FOLIAR NUTRIENT ANALYSIS OF COTTONWOOD ON A MARGINAL SITE UNDER VARIOUS CULTURAL TREATMENTS

By

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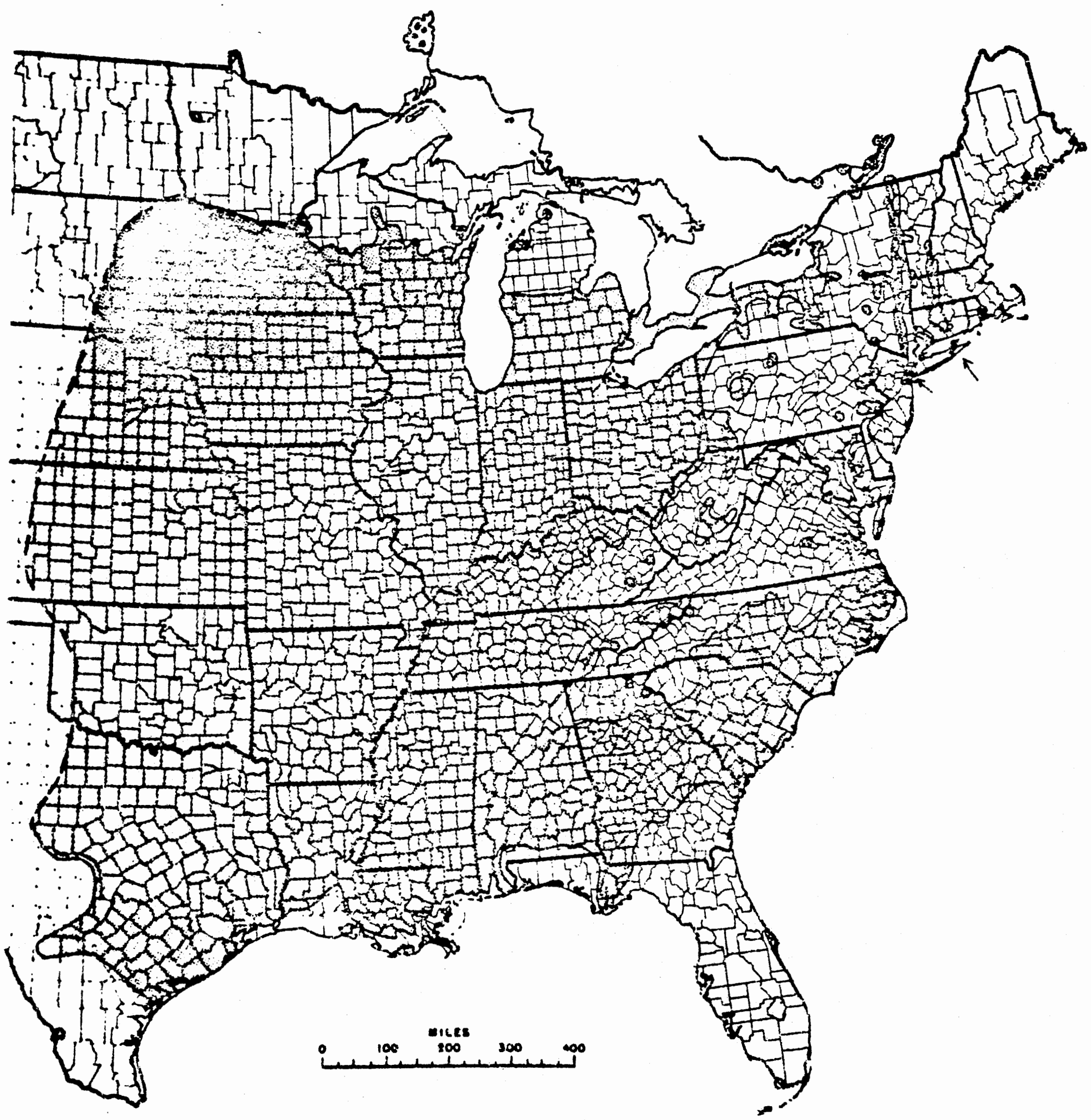
CHAPTER I

INTRODUCTION

Eastern cottonwood (<u>Populus</u> <u>deltoides</u> Bartr.) is one of the fastest-growing trees in North America. When grown on high quality sites, this species is capable of growing 5 centimeters in diameters and 3.7 meters in height each year. Even on more marginal sites, growth rates of 2.5 centimeters in diameter and 1.5 meters in height are common (18, 34).

Cottonwood is referred to as one of the most site demanding species, attaining its best growth only within a narrow range of site conditions (18). However, cottonwood is capable of surviving over a wide range of sites, preferring the well-drained sandy and silty loams associated with the river bottoms of the southern United States (Figure 1) (35).

The <u>Populus</u> genus comprises eight percent of the hardwood growing stock in the United States. In the south cottonwood makes up most of the poplar inventory (49). The bottomland forests have been the major source of cottonwood since the 1900's (29). It was estimated in 1930 that in the Mississippi delta region alone there were 11.8 million acres of this land lost from cottonwood production due to agricultural conversion (29). Clearing land for agricultural crops and river stabilization projects continues to cause cottonwood



Source: Fowells (18).

Figure 1. The Natural Range of Eastern Cottonwood (<u>Populus deltoides</u> Bartr.)

supplies to decline at an average annual rate of slightly less than two percent in the delta region (29).

In the Central Great Plains states the shrinkage of available cottonwood sites has also been evident. Thousands of acres and millions of boardfeet are bulldozed annually to increase agronomic cropland and to improve and/or expand pasture lands (15). For example, from 1966 to 1976, commercial forest land in Oklahoma decreased 12 percent mainly due to agricultural conversion, and the trend is continuing (25).

Cottonwood, valuable for lumber, veneer, and pulp is increasingly more in demand (34). However, due to cottonwood's high site requirements, it grows best on sites which are well-suited for high value agricultural crops, such as soybeans (30). Since cottonwood cannot compete financially with agricultural crops on an acre-for-acre basis, pressure exists to convert the land to purely agricultural uses.

As agricultural pressures continue to mount against the ever-increasing demand for cottonwood products, one option open to increase the available supply of fiber is to improve the per-acre productivity of the land on which cottonwood is to be grown (29). In addition, gains in productivity may be accomplished by planting cottonwood on suboptimal sites using genetically improved stock and intensive cultural practices (26).

The subject of this thesis involves eastern cottonwood plantation culture on one of the seven soils originally selected for study by Strine (50). The soil on which this study was carried out was Oklared very find sandy loam.[1] The overall object of the project was to investigate the effects of agroforestry, specifically agricultural intercropping, on a juvenile cottonwood stand. The rationale for initiating the study was that intercropping the areas between rows of trees with high quality forage crops could provide a landowner with a means for an annual financial return, thereby reducing the investment involved in plantation establishment. This report will deal specifically with the evaluation of the seasonal effects of several combinations of intercropped species and cultural treatments on the nutritional status of three clones of cottonwood.

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[1]Soil Series, Oklared very find sandy loam; Family, Coarse-loamy, mixed. calcareous, thermic; Sub-Group, Typic udifluvent; Association, Severn-Oklared-Gallion (45).

CHAPTER II

LITERATURE REVIEW

Agroforestry

Agroforestry, in the sense of agricultural intercropping, is simply a multiple cropping system that provides for the production of agricultural crops and trees on the same site (48). If applied properly, agroforestry can be both a productive and ecologically sound system of food, forage, and timber production in which timber and agricultural crops coexist, benefitting each other (48). From the standpoint of timber production the crops provide weed control in the plantation and a source of annual income to help offset the cost of plantation establishment, maintenance, and protection (39, 48). From the standpoint of crop production, research shows that trees play an important role in recycling nutrients and improving microclimates for crop growth (39, 50). Agroforestry, in short, is an intensive management system that combines two traditional land practices into one to allow the landowner to obtain maximum use of the land return an annual or periodic income.

Agroforestry has been practiced extensively for centuries in European and African countries (7, 20, 28, 39, 47), but has never gained much momentum in the United States, possibly due to the large amount of land available for agricultural production and the success of modern monocropping and mechanized farming in the states (48). Forestry and agriculture, instead of coexisting as in Europe and Asia, have historically been competing for acreage in the United States. A typical example of this competition in the southern United States involves two crops, cottonwood and soybeans (15). Instead of culturing the two crops together on the same land, and thereby deriving mutual benefits for each crop, the land generally has been utilized for the exclusive production of the agronomic crop (48).

Integrating trees on land that has traditionally been used for agricultural production can be accomplished in five ways:

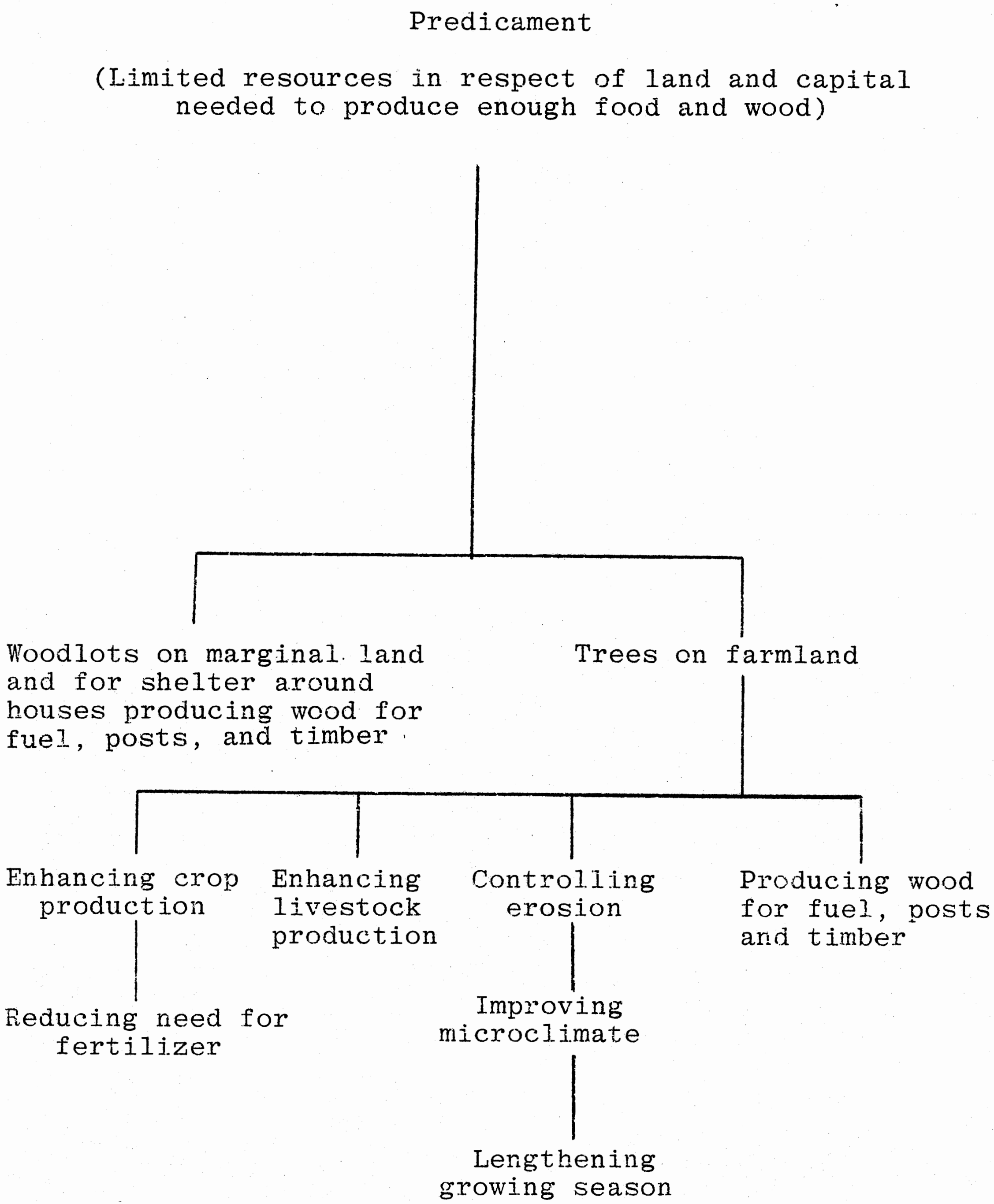
1. Planting trees on land that frequently floods and therefore is not well suited for crops.
2. Planting trees along fields, roads, and ditches and using them as a windbreak.
3. Planting trees on range or pasture land.
4. Having a total replacement of crops with trees.
5. Intercropping under the trees on the same site (39).

The emphasis of this report is on the intercropping aspect of agroforestry.

There is a great potential in the United States for increasing our timber production through the use of agroforestry techniques. The greatest potential benefits to be gained from agroforestry practices lie with the small private landowners, whose ownerships commonly consist of a limited land base (25, 39). Under an agroforestry system, an option open to the landowner is the use of a two-pronged land managment approach emphasizing woodlots on the marginal, less productive sites and intercropping on the better sites (39). This approach would allow increased production of fuel, fiber, posts, and timber as well as the production of food and forage (38, 39). European researchers have shown that intercropping can work and that in the first four years of a plantation, there are no significant differences in the way trees responded to clean-tilled treatments and intercropped treatments (38). In fact, intercropped plantations showed slightly better economic results than plantations tilled annually (38). The interrelationships described, along with potential benefits, are illustrated in Figure 2.

Currently in the southern United States farmers are using an agroforestry approach by combining plantations of walnut and pecan trees on land also being used for the production of soybeans, corn, and forage (48). This intensive management of the land allows the owner both an annual income from the crops and nuts and a periodic return from the timber provided by the mature trees.

Prior to the initiation of research to investigate the effects of agroforestry practices with cottonwood in Oklahoma, Strine (50) evaluated selected alluvial soils along the Red River in southern Oklahoma as potential sites for cottonwood



Source: Poulsen (39)

Figure 2. The Agroforestry Solution: Two Pronged Attack on the Small Landholders Predicament

plantations. He found that on selected sites, acceptable survival rates were obtained by combining intensive cultural practices and improved genetic planting stock.

Following this work, Prewitt (40) conducted studies to determine the feasibility of intercropping forage crops (oats, or rye-vetch) between rows of trees in cottonwood plantations. He found that winter cropping seemed to have little adverse effect on soil moisture, height growth of the trees, or survival rates. However, trees in the intercropped plots exhibited significantly lower levels of foliar nitrogen, indicating notable competition for this nutrient between trees and crops. Summer intercropping resulted in considerable tree mortality due to competition for available soil moisture. Prewitt recommended that further investigations be conducted regarding tree-crop nutrient interrelations on those sites where agroforestry was to be practiced.

Nutrient Surveying

A well-accepted practice of surveying the nutrient relationships of both soil and plant material is through the use of chemical analysis. Several researchers have done work in soil and plant analysis allowing them to establish critical concentration levels of various nutrients for a wide range of soil types and plants (2, 19, 23, 24, 27). A critical concentration is defined as that concentration of a given nutrient within a specified plant part or soil at which plant growth begins to decline (54). By comparison to these standardized values, it then becomes possible to determine if a plant or soil of interest is in a stressed condition.

There are many divergent ideas about sampling plants and soil for their nutrient status. However, researchers involved in this field seem to agree that there are two overlying concerns that must be considered, the first being that samples be carefully evaluated to avoid erroneous conclusions based on a faulty sampling scheme, and secondly that the sampling scheme must combine both a soil and plant analysis to give an overall view of the site and plant potential (61).

Chemical analysis of plant parts for a nutrient inventory can be a valuable tool as an indicator of plant stress (21). In trees, both foliage and stemwood have shown potential for use in assessing nutrient levels (30, 42). Theoretically, a leaf should be the best reflection of the current nutrient status of a tree, because it is one of the most rapidly expanding and physiologically active organs during the growing season (21, 30). The ability of the leaf to accumulate nutrients is governed by both the capacity of the site to supply nutrients and the condition of the environment surrounding the leaf. Thus, the leaf is the first organ to respond as site and environmental conditions change throughout the growing season (21). While a variety of foliar sampling techniques have been used in the past to survey plant nutrients, there is no standardized procedure which has the agreement of all researchers. This is probably due to the fact that any sampling scheme should be based on the particular morphology, taxonomy, and general growth behavior of the species being tested (31). However, if foliar analysis is to be used as a diagnostic tool, it is essential that a systematic field sampling scheme be developed to allow for a consistent and accurate survey with minimal sampling errors (1, 4, 61). Nine essential items that must be considered when designing a sampling scheme are:

1. The number of leaves sampled.
2. The part of the leaf sampled.
3. The level of the crown sampled.
4. The crown class of the tree sampled.
5. The season of the year samples are taken.
6. Physiological factors, such as seed production.
7. Extent of disease and insect damage.
8. Potential environmental concerns, such as drought and periods of flooding.
9. Soil factors, such as soil moisture and nutrient availability (16).

When designing a sampling system, the first thing to consider is the amount of foliage to be sampled. It is essential that enough foliage be obtained to estimate the within-tree variation for the nutrient being analyzed. This amount of material will vary for different species of trees, but from 10 to 25 leaves should be adequate for most (5, 16). However, before starting the main study a small one should be conducted to insure that enough dried material will be present to perform the analysis.

The part of the foliage being sampled can also have a great effect on the outcome of the final analysis. Auchmoody (4) has shown that the nutrient content of petioles and blades are often so different for many plants that either one or the other part should be used in the final analysis. If the two parts are combined, sample variation could occur. Concentration levels in the blade have been shown to be more responsive to external nutrient supplies and cultural practices than the petiole and whole leaf. This makes blade analysis a more accurate measure of the nutritional status (4).

Guha and Mitchell (23) suggest that one of the basic problems with foliar sampling and subsequent analysis is that the leaves change in size throughout the growing season. This affects their oven-dried weight and causes fluctuations in nutrient concentrations (24). To avoid this problem, leaves of the same physiological age only should be sampled (36). Studies have shown that recently matured leaves are the most active in the sink-source relationship, and that this activity decreases with age (52, 57). Therefore, the recently matured leaves should be sampled, if peak demands are of interest.

The leaf plastichron age (LPA) index is one method used to identify recently matured leaves (17, 33). The logic used in developing an LPA index for a species is that if leaves are initiated at a uniform rate and morphogenesis is a continuum, then it should be possible to relate some measure of morphogenesis to anatomical, physiological, and biochemical events in a leaf (17, 33). Thus LPA is a numerical indexing system which relates morphological development directly to time, allowing leaves of a known physiological age to be identified throughout the growing season.

When considering the crown position of the foliage to be sampled, it is important to understand that differences in nutrient composition can be encountered at different crown levels (5). Therefore, it is important not to combine samples from both the upper and lower crown for one analysis. Research has shown that while cardinal direction for determination of samples is not in itself critical, nonetheless sampling should be conducted in a consistent fashion with respect to direction (5).

The dominant and codominant trees of a stand should be the only trees sampled in any study (60). Suppressed trees should be avoided because they tend to accumulate abnormal levels of nutrients and are not representative of the requirements of the dominant trees (60).

If one is interested only in determining the period of the peak nutrient accumulation, then samples should be taken late in the growing season (16). Sampling of confiers is recommended between September 15 and December 15, and during August for deciduous trees (16). If seasonal trends are of interest, then sampling should be carried out periodically throughout the active growing season (60).

Sampling during periods of seed production shoud be avoided due to abnormal allocation of nutrients by the tree. For the same reason, trees that show stress from disease and/or insects should also be avoided in a sampling scheme (5). In addition, periods of prolonged drought or flooding can also markedly affect the levels of nutrients in the foliage. Finally, the soil conditions under which the trees are growing should always be a major consideration when interpreting the results from a foliar nutrient survey (16).

CHAPTER III

OBJECTIVE OF THE STUDY

The objective of the study was to investigate the response of various clones of eastern cottonwood when intercropped with agricultural forage crops. The foliar nutritional status of the trees was used as an indicator of a stressed condition due to intercropping as compared to clean-tilled control plots.

In order to evaluate the seasonal effects of the cultural combinations on the nutritional status of the trees, a systematic sampling scheme was designed, utilizing two crown levels in the tree and foliage of known physiological age. Subsequent analysis of the foliar samples for nitrogen, phosphorus, potassium, calcium, magnesium, iron, manganese, and zinc provided data that was the basis for comparisons between the effects of intercropping and clean-tilling on the seasonal nutrient accumulation patterns by the trees. These comparisons, in combination with seasonal soil moisture measurements and soil nutrient measurements, were then used in drawing conclusions about the effects of agricultural intercropping on a cottonwood plantation.

CHAPTER IV

METHODS

The experimental site was located in southeastern Oklahoma on an alluvial Oklared very fine sandy loam in a four-year-old plantation of cottonwood (*Populus deltoides* var. deltoides Bartr.) that had a continuous history of intercropping. Three different clones of cottonwood and six cultural treatments were utilized in the experiment. The clones were United States Forest Service clones 66, 92, and 109, planted on a 4.28 meter x 4.28 meter spacing. The six cultural treatments used were:

1. Intercropping with a fertilized rye-vetch winter crop.
2. Intercropping with an unfertilized rye-vetch winter crop.
3. Intercropping with a fertilized oats winter crop.
4. Intercropping with an unfertilized oats winter crop.
5. Fertilized clean-tilling.
6. Unfertilized clean-tilling.

