-20<br>w. 20-25# bor.<br>120#P <sub>2</sub> O <sub>5</sub><br>200#K <sub>2</sub> O<br>20-25# borax                          |
| Kentucky (12)       | Aug. 15 to Sept. 1<br>March 1 to April 1                      | Atlantic<br>Narragansett<br>Hanger<br>Buffalo                             | 10-12 lbs.                                                  | Firm weed free seed bed                                                                | Generally 3 tons/A                          | 1000# 3-12-12<br>or 0-12-12, 20-50# borax<br>30#N, 120#K <sub>2</sub> O<br>120# P <sub>2</sub> O <sub>5</sub>                         |
| North Carolina (10) | August 15 to Sept. 1                                          | Atlantic<br>Williamsburg<br>Kansas<br>Oklahoma<br>Buffalo                 | 20-25 lbs.                                                  | Fallow land 4-6 wks. bef. seed. followed by disk. & cultupacker                        | According to soil tst. usually 1-1 1/2 tons | Acc. to soil test on avg. soils 800-1000# 2-12-12<br>w. borax, 120# 20#N, 120# K <sub>2</sub> O<br>120# P <sub>2</sub> O <sub>5</sub> |
| Virginia (28)       | After 1st good rain in Aug. to Sept. 1<br>March 1 to April 15 | Williamsburg<br>Atlantic<br>Buffalo<br>Narragansett<br>Kansas<br>Oklahoma | 15-25 lbs. alone<br>10-20 lbs. with 3-5 lbs.<br>orch. grass | Fallow land 4-8 wks. before seeding followed by disking and cultupacker                | 6.5 or above                                | 1000-1200 lbs 2-12-12 with 20-24 lbs. N<br>120-144#P <sub>2</sub> O <sub>5</sub><br>120-144# K <sub>2</sub> O                         |



## APPENDIX A

## RECOMMENDED PRACTICES FOR PRODUCTION OF ALFALFA IN TENNESSEE AND ADJOINING STATES (continued)

| State               | Fertilizer Maintenance Requirements                                                                       | General Recommendations                                                                                                                                                                                            |
|---------------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tennessee (5)       | 500 to 600 lbs. 0-10-20 with borax - yearly in early spring or after 1st. cutting                         | Cut at early bloom stage limited rotational grazing will not injure stand. Careful inoculation important                                                                                                           |
| Alabama (3)         | 1000 lbs. 0-12-20 with borax winter or after 1st cutting. Yearly after first year.                        | Cut in early bloom stage. Grazing during first winter reduces stand. Cutting in early stages reduces stand.                                                                                                        |
| Kentucky (12)       | 1000 lbs. 0-6-12 with borax immediately after any cutting, yearly                                         | Cuttings by date desirable - May 15 and 5 to 6 week intervals thereafter up to 5 weeks before frost. Mixture of orchardgrass or Bluegrass desirable. Harrowing immediately after cutting for control of crabgrass. |
| North Carolina (10) | 500 to 800 lbs. yearly of borated 0-9-27 or 0-10-20 or 400 to 500 lbs. of 0-20-20 dependent on soil test. | Cut in early bloom stage. Lime should be thoroughly mixed in the plow layer. No mention made of mixtures.                                                                                                          |
| Virginia (28)       | 600 to 1000 lbs. of borated 0-10-20 yearly                                                                | Cut in early bloom stage. Flow down and disk lime thoroughly into soil. Mixture of alfalfa and orchard grass considered more flexible and surer in establishment of stand.                                         |







## APPENDIX C

## QUESTIONNAIRE TO EXPERIENCED ALFALFA GROWERS IN PUTNAM COUNTY

1. How long have you been growing alfalfa? \_\_\_\_\_ yrs.
2. How many times have you failed to obtain a good stand? \_\_\_\_\_
3. What do you think caused these failures? \_\_\_\_\_  
\_\_\_\_\_
4. What has been your experience with fall and spring seedings? \_\_\_\_\_  
\_\_\_\_\_
5. When do you consider that a stand is established? \_\_\_\_\_  
\_\_\_\_\_
6. What cropping system have you usually followed prior to seeding alfalfa? \_\_\_\_\_  
\_\_\_\_\_
7. What is your opinion on the most desirable seeding date? \_\_\_\_\_  
seeding rate? \_\_\_\_\_ variety? \_\_\_\_\_
8. What has been your method of seeding? cyclone \_\_\_\_\_ grain drill \_\_\_\_\_  
cultipacker \_\_\_\_\_ before seeding \_\_\_\_\_ after seeding \_\_\_\_\_
9. What has been your usual method of land preparation? \_\_\_\_\_  
\_\_\_\_\_
10. Have you usually had a soil test before seeding? Yes \_\_\_\_\_ No \_\_\_\_\_  
If so, did you follow the recommendations? Yes \_\_\_\_\_ No \_\_\_\_\_
11. What has been your usual fertilization practice at seeding? \_\_\_\_\_  
Maintenance? \_\_\_\_\_
12. What is your usual liming practice? \_\_\_\_\_  
\_\_\_\_\_
13. Do you always innoculate? \_\_\_\_\_  
sp.



## APPENDIX C (continued)

14. Do you ever seed small grain with alfalfa? Yes \_\_\_\_\_ No \_\_\_\_\_  
If so, what rate? \_\_\_\_\_  
Do you think it is a good practice? \_\_\_\_\_
15. Do you seed orchard grass with alfalfa? Yes \_\_\_\_\_ No \_\_\_\_\_  
If so, what rate? \_\_\_\_\_  
Do you think it is a good practice? \_\_\_\_\_
16. Have you had trouble with volunteer plants (especially oats)? \_\_\_\_\_  
\_\_\_\_\_ When has this occurred? \_\_\_\_\_
17. Have you had disease problems? \_\_\_\_\_  
\_\_\_\_\_  
Insect problems? \_\_\_\_\_
18. How long does your stand usually last? \_\_\_\_\_
19. What is your usual number of cuttings? \_\_\_\_\_
20. Do you have any idea of your usual yield in tons? \_\_\_\_\_
21. Have you noticed any differences in success of alfalfa on different types of soil? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
22. What is your idea as to how long alfalfa should last under good management? \_\_\_\_\_ What should the yield be? \_\_\_\_\_
23. What do you think of alfalfa in comparison with other forage crops? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



## APPENDIX D

## RECORD OF 1957 (FALL) SEEDED ALFALFA STANDS IN PUTNAM COUNTY

Community \_\_\_\_\_

Owner \_\_\_\_\_

Address \_\_\_\_\_ Phone No. \_\_\_\_\_

Operator \_\_\_\_\_

Address \_\_\_\_\_ Phone No. \_\_\_\_\_

Photo No. \_\_\_\_\_

General location of farm \_\_\_\_\_

No. acres in farm \_\_\_\_\_ Type of farming \_\_\_\_\_ Acreage in stand \_\_\_\_\_

Field History

## 1. Crops grown prior to present stand of alfalfa.

| <u>Years</u> | <u>Crop</u> | <u>Use of Crop</u> |
|--------------|-------------|--------------------|
| 1954         | _____       | _____              |
| 1955         | _____       | _____              |
| 1956         | _____       | _____              |
| 1957         | _____       | _____              |