Each treatment was randomly assigned to two plots in the plantation and all three clones were represented on each plot (Figure 3).

OKLARED VERY FINE SANDY LOAM

TRT 5	TRT 3	TRT 1	TRT 6
TRT 1	TRT 3	TRT 5	TRT 2
TRT 2	TRT 4	TRT 6	TRT 4

Legend

Treatments

TRT 1 = Fertilized Clean-Tilled
TRT 2 = Unfertilized Clean-Tilled
TRT 3 = Fertilized Oats
TRT 4 = Unfertilized Oats
TRT 5 = Fertilized Rye-Vetch
TRT 6 = Unfertilized Rye-Vetch

Figure 3. Field Layout and Design of Treatments Applied in the Cottonwood Study

Prior to treatment application, intense soil sampling was carried out. Three cores were bored randomly in each plot and samples were extracted from 30 centimeter intervals to a depth of 120 centimeters. The three samples from each level were then mixed and a composite sample was used for analysis. A similar analysis was performed at the end of the study as well. The Oklahoma State Soil Testing Laboratory performed the soil analysis for soil texture, pH, NO_3-nitrogen, phosphorus, potassium, calcium, magnesium, iron, manganese, and zinc on each composite sample.

The agricultural crops were sown on October 10, 1980. The Elbon rye and Nora oats were sown by using a tractor mounted, p-t-o-powered, Cyclone seeder at a rate of 112 kilograms per hectare. The hairy vetch was sown at a rate of 22 kilograms per hectare with the use of a hand-operated Cyclone seeder after it was inoculated with Rhizobium spp. bacteria. A fertilizer with an analysis of 17-17-17 (N-P_2O_5-K_2O) was applied to the appropriate plots after seeding at a rate of 224 kilograms per hectare. An additional application of fertilizer of analysis 34-0-0 was applied April 10, 1981, approximately one month before crop harvest, at a rate of 224 kilograms per hectare.

On May 5, 1981, samples were taken within each intercropped plot to determine the amount of forage production. Three randomly located subsamples (60 centimeters by 90 centimeters) were taken from each plot and dried to calculate the dry weight production per hectare of each treatment. After the subsampling was completed, the crops were harvested, using a six-foot, tractor-pulled rotary mower, then raked off the plots to be used as forage. All the plots were maintained throughout the rest of the growing season by disking at the first of each month. The plots were disked in both directions with a six-foot tandem disk pulled by a 40-horsepower gasoline tractor.

Foliar sampling was done monthly from June through October over the 1981 growing season to assess the trends of seasonal nutrient accumulations. A 10.5-meter aluminum extension ladder mounted on the three-point hitch of a tractor was utilized in picking the samples. Two dominant or codominant trees of each clone were selected from each replication and used throughout the study for the foliar sampling and analyses. The leaves sampled were of a specific leaf plastchron age (LPA) after Dickmann (17). The first index leaf was designated as the first leaf to be two centimeters in lamina length, giving it an LPA of 0. Leaves were then progressively counted back from the apex to reach those leaves having an LPA of 9, 10, and 11 (index leaves 9, 10, and 11) for sampling. The sampled leaves were always obtained from the south side of the top one-third and bottom one-third of the crown, keeping the samples from each crown level separate at all times. Twelve leaves were picked from each crown level; the first three leaves from the top one-third of the crown always came from the terminal leader, while the rest of the leaves came from lateral branches. In summary, an upper and lower foliar sample consisting of 12 leaves was taken from two trees of each of the three clones on all 12 plots making a total of 144 samples per sampling period. The samples were then prepared for analysis by drying the leaves at 105° Centigrade for 12 hours and grinding them in a Willey Mill to pass through a 20-mesh screen.

Analysis of the foliar samples for nitrogen was done by the modified macro-Kjeldhal method (10); phosphorus by the colormetric blue method (37) (Appendix B); and potassium, calcium, magnesium, iron, and zinc by atomic absorption spectrophotometry (9, 41, 42) (Appendix B). A Brinkmann PC 800 colorimeter was used in the phosphorus determination and a Perkin-Elmer 403 Flame spectrophotometer was used in the analysis of the metals. All samples run on the spectrophotometers were prepared by using a 3-to-1 nitric perchloric acid digestion.

Soil moisture was also monitored throughout the growing season. At 8-to-10-day intervals, soil cores were extracted on each plot and samples were taken at 5-centimeter intervals to a depth of 120 centimeters and placed in soil cans. The soil was then weighed wet, dried at 105° Centigrade for 8 to 10 hours, and reweighted so that the percent moisture content could be calculated and recorded.

Past history of grasshopper (*Romulea microptera*) infestations and problems with the cottonwood borer (*Plectrodera scalator*) in the plantation lead to a preventative measure of spraying the trees after each sampling period through

August. A 44-percent concentration of emulsifiable Sevimol[R] was sprayed at the rate of one-half ounce per gallon of water using a p-t-o-powered agricultural spraying unit.

An analysis of variance was used to compare the interaction of the crops and the trees. Analyses were performed on foliar nutrient levels by treatment, clone, and crown level in order to determine if there was a response to the cultural treatments applied. Results of the analysis producing an observed significance level of $\leq$ 0.05 were considered statistically significant.

CHAPTER V

RESULTS

Major Nutrient Analysis

Seasonal Trends in Nutrient Content

Trends for foliar concentrations of nitrogen, phosphorus, and potassium over the growing season are shown in Figures 4, 5, and 6, respectively. Results indicated that patterns for phosphorus and potassium were similar, showing a gradual increase through August, followed by a gradual decline through October. The pattern for nitrogen content differed from the other two elements. Foliar nitrogen concentrations were highest in June, decreased through July and August, rose slightly in September and then declined again in October. Nitrogen ranged in concentration from an average seasonal high of 2.61 percent of oven dry weight to a low of 2.32 percent. Phosphorus ranged from an average seasonal high of 0.40 percent of oven dry weight to a low of 0.32 percent. Potassium ranged from an average seasonal high of 1.14 percent of oven dry weight to a low of 0.99 percent. Mean values for nitrogen, phosphorus, and potassium by sample date are shown in Table V (Appendix A) and the results of the statistical

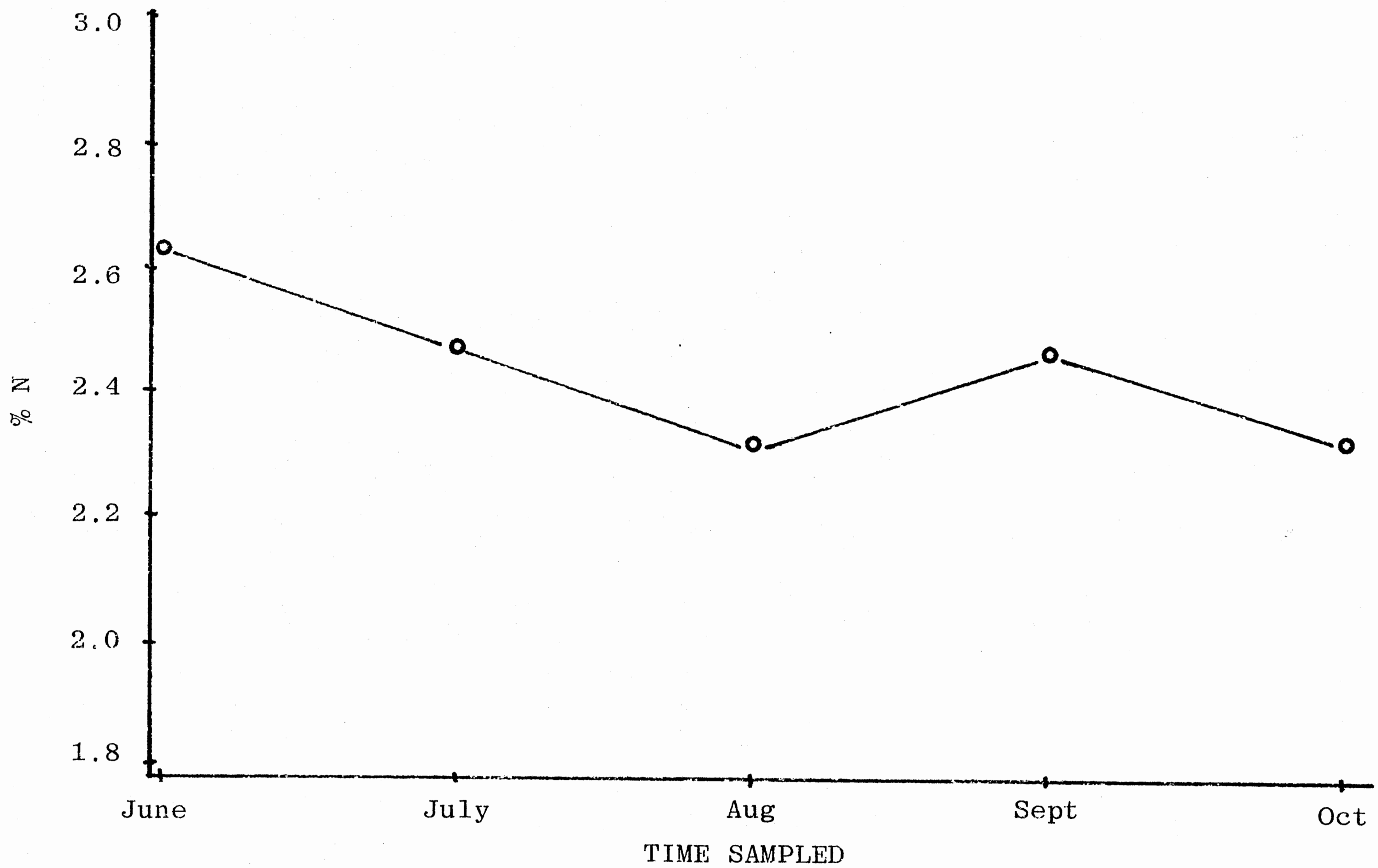


Figure 4. Seasonal Trend in Foliar Nitrogen Content for Pooled Cottonwood Clones

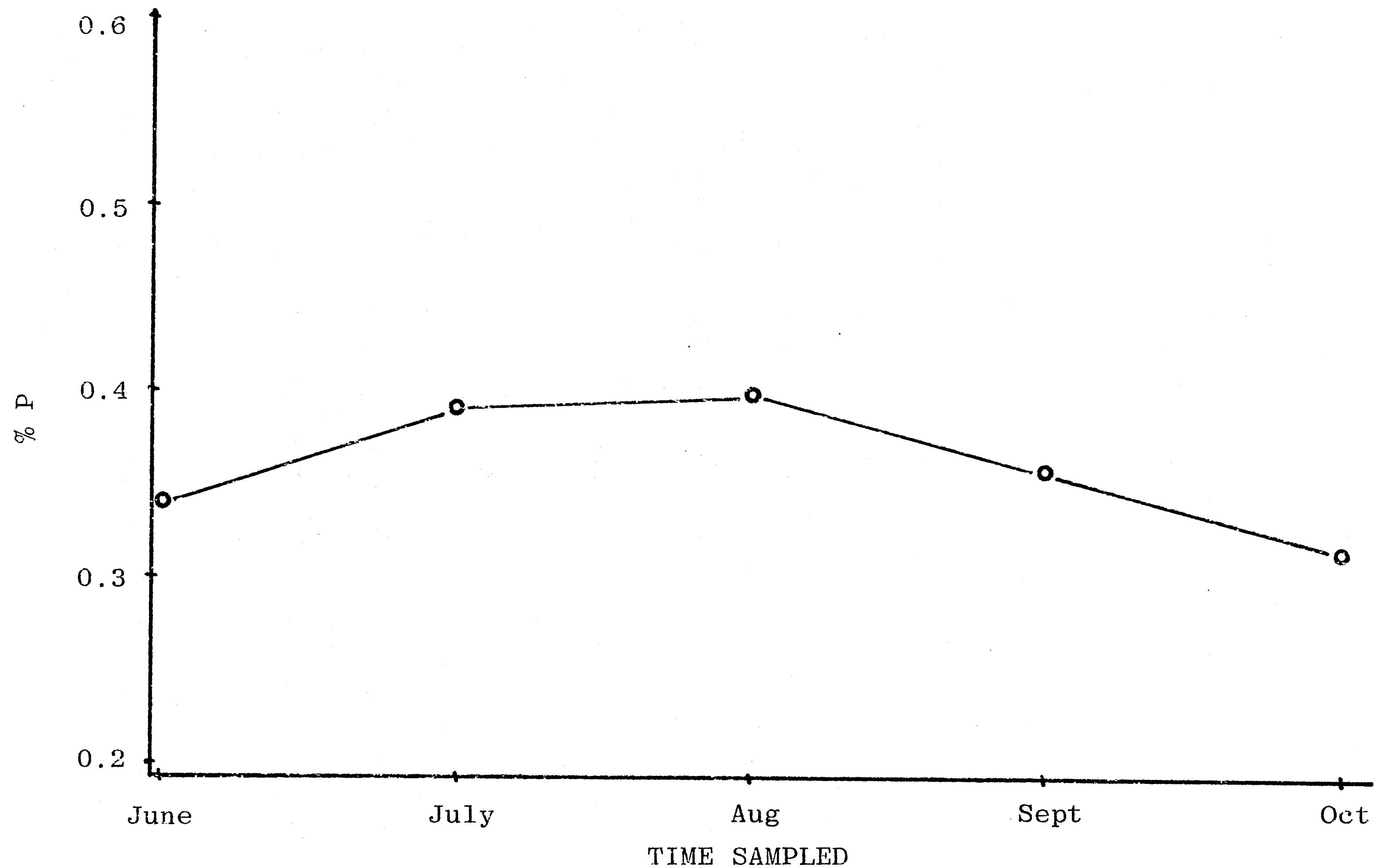


Figure 5. Seasonal Trend in Foliar Phosphorus Content for Pooled Cottonwood Clones

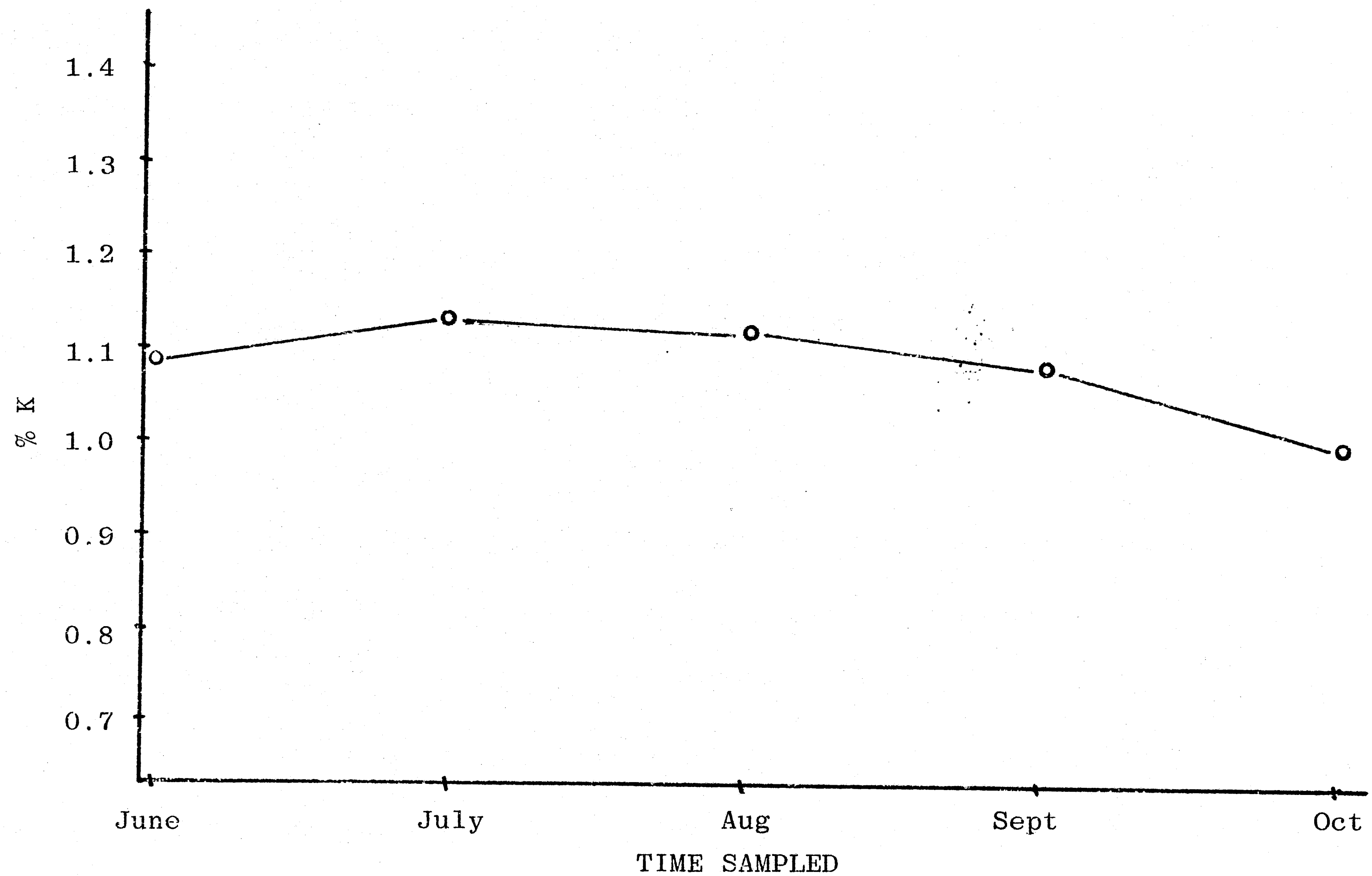


Figure 6. Seasonal Trend in Foliar Potassium Content for Pooled Cottonwood Clones

analysis for the three elements are shown in Tables VI, VIII, and VIII (Appendix A), respectively.

Clonal Differences in Nutrient Content

While significant differences were found between the three clones with respect to the absolute foliar concentration of nitrogen and phosphorus over the growing season, no clone consistently outranked the others over the entire growing season (Tables VI, VII, VIII, Appendix A). Although the magnitude of the concentration values differed significantly by clone for nitrogen and phosphorus, the seasonal concentration trends were similar, as illustrated in Figures 7 and 8, respectively. A significant difference was found betwen the three clones with respect to foliar concentration of potassium. In this case, clone 109 consistently out-performed clones 66 and 92 throughout the growing season as shown in Figure 9. Mean values by clone are shown in Table V (Appendix A).

Nutrient Content by Crown Level

Data analysis indicated that the differences in foliar nutrient concentration between crown positions were significant for nitrogen, phosphorus, and potassium (Tables VI, VII, and VIII, Appendix A). The samples obtained from the upper crown were consistently higher in foliar nutrient concentrations than those sampled from the lower crown for all three elements. Seasonal concentration patterns for nitrogen,

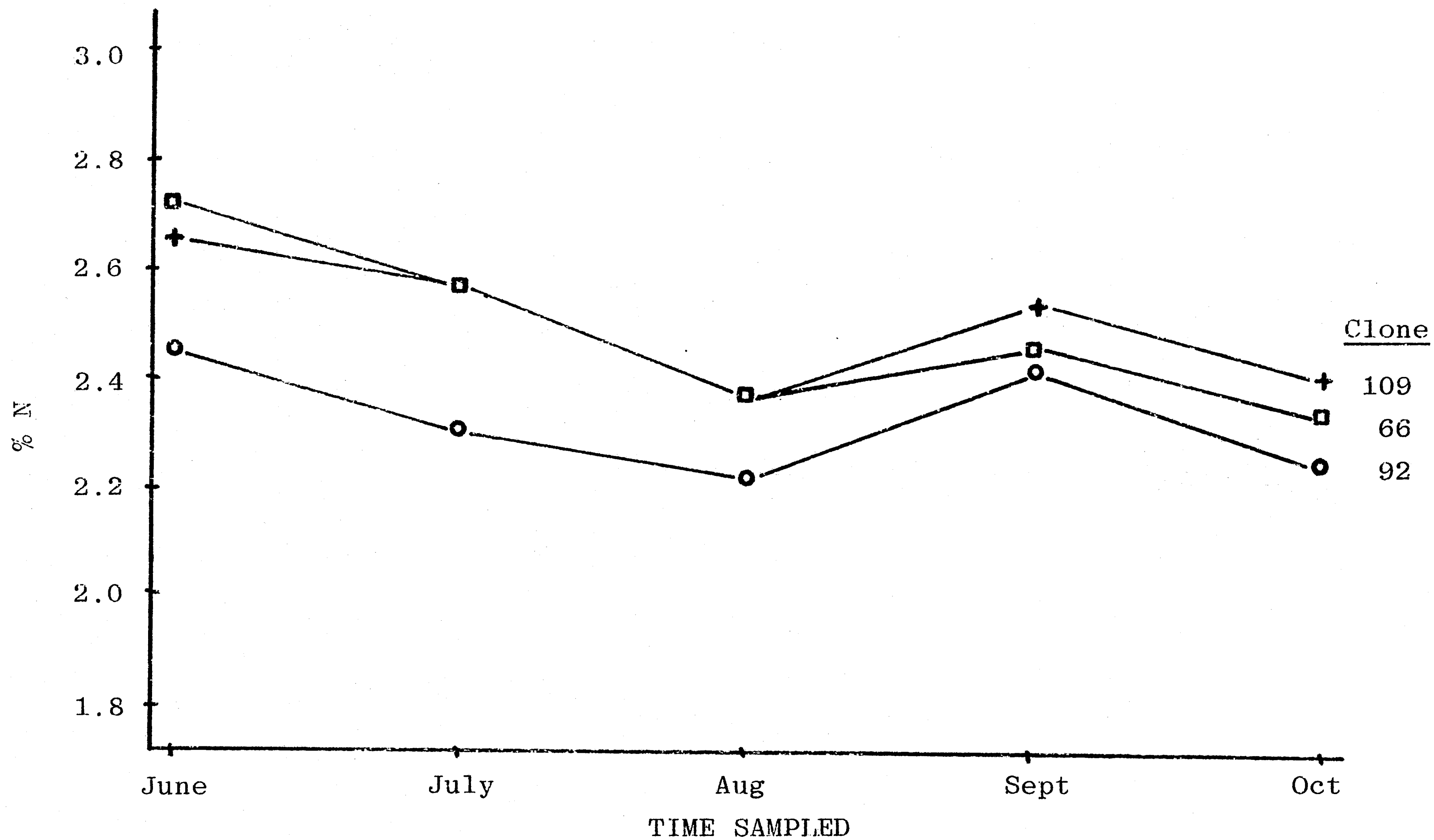


Figure 7. Clonal Foliar Content Trends for Nitrogen for Three Cottonwood Clones

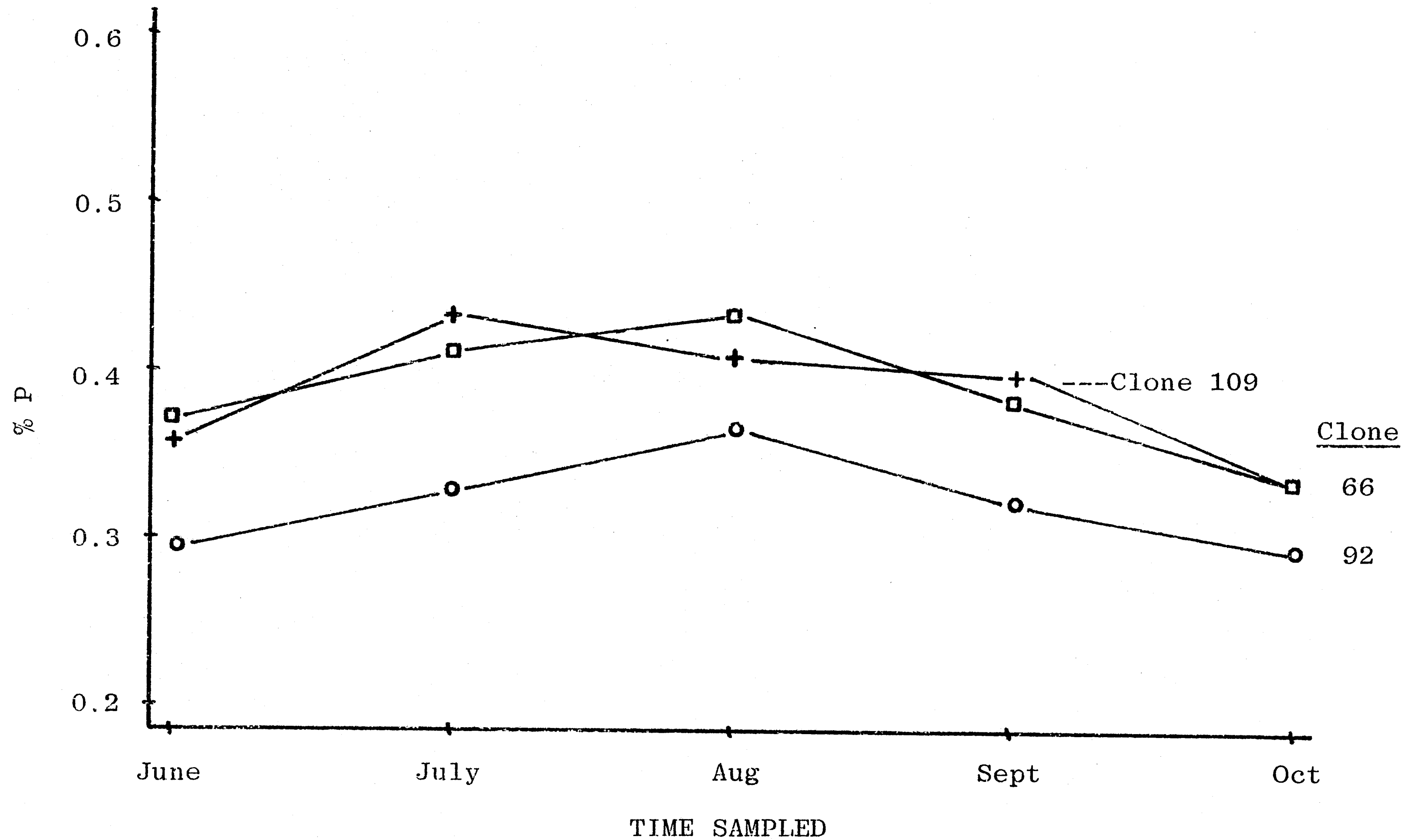


Figure 8. Clonal Foliar Content Trends for Phosphorus for Three Cottonwood Clones

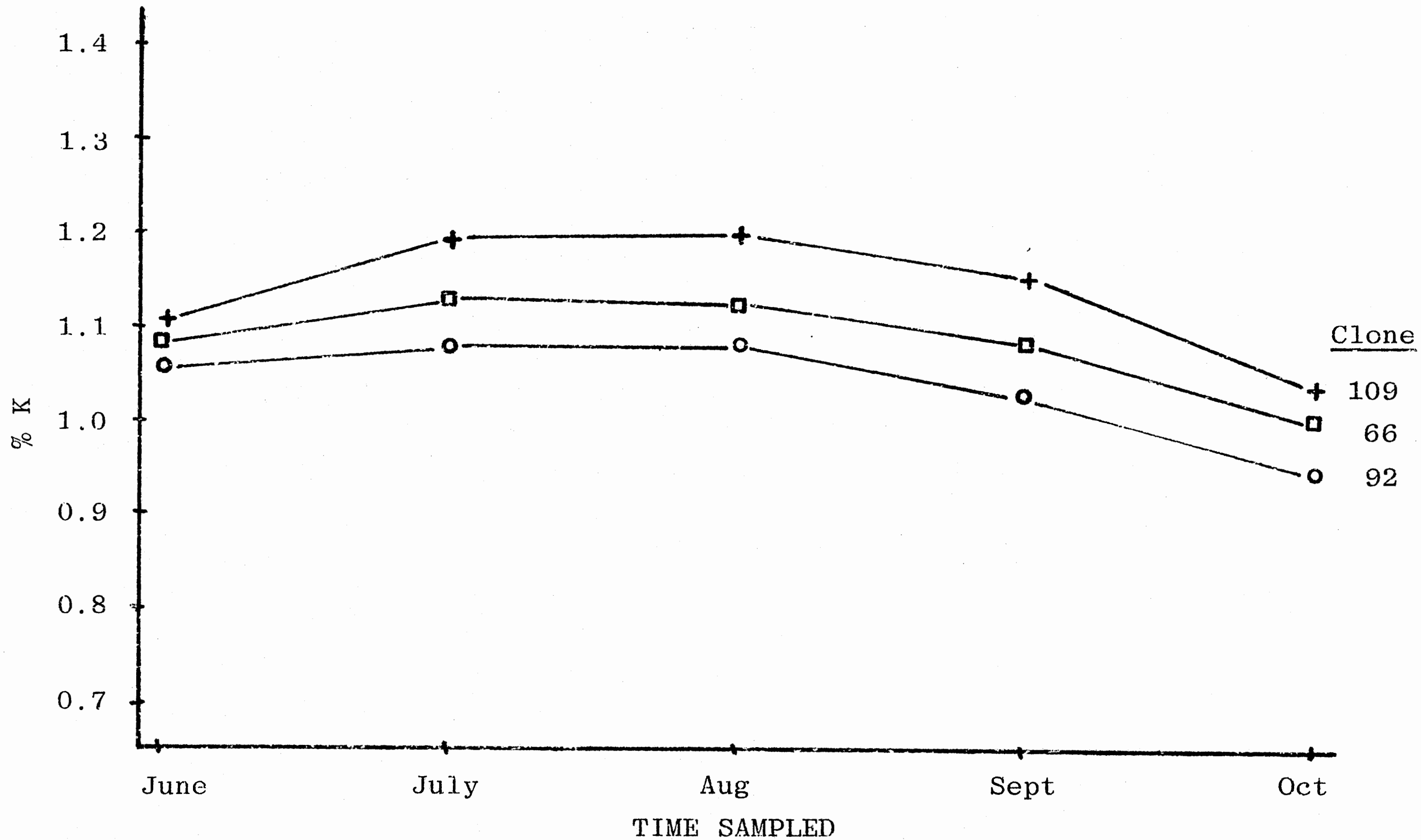


Figure 9. Clonal Foliar Content Trends for Potassium for Three Cottonwood Clones

phosphorus, and potasium were generally the same for both levels, as illustrated in Figures 10, 11, and 12. Mean values for nitrogen, phosphorus, and potassium by crown level are shown in Table V (Appendix A).

Cultural Effects on Nutrient Content

Statistical analysis of the cultural effects on foliar nutrient concentrations indicated that no significant differences existed between all six cultural treatments with respect to foliar concentrations of phosphorus and potassium (Tables VII and VIII, Appendix A), but nitrogen levels with respect to treatments, in Figure 13, were attributed to the fertilizer applications.

Secondary Nutrient Analysis

Seasonal Trends in Nutrient Content

Seasonal trends in nutrient content for calcium and magnesium are shown in Figures 14 and 15, respectively. Foliar concentrations of calcium showed a gradual increase through July and then a gradual decline through August, followed by a continued increase to the highest level in October. Magnesium concentrations, on the other hand, showed a continual increase throughout the growing season. Calcium ranged from an average seasonal high of 1.81 percent of oven dry weight to a low of 1.27 percent. Magnesium ranged from an average seasonal high of 0.49 percent of oven dry weight to a low of

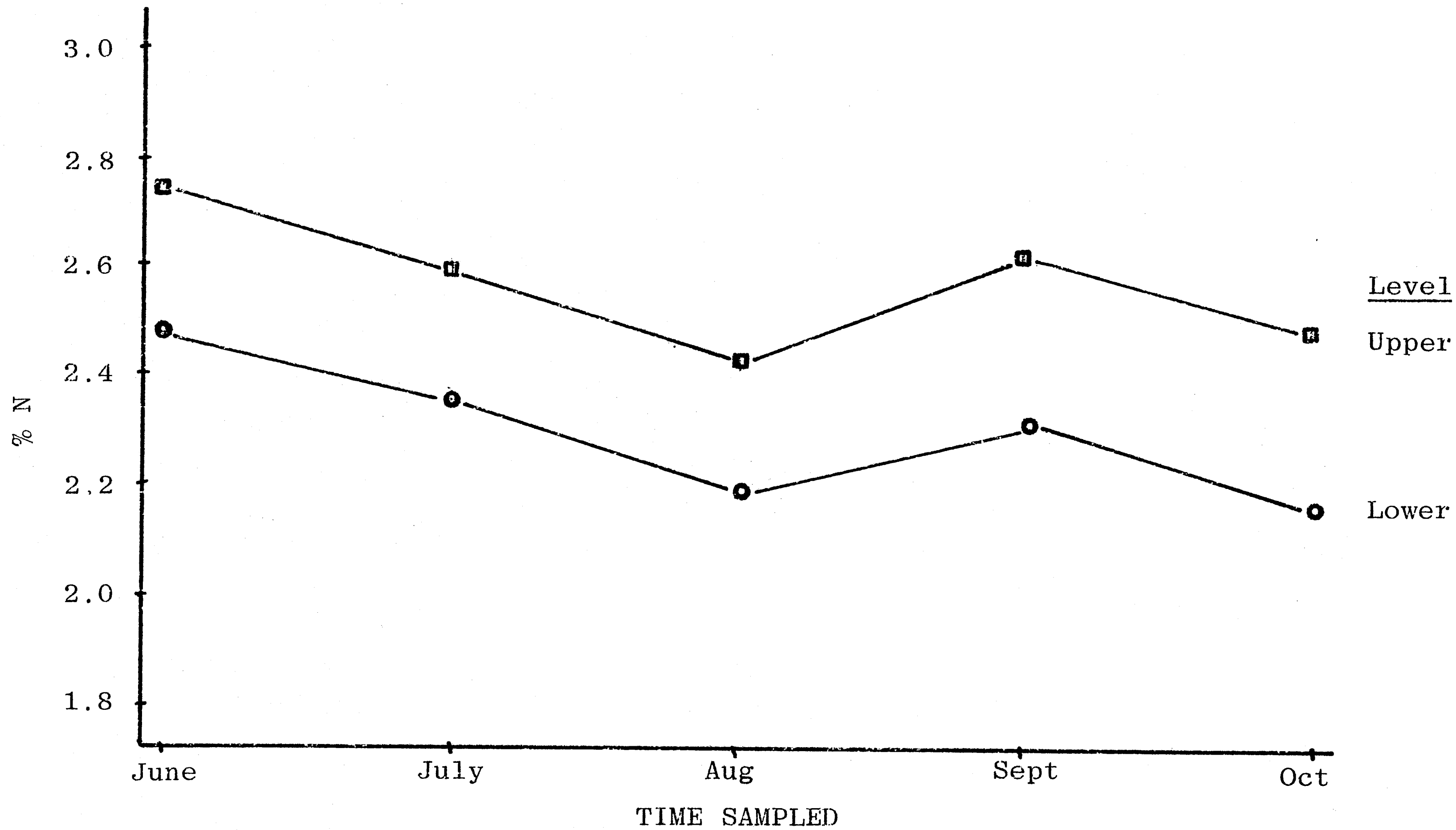


Figure 10. Crown Level Content Trends for Nitrogen for Pooled Cottonwood Clones

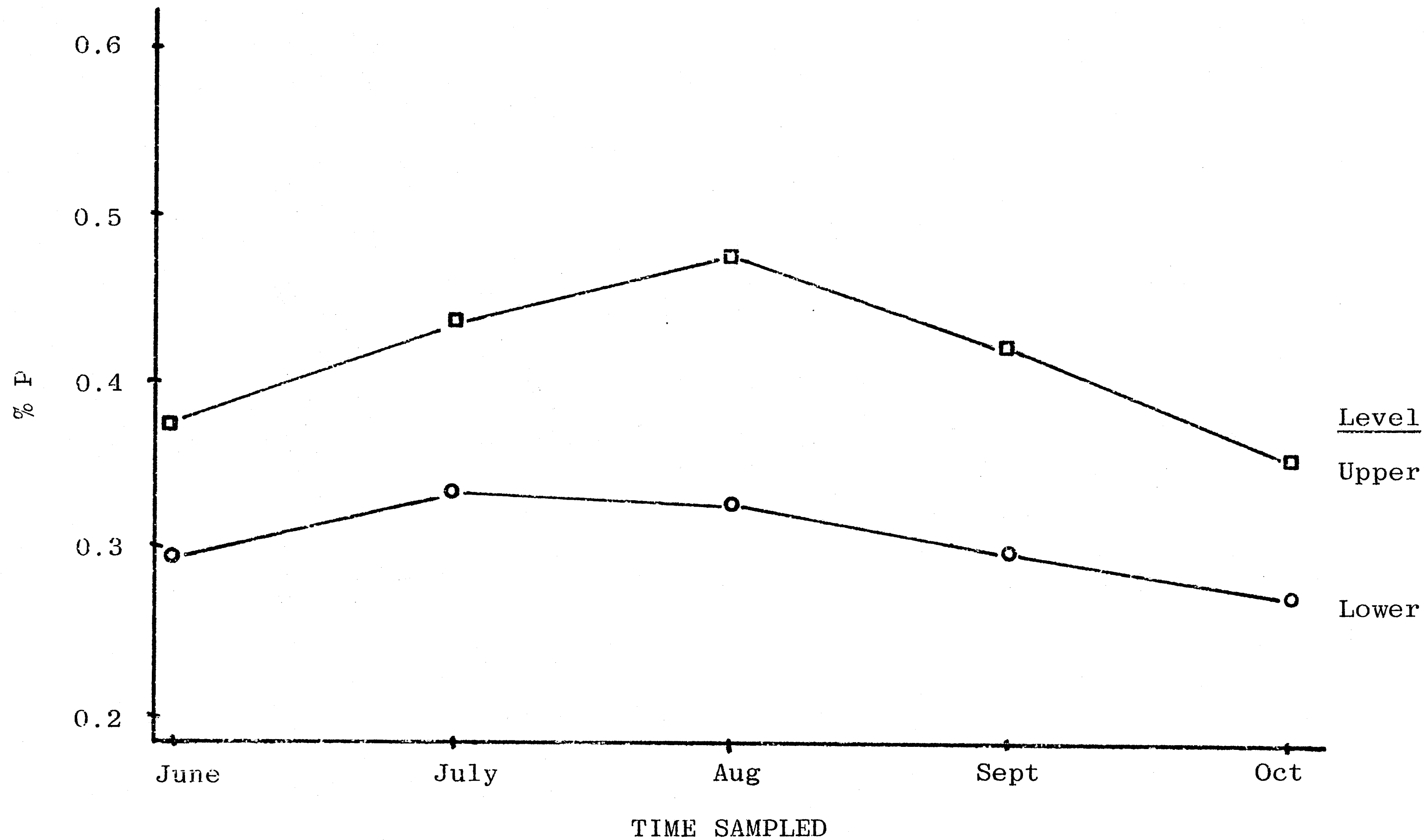


Figure 11. Crown Level Content Trends for Phosphorus for Pooled Cottonwood Clones