## 2. Why have you used this cropping system? \_\_\_\_\_

Establishment

1. Did you summer fallow before seeding the stand? Yes \_\_\_\_\_ No \_\_\_\_\_

2. Date of plowing \_\_\_\_\_ Type of plow \_\_\_\_\_

Bottom Disc

3. Did you subsoil field? Yes \_\_\_\_\_ No \_\_\_\_\_ Depth \_\_\_\_\_

Why? \_\_\_\_\_



## APPENDIX D (continued)

4. Type of equipment and method of seed-bed preparation used \_\_\_\_\_  
\_\_\_\_\_
5. Date of seeding \_\_\_\_\_
6. Method of seeding \_\_\_\_\_
7. Variety \_\_\_\_\_
8. Rate of seeding \_\_\_\_\_
9. Was land free of weeds at time of seeding? Yes \_\_\_\_\_ No \_\_\_\_\_
10. General condition of seed-bed at time of seeding. Loose \_\_\_\_\_  
Firm \_\_\_\_\_ Free of excess filth. Yes \_\_\_\_\_ No \_\_\_\_\_
11. Moisture conditions before seeding. Good \_\_\_\_\_ Fair \_\_\_\_\_  
Poor \_\_\_\_\_ At time of seeding. Good \_\_\_\_\_ Fair \_\_\_\_\_  
Poor \_\_\_\_\_ After seeding. Good \_\_\_\_\_ Fair \_\_\_\_\_ Poor \_\_\_\_\_
12. Was a soil test made prior to seeding? Yes \_\_\_\_\_ No \_\_\_\_\_  
Recommendations followed \_\_\_\_\_ over \_\_\_\_\_ under \_\_\_\_\_
13. a. Source of lime \_\_\_\_\_  
b. Amount applied per acre \_\_\_\_\_  
c. Time of application \_\_\_\_\_
14. a. Rate and analysis of fertilizer applied \_\_\_\_\_  
\_\_\_\_\_  
b. Method of application \_\_\_\_\_  
c. Date applied \_\_\_\_\_
15. Inoculation
  - a. Was land ever in alfalfa before? Yes \_\_\_\_\_ No \_\_\_\_\_ When? \_\_\_\_\_  
\_\_\_\_\_
  - b. Did you use new inoculant recommended for alfalfa? Yes \_\_\_\_\_ No \_\_\_\_\_



## APPENDIX D (continued)

- c. Procedure followed after inoculating seed, \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- d. Proper inoculation procedure? Yes \_\_\_\_\_ No \_\_\_\_\_
- e. Nodulation of plants. None \_\_\_\_\_ Few \_\_\_\_\_  
Some \_\_\_\_\_ Many \_\_\_\_\_ Pink- Yes \_\_\_\_\_ No \_\_\_\_\_

Crops Grown With Alfalfa

1. a. Was small grain seeded with alfalfa? Yes \_\_\_\_\_ No \_\_\_\_\_  
b. Type of small grain \_\_\_\_\_  
Rate of seeding \_\_\_\_\_  
c. Reason for seeding small grain \_\_\_\_\_  
\_\_\_\_\_
2. a. Was grass seeded with alfalfa? Yes \_\_\_\_\_ No \_\_\_\_\_  
Kind of grass \_\_\_\_\_ Rate of seeding \_\_\_\_\_  
b. Reason for seeding or not seeding grass in alfalfa \_\_\_\_\_  
\_\_\_\_\_
3. Are volunteer plants prevalent in stand? Yes \_\_\_\_\_ No \_\_\_\_\_
4. Weed problems  
Summer: Few \_\_\_\_\_ Some \_\_\_\_\_ Many \_\_\_\_\_  
Cool season: Few \_\_\_\_\_ Some \_\_\_\_\_ Many \_\_\_\_\_

Maintenance

1. Amount and analysis of fertilizer or lime applied \_\_\_\_\_  
\_\_\_\_\_ When applied \_\_\_\_\_
2. Amount of heaving (1957). Much \_\_\_\_\_ Some \_\_\_\_\_ Little \_\_\_\_\_
3. Occurrence of diseases, insects and deficiencies:



## APPENDIX D (continued)

- a. Insects \_\_\_\_\_  
 \_\_\_\_\_
- b. Diseases \_\_\_\_\_  
 \_\_\_\_\_
- c. Deficiencies \_\_\_\_\_  
 \_\_\_\_\_
- d. Growth & vigor:  
 Before first cutting: Good \_\_\_\_\_ Fair \_\_\_\_\_ Poor \_\_\_\_\_  
 After first cutting: Good \_\_\_\_\_ Fair \_\_\_\_\_ Poor \_\_\_\_\_

Percent Stand Evaluation

1. Estimated percent of first cutting hay that is: Alfalfa \_\_\_\_\_  
 Oats \_\_\_\_\_ Ryegrass \_\_\_\_\_ Cheat \_\_\_\_\_ Weeds \_\_\_\_\_
- b. Second cutting: Alfalfa \_\_\_\_\_ Orchard grass \_\_\_\_\_  
 Weeds \_\_\_\_\_
- c. Third cutting: Alfalfa \_\_\_\_\_ Orchard grass \_\_\_\_\_  
 Weeds \_\_\_\_\_
- d. Fourth cutting: Alfalfa \_\_\_\_\_ Orchard grass \_\_\_\_\_  
 Weeds \_\_\_\_\_
2. Stand count after first cutting:
- a. Date \_\_\_\_\_
- b. Plants per square foot \_\_\_\_\_
- c. Percent full cover or stand \_\_\_\_\_
- d. Recovery: Good \_\_\_\_\_ Fair \_\_\_\_\_ Poor \_\_\_\_\_
- e. Remarks \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



## APPENDIX D (continued)

Yield Data

## 1. First cutting:

a. Date \_\_\_\_\_ b. No. of bales \_\_\_\_\_  
 c. Average weight per bale \_\_\_\_\_  
 d. Yield of field \_\_\_\_\_ e. Yield per acre \_\_\_\_\_

## 2. Second cutting:

a. Date \_\_\_\_\_ b. No. of bales \_\_\_\_\_  
 c. Average weight per bale \_\_\_\_\_  
 d. Yield of field \_\_\_\_\_ e. Yield per acre \_\_\_\_\_

## 3. Third cutting:

a. Date \_\_\_\_\_ b. No. of bales \_\_\_\_\_  
 c. Average weight per bale \_\_\_\_\_  
 d. Yield of field \_\_\_\_\_ e. Yield per acre \_\_\_\_\_

## 4. Fourth cutting:

a. Date \_\_\_\_\_ b. No. of bales \_\_\_\_\_  
 c. Average weight per bale \_\_\_\_\_  
 d. Yield of field \_\_\_\_\_ e. Yield per acre \_\_\_\_\_

Total 1958 yield per acre \_\_\_\_\_

Soil Type and Fertility

1. Identification of type or types within field \_\_\_\_\_

\_\_\_\_\_ Percent inclusions \_\_\_\_\_

2. Soil Test Results: Surface: pH \_\_\_\_\_  $P_2O_5$  lbs/Ac \_\_\_\_\_ rate \_\_\_\_\_

$K_2O$  lbs/Ac \_\_\_\_\_ rate \_\_\_\_\_

B<sub>2</sub> horizon: pH \_\_\_\_\_  $P_2O_5$  lbs/Ac \_\_\_\_\_ rate \_\_\_\_\_