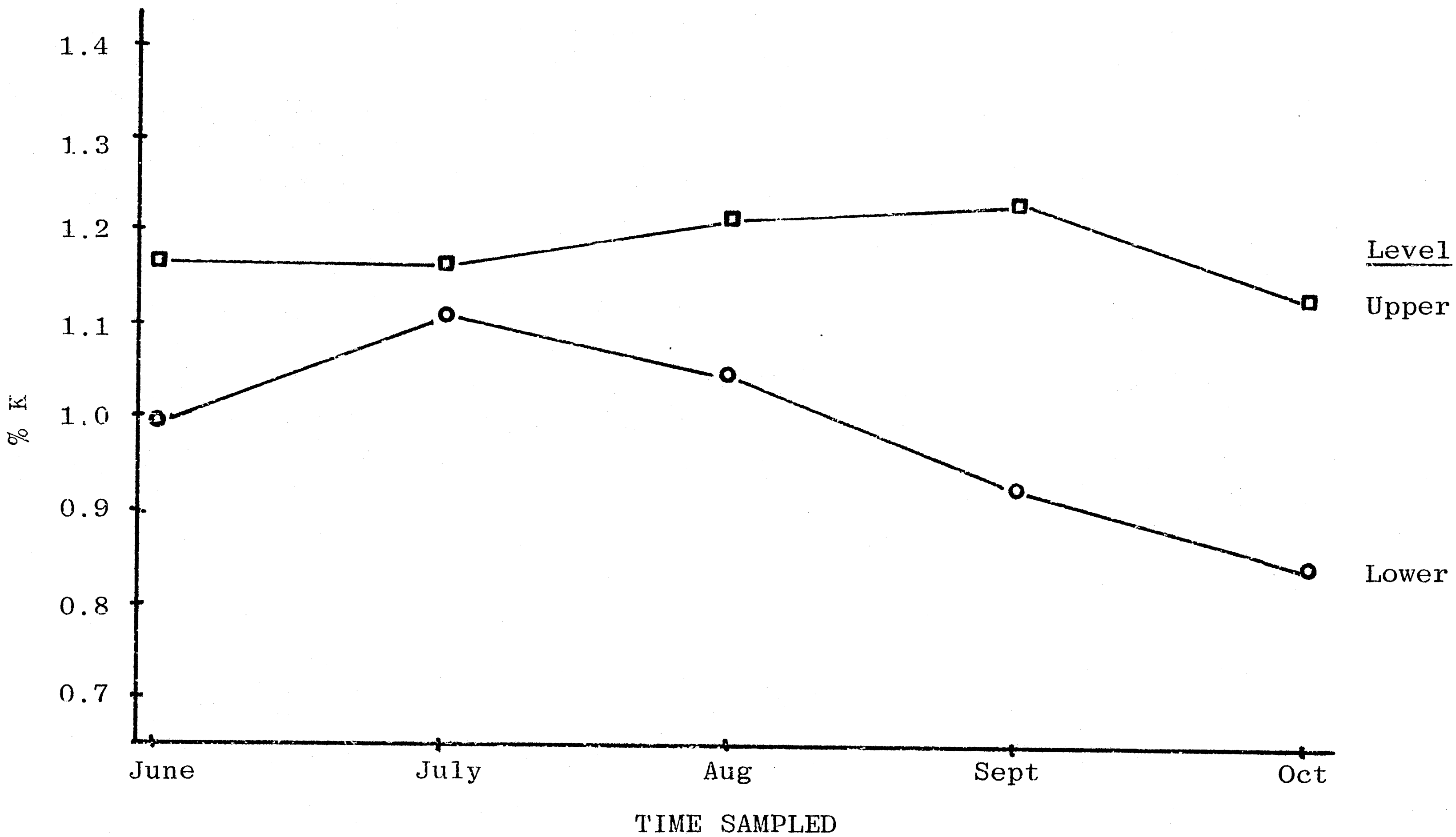


Figure 12. Crown Level Content Trends for Potassium for Pooled Cottonwood Clones

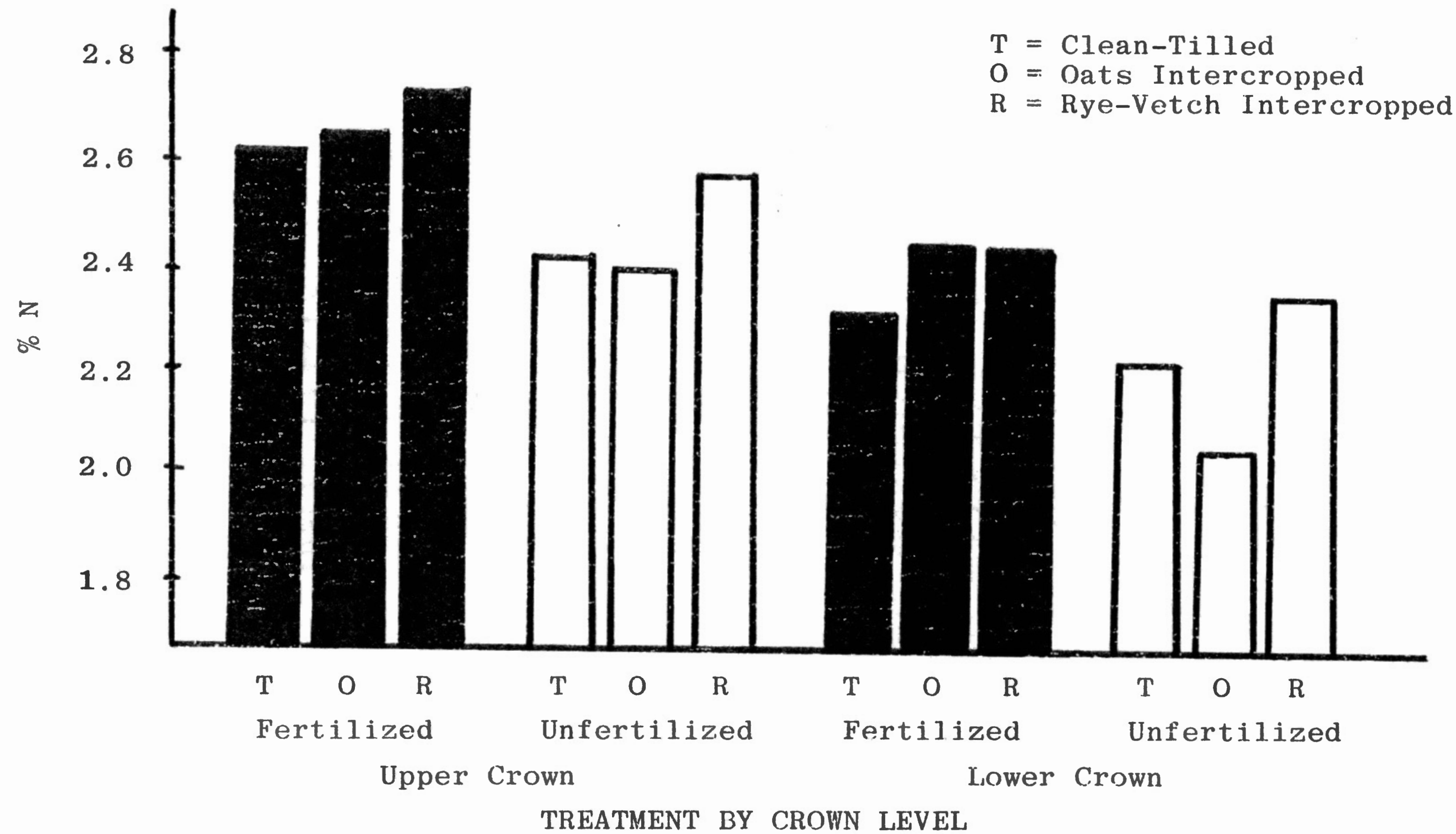


Figure 13. Percent Foliar Nitrogen for Fertilized and Unfertilized Treatments by Crown Level for Pooled Cottonwood Clones

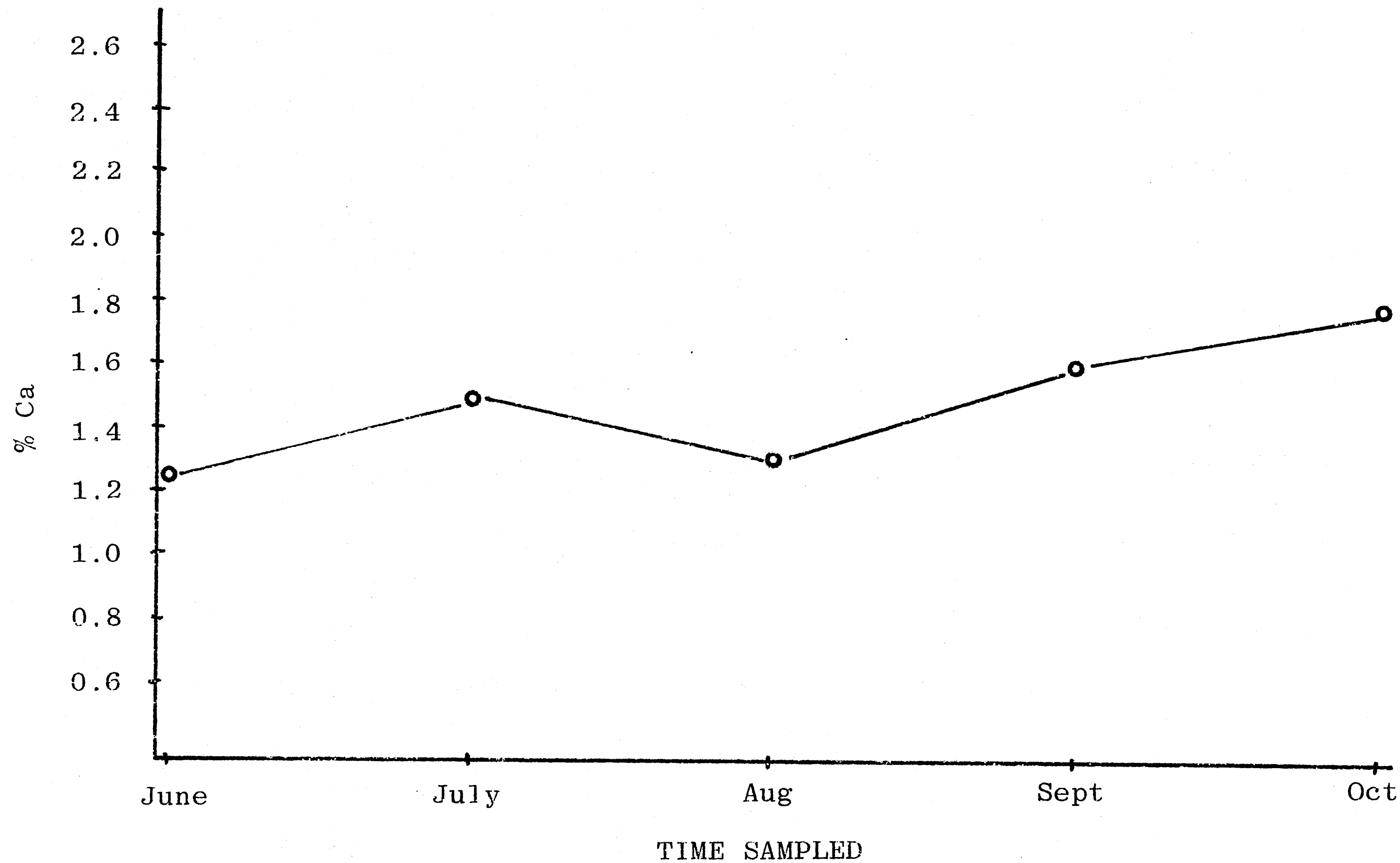


Figure 14. Seasonal Trend in Foliar Calcium Content for Pooled Cottonwood Clones

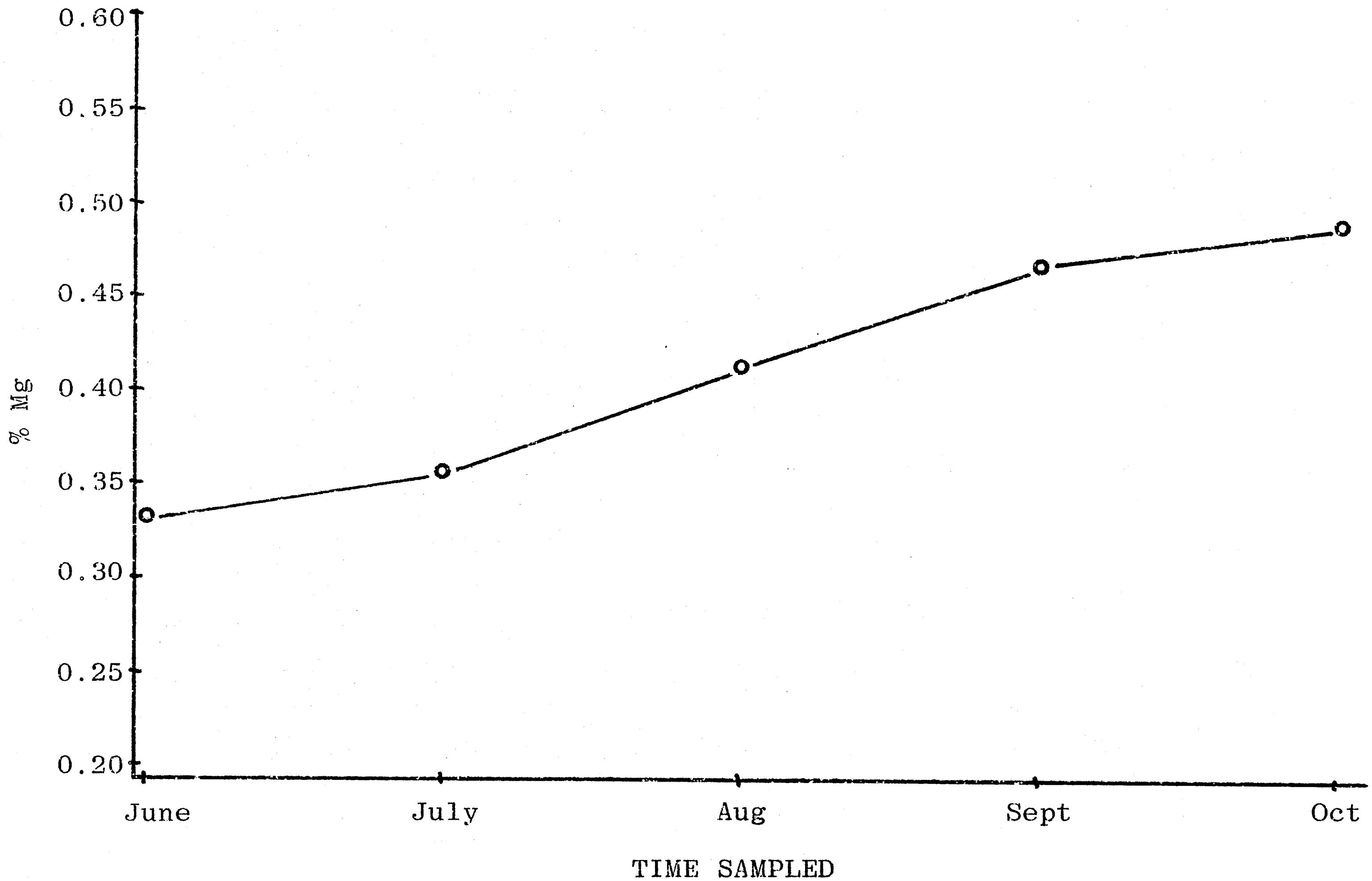


Figure 15. Seasonal Trend in Foliar Magnesium Content for Pooled Cottonwood Clones

0.33 percent. Statistical analysis of calcium and magnesium (Tables IX and X, Appendix A) indicated that there were no significant cultural effects on seasonal concentration levels.

Clonal Differences in Nutrient Content

No significant differences were found between clones with respect to absolute foliar content of calcium and magnesium (Tables IX and X, Appendix A) and no one clone out-performed the other over the entire growing season. Although accumulations by each clone differed throughout the season, accumulation patterns of calcium and magnesium were similar for all clones, as shown in Figures 16 and 17, respectively. Mean values for calcium and magnesium by clone are shown in Table V (Appendix A).

Nutrient Content by Crown Level

Data analysis indicated that the differences in nutrient accumulations between crown positions were significant for calcium and magnesium (Tables IX and X, Appendix A). Samples obtained from the upper crown were consistently lower in foliar nutrient concentrations than those sampled from the lower crown position for both calcium and magnesium. Both elements had similar seasonal accumulation patterns between crown levels, as shown in Figures 18 and 19. Mean values for calcium and magnesium by crown level are shown in Table V (Appendix A).

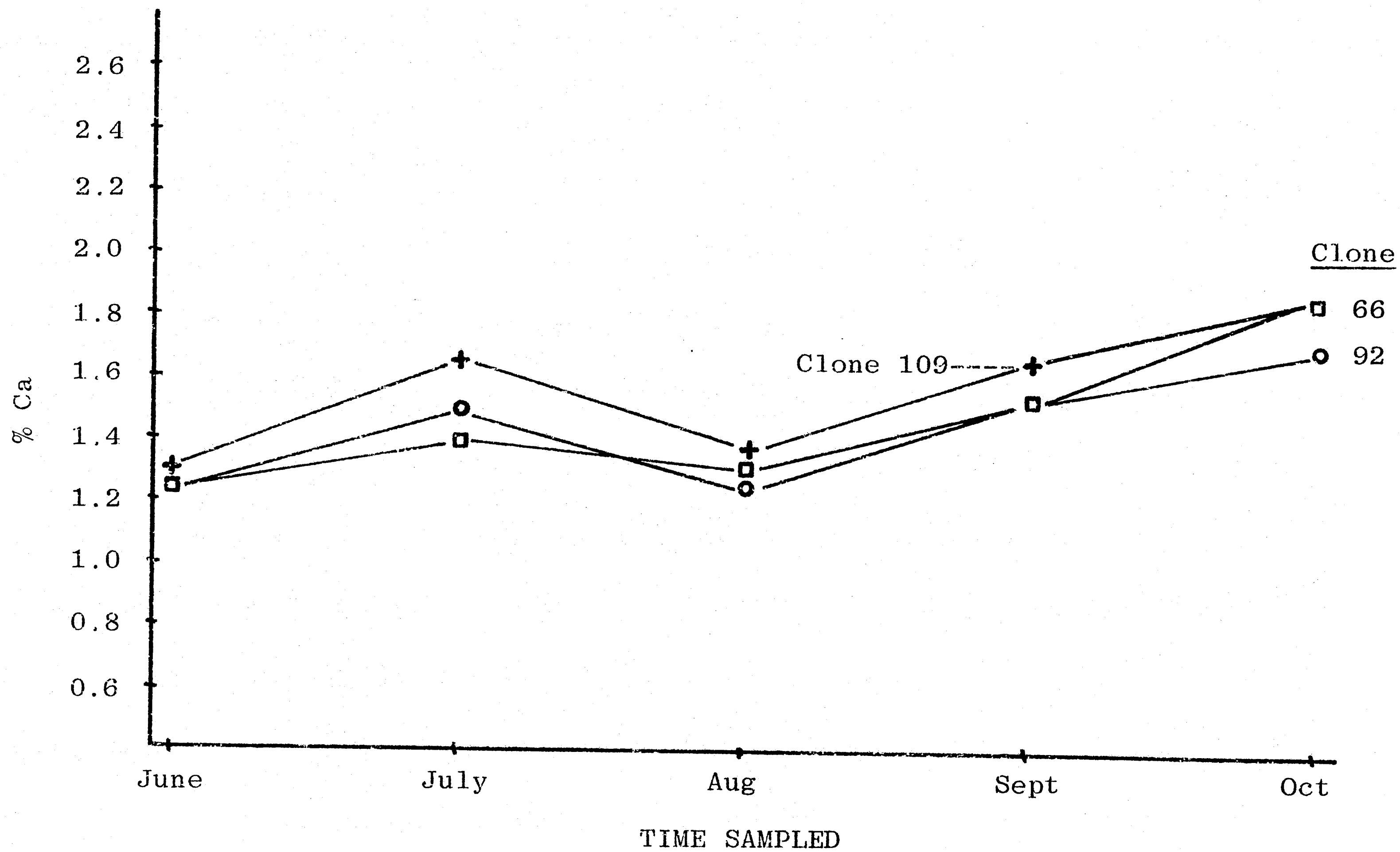


Figure 16. Clonal Foliar Content Trends for Calcium for Three Cottonwood Clones

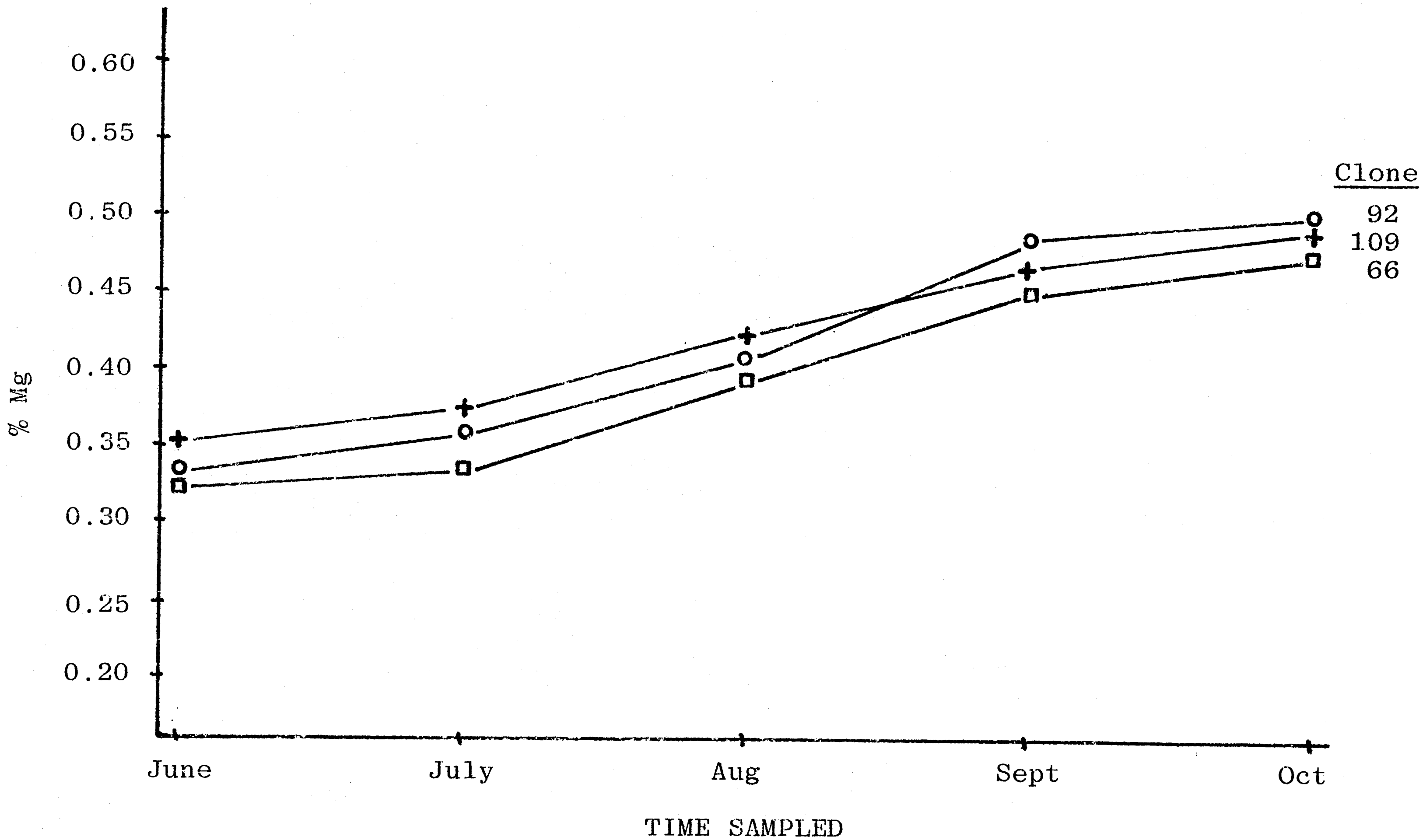


Figure 17. Clonal Foliar Content Trends for Magnesium for Threee Cottonwood Clones

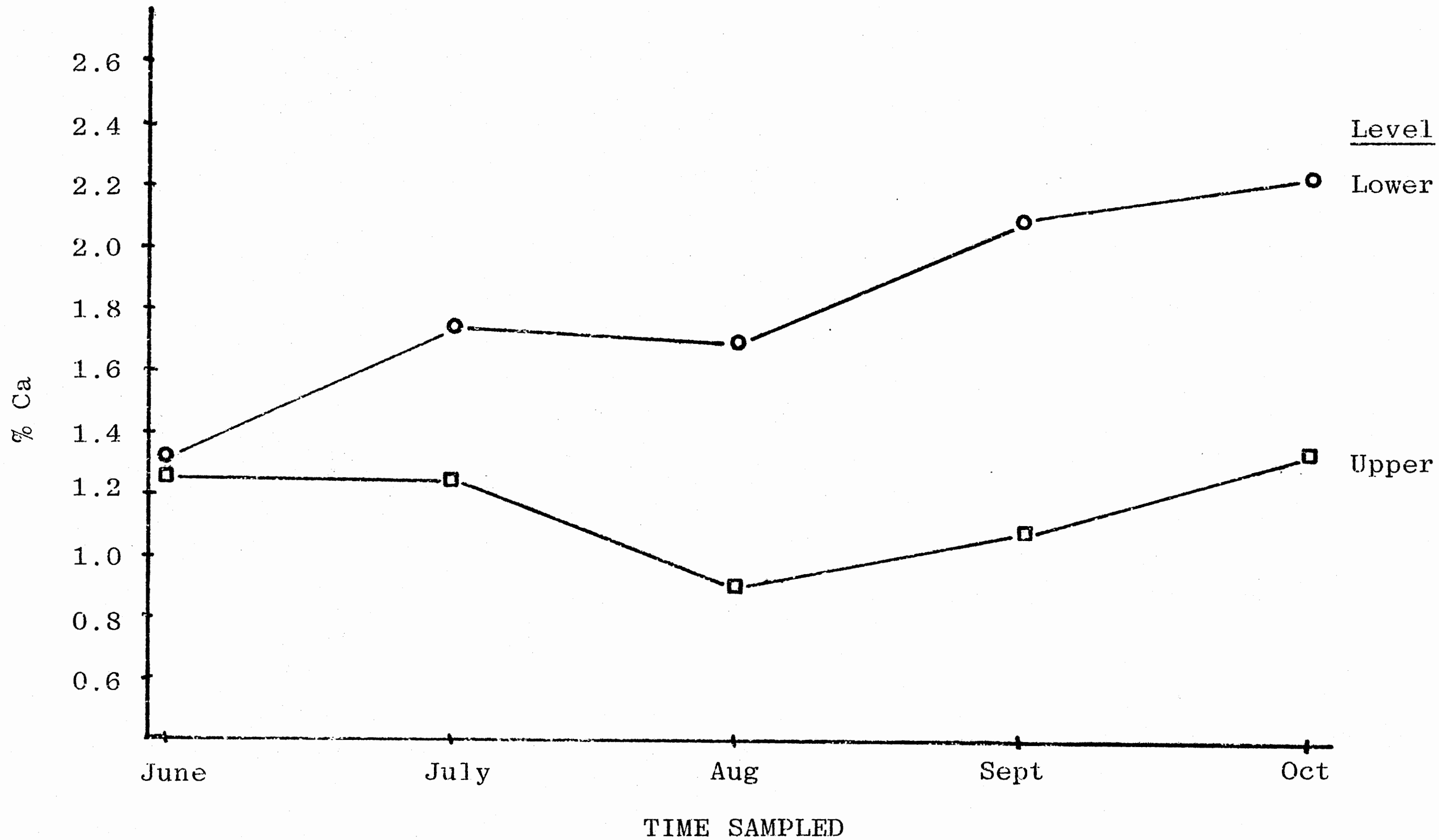


Figure 18. Crown Level Content Trends for Calcium for Pooled Cottonwood Clones

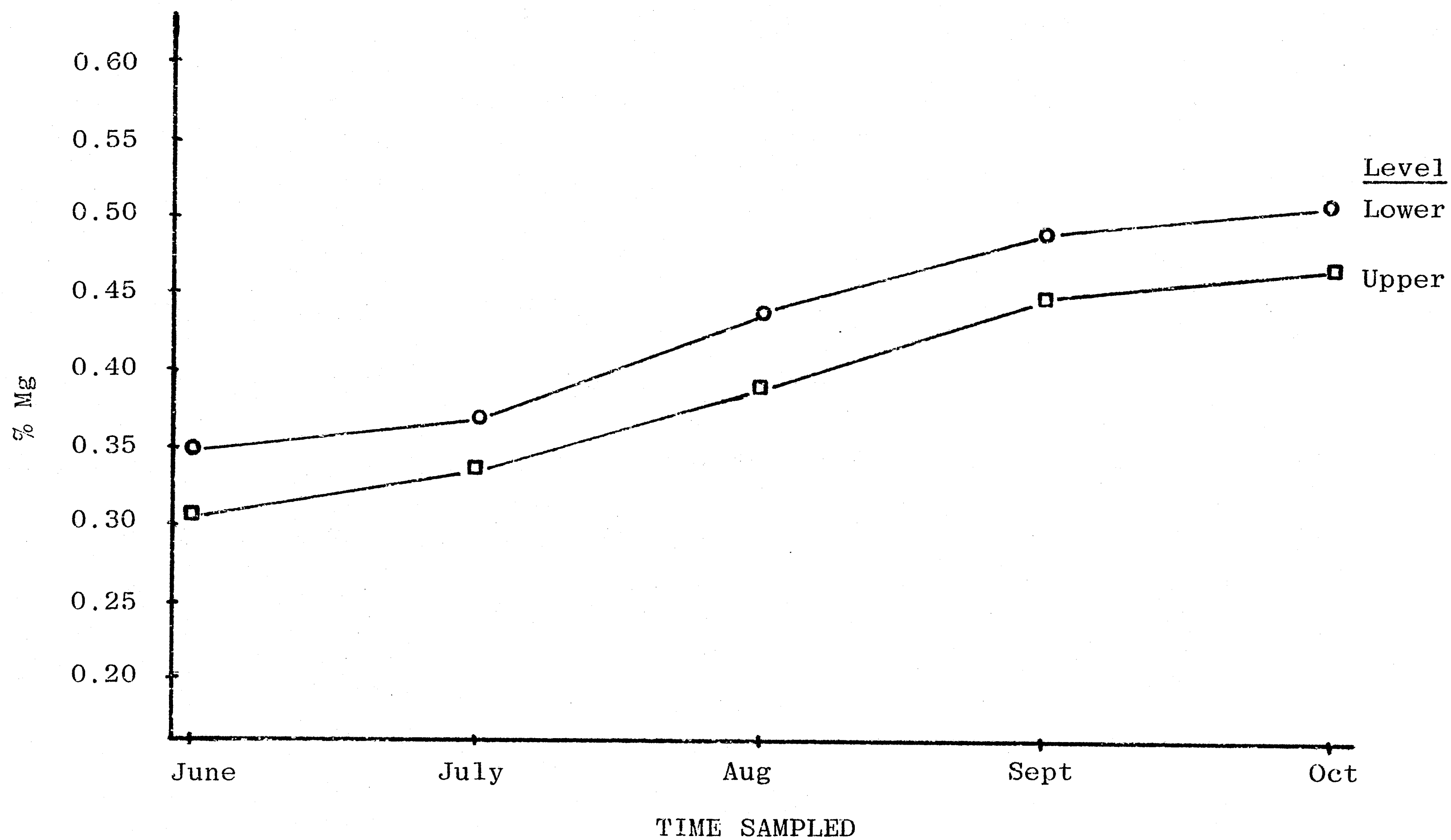


Figure 19. Crown Level Content Trends for Magnesium for Pooled Clones

Micronutrient Analysis

Seasonal Trends in Nutrient Content

The seasonal trends in foliar nutrient content for iron, zinc, and manganese are shown in Figures 20, 21, and 22, respectively. Iron concentrations showed an initial increase through July, then decreased gradually through September, followed by a sudden jump to the maximum value in October. Zinc, on the other hand, increased sharply from June to a peak level in July, followed by a gradual decrease through October. Manganese concentration reached a peak level in June, decreased through August, then gradually increased through September, followed by a final decrease through October. Statistical analysis (Table XI, XII, and XIII, Appendix A) indicated that there were no significant cultural effects on seasonal micronutrient patterns. The concentration of iron ranged from an average seasonal high of 128 ppm to a low of 73 ppm. The concentration of zinc ranged from an average seasonal high of 92 ppm to a low of 28 ppm. The concentration of manganese ranged from an average high of 69 ppm to a low of 38 ppm. Mean values for iron, zinc, and manganese by sample data are shown in Table V (Appendix A).

Clonal Differences in Nutrient Content

There were no significant clonal effects for either iron or zinc content (Tablex XI and XII, Appendix A). Even though seasonal trends were similar for each clone, no one clone

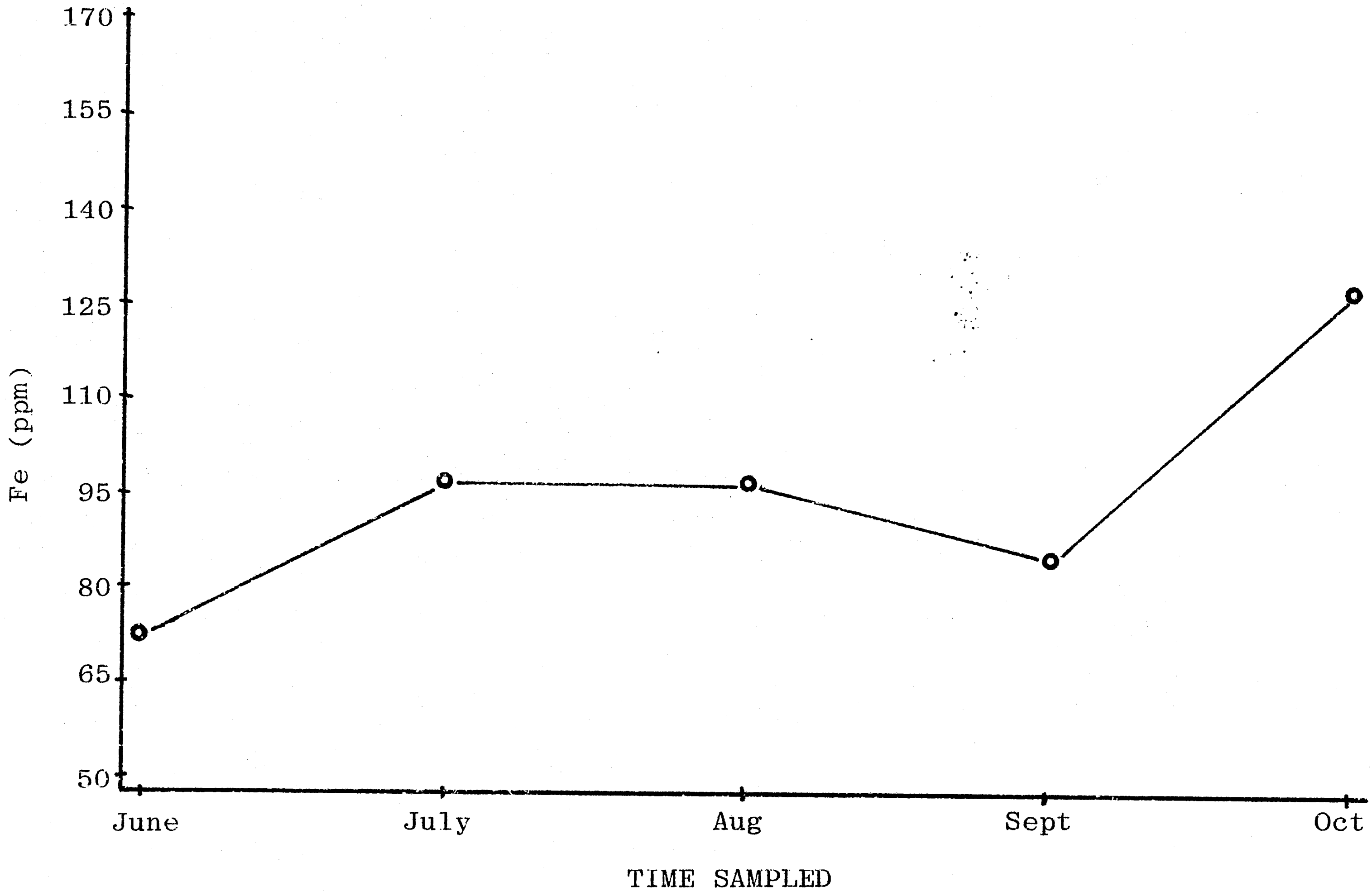


Figure 20. Seasonal Trend in Foliar Iron Content for Pooled Cottonwood Clones

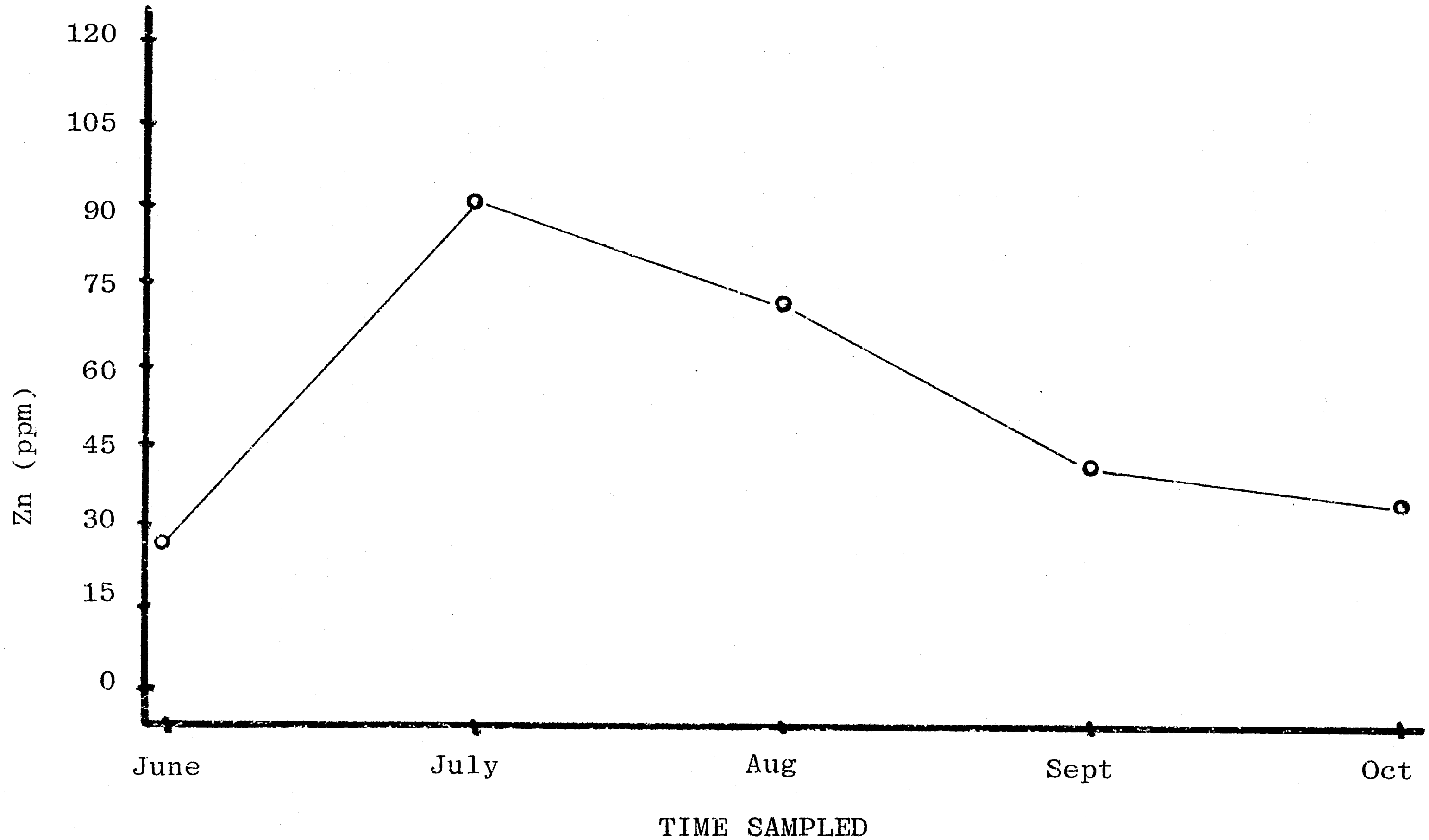


Figure 21. Seasonal Trend in Foliar Zinc Content for Pooled Cottonwood Clones

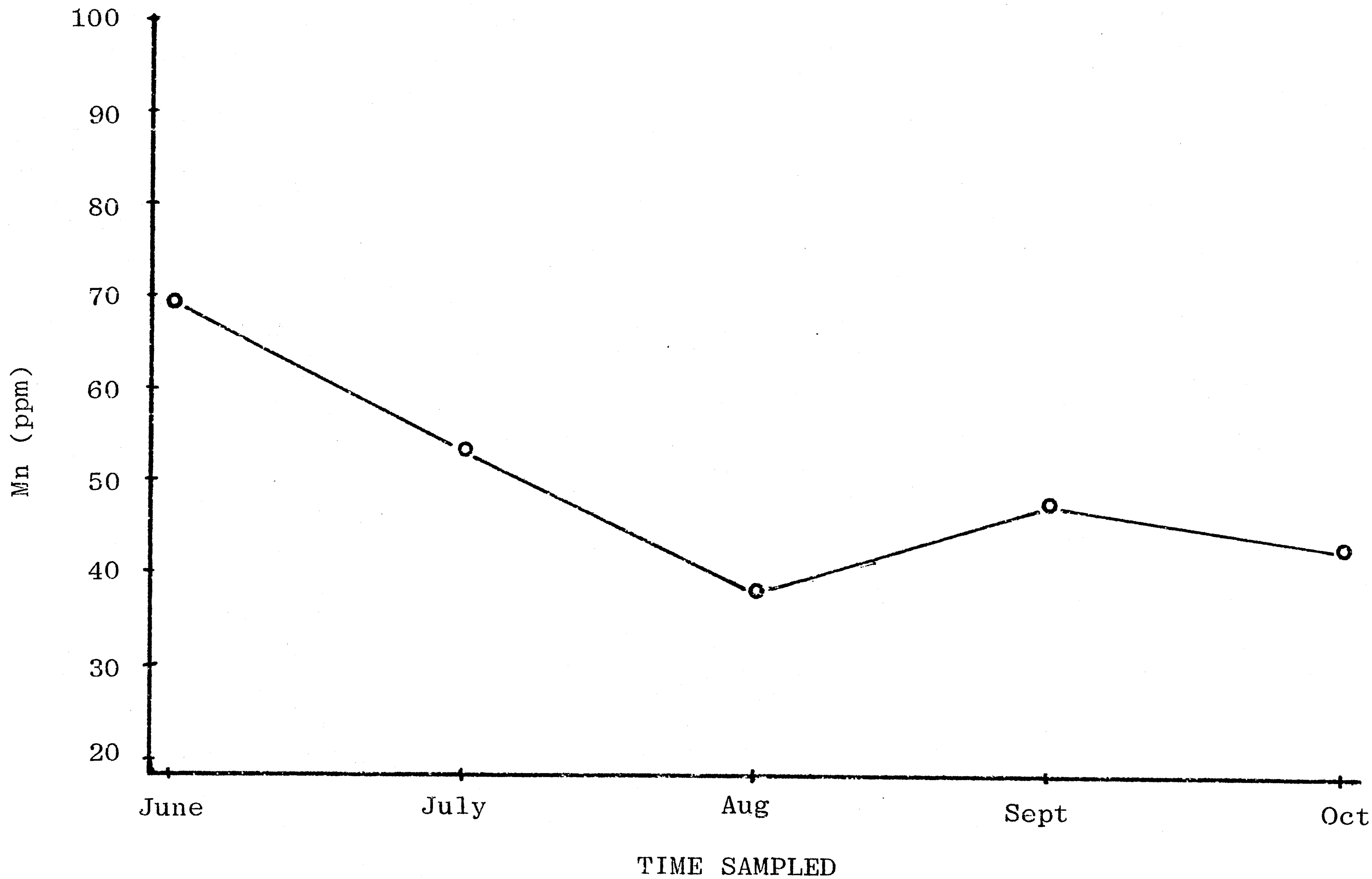


Figure 22. Seasonal Trend in Foliar Manganese Content for Pooled Cottonwood Clones

consistently out-performed the other in its ability to accumulate iron and zinc (Figures 23 and 24). For manganese, however, clonal effects were significant (Table XIII, Appendix A). Even though the seasonal trends were similar for each clone, greater concentrations of manganese were consistently found in the foliage of clone 66 (Figure 25).

Nutrient Content by Crown Level

Statistical analysis indicated that there were no significant differences between crown level concentration patterns for iron and zinc (Tables XI and XII, Appendix A) as illustrated in Figures 26 and 27, respectively. The effect of crown level was significantly different for manganese (Table XIII, Appendix A). Higher foliar concentrations were consistently found in samples taken from the lower one-third of the crown (Figure 28).

Forage Production

A complete summary of the per-hectare forage production for all intercropping treatments is given in Table I. The average production for fertilized treatments were consistently higher than those for the unfertilized treatments. The fertilized oats had the highest production level and the unfertilized oats had the lowest production level of all the intercropped treatments.