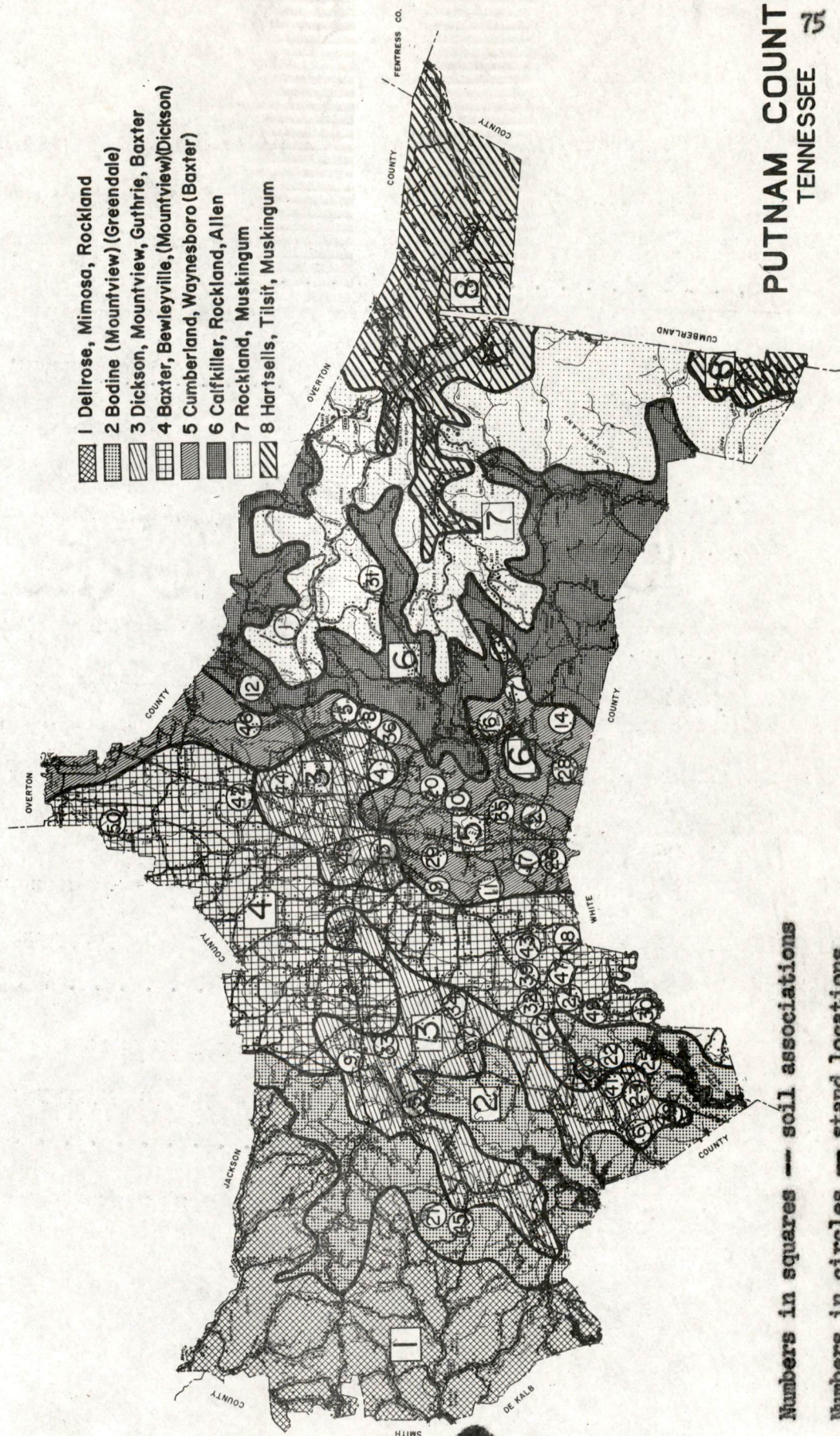
$K_2O$  lbs/Ac \_\_\_\_\_ rate \_\_\_\_\_

Notes & Remarks: \_\_\_\_\_



# APPENDIX E

## SOIL ASSOCIATION MAP OF PUTNAM COUNTY SHOWING LOCATIONS OF STANDS





# APPENDIX F

## PROFILE DESCRIPTION OF WAYNESBORO SILT LOAM

| HORIZON<br>DESIGNATION | DEPTH<br>INCHES | COLOR                                                               |                  | CONSISTENCE<br>(MOIST) | STRUCTURE                                   | TEXTURE            |
|------------------------|-----------------|---------------------------------------------------------------------|------------------|------------------------|---------------------------------------------|--------------------|
|                        |                 | NAME                                                                | MUNSELL NOTATION |                        |                                             |                    |
| A <sub>p</sub>         | 0-8             | Brown to<br>grayish brown                                           | 10 Yr 4/2-4/3    | Very friable           | Weak fine<br>granular                       | Silt loam          |
| B <sub>1</sub>         | 8-13            | Reddish brown                                                       | 5 Yr 4/4         | Friable                | Moderate medium<br>subangular blocky        | Silt loam          |
| B <sub>21</sub>        | 13-21           | Yellowish red                                                       | 5 Yr 4/6         | Friable                | Weak to moderate<br>medium subangular       | Silty clay<br>loam |
| B <sub>22</sub>        | 21-27           | Dark reddish<br>brown to<br>dark red                                | 2.5 Yr 3/4-3/6   | Friable                | Moderate fine<br>subangular blocky          | Silty clay<br>loam |
| B <sub>23</sub>        | 27-37           | Dark red                                                            | 10 Yr 3/6        | Friable to<br>firm     | Strong fine<br>angular blocky               | Silty clay         |
| C <sub>1</sub>         | 37-50+          | Dark red<br>variegated with<br>yellowish red<br>and strong<br>brown | 10 Yr 3/6        | Firm                   | Strong fine and<br>medium angular<br>blocky | Silty clay         |

Site location: Road cut at the intersection of Old Sparta Road and Dry Valley Road. Initial review site - gently sloping phase.



# APPENDIX G

## PROFILE DESCRIPTION OF MOUNTVIEW SILT LOAM

| HORIZON<br>DESIGNATION | DEPTH<br>INCHES | COLOR                                                            |                                      | CONSISTENCE<br>(MOIST) | STRUCTURE                                  | TEXTURE         |
|------------------------|-----------------|------------------------------------------------------------------|--------------------------------------|------------------------|--------------------------------------------|-----------------|
|                        |                 | NAME                                                             | MUNSELL NOTATION                     |                        |                                            |                 |
| A <sub>1</sub>         | 0-1             | Grayish brown                                                    | 10 Yr 4/2                            | Very friable           | Weak fine granular                         | Silt loam       |
| A <sub>2</sub>         | 1-10            | Light yellowish brown                                            | 10 Yr 6/4                            | Friable                | Weak fine granular                         | Silt loam       |
| B <sub>2</sub>         | 10-26           | Yellowish brown                                                  | 10 Yr 5/6                            | Friable                | Moderate fine and medium subangular blocky | Silty clay loam |
| B <sub>3</sub>         | 26-32           | Variegated yellowish brown, strong brown and light brownish gray | 10 Yr 5/6<br>7.5 Yr 5/6<br>10 Yr 6/2 | Friable to firm        | Moderate fine and medium subangular blocky | Silty clay loam |
| B <sub>b</sub>         | 32-50+          | Variegated yellowish red, yellowish brown and light gray         | 5 Yr 4/8<br>10 Yr 5/6<br>2.5 Yr 7/2  | Firm                   | Strong angular blocky                      | Silty clay      |

Site location: Fresh road cut 100 yards west of intersection on Nashes Chapel Road and 3/4 mile northeast of Twin Oak School. Gently sloping phase.



# APPENDIX H

## PROFILE DESCRIPTION OF BAXTER CHERTY SILT LOAM

| HORIZON<br>DESIGNATION | DEPTH<br>INCHES | COLOR                                                                                                                                                                              |  | MUNSELL NOTATION        | CONSISTENCE<br>(MOIST) | STRUCTURE                                               | TEXTURE                                       |
|------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------|------------------------|---------------------------------------------------------|-----------------------------------------------|
|                        |                 | NAME                                                                                                                                                                               |  |                         |                        |                                                         |                                               |
| A <sub>p</sub>         | 0-7             | Yellowish<br>brown                                                                                                                                                                 |  | 10 Yr 5/4               | Friable                | Weak crumb to<br>weak subangular<br>blocky              | Cherty<br>silt loam                           |
| A <sub>2</sub>         | 7-12            | Brownish<br>yellow to<br>yellowish brown                                                                                                                                           |  | 10 Yr 6/8<br>10 Yr 5/8  | Friable                | Weak to moderate<br>medium subangular<br>blocky         | Cherty<br>silt loam                           |
| B <sub>1</sub>         | 12-19           | Strong brown                                                                                                                                                                       |  | 7.5 Yr 5/6              | Friable                | Moderate medium<br>subangular and<br>angular blocky     | Cherty<br>silt loam                           |
| B <sub>2</sub>         | 19-30           | Yellowish red<br>to red                                                                                                                                                            |  | 5 Yr 4/6<br>2.5 Yr 4/6  | Firm                   | Strong medium<br>subangular blocky                      | Cherty<br>silty clay<br>loam to<br>silty clay |
| B <sub>3</sub>         | 30-42           | Mottled dark<br>red and<br>yellowish brown                                                                                                                                         |  | 2.5 Yr 3/6<br>10 Yr 5/6 | Firm                   | Moderate coarse<br>platy to medium<br>subangular blocky | Cherty<br>silty clay<br>to clay               |
| C                      | 42+             | Partially weathered porous chert beds, slightly cemented in places -<br>stratified with lenses of red and gray clay. Depth of chert beds over<br>bedrock varies from 5 to 10 feet. |  |                         |                        |                                                         |                                               |



# APPENDIX I

## PROFILE DESCRIPTION OF HERMITAGE CHERTY SILT LOAM

| HORIZON<br>DESIGNATION | DEPTH<br>INCHES | COLOR              |                  | CONSISTENCE<br>(MOIST) | STRUCTURE                   | TEXTURE           |
|------------------------|-----------------|--------------------|------------------|------------------------|-----------------------------|-------------------|
|                        |                 | NAME               | MUNSELL NOTATION |                        |                             |                   |
| A <sub>p</sub>         | 0-10            | Very dark brown    | 10 Yr 3/3        | Friable                | Weak fine granular          | Cherty silt loam  |
| B <sub>1</sub>         | 10-16           | Dark brown         | 7.5 Yr 3/2       | Friable                | Weak fine granular          | Cherty silty loam |
| B <sub>2</sub>         | 16-42           | Dark reddish brown | 5 Yr 3/4         | Friable                | Weak fine subangular blocky | Cherty silt loam  |

Site location: On southwest edge of alfalfa field on farm of Boyd Qualls. Gently sloping phase.



# APPENDIX J

## PROFILE DESCRIPTION OF HUNTINGTON SILT LOAM

| HORIZON<br>DESIGNATION | DEPTH<br>INCHES | COLOR         |                  | CONSISTENCE<br>(MOIST) | STRUCTURE                   | TEXTURE               |
|------------------------|-----------------|---------------|------------------|------------------------|-----------------------------|-----------------------|
|                        |                 | NAME          | MUNSELL NOTATION |                        |                             |                       |
| A <sub>p</sub>         | 0-6             | Dark brown    | 10 Yr 5/6        | Friable                | Weak fine granular          | Silt loam             |
| C <sub>11</sub>        | 6-30            | Dark brown    | 7.5 Yr 4/4       | Friable                | Weak fine subangular blocky | Light silty clay loam |
| C <sub>12</sub>        | 30-40           | Dark brown    | 7.5 Yr 4/4       | Friable                | Weak fine granular          | Silt loam             |
| C <sub>13</sub>        | 40-50           | Reddish brown | 5 Yr 4/4         | Friable                | Weak fine granular          | Silt loam             |

Site location: On southwest edge of alfalfa field on Horace Henry farm at western foot of Cumberland Escarpment on U.S. 70.



# APPENDIX K

## PROFILE DESCRIPTION OF SEQUATCHIE LOAM

| HORIZON<br>DESIGNATION | DEPTH<br>INCHES | NAME                                                     | COLOR            |                  | CONSISTENCE<br>(MOIST) | STRUCTURE                   | TEXTURE                 |
|------------------------|-----------------|----------------------------------------------------------|------------------|------------------|------------------------|-----------------------------|-------------------------|
|                        |                 |                                                          | MUNSELL NOTATION |                  |                        |                             |                         |
| A <sub>p</sub>         | 0-14            | Dark brown                                               | 7.5              | Yr 3/2           | Very friable           | Weak fine granular          | Loam                    |
| A <sub>3</sub>         | 14-16           | Strong brown                                             | 7.5              | Yr 5/6           | Friable                | Weak fine granular          | Loam                    |
| B <sub>2</sub>         | 16-36           | Strong brown                                             | 7.5              | Yr 5/6           | Friable                | Weak fine subangular blocky | Light clay loam         |
| B <sub>3</sub>         | 36-50           | Strong brown and dark reddish brown                      | 7.5<br>5         | Yr 5/6<br>2/2    | Friable                | Weak fine granular          | Loam                    |
| C                      | 50-56+          | Reddish brown<br>Very dark grayish brown<br>Strong brown | 5<br>10          | Yr 5/3<br>Yr 3/2 | Friable                | Weak fine granular          | Loam to fine sandy loam |
|                        |                 |                                                          | 7.5              | Yr 5/6           |                        |                             |                         |

Site location: At east edge of alfalfa field on Professor Joe Conrey's farm - south of Route 70, 1/2 mile west of foot of the Cumberland Escarpment.



# APPENDIX I

## PROFILE DESCRIPTION OF WELLSTON SILT LOAM

| HORIZON<br>DESIGNATION         | DEPTH<br>INCHES | NAME                                        | COLOR                                |  | CONSISTENCE<br>(MOIST) | STRUCTURE                       | TEXTURE         |
|--------------------------------|-----------------|---------------------------------------------|--------------------------------------|--|------------------------|---------------------------------|-----------------|
|                                |                 |                                             | MUNSELL NOTATION                     |  |                        |                                 |                 |
| A <sub>p</sub>                 | 0-5             | Yellowish brown                             | 10 Yr 5/4                            |  | Friable                | Weak fine granular              | Silt loam       |
| B <sub>1</sub><br>(transition) | 5-7             | Yellowish brown<br>and dark brown           | 10 Yr 5/8<br>10 Yr 5/6               |  | Friable                | Weak fine subangular blocky     | Silty clay loam |
| B <sub>21</sub>                | 7-25            | Yellowish brown                             | 10 Yr 5/8                            |  | Friable                | Moderate fine subangular blocky | Silty clay loam |
| B <sub>22</sub>                | 25-36           | Yellowish brown<br>Pale brown<br>Dark brown | 10 Yr 5/8<br>10 Yr 4/3<br>7.5 Yr 4/4 |  | Firm compact           | Moderate fine subangular blocky | Silty clay loam |
| C <sub>1</sub>                 | 36-52           | Strong brown<br>Yellowish red<br>Pale brown | 7.5 Yr 5/6<br>5 Yr 4/6<br>10 Yr 6/3  |  | Firm                   | Moderate angular blocky         | Silty clay loam |
| C <sub>2</sub>                 | 52-65+          | Red mottled with strong brown               | firm silty clay - residuum           |  |                        |                                 |                 |

Site location: In alfalfa field on farm of A. C. Maxwell located one mile southeast of Brotherton. Nearly level phase.