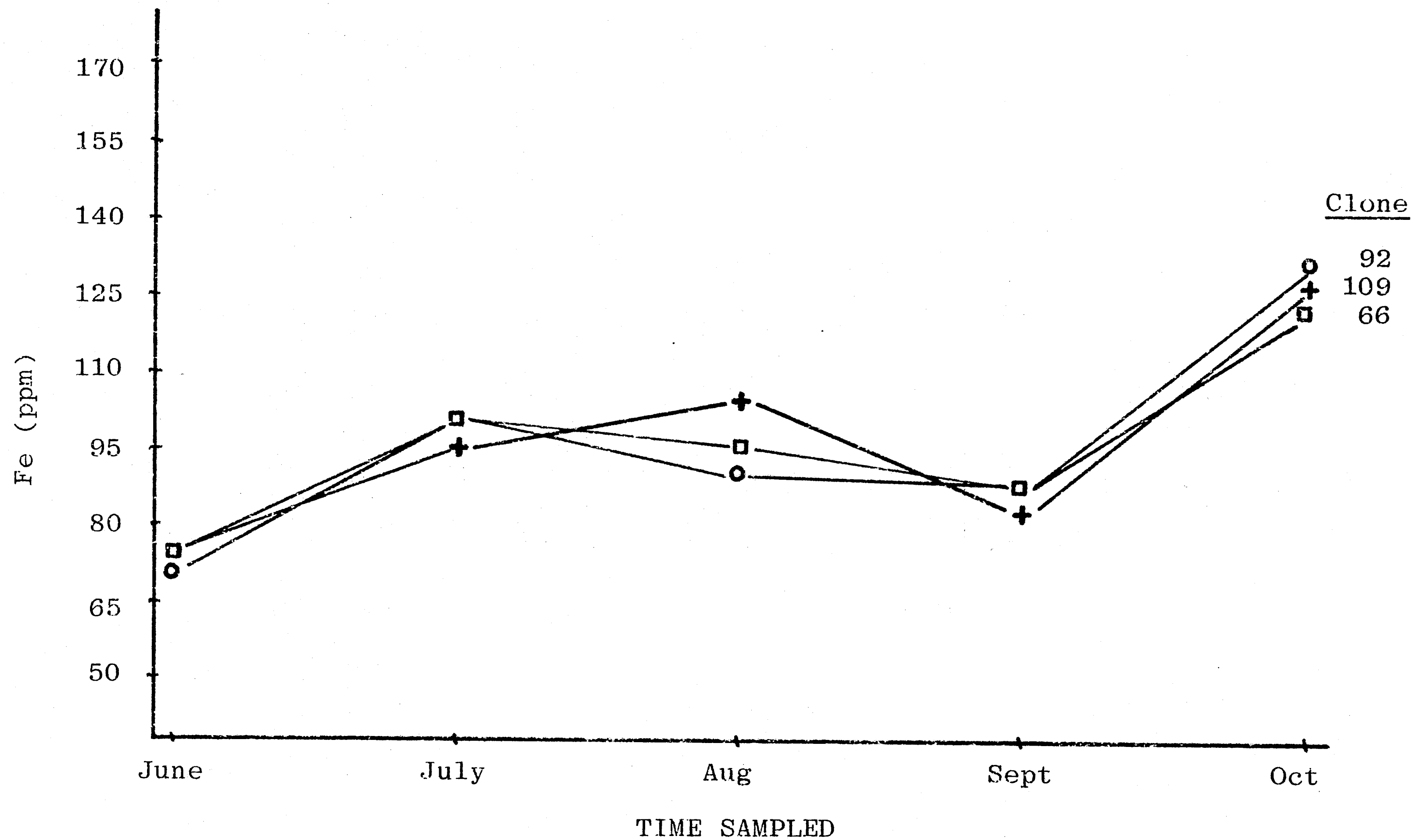


Figure 23. Clonal Foliar Content Trends for Iron for Three Cottonwood Clones

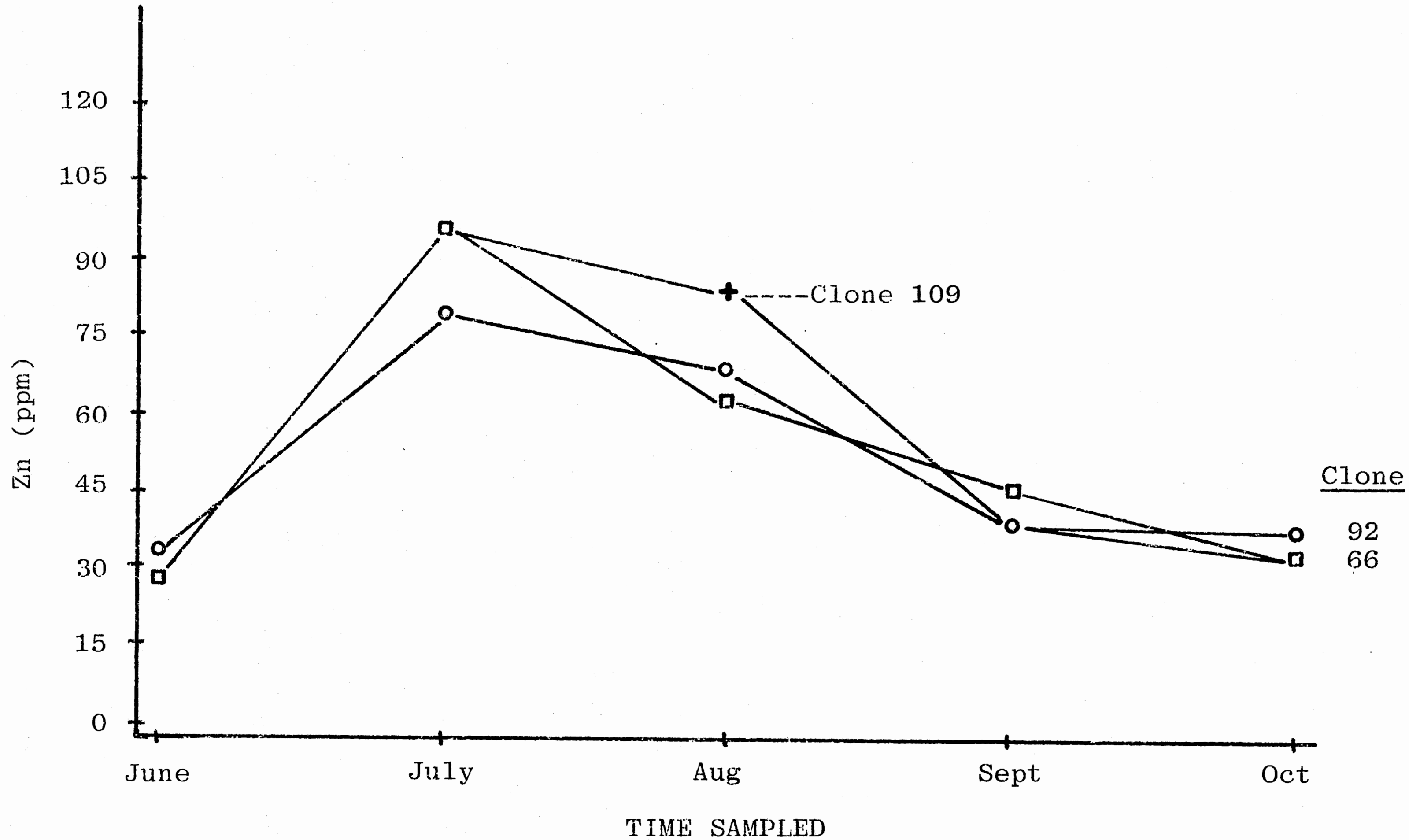


Figure 24. Clonal Foliar Content Trends for Zinc for Three Cottonwood Clones

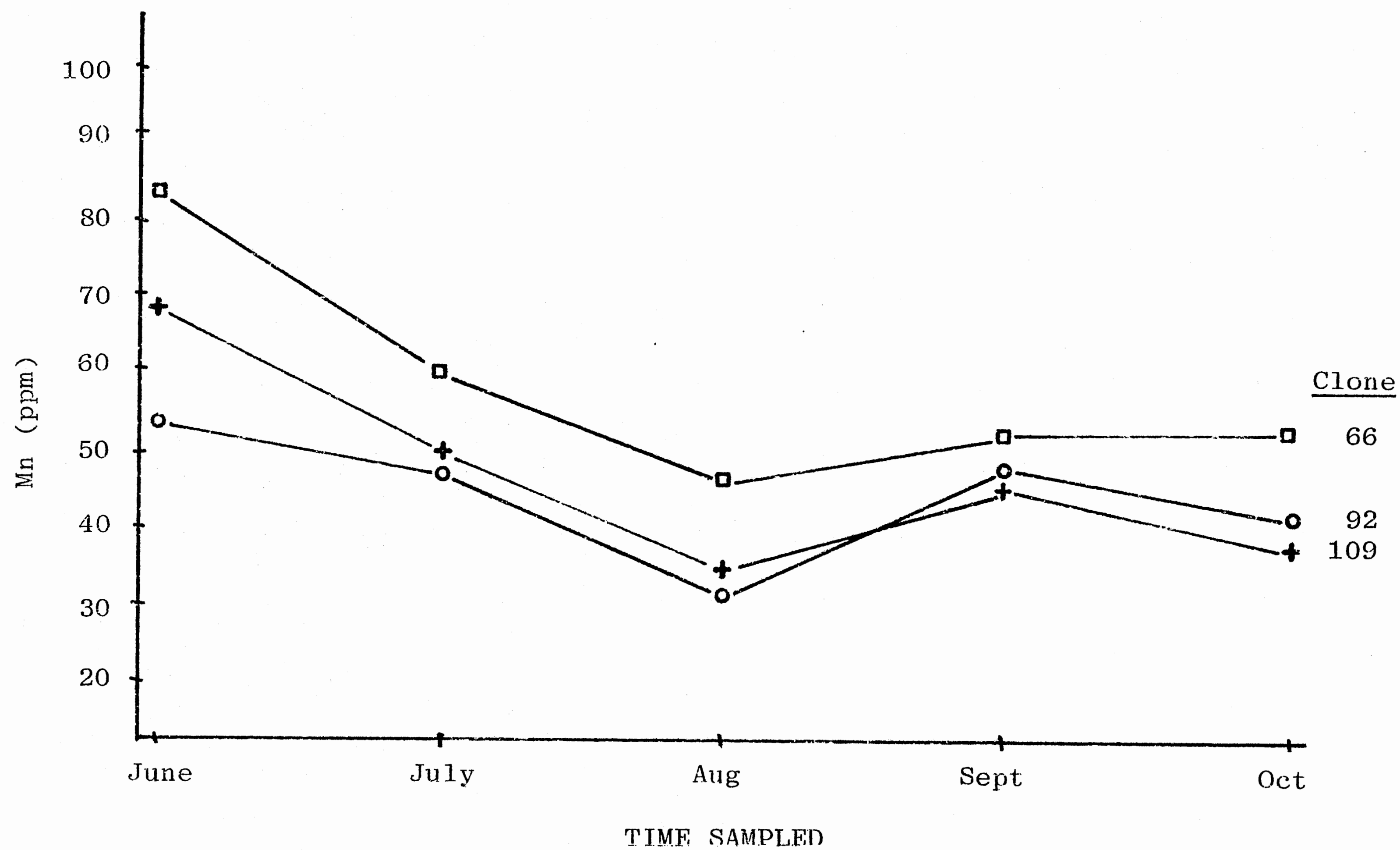


Figure 25. Clonal Foliar Content Trends for Manganese for Three Cottonwood Clones

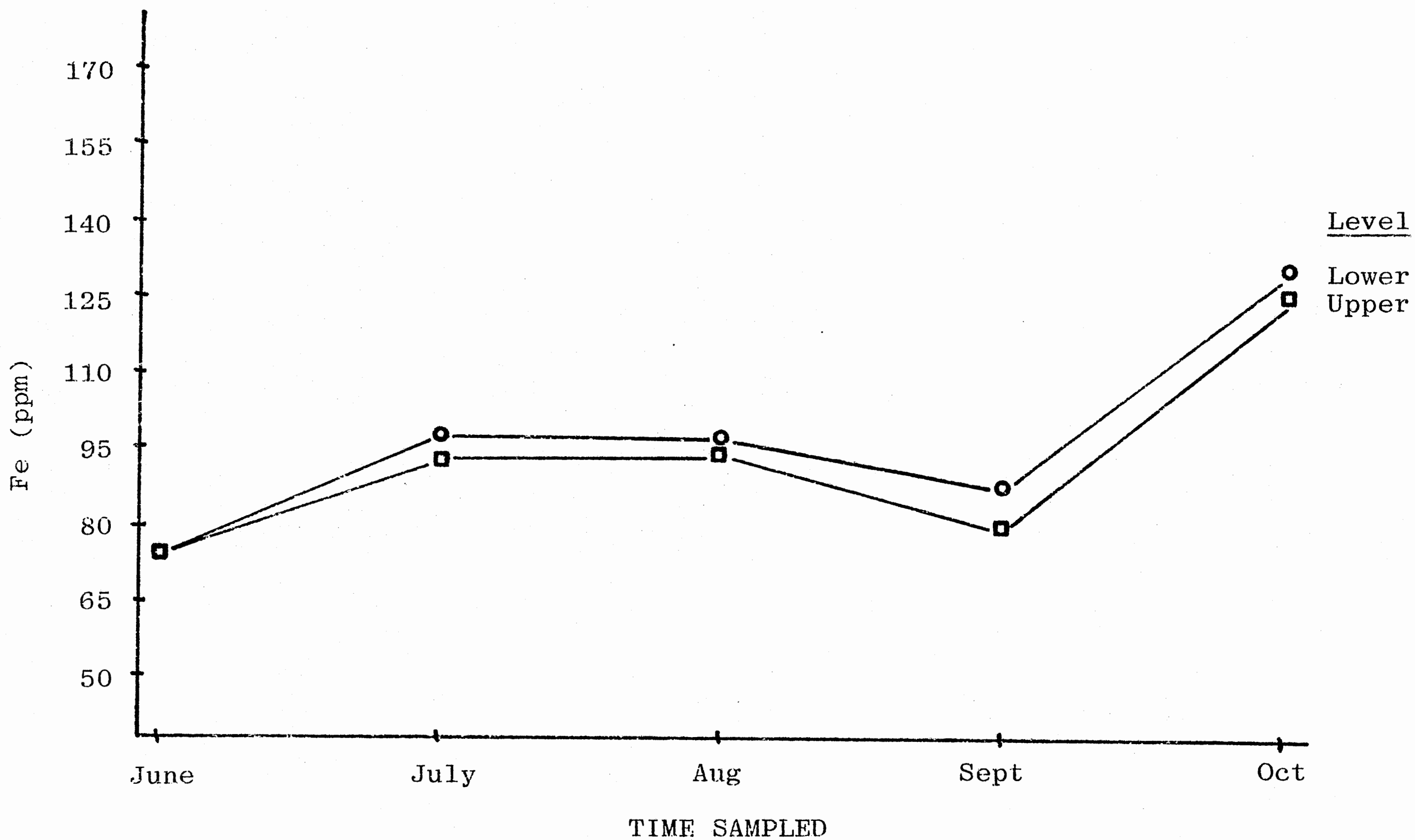


Figure 26. Crown Level Content Trends for Iron for Pooled Cottonwood Clones

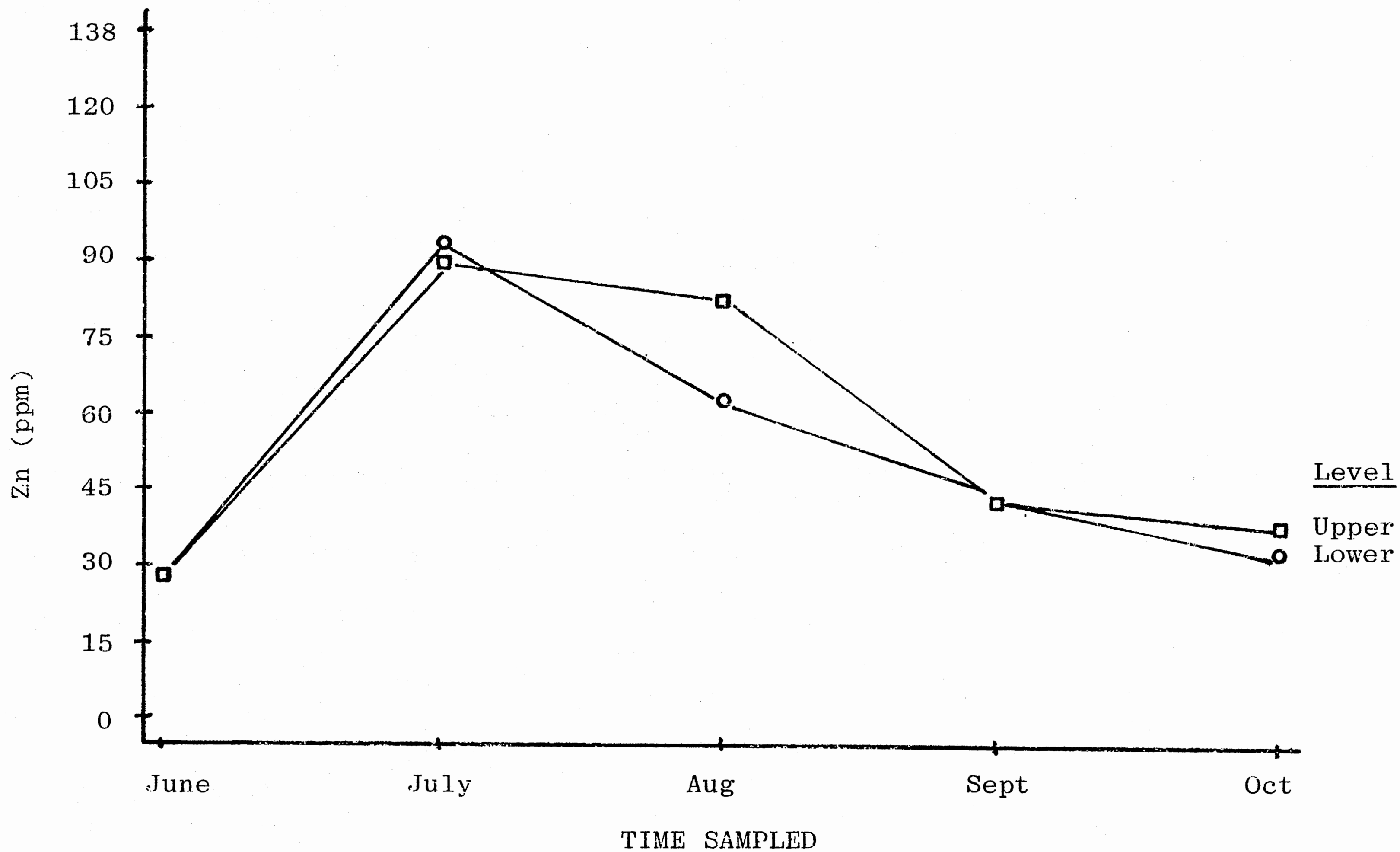


Figure 27. Crown Level Content Trends for Zinc for Pooled Cottonwood Clones

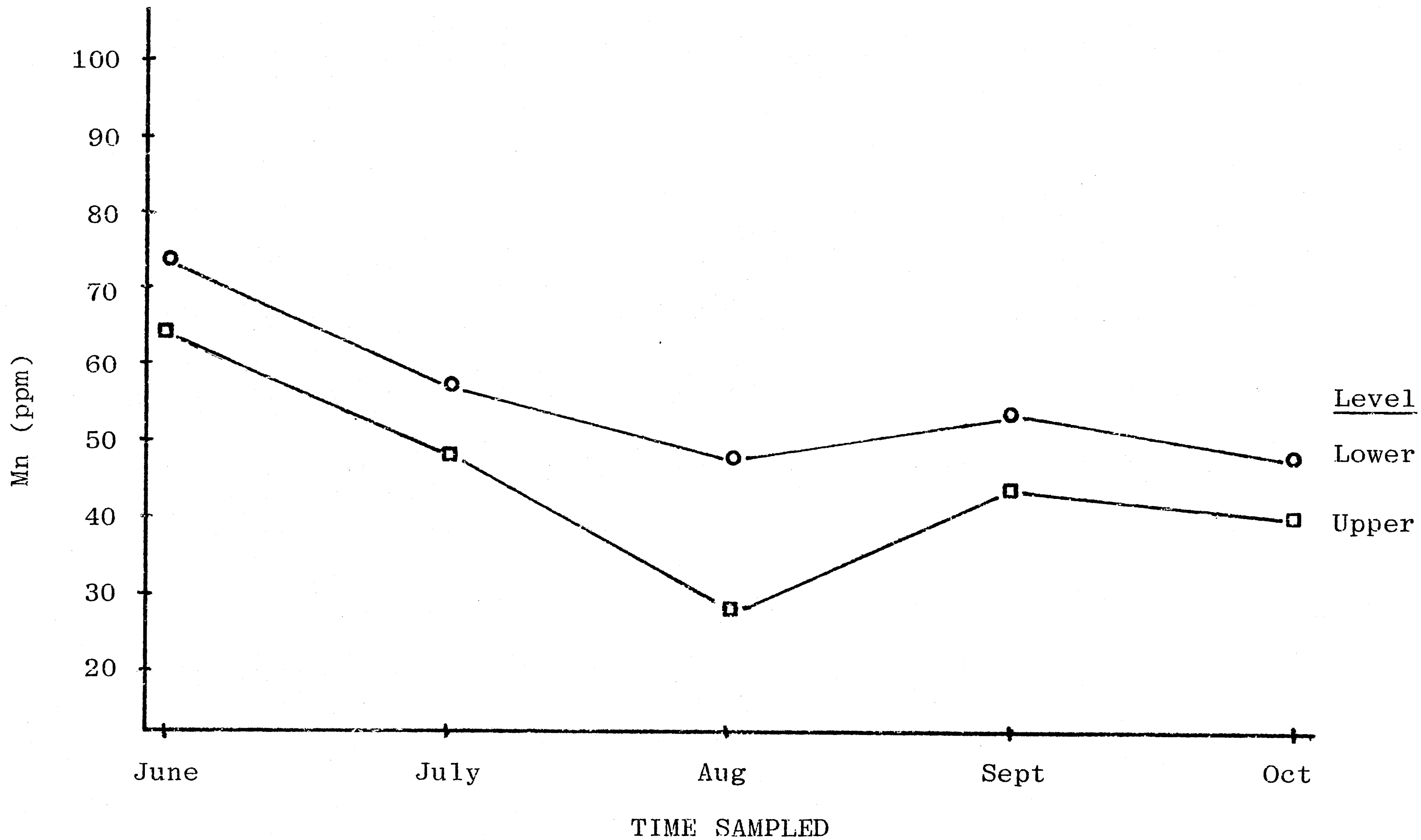


Figure 28. Crown Level Content Trends for Manganese for Pooled Cottonwood Clones

TABLE I

FORAGE PRODUCTION FROM AN AGRICULTURALLY INTERCROPPED COTTONWOOD PLANTATION

Intercropped Species	Plots	Production (metric tons dry wt./ha)	Average Production (metric tons dry wt./ha)
Fertilized			
Oats	4 5	3.16 4.64	3.90
Rye-Vetch	1 8	4.20 1.52	2.86
Unfertilized			
Oats	6 12	1.00 1.49	1.25
Rye-Vetch	9 10	1.50 1.88	1.69

Soil Conditions

Statistical analysis (Table XIV, Appendix A) indicated that there was a significant difference between percent soil moisture at soil depths of 12, 60, and 120 centimeters, that percent soil moisture varied throughout the growing season, and that there was an interaction between percent soil moisture at specific depths and the sample date. The analysis also indicated that there were no significant differences in percent soil moisture by the imposed cultural treatments.