# APPENDIX M

## PROFILE DESCRIPTION OF EMORY SILT LOAM

| HORIZON<br>DESIGNATION | DEPTH<br>INCHES | COLOR                                                         |                          | CONSISTENCE<br>(MOIST) | STRUCTURE          | TEXTURE                                                           |
|------------------------|-----------------|---------------------------------------------------------------|--------------------------|------------------------|--------------------|-------------------------------------------------------------------|
|                        |                 | NAME                                                          | MUNSELL NOTATION         |                        |                    |                                                                   |
| A <sub>1</sub>         | 0-15            | Dark brown                                                    | 7.5 Yr 4/4               | Friable                | Weak fine granular | Silt loam                                                         |
| C <sub>11</sub>        | 15-35           | Dark brown                                                    | 7.5 Yr 4/4               | Friable                | Weak fine granular | Loam                                                              |
| C <sub>12</sub>        | 35-40           | Dark brown<br>Very dark brown                                 | 7.5 Yr 4/4<br>7.5 Yr 2/2 | Friable                | Granular           | Loam with<br>20%<br>angular<br>and<br>rounded<br>quartz<br>gravel |
| C <sub>13</sub>        | 40-50+          | Mottled very dark brown, yellowish brown, black and gray loam |                          |                        |                    |                                                                   |

Site location: Alfalfa field on Horace Boatman farm.  
Nearly level phase.



# APPENDIX N

## PROFILE DESCRIPTION OF HOLSTON SILT LOAM

| HORIZON<br>DESIGNATION | DEPTH<br>INCHES | COLOR                              |                                      | CONSISTENCE<br>(MOIST) | STRUCTURE                          | TEXTURE            |
|------------------------|-----------------|------------------------------------|--------------------------------------|------------------------|------------------------------------|--------------------|
|                        |                 | NAME                               | MUNSELL NOTATION                     |                        |                                    |                    |
| A <sub>p</sub>         | 0-6             | Dark brown to<br>yellowish brown   | 10 Yr 4/3<br>10 Yr 5/4               | Friable                | Weak fine<br>granular              | Silt loam          |
| A <sub>3</sub>         | 6-9             | Yellowish brown<br>to dark brown   | 10 Yr 5/6<br>10 Yr 4/3               | Friable                | Weak fine<br>granular              | Silt loam          |
| B <sub>2</sub>         | 9-30            | Yellowish brown                    | 10 Yr 5/6                            | Friable                | Moderate fine<br>subangular blocky | Silty clay<br>loam |
| B <sub>3</sub>         | 30-44           | Yellowish brown<br>to brown        | 10 Yr 5/8<br>7.5 Yr 5/3<br>10 Yr 5/3 | Friable                | Weak fine<br>subangular blocky     | Silty clay<br>loam |
| C <sub>1</sub>         | 44-58           | Light yellowish<br>brown           | 10 Yr 6/4                            | Friable                |                                    | loam               |
| C <sub>2</sub>         | 58+             | Red, yellow and<br>brownish yellow | firm clay loam residuum              |                        |                                    |                    |

Site location: Alfalfa field on Harvey Nash farm. Nearly level phase.



## APPENDIX O

## NUMERICAL RATING OF MANAGEMENT PRACTICES

| Stand No. | Seed-<br>ing<br>Date | Land<br>Prepara-<br>tion | Ferti-<br>liza-<br>tion | pH | Use of<br>Culti-<br>packer | Top<br>Dress-<br>ing | Numer-<br>ical<br>Rating | Manage-<br>ment<br>Level |
|-----------|----------------------|--------------------------|-------------------------|----|----------------------------|----------------------|--------------------------|--------------------------|
| 1         | 3                    | 3                        | 2                       | 1  | 2                          | 1                    | 12                       | B                        |
| 2         | 3                    | 3                        | 2                       | 2  | 2                          | 1                    | 13                       | A                        |
| 3         | 3                    | 3                        | 2                       | 2  | 2                          | 1                    | 13                       | A                        |
| 4         | 3                    | 1                        | 2                       | 1  | 2                          |                      | 9                        | C                        |
| 5         | 3                    | 1                        | 2                       | 1  | 2                          |                      | 9                        | C                        |
| 6         | 2                    | 2                        | 2                       | 2  | 2                          | 1                    | 11                       | B                        |
| 7         | 3                    | 2                        | 4                       | 2  | 2                          | 1                    | 14                       | A                        |
| 8         | 1                    | 3                        | 2                       | 2  | 3                          |                      | 11                       | B                        |
| 9         | 1                    | 1                        | 2                       | 3  | 3                          | 1                    | 11                       | B                        |
| 10        | 1                    | 1                        | 2                       | 1  | 2                          |                      | 7                        | C                        |
| 11        | 3                    | 2                        | 4                       | 2  | 3                          |                      | 14                       | A                        |
| 12        | 2                    | 1                        | 2                       | 1  | 1                          | (2 no<br>inoculum)   | 7                        | C                        |
| 13        | 3                    | 3                        | 3                       | 3  | 2                          |                      | 14 <sup>1</sup>          | A                        |
| 14        | 3                    | 3                        | 3                       | 3  | 2                          |                      | 14 <sup>1</sup>          | A                        |
| 15        | 3                    | 2                        | 2                       | 2  | 1                          |                      | 10                       | B                        |
| 16        | 2                    | 1                        | 4                       | 2  | 1                          |                      | 10 <sup>1</sup>          | B                        |
| 17        | 2                    | 3                        | 4                       | 3  | 3                          |                      | 16                       | A                        |
| 18        | 3                    | 3                        | 4                       | 2  | 3                          |                      | 15                       | A                        |
| 19        | 3                    | 2                        | 3                       | 1  | 2                          | -                    | 11                       | B                        |
| 20        | 1                    | 2                        | 2                       | 3  | 1                          | 1                    | 10                       | B                        |
| 21        | 3                    | 2                        | 2                       | 2  | 1                          |                      | 10                       | B                        |
| 22        | 3                    | 3                        | 2                       | 1  | 2                          | (2 no<br>borax)      | 9                        | C                        |
| 23        | 1                    | 1                        | 1                       | 3  | 2                          |                      | 8                        | C                        |
| 24        | 1                    | 1                        | 2                       | 1  | 2                          |                      | 7                        | C                        |
| 25        | 3                    | 3                        | 3                       | 3  | 2                          | 1                    | 15                       | A                        |
| 26        | 3                    | 3                        | 3                       | 3  | 2                          | 1                    | 15                       | A                        |
| 27        | 3                    | 3                        | 2                       | 1  | 2                          | 1                    | 12 <sup>1</sup>          | B                        |
| 28        | 3                    | 2                        | 2                       | 3  | 2                          |                      | 12                       | B                        |
| 29        | 3                    | 1                        | 1                       | 2  | 1                          | (2 no<br>borax)      | 6                        | C                        |
| 30        | 1                    | 3                        | 2                       | 3  | 1                          |                      | 10                       | B                        |
| 31        | 3                    | 3                        | 2                       | 3  | 1                          |                      | 12                       | B                        |
| 32        | 3                    | 3                        | 2                       | 3  | 3                          |                      | 14                       | A                        |
| 33        | 3                    | 3                        | 2                       | 3  | 3                          |                      | 14                       | A                        |
| 34        | 3                    | 3                        | 2                       | 2  | 2                          |                      | 12                       | B                        |
| 35        | 3                    | 1                        | 3                       | 2  | 1                          | 1                    | 11                       | B                        |
| 36        | 3                    | 1                        | 2                       | 3  | 1                          |                      | 10                       | B                        |



## APPENDIX O (continued)

## NUMERICAL RATING OF MANAGEMENT PRACTICES

| Stand No. | Seed-<br>ing<br>Date | Land<br>Prepara-<br>tion | Ferti-<br>liza-<br>tion | pH | Use of<br>Culti-<br>packer | Top<br>Dress-<br>ing | Numer-<br>ical<br>Rating | Manage-<br>ment<br>Level |
|-----------|----------------------|--------------------------|-------------------------|----|----------------------------|----------------------|--------------------------|--------------------------|
| 37        | 3                    | 1                        | 2                       | 3  | 1                          |                      | 10                       | B                        |
| 38        | 3                    | 2                        | 4                       | 3  | 3                          | 1                    | 16                       | A                        |
| 39        | 3                    | 2                        | 2                       | 3  | 3                          |                      | 13                       | A                        |
| 40        | 3                    | 3                        | 2                       | 3  | 2                          |                      | 13 <sup>1</sup>          | A                        |
| 41        | 1                    | 2                        | 2                       | 3  | 2                          |                      | 10                       | B                        |
| 42        | 3                    | 3                        | 2                       | 2  | 2                          |                      | 12                       | B                        |
| 43        | 3                    | 3                        | 4                       | 3  | 2                          | 1                    | 16                       | A                        |
| 44        | 3                    | 1                        | 2                       | 3  | 2                          |                      | 11                       | B                        |
| 45        | 3                    | 3                        | 2                       | 3  | 3                          |                      | 14                       | A                        |
| 46        | 3                    | 3                        | 3                       | 2  | 2                          |                      | 13                       | A                        |
| 47        | 3                    | 3                        | 2                       | 3  | 2                          | 1                    | 14                       | A                        |
| 48        | 1                    | 1                        | 2                       | 3  | 2                          |                      | 9                        | C                        |
| 49        | 3                    | 2                        | 2                       | 3  | 3                          |                      | 13                       | A                        |
| 50        | 1                    | 3                        | 2                       | 3  | 2                          | 1                    | 12                       | B                        |
| 51        | 1                    | 3                        | 2                       | 2  | 1                          |                      | 9 <sup>1</sup>           | C                        |
| 52        | 3                    | 2                        | 3                       | 2  | 2                          |                      | 12                       | B                        |
| 53        | 3                    | 1                        | 2                       | 1  | 2                          |                      | 10                       | B                        |
| 54        | 3                    | 2                        | 4                       | 2  | 2                          | 1                    | 14                       | A                        |
| 55        | 3                    | 3                        | 2                       | 3  | 1                          |                      | 12                       | B                        |
| 56        | 3                    | 3                        | 1                       | 2  | 2                          |                      | 11                       | B                        |
| 57        | 3                    | 3                        | 4                       | 2  | 2                          |                      | 14                       | A                        |
| 58        | 3                    | 3                        | 2                       | 3  | 2                          | 1                    | 14                       | A                        |
| 59        | 3                    | 2                        | 4                       | 3  | 3                          |                      | 15                       | A                        |
| 60        | 3                    | 1                        | 2                       | 3  | 1                          |                      | 10                       | B                        |

<sup>1</sup>Rating changed from personal knowledge of stand.



## APPENDIX O (continued)

Changed made from personal knowledge of stand

- 13 & 14. From A to B -- these stands were grazed and the yield of second cutting does not reflect a true value of production.
- 16 From B to C. This stand was considerably thinned from heaving which was thought to be the result of late turning of rank weed growth that left a puffy seed bed.
- 27 From B to A. Very good methods used but pH was 5.9. While this is not desirable 4 tons of lime were applied per acre and growth of the stand would indicate that there could have been an error in sampling.
- 40 From A to B. Harvesting methods seriously affected yield of this stand. The second cutting was rained on and not all of it was saved.
- 51 From C to B. Although cultipacker was not used on stand it was seeded during rain resulting in excellent stand.



SUMMARY OF MANAGEMENT PRACTICES AND STAND EVALUATIONS FOR SIXTY ALFALFA STANDS  
IN PUTNAM COUNTY, TENNESSEE

| Stand | No. Acres | Soil Type   | Seeding Date | Land Preparation | Use of Cultipacker Fertilization | Top dressing                                         |
|-------|-----------|-------------|--------------|------------------|----------------------------------|------------------------------------------------------|
| 1     | 1.4       | Mountain B1 | Aug. 25      | Summer fallow    | X                                | 350# 0-9-27                                          |
| 2     | 1.5       | Mountain B1 | Aug. 25      | Summer fallow    | X                                | 400# 6-12-12B before 1st cut.                        |
| 3     | 1.6       | "           | "            | "                | X                                | "                                                    |
| 4     | 7.0       | "           | Sept. 15     | Turned late      | X                                | 600# 6-12-12B                                        |
| 5     | 5.0       | "           | Sept. 30     | Summer crop      | X                                | 500# 6-12-12B                                        |
| 6     | 10.3      | "           | Sept. 30     | Summer crop      | X                                | 500# 6-12-12B 200# 0-9-27 before 1st cut.            |
| 7     | 1.25      | "           | Aug. 30      | "                | X                                | 1000# 6-12-12B 600# 0-7-27 before 1st cut.           |
| 8     | 7.8       | "           | Oct. 10      | Turned late      | X                                | 400# 6-12-12B 1st cutting                            |
| 9     | 5.5       | "           | Oct. 8       | "                | X                                | 400# 6-12-12B 200# 0-9-27 after 1st cutting          |
| 10    | 3.85      | "           | Oct. 30      | "                | X                                | 500# 6-12-12B 200# 0-9-27 after 1st cut.             |
| 11    | 10.0      | "           | Sept. 1      | Summer crop      | X                                | 500# 6-12-12B 100# 60% P <sub>2</sub> O <sub>5</sub> |
| 12    | 2.5       | "           | Sept. 20     | Turned late      | X                                | 400# 6-12-12B 1 lb.                                  |
| 13    | 6.8       | Holston C2  | Aug. 20      | Summer fallow    | X                                | 400# 3-12-12B                                        |
| 14    | 6.0       | Holston B2  | Aug. 20      | "                | X                                | 400# 3-12-12B                                        |
| 15    | 3.3       | Holston B1  | Sept. 12     | Summer crop      | X                                | 400# 6-12-12B 200# 0-9-27 after 1st cut.             |
| 16    | 6.5       | Wellston B1 | Sept. 27     | Turned late      | X                                | 1000# 6-12-12B 200# 0-9-27 after 1st cut.            |
| 17    | 5.8       | Mountain B1 | Sept. 30     | Summer fallow    | X                                | 600# 0-9-27B 200# 0-9-27 after 1st cut.              |
| 18    | 5.3       | Mountain C1 | Aug. 30      | Summer fallow    | X                                | 400# 3-12-12B                                        |
| 19    | 13.5      | Mountain B1 | Sept. 8      | Summer crop      | X                                | 300# 0-10-20B                                        |
| No.   | Used      | Time and    | Seeding      | Seeding          | Stand Evaluation                 |                                                      |
| 1     | X         | 3T per Acre | 57           | Cyclone          | 40                               | 12                                                   |
| 2     | X         | 3T per Acre | 57           | Cyclone          | 60                               | 16                                                   |
| 3     | X         | 3T per Acre | 57           | Cyclone          | 40                               | 16                                                   |
| 4     | X         | 2T per Acre | 52           | Cyclone          | 15                               | 7                                                    |
| 5     | X         | 3T per Acre | 54           | Cyclone          | 30                               | 11                                                   |
| 6     | X         | 3T per Acre | 57           | Cyclone          | 65                               | 35                                                   |
| 7     | X         | 3T per Acre | 57           | Cyclone          | 95                               | 35                                                   |
| 8     | X         | 3T per Acre | 57           | grain drill      | 60                               | 15                                                   |
| 9     | X         | 2 1/2T/Acre | 57           | Cyclone          | 60                               | 15                                                   |
| 10    | X         | 3T per Acre | 57           | grain drill      | 10                               | 6                                                    |
| 11    | X         | 2T per Acre | 57           | Cyclone          | 70                               | 16                                                   |
| 12    | No        | 2T per Acre | 57           | Cyclone          | 20                               | 18                                                   |
| 13    | X         | 3T per Acre | 57           | grain drill      | 90                               | 18                                                   |
| 14    | X         | 3T per Acre | 57           | grain drill      | 20                               | 16                                                   |
| 15    | X         | 2T per Acre | 57           | Cyclone          | 75                               | 14                                                   |
| 16    | X         | 2T per Acre | 57           | Cyclone          | 60                               | 11                                                   |
| 17    | X         | 2 1/2T/Acre | 56           | grain drill      | 75                               | 12                                                   |
| 18    | X         | 3T per Acre | 56           | Cyclone          | 85                               | 12                                                   |
| 19    | X         | 3T per Acre | 54           | Cyclone          | 85                               | 7                                                    |
|       |           |             |              |                  |                                  | 80                                                   |
|       |           |             |              |                  |                                  | 90                                                   |
|       |           |             |              |                  |                                  | 90                                                   |
|       |           |             |              |                  |                                  | 50                                                   |
|       |           |             |              |                  |                                  | 80                                                   |
|       |           |             |              |                  |                                  | 90                                                   |
|       |           |             |              |                  |                                  | 90                                                   |
|       |           |             |              |                  |                                  | 0                                                    |
|       |           |             |              |                  |                                  | 80                                                   |
|       |           |             |              |                  |                                  | 20                                                   |
|       |           |             |              |                  |                                  | 85                                                   |
|       |           |             |              |                  |                                  | 80                                                   |
|       |           |             |              |                  |                                  | 100                                                  |
|       |           |             |              |                  |                                  | 60                                                   |
|       |           |             |              |                  |                                  | 20                                                   |
|       |           |             |              |                  |                                  | 0                                                    |
|       |           |             |              |                  |                                  | 70                                                   |
|       |           |             |              |                  |                                  | 75                                                   |
|       |           |             |              |                  |                                  | 60                                                   |