Percent soil moisture (all depths pooled) varied from an average high of 21 percent early in the season to a low of 4 percent late in the season. The trend in percent soil moisture is shown in Figure 29.

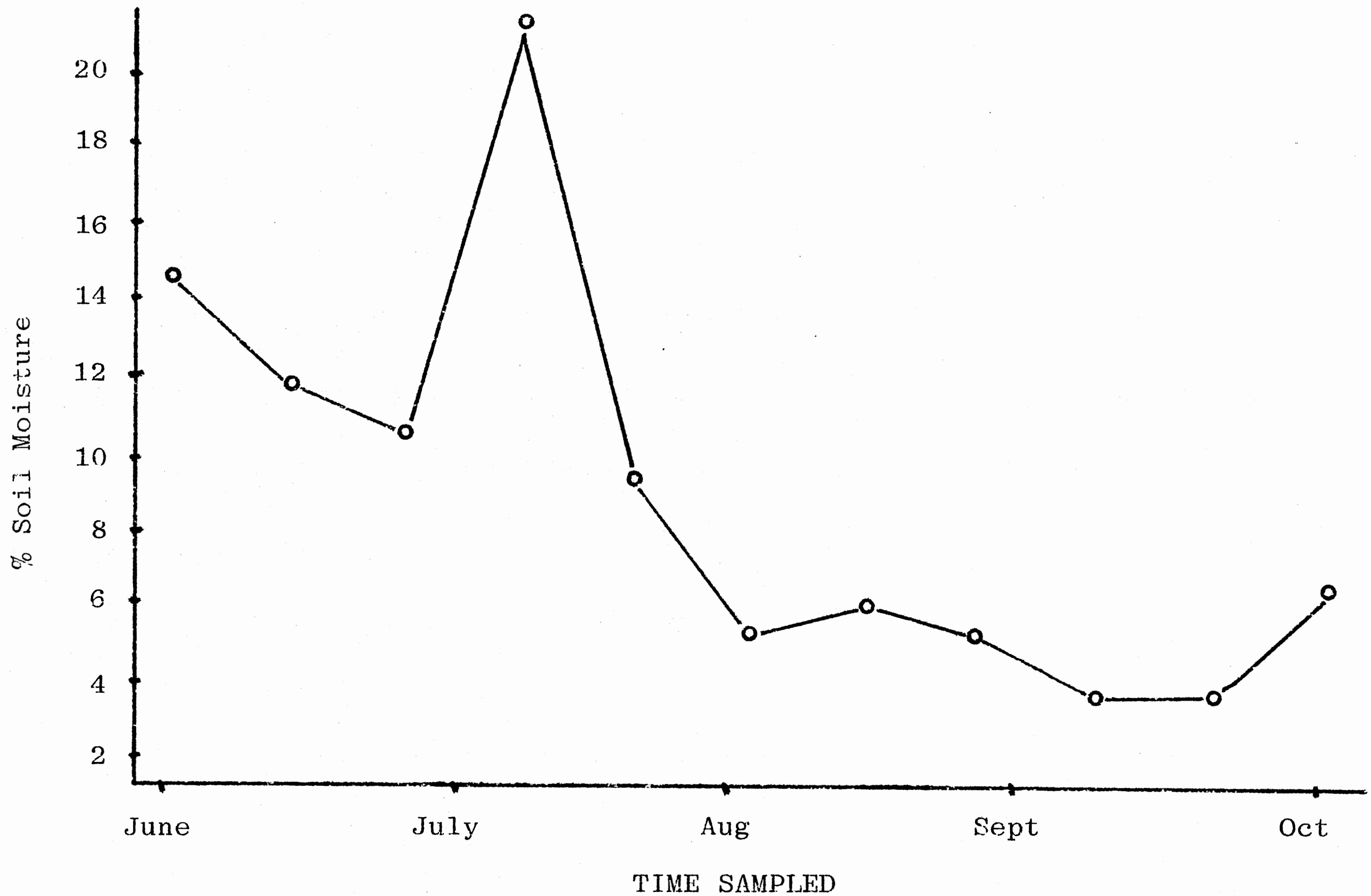


Figure 29. Seasonal Percent Soil Moisture Trend All Depths Pooled

CHAPTER VI

DISCUSSION

While significant seasonal changes in foliar content occurred for all nutrients reported, the range of concentrations encountered within each element were not large and were unaffected by the cultural treatments imposed. It would appear that the application of fertilizer in the fall (38 kilograms per hectare of N, P_2O_5, and K_2O_5) and spring (71 kilograms per hectare of N) were the phases of the treatments that influenced the nutritional status of the trees. The fertilizer applications with respect to nitrogen were sufficient to meet both the crop demands and still provide a beneficial effect to the trees. However, the fertilizer applications did not seem to have any effect on the foliar levels of either phosphorus or potassium.

The order of magnitude for the elemental values found in this study was $N>Ca>K>Mg>P>Fe>Zn\geq Mn$. This ordering is similar to one found by Shelton, Nelson, Switzer, and Blackmon (43) for cottonwood, except that calcium concentrations were found to be greater than nitrogen concentrations in their study.

The magnitude of the average seasonal values found for nitrogen, phosphorus, and magnesium were all greater than published nutrient deficiency levels for cottonwood, while those for potassium and calcium were only slightly below the reported levels, shown in Table II.

TABLE II

A COMPARISON OF PUBLISHED VALUES INDICATING FOLIAR NUTRIENT DEFICIENCIES

Nutrient	Reference: White and Carter (59)	Reference: van der Meiden (55)
	Percent Dry Weight	
N	2.00	2.20
P	0.17	-
K	1.30	1.40
Ca	2.30	-
Mg	0.18	0.20

In addition, the magnitude of the average values found in this study for manganese, zinc, and iron were all above, or in the range of, relative magnitudes in Table III for healthy fruit trees.

The seasonal foliar content patterns found in this study for nitrogen, phosphorus, and potassium are similar to those reported by Baker and Blackmon (6) in a foliar nutrient study of cottonwood. The decrease in foliar nitrogen and phosphorus encountered at the end of the growing season is attributed to the translocation of these elements to the branches, stem, and root tissue for storage (6). Unlike nitrogen and phosphorus, little or no foliar potassium seems to be translocated to other tissue for storage by cottonwood; the decrease in foliar potassium levels is attributed to loss due to leaching or translocation of potassium to the roots where it is lost through exudation (6). There is also little evidence to show that calcium, magnesium, and iron are involved in biochemical cycling to other tissues for storage (32, 43). Therefore, accumulated amounts of foliar calcium, magnesium, and iron are believed to be returned to the soil through leaf abcission (6, 32). Little is known about the biochemical cycling of zinc and manganese, but Kramer and Kozlowski (32) indicated that both elements tend to concentrate and be stored in woody tissues. Seasonal patterns of concentrations for both zinc and manganese would suggest that either biochemical cycling of the two elements into the woody tissue is occurring, or the elements are being leached from the leaves throughout the growing season.

The systematic sampling scheme, using leaves of predetermined LPA, allowed comparisons to be made concerning seasonal nutrient accumulation by crown level. While samples from the rapidly growing top one-third of the crown consistently provided higher nutrient concentrations for nitrogen, phosphorus, and potassium compared to the bottom one-third of the crown, the seasonal trends were similar for both levels. Therefore, samples from the lower crown could be used, as suggested by Blackmon and White (8), to indicate the foliar nutrient status of the cottonwood with respect to nitrogen, phosphorus, and potassium content. However, in this study, the greatest concentration of foliar nitrogen, phosphorus, and potassium were found in the upper one-third of the crown in June and August, respectively. This indicates that if peak nutritional levels of these elements are to be evaluated, samples should be taken from the top one-third of the crown in June for nitrogen and in August for phosphorus and potassium.

TABLE III

RELATIVE AMOUNTS OF VARIOUS ELEMENTS FOUND IN DRIED LEAF TISSUE OF FRUIT TREES

Element	Content (ppm)
Fe	100
Zn	40
Mn	40

Source: Kramer and Kozlowski (32).

While calcium, magnesium, and manganese had similar seasonal foliar concentration trends for both crown levels, they achieved their highest concentration in the lower one-third of the crown. This indicates that the lower one-third of the crown's foliage could be used again, as in the case of nitrogen, phosphorus, and potassium, to assess the relative vigor of the trees with respect to content of calcium, magnesium, and manganese, as well as in the determination of peak concentration levels of these elements. In this study, the greatest foliar concentrations of calcium and magnesium were found in October, whereas samples taken in June reflected peak levels of manganese, suggesting that samples should be taken at these times to capture peak foliar accumulations in cottonwood.

In this study, no differences in the foliar concentration patterns for zinc and iron were observed between the upper one-third and the lower one-third of the crown. Therefore, the lower crown could be sampled to evaluate the peak foliar concentrations as well as to assess the relative vigor of the tree with respect to foliar content of zinc and iron.

Based on the results of the foliar nutrient tests it was possible to evaluate the vigor of the cottonwood, but it was not possible to make selections for clonal superiority regarding nutrient uptake. However, it is likely that genotypes could be selected for maximum response to specific cultural environments, as suggested by Gordon (22).

When conducting this type of foliar sampling it is important to monitor the soil moisture and nutrient status in the environment of the trees (50). The availability of soil moisture and nutrients during the growing season can strongly influence the growth of all plants, including trees (32, 53).

On the riverbottom sites, similar to where this study site is located, the soil moisture supplies are generally determined by the water table, which fluctuates with the level of the river (11, 35). This fluctuation in the water table accounts for the pattern seen in the seasonal moisture trend in this study. When the Red River was at flood stage, the percent soil moisture was extremely high for the soil type. Subsequently, soil moisture began to decrease as the level of the river decreased. It was of particular interest that there was no significant difference in percent soil moisture by cultural treatment, indicating that in this four-year-old cottonwood plantation agricultural intercropping had no effect on soil moisture content. Similar results were reported by Hennessey, Prewitt, and Sturgeon (26) for a one-year-old cottonwood plantation. Through the use of regular soil testing and recommended application rates for crop fertilization, the fertility of an intercropped site could be maintained and improved over the years, providing sufficient amounts of nutrients in the soil to meet the agricultural production goals while still providing a beneficial effect on the trees.

The agroforestry system of winter cropping between tree rows provided a method by which some of the cost of plantation establishment and management could have been recovered, and did provide a supplement to the landowner's livestock feeding program. Based on the 1982 average price for improved hay

($85.00 per metric ton), production yields and income that could have been derived from the sale of the hay generated by the intercropped treatments is shown in Table IV. In this study, fertilized oat intercropping would have grossed the most income by virtue of having the greatest production of forage.

TABLE IV

GROSS FINANCIAL RETURN DERIVED FROM THE SALE OF HAY FROM THE INTERCROPPED TREATMENTS

Intercropped Species	Production (metric tons dry wt./ha)	Dollars/ha
Fertilized		
Oats	3.89	322
Rye-Vetch	1.86	236
Unfertilized		
Oats	1.25	103
Rye-Vetch	1.69	139

CHAPTER VII

CONCLUSIONS

Trends in foliar nutrient contents provide a good method of evaluating the effects of agricultural intercropping in a cottonwood plantation. With further quantification of standard foliar concentration levels for cottonwood, foliar sampling should become a very efficient approach for detecting nutrient imbalance in cottonwood, particularly when used in conjunction with the monitoring of soil moisture and soil nutrients. The following conclusions concerning foliar sampling and agricultural intercropping in a four-year-old cottonwood plantation are made on the basis of experience and data analysis from the intensive nutrient survey that was conducted:

1. The nutrient of cottonwood clones in an agriculturally intercropped plantation can be assessed by the use of foliar sampling and soil moisture and nutrient monitoring.

2. Both unfertilized and fertilized intercropped winter forage crops in a cottonwood plantation have no significant effect on the foliar nutritional status of the trees or on the available soil moisture, when compared with a clean-tilled treatment.

3. The relative nutrient status of cottonwood clones in a cottonwood plantation can be evaluated by assessing the foliage from the lower one-third of the crown.

4. The peak concentration levels of foliar nitrogen in a cottonwood plantation should be evaluated in June, and samples should be collected from the top one-third of the crown.

5. The peak concentration levels of foliar phosphorus and potassium in a cottonwood plantation should be evaluated in August and samples should be collected from the top one-third of the crown.

6. The peak concentration levels of foliar calcium and magnesium in a cottonwood plantation should be collected from the bottom one-third of the crown in October.

7. The peak concentration levels of foliar manganese in a cottonwood plantation should be evaluated in June, and samples should be from the lower one-third of the crown.

8. The peak concentration levels of foliar iron in a cottonwood plantation should be evaluated in October, and samples can be from the upper or lower crown.

9. The peak concentration levels of foliar zinc in a cottonwood plantation should be evaluated in July, from either crown level.

10. Fertilizing with a split fall-spring fertilizer application schedule based on soil test values and crop yield goals will meet the needs of the crops and provide additional nitrogen for use by the trees.

If agroforestry is to gain momentum in the United States, more research, such as the type conducted in this study, is needed concerning the cultural effects of this practice on other tree species. In addition, improved methods of implementation must also be investigated, including techniques to aid in crop cultivation and harvesting, to increase efficiency and in turn reduce costs. Not until this research is conducted, can a sound base be developed to give advice to landowners on the best agroforestry techniques to use on their land.

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APPENDIXES

APPENDIX A

STATISTICAL ANALYSES AND MEAN TABLES

TABLE V

MEAN TABLE FOR FOLIAR NUTRIENT CONCENTRATIONS BY TREATMENTS, CLONES, CROWN LEVELS, AND SAMPLE DATES FOR COTTONWOOD IN AN AGRICULTURALLY INTERCROPPED PLANTATION

Legend

Treatments

TRT 1 = Fertilized Clean-Tilled

TRT 2 = Unfertilized Clean-Tilled

TRT 3 = Fertilized Oats

TRT 4 = Unfertilized Oats

TRT 5 = Fertilized Rye-Vetch

TRT 6 = Unfertilized Rye-Vetch

Crown Level Sampled

LEVEL 1 = Upper One-Third

LEVEL 2 = Lower One-Third

Sample Dates

Pickd 1 = June

Pickd 2 = July

Pickd 3 = August

Pickd 4 = September

Pickd 5 = October

Clone Sampled

CLONE 1 = Clone 66

CLONE 2 = Clone 92

CLONE 3 = Clone 109

TABLE V (Continued)

TRT	N	N	P	MG	CA	K	FE	MN	ZN
1	60	2.48058333	0.33065000	0.43575000	1.55491667	1.05141667	94.908333	56.6083333	42.7583333
2	60	2.33041667	0.35760000	0.39491667	1.44683333	1.07825000	96.591667	48.5750000	49.9333333
3	60	2.55833333	0.36133333	0.43508333	1.49333333	1.08483333	95.225000	47.9916667	44.3833333
4	60	2.23841667	0.38606667	0.38000000	1.50025000	1.12325000	103.925000	45.5750000	64.4250000
5	60	2.60533333	0.36908333	0.41916667	1.51725000	1.11091667	87.866667	49.7416667	54.2166667
6	60	2.48133333	0.35767500	0.41066667	1.48575000	1.06983333	97.250000	54.0416667	64.4583333

CLONE	N	N	P	MG	CA	K	FE	MN	ZN
1	120	2.49450000	0.38258333	0.40016667	1.47970833	1.08141667	95.4708333	59.7375000	53.3625000
2	120	2.34308333	0.31781250	0.41825000	1.45508333	1.04300000	95.6000000	44.8541667	51.0500000
3	120	2.50962500	0.38080833	0.41937500	1.56437500	1.13483333	96.8125000	47.6750000	55.6750000

TRT	CLONE	N	N	P	MG	CA	K	FE	MN
1	1	20	2.44500000	0.34160000	0.41100000	1.49950000	1.04200000	99.475000	63.2500000
1	2	20	2.35475000	0.28835000	0.44325000	1.50600000	0.99275000	91.700000	49.6000000
1	3	20	2.64200000	0.36200000	0.45300000	1.65925000	1.11950000	93.550000	56.9750000
2	1	20	2.39750000	0.37200000	0.38725000	1.36750000	1.07525000	93.650000	54.8750000
2	2	20	2.26375000	0.32585000	0.38825000	1.39900000	1.03600000	95.925000	42.7500000
2	3	20	2.33000000	0.37495000	0.40925000	1.57400000	1.12350000	100.200000	48.1000000
3	1	20	2.65550000	0.40265000	0.40125000	1.48275000	1.10375000	97.225000	60.0250000
3	2	20	2.44550000	0.33060000	0.43400000	1.39675000	1.05550000	95.600000	37.8500000
3	3	20	2.57400000	0.35075000	0.47000000	1.60050000	1.09525000	92.850000	46.1000000
4	1	20	2.30050000	0.41040000	0.38300000	1.47825000	1.09225000	110.275000	51.4250000
4	2	20	2.10750000	0.32235000	0.38300000	1.51550000	1.04850000	102.875000	41.9500000
4	3	20	2.30725000	0.42545000	0.37400000	1.50700000	1.22900000	98.625000	43.3500000
5	1	20	2.60700000	0.37495000	0.42875000	1.52150000	1.08675000	81.525000	56.1750000
5	2	20	2.55550000	0.33985000	0.42625000	1.43875000	1.10350000	88.975000	48.9000000
5	3	20	2.65350000	0.39245000	0.40250000	1.59150000	1.14250000	93.100000	44.1500000
6	1	20	2.56150000	0.39390000	0.38975000	1.52875000	1.08850000	90.675000	66.6750000
6	2	20	2.33150000	0.29987500	0.43475000	1.47450000	1.02175000	98.525000	48.0750000
6	3	20	2.55100000	0.37925000	0.40750000	1.45400000	1.09925000	102.550000	47.3750000

TRT	CLONE	N	ZN
1	1	20	37.9000000
1	2	20	47.4250000
1	3	20	42.9500000
2	1	20	42.7500000
2	2	20	49.7250000
2	3	20	57.3250000
3	1	20	44.0750000
3	2	20	46.9250000
3	3	20	42.1500000
4	1	20	70.1500000
4	2	20	67.6750000
4	3	20	55.4500000
5	1	20	50.7500000

TABLE V (Continued)

TRT	CLONE	N	ZN
5	2	20	41.6000000
5	3	20	70.3000000
6	1	20	74.5500000
6	2	20	52.9500000
6	3	20	65.8750000

LEVEL	N	N	P	MG	CA	K	FE	MN	ZN
1	180	2 57869444	0 41323333	0.39188889	1.17675000	1.18388889	93.8527778	44 9611111	55 6833333
2	180	2.31944444	0.30756944	0.43330556	1.82269444	0.98894444	98.0694444	55.8833333	51.0416667