89



SUMMARY OF MANAGEMENT PRACTICES AND STAND EVALUATIONS FOR SIXTY ALFALFA STANDS  
IN PUTNAM COUNTY, TENNESSEE (continued)

APPENDIX P

| Stand | No. Acres | Soil Type     | Seeding Date | Land Preparation | Use of Cultipacker Fertilization | Top dressing   |
|-------|-----------|---------------|--------------|------------------|----------------------------------|----------------|
| 43    | 1.55      | Waynesboro C2 | Aug. 15      | Summer fallow    | X                                | 200# 0-9-27    |
| 44    | 7.4       | Cumberland B1 | Sept. 25     | Turned late      | X                                | 400# 6-12-12B  |
| 45    | 9.3       | Cumberland C2 | Sept. 1      | Summer fallow    | X                                | 450# 6-12-12B  |
| 46    | 4.2       | Cumberland B2 | Aug. 23      | Summer fallow    | X                                | 600# 2-12-12B  |
| 47    | 7.1       | Cumberland B1 | Sept. 2      | Summer fallow    | X                                | 400# 6-12-12B  |
| 48    | 6.5       | Cumberland B1 | Oct. 15      | Turned late      | X                                | 400# 6-12-12B  |
| 49    | 1.0       | Cumberland B1 | Sept. 15     | Summer crop      | X                                | 500# 6-12-12B  |
| 50    | 7.2       | Cumberland C3 | Oct. 15      | Summer fallow    | X                                | 400# 6-12-12B  |
| 51    | 3.75      | Hermitage C1  | Oct. 1       | Summer fallow    | X                                | 400# 6-12-12B  |
| 52    | 9.0       | Hermitage C1  | Sept. 15     | Summer crop      | X                                | 400# 0-9-27B   |
| 53    | 4.5       | Mix. coll. B1 | Aug. 30      | Summer crop      | X                                | 400# 6-12-12B  |
| 54    | 3.0       | Baxter C2     | Sept. 12     | Summer crop      | X                                | 1100# 3-12-12B |
| 55    | 2.7       | Baxter C2     | Aug. 30      | Summer fallow    | X                                | 400# 6-12-12B  |
| 56    | 3.5       | Baxter B2     | Aug. 15      | Summer fallow    | X                                | 300# 6-12-12B  |
| 57    | .5        | Baxter B2     | Aug. 20      | Summer fallow    | X                                | 750# 6-12-12B  |
| 58    | 2.65      | Emory         | Sept. 1      | Summer fallow    | X                                | 400# 6-12-12B  |
| 59    | 6.0       | Sequatchie    | Sept. 1      | Summer fallow    | X                                | 200# 0-9-27B   |
| 60    | 18.0      | Huntington    | Aug. 30      | Turned late      | X                                | 400# 6-12-12B  |

| Stand | Inoculum | Used        | Lime and Tr. Applied | Seeding Method | Seeding Rate | Variety*  | % Alf. Ist. Cutt. | Plants per sq. ft. | Per Cent Full Cover |
|-------|----------|-------------|----------------------|----------------|--------------|-----------|-------------------|--------------------|---------------------|
| 43    | X        | 2 1/2T/Acre | 57 Grain drill       | 50#            | K & O        | 85        | 10                | 85                 | 95                  |
| 44    | X        | 3T per acre | 57 Grain drill       | 25#            | B            | 80        | 8                 | 40                 | 95                  |
| 45    | X        | 3 1/2T/Acre | 57 Grain drill       | 20#            | B            | 95        | 20                | 95                 | 95                  |
| 46    | X        | 3 1/2T/Acre | 57 Grain drill       | 25#            | K            | 60        | 18                | 90                 | 95                  |
| 47    | X        | 3T per acre | 57 Grain drill       | 20#            | B            | 95        | 25                | 95                 | 95                  |
| 48    | X        | 3T per acre | 57 Grain drill       | 20#            | O            | 65        | 17                | 80                 | 95                  |
| 49    | X        | 3T per acre | 57 Grain drill       | 25#            | B            | 95        | 22                | 95                 | 95                  |
| 50    | X        | 3T per acre | 57 Grain drill       | 25#            | B            | 98        | 20                | 90                 | 95                  |
| 51    | X        | 3T per acre | 57 Grain drill       | 40#            | O            | 80        | 16                | 80                 | 95                  |
| 52    | X        | 3T per acre | 57 Grain drill       | 25#            | K            | 85        | 14                | 80                 | 95                  |
| 53    | X        | 2T per acre | 57 Grain drill       | 20#            | B            | 50        | 14                | 70                 | 95                  |
| 54    | X        | 4T per acre | 57 Grain drill       | 25#            | B            | 95 to 100 | 35                | 100                | 95                  |
| 55    | X        | 3T per acre | 55 Grain drill       | 20#            | K            | 95        | 14                | 85                 | 95                  |
| 56    | X        | 2T per acre | 56 Grain drill       | 30#            | O            | —         | —                 | —                  | 100                 |
| 57    | X        | 3T per acre | 56 Grain drill       | 30#            | B            | 95        | 20                | 95                 | 95                  |
| 58    | X        | 3T per acre | 57 Grain drill       | 20#            | B            | 95        | 25                | 85                 | 95                  |
| 59    | X        | 3T per acre | 57 Grain drill       | 10#            | B            | 70        | 18                | 85                 | 95                  |
| 60    | X        | 2T per acre | 57 Grain drill       | 25#            | B            | 92        | 30                | 95                 | 95                  |

\*0 indicates Oklahoma Common; K indicates Kansas Common; B indicates Buffalo.



## APPENDIX Q

RESULTS OF TESTS OF SOIL SAMPLES FOR SIXTY ALFALFA STANDS  
IN PUTNAM COUNTY, TENNESSEE

| Stand No. | PH   |                | P <sub>2</sub> O <sub>5</sub> |                        | K <sub>2</sub> O   |                        | Stand No. | PH   |                | P <sub>2</sub> O <sub>5</sub> |                        | K <sub>2</sub> O   |                        |
|-----------|------|----------------|-------------------------------|------------------------|--------------------|------------------------|-----------|------|----------------|-------------------------------|------------------------|--------------------|------------------------|
|           | face | B <sub>2</sub> | Lbs./Acre and Rate            | Surface B <sub>2</sub> | Lbs./Acre and Rate | Surface B <sub>2</sub> |           | face | B <sub>2</sub> | Lbs./Acre and Rate            | Surface B <sub>2</sub> | Lbs./Acre and Rate | Surface B <sub>2</sub> |
| 1         | 5.5  | 4.5            | 103-H-3VL                     |                        | 268-H-153M         |                        | 31        | 6.4  | 4.9            | 39-H-4VL                      |                        | 317-H-197H         |                        |
| 2         | 6.2  | 4.7            | 31-H-2VL                      |                        | 84-L-64VL          |                        | 32        | 7.1  | 4.9            | 29-H-2VL                      |                        | 230-H-123L         |                        |
| 3         | 6.2  | 4.6            | 47-H-3VL                      |                        | 157-M-100L         |                        | 33        | 6.8  | 5.5            | 14-L-3VL                      |                        | 174-M-201H         |                        |
| 4         | 5.3  | 4.7            | 14-L-3VL                      |                        | 115-L-88L          |                        | 34        | 6.2  | 5.3            | 23-M-2VL                      |                        | 215-H-168M         |                        |
| 5         | 5.8  | 4.5            | 33-H-2VL                      |                        | 88-L-84L           |                        | 35        | 6.4  | 4.8            | 9-L-2VL                       |                        | 138-M-130L         |                        |
| 6         | 6.4  | 4.7            | 42-H-3VL                      |                        | 237-H-108L         |                        | 36        | 6.9  | 5.2            | 55-H-2VL                      |                        | 249-H-160M         |                        |
| 7         | 6.4  | 4.7            | 17-M-2VL                      |                        | 72-VL-80VL         |                        | 37        | 6.7  | 5.3            | 21-M-2VL                      |                        | 96-L-84L           |                        |
| 8         | 6.3  | 4.7            | 32-H-3VL                      |                        | 234-H-134L         |                        | 38        | 6.8  |                | 55-H                          |                        | 230-H              |                        |
| 9         | 6.9  | 5.1            | 29-H-1VL                      |                        | 142-M-108L         |                        | 39        | 6.7  |                | 19-M                          |                        | 386-H              |                        |
| 10        | 5.3  | 5.0            | 17-M-2VL                      |                        | 153-M-92L          |                        | 40        | 6.8  |                | 9-L                           |                        | 260-H              |                        |
| 11        | 6.2  |                | 8-L                           |                        | 115-L              |                        | 41        | 6.5  | 4.8            | 7-L-1VL                       |                        | 134-L-92L          |                        |
| 12        | 5.8  | 4.6            | 6-L-2VL                       |                        | 168-M-72VL         |                        | 42        | 6.1  | 5.6            | 58-H-3VL                      |                        | 286-H-157M         |                        |
| 13        | 6.6  |                | 5-VL                          |                        | 130-L              |                        | 43        | 6.9  |                | 120-H                         |                        | 317-H              |                        |
| 14        | 6.6  |                | 8-L                           |                        | 104-L              |                        | 44        | 6.8  |                | 5-VL                          |                        | 234-H              |                        |
| 15        | 6.2  |                | 17-M                          |                        | 80-VL              |                        | 45        | 6.9  | 5.2            | 6-VL-1VL                      |                        | 211-H-142M         |                        |
| 16        | 6.1  | 4.8            | 21-M-1VL                      |                        | 123-L-84L          |                        | 46        | 6.0  | 5.0            | 5-VL-2VL                      |                        | 234-H-190H         |                        |
| 17        | 6.6  |                | 38-H                          |                        | 237-H              |                        | 47        | 6.7  | 5.6            | 3-VL-1VL                      |                        | 201-H-149M         |                        |
| 18        | 6.3  |                | 9-L                           |                        | 104-L              |                        | 48        | 6.6  | 5.3            | 9-L-1VL                       |                        | 219-H-178M         |                        |
| 19        | 5.9  | 4.6            | 19-M-1VL                      |                        | 149-M-130L         |                        | 49        | 6.7  |                | 7-L                           |                        | 149-M              |                        |
| 20        | 6.8  | 5.2            | 2-VL-76VL                     |                        | 2-VL-138M          |                        | 50        | 6.7  | 6.0            | 7-L-1VL                       |                        | 208-H-138M         |                        |
| 21        | 6.0  |                | 16-L                          |                        | 245-H              |                        | 51        | 6.1  |                | 23-M                          |                        | 400-H              |                        |
| 22        | 5.8  | 4.8            | 21-M-3VL                      |                        | 222-H-182M         |                        | 52        | 6.0  |                | 10-L                          |                        | 190-H              |                        |
| 23        | 6.5  | 4.8            | 7-L-3VL                       |                        | 134-L-100L         |                        | 53        | 5.7  |                | 16-M                          |                        | 186-H              |                        |
| 24        | 5.0  |                | 8-L                           |                        | 100-L              |                        | 54        | 6.3  |                | 14-L                          |                        | 234-H              |                        |
| 25        | 6.7  | 4.9            | 10-L-3VL                      |                        | 115-L-104L         |                        | 55        | 7.0  | 5.2            | 10-L-1VL                      |                        | 193-H-160M         |                        |
| 26        | 6.8  | 6.2            | 112-H-7L                      |                        | 272-H-400H         |                        | 56        | 6.1  |                | 21-M                          |                        | 149-M              |                        |
| 27        | 5.9  | 4.5            | 53-H-7L                       |                        | 400-H-400H         |                        | 57        | 6.1  |                | 83-H                          |                        | 346-H              |                        |
| 28        | 6.5  | 5.4            | 9-L-3VL                       |                        | 306-H-400H         |                        | 58        | 6.5  |                | 8-L                           |                        | 160-M              |                        |
| 29        | 6.4  | 5.1            | 19-M-3VL                      |                        | 237-H-197H         |                        | 59        | 6.5  |                | M                             |                        | H                  |                        |
| 30        | 6.6  | 5.0            | 5-VL-3VL                      |                        | 219-H-193H         |                        | 60        | 6.6  |                | 12-L                          |                        | 164-M              |                        |