TRT	LEVEL	N	N	P	MG	CA	K	FE	MN
1	1	30	2.62750000	0.36756667	0.41600000	1.25966667	1 13050000	89.433333	49 4666667
1	2	30	2.33366667	0.29363333	0.45550000	1 85016667	0.97233333	100.383333	63 7500000
2	1	30	2.43016667	0.39950000	0.38016667	1.17083333	1.14166667	94.683333	44.3000000
2	2	30	2.23066667	0.31570000	0.40966667	1.72283333	1.01483333	98.500000	52 8500000
3	1	30	2.66750000	0.41363333	0.40483333	1.17950000	1.18816667	87.433333	42 0000000
3	2	30	2.44916667	0.30903333	0.46533333	1.80716667	0.98150000	103 016667	53.9833333
4	1	30	2.42200000	0.46850000	0.36866667	1.06416667	1.27466667	103.466667	38 8333333
4	2	30	2 05483333	0.30363333	0.39133333	1.93633333	0.97183333	104.383333	52.3166667
5	1	30	2 74400000	0.43266667	0.39416667	1.20833333	1.20233333	89.666667	45.4000000
5	2	30	2.46666667	0.30550000	0.44416667	1.82616667	1.01950000	85.866667	54.0833333
6	1	30	2.58100000	0.39743333	0.38750000	1.17800000	1.16600000	98.233333	49 7666667
6	2	30	2.38166667	0.31791667	0.43383333	1.79350000	0.97366667	96.266667	58.3166667

TRT	LEVEL	N	ZN
1	1	30	41.3500000
1	2	30	44.1666667
2	1	30	51.0000000
2	2	30	48.8666667
3	1	30	48 7666667
3	2	30	40.0000000
4	1	30	64.9333333
4	2	30	63 9166667
5	1	30	59 5500000
5	2	30	48 8833333
6	1	30	68 5000000
6	2	30	60 4166667

TABLE V (Continued)

CLONE	LEVEL	N	N	P	MG	CA	K	FE	MN
1	1	60	2.60466667	0.43536667	0.38875000	1.17691667	1.17766667	94.000000	51.0583333
1	2	60	2.38433333	0.32980000	0.41158333	1.78250000	0.98516667	96.941667	66.4166667
2	1	60	2.47625000	0.36458333	0.38283333	1.12358333	1.12533333	90.816667	40.5416667
2	2	60	2.20991667	0.27104167	0.45366667	1.78658333	0.96066667	100.383333	49.1666667
3	1	60	2.65516667	0.43975000	0.40408333	1.22975000	1.24866667	96.741667	43.2833333
3	2	60	2.36408333	0.32186667	0.43466667	1.89900000	1.02100000	96.883333	52.0666667

CLONE	LEVEL	N	ZN
1	1	60	51.4500000
1	2	60	55.2750000
2	1	60	55.2666667
2	2	60	46.8333333
3	1	60	60.3333333
3	2	60	51.0166667

TRT	CLONE	LEVEL	N	N	P	MG	CA	K	FE	MN
1	1	1	10	2.60400000	0.37530000	0.39850000	1.20600000	1.12850000	94.400000	50.3500000
1	1	2	10	2.28600000	0.30790000	0.42350000	1.79300000	0.95550000	104.550000	76.1500000
1	2	1	10	2.51300000	0.32750000	0.40700000	1.19150000	1.09050000	84.600000	45.6000000
1	2	2	10	2.19650000	0.24920000	0.47950000	1.82050000	0.89500000	98.800000	53.6000000
1	3	1	10	2.76550000	0.40020000	0.44250000	1.38150000	1.17250000	89.300000	52.4500000
1	3	2	10	2.51850000	0.32380000	0.46350000	1.93700000	1.06650000	97.800000	61.5000000
2	1	1	10	2.45200000	0.41330000	0.38150000	1.17800000	1.14100000	99.250000	50.3500000
[illegible]	1	2	10	2.34300000	0.33070000	0.39300000	1.55700000	1.00950000	88.050000	59.4000000
2	2	1	10	2.39850000	0.36300000	0.35800000	1.01750000	1.10100000	90.000000	38.5000000
2	2	2	10	2.12900000	0.28870000	0.41850000	1.78050000	0.97100000	101.850000	47.0000000
2	3	1	10	2.44000000	0.42220000	0.40100000	1.31700000	1.18300000	94.800000	44.0500000
2	3	2	10	2.22000000	0.32770000	0.41750000	1.83100000	1.06400000	105.600000	52.1500000
3	1	1	10	2.73950000	0.44600000	0.38900000	1.19700000	1.16450000	90.600000	52.5000000
3	1	2	10	2.57150000	0.35930000	0.41350000	1.76850000	1.04300000	103.850000	67.5500000
3	2	1	10	2.54100000	0.39340000	0.38400000	1.05750000	1.16600000	86.800000	32.2000000
3	2	2	10	2.35000000	0.26780000	0.48400000	1.73600000	0.94500000	104.400000	43.5000000
3	3	1	10	2.72200000	0.40150000	0.44150000	1.28400000	1.23400000	84.900000	41.3000000
3	3	2	10	2.42600000	0.30000000	0.49850000	1.91700000	0.95650000	100.800000	50.3000000
4	1	1	10	2.49300000	0.50540000	0.37950000	1.01850000	1.27550000	108.200000	42.6000000
4	1	2	10	2.10800000	0.31540000	0.38650000	1.93800000	0.90800000	112.350000	60.2500000
4	2	1	10	2.28000000	0.38490000	0.35500000	1.07950000	1.17300000	97.350000	35.8000000
4	2	2	10	1.93500000	0.25980000	0.41100000	1.95150000	0.92400000	108.400000	48.1000000
4	3	1	10	2.49300000	0.51520000	0.37150000	1.09450000	1.37550000	104.850000	38.1000000
4	3	2	10	2.12150000	0.33570000	0.37650000	1.91950000	1.08250000	92.400000	48.6000000
5	1	1	10	2.70200000	0.42730000	0.41950000	1.28100000	1.15200000	82.000000	50.0500000
5	1	2	10	2.51200000	0.32260000	0.43800000	1.76200000	1.02150000	81.050000	62.3000000
5	2	1	10	2.73950000	0.39580000	0.38700000	1.15600000	1.16850000	92.600000	45.2500000
5	2	2	10	2.37150000	0.28390000	0.46550000	1.72150000	1.03850000	85.350000	52.5500000
5	3	1	10	2.79050000	0.47490000	0.37600000	1.18800000	1.28650000	95.000000	40.9000000
5	3	2	10	2.51650000	0.31000000	0.42900000	1.99500000	0.99850000	91.200000	47.4000000
6	1	1	10	2.63750000	0.44490000	0.36450000	1.18100000	1.20450000	89.550000	60.5000000
6	1	2	10	2.48550000	0.34290000	0.41500000	1.87650000	0.97250000	91.800000	72.8500000

TABLE V (Continued)

TRT	CLONE	LEVEL	N	N	P	MG	CA	K	FE	MN
6	2	1	10	2.38550000	0.32290000	0.40600000	1.23950000	1.05300000	93.550000	45.9000000
6	2	2	10	2.27750000	0.27685000	0.46350000	1.70950000	0.99050000	103.500000	50.2500000
6	3	1	10	2.72000000	0.42450000	0.39200000	1.11350000	1.24050000	111.600000	42.9000000
6	3	2	10	2.38200000	0.33400000	0.42300000	1.79450000	0.95800000	93.500000	51.8500000

TRT	CLONE	LEVEL	N	ZN
1	1	1	10	36.4000000
1	1	2	10	39.4000000
1	2	1	10	47.0500000
1	2	2	10	47.8000000
1	3	1	10	40.6000000
1	3	2	10	45.3000000
2	1	1	10	40.5500000
2	1	2	10	44.9500000
2	2	1	10	59.0000000
2	2	2	10	40.4500000
2	3	1	10	53.4500000
2	3	2	10	61.2000000
3	1	1	10	45.0500000
3	1	2	10	43.1000000
3	2	1	10	56.6000000
3	2	2	10	77.2500000
3	3	1	10	44.6500000
3	3	2	10	39.6500000
4	1	1	10	67.9000000
4	1	2	10	72.4000000
4	2	1	10	73.8500000
4	2	2	10	61.5000000
4	3	1	10	53.0500000
4	3	2	10	57.8500000
5	1	1	10	41.9500000
5	1	2	10	59.5500000
5	2	1	10	41.5500000
5	2	2	10	41.6500000
5	3	1	10	95.1500000
5	3	2	10	45.4500000
6	1	1	10	76.8500000
6	1	2	10	72.2500000
6	2	1	10	53.5500000
6	2	2	10	52.3500000
6	3	1	10	75.1000000
6	3	2	10	56.6500000

TABLE V (Continued)

PICKD	N	N	P	MG	CA	K	FE	MN	ZN
1	72	2.61069444	0.33637500	0.33354167	1.27500000	1.07833333	73.090278	68.7569444	28.0347222
2	72	2.48840278	0.38851389	0.35611111	1.50722222	1.13833333	96.263889	52.8541667	91.5555556
3	72	2.32409722	0.39981250	0.41368056	1.30777778	1.13201389	96.986111	37.9791667	71.0694444
4	72	2.48375000	0.36186111	0.46875000	1.59465278	1.08854167	85.618056	48.6180556	41.6458333
5	72	2.33840278	0.31544444	0.49090278	1.81395833	0.99486111	127.847222	43.9027778	34.5069444

TRI	PICKD	N	N	P	MG	CA	K	FE	MN
1	1	12	2.67750000	0.33941667	0.34166667	1.28791667	1.05375000	58.416667	80.4166667
1	2	12	2.56666667	0.33508333	0.37375000	1.64958333	1.08000000	101.416667	61.1666667
1	3	12	2.35666667	0.36200000	0.44750000	1.41125000	1.09875000	96.500000	42.2500000
1	4	12	2.47083333	0.32458333	0.50166667	1.63125000	1.03500000	100.333333	50.0833333
1	5	12	2.32125000	0.29216667	0.51416667	1.79458333	0.98958333	117.875000	49.1250000
2	1	12	2.56708333	0.35900000	0.32000000	1.26916667	1.09791667	77.166667	69.2500000
2	2	12	2.26500000	0.37216667	0.34375000	1.40250000	1.10458333	98.333333	49.8333333
2	3	12	2.17708333	0.39008333	0.39708333	1.27708333	1.11958333	95.916667	35.8333333
2	4	12	2.40291667	0.35266667	0.43916667	1.51750000	1.07833333	79.000000	46.4166667
2	5	12	2.24000000	0.31408333	0.47458333	1.76791667	0.99083333	132.541667	41.5416667
3	1	12	2.66166667	0.30916667	0.35541667	1.28375000	1.01875000	66.541667	66.9583333
3	2	12	2.61416667	0.36091667	0.38875000	1.55083333	1.10000000	100.041667	41.0000000
3	3	12	2.42875000	0.46691667	0.42708333	1.23416667	1.11416667	94.583333	37.5000000
3	4	12	2.50833333	0.35750000	0.49166667	1.59875000	1.12458333	90.250000	50.4166667
3	5	12	2.47875000	0.31216667	0.51250000	1.79916667	1.06666667	124.708333	44.0833333
4	1	12	2.49500000	0.35983333	0.33125000	1.26666667	1.18791667	83.333333	65.1666667
4	2	12	2.29916667	0.43758333	0.34083333	1.45000000	1.23625000	90.666667	41.6666667
4	3	12	2.07291667	0.40491667	0.37000000	1.31500000	1.13041667	91.333333	32.3333333
4	4	12	2.23166667	0.38391667	0.42833333	1.63083333	1.08458333	82.791667	48.5416667
4	5	12	2.09333333	0.34408333	0.42958333	1.83875000	0.97708333	171.500000	40.1666667
5	1	12	2.69041667	0.31408333	0.32708333	1.26791667	1.03083333	62.541667	62.7083333
5	2	12	2.62041667	0.39325000	0.36333333	1.55875000	1.17541667	86.791667	60.0000000
5	3	12	2.48583333	0.41658333	0.42083333	1.35916667	1.20416667	99.666667	38.6250000
5	4	12	2.65125000	0.39566667	0.48416667	1.54083333	1.17250000	79.208333	44.9166667
5	5	12	2.58875000	0.32583333	0.50041667	1.85958333	0.97166667	111.125000	42.4583333
6	1	12	2.58250000	0.33675000	0.32583333	1.27458333	1.08083333	90.541667	68.0416667
6	2	12	2.56500000	0.43208333	0.32625000	1.43166667	1.13375000	100.333333	63.4583333
6	3	12	2.41333333	0.35837500	0.41958333	1.25000000	1.12500000	103.916667	41.3333333
6	4	12	2.53750000	0.35683333	0.46750000	1.64875000	1.03625000	82.125000	51.3333333
6	5	12	2.30833333	0.30433333	0.51416667	1.82375000	0.97333333	109.333333	46.0416667

TRI	PICKD	N	ZN
1	1	12	14.291667
1	2	12	86.291667
1	3	12	45.708333
1	4	12	39.583333
1	5	12	28.916667
2	1	12	36.625000
2	2	12	83.666667
2	3	12	61.125000
2	4	12	38.541667

TABLE V (Continued)

TRT	PICKD	N	ZN
2	5	12	29.708333
3	1	12	14.833333
3	2	12	65.541667
3	3	12	69.791667
3	4	12	40.666667
3	5	12	31.083333
4	1	12	66.000000
4	2	12	88.000000
4	3	12	64.541667
4	4	12	55.958333
4	5	12	47.625000
5	1	12	15.625000
5	2	12	89.625000
5	3	12	98.083333
5	4	12	39.250000
5	5	12	28.500000
6	1	12	20.833333
6	2	12	136.208333
6	3	12	87.166667
6	4	12	36.875000
6	5	12	41.208333

CLONE	PICKD	N	N	P	MG	CA	K	FE	MN
1	1	24	2.71979167	0.36633333	0.32354167	1.27416667	1.08354167	75.083333	84.2708333
1	2	24	2.55875000	0.41170833	0.33979167	1.41437500	1.12562500	97.500000	60.6458333
1	3	24	2.38020833	0.42958333	0.40395833	1.30041667	1.11520833	95.250000	46.1041667
1	4	24	2.46937500	0.37608333	0.45041667	1.57437500	1.07666667	88.854167	51.6875000
1	5	24	2.34437500	0.32920833	0.48312500	1.83520833	1.00604167	120.666667	50.9791667
2	1	24	2.45041667	0.29175000	0.32625000	1.27416667	1.05395833	70.625000	54.2708333
2	2	24	2.33708333	0.32550000	0.36041667	1.47854167	1.08520833	97.458333	47.3125000
2	3	24	2.22812500	0.36152083	0.41562500	1.25395833	1.08520833	90.562500	32.8541667
2	4	24	2.43562500	0.32087500	0.48687500	1.55250000	1.04020833	85.104167	47.4166667
2	5	24	2.26416667	0.28841667	0.50208333	1.71625000	0.95041667	134.250000	42.4166667
3	1	24	2.66187500	0.35104167	0.35083333	1.27666667	1.09750000	73.562500	67.7291667
3	2	24	2.56937500	0.42733333	0.36812500	1.62875000	1.20416667	93.833333	50.6041667
3	3	24	2.36395833	0.40833333	0.42145833	1.36895833	1.19562500	105.145833	34.9791667
3	4	24	2.54625000	0.38862500	0.46895833	1.65708333	1.14875000	82.895833	46.7500000
3	5	24	2.40666667	0.32870833	0.48750000	1.89041667	1.02812500	128.625000	38.3125000

CLONE	PICKD	N	ZN
1	1	24	26.9375000
1	2	24	97.0000000
1	3	24	64.4791667
1	4	24	45.2916667
1	5	24	33.1041667
2	1	24	31.1041667
2	2	24	81.6458333
2	3	24	66.8541667

TABLE V (Continued)

CLONE	PICKD	N	ZN
2	4	24	39.0416667
2	5	24	36.6041667
3	1	24	26.0625000
3	2	24	96.0208333
3	3	24	81.8750000
3	4	24	40.6041667
3	5	24	33.8125000

TRT	CLONE	PICKD	N	N	P	MG	CA	K	FE	MN
1	1	1	4	2.76000000	0.36225000	0.33125000	1.28125000	1.06000000	65.500000	91.2500000
1	1	2	4	2.57125000	0.34725000	0.35625000	1.52625000	1.08250000	103.500000	63.6250000
1	1	3	4	2.26125000	0.36500000	0.40750000	1.39625000	1.06750000	96.875000	47.0000000
1	1	4	4	2.43125000	0.33900000	0.47250000	1.56500000	1.03750000	116.625000	51.7500000
1	1	5	4	2.20125000	0.29450000	0.48750000	1.72875000	0.96250000	114.875000	62.6250000
1	2	1	4	2.34500000	0.26950000	0.32500000	1.28875000	0.96875000	52.875000	61.5000000
1	2	2	4	2.36500000	0.29925000	0.37875000	1.54375000	1.05375000	111.875000	53.2500000
1	2	3	4	2.25875000	0.30125000	0.46000000	1.40625000	1.05625000	95.250000	40.1250000
1	2	4	4	2.48625000	0.29325000	0.53875000	1.68250000	0.95875000	89.500000	49.1250000
1	2	5	4	2.31875000	0.27850000	0.51375000	1.60875000	0.92625000	109.000000	44.0000000
1	3	1	4	2.92750000	0.38650000	0.36875000	1.29375000	1.13250000	56.875000	88.5000000
1	3	2	4	2.76375000	0.35875000	0.38625000	1.87075000	1.10375000	88.875000	66.6250000
1	3	3	4	2.58000000	0.41975000	0.47500000	1.43125000	1.17250000	97.375000	39.6250000
1	3	4	4	2.49500000	0.34150000	0.49375000	1.64625000	1.10875000	94.875000	49.3750000
1	3	5	4	2.44375000	0.30350000	0.54125000	2.04625000	1.08000000	129.750000	40.7500000
2	1	1	4	2.71375000	0.36150000	0.30375000	1.26625000	1.08500000	77.000000	76.7500000
2	1	2	4	2.32125000	0.38950000	0.32500000	1.32125000	1.10875000	96.125000	60.3750000
2	1	3	4	2.23750000	0.43125000	0.38875000	1.12500000	1.15625000	84.125000	38.7500000
2	1	4	4	2.42250000	0.36350000	0.43625000	1.39500000	1.03500000	90.875000	50.0000000
2	1	5	4	2.29250000	0.31425000	0.48250000	1.73000000	0.99125000	120.125000	48.5000000
2	2	1	4	2.53125000	0.33200000	0.30625000	1.25875000	1.06250000	74.875000	56.0000000
2	2	2	4	2.21000000	0.32100000	0.34250000	1.38500000	1.05375000	91.125000	44.8750000
2	2	3	4	2.14250000	0.36325000	0.38000000	1.25625000	1.08250000	90.750000	31.1250000
2	2	4	4	2.34625000	0.32175000	0.44625000	1.42875000	1.04625000	77.750000	44.1250000
2	2	5	4	2.08875000	0.29125000	0.46625000	1.66625000	0.93500000	145.125000	37.6250000
2	3	1	4	2.45625000	0.38350000	0.35000000	1.28250000	1.14625000	79.625000	75.0000000
2	3	2	4	2.26375000	0.40600000	0.36375000	1.50125000	1.15125000	107.750000	44.2500000
2	3	3	4	2.15125000	0.37575000	0.42250000	1.45000000	1.12000000	112.875000	37.6250000
2	3	4	4	2.44000000	0.37275000	0.43500000	1.72875000	1.15375000	68.375000	45.1250000
2	3	5	4	2.33875000	0.33675000	0.47500000	1.90750000	1.04625000	132.375000	38.5000000
3	1	1	4	2.77625000	0.34150000	0.34750000	1.28875000	1.04000000	73.625000	92.1250000
3	1	2	4	2.74250000	0.38150000	0.35750000	1.47125000	1.10125000	102.875000	51.0000000
3	1	3	4	2.55625000	0.54200000	0.39875000	1.28750000	1.10625000	100.250000	52.6250000
3	1	4	4	2.59125000	0.39400000	0.43000000	1.60000000	1.14375000	100.750000	55.7500000
3	1	5	4	2.61125000	0.35425000	0.47250000	1.76625000	1.12750000	108.625000	48.6250000
3	2	1	4	2.56500000	0.28375000	0.32125000	1.27125000	1.01125000	58.375000	45.3750000
3	2	2	4	2.46375000	0.33400000	0.38875000	1.43125000	1.13750000	105.500000	30.7500000
3	2	3	4	2.31625000	0.46275000	0.42750000	1.13125000	1.08000000	82.000000	27.6250000
3	2	4	4	2.54250000	0.30000000	0.51000000	1.49000000	1.04750000	88.250000	45.7500000
3	2	5	4	2.34000000	0.27250000	0.52250000	1.66000000	1.00125000	143.875000	39.7500000
3	3	1	4	2.64375000	0.30225000	0.39750000	1.29125000	1.00500000	67.625000	63.3750000

TABLE V (Continued)

TRT	CLONE	PICKD	N	N	P	MG	CA	K	FE	MN
3	3	2	4	2.63625000	0.36725000	0.42000000	1.75000000	1.06125000	91.750000	41.2500000
3	3	3	4	2.41375000	0.39600000	0.45500000	1.28375000	1.15625000	101.500000	32.2500000
3	3	4	4	2.69125000	0.37850000	0.53500000	1.70625000	1.18250000	81.750000	49.7500000
3	3	5	4	2.48500000	0.30975000	0.54250000	1.97125000	1.07125000	121.625000	43.8750000
4	1	1	4	2.55875000	0.38700000	0.35000000	1.26375000	1.17875000	84.625000	78.8750000
4	1	2	4	2.39000000	0.47275000	0.32750000	1.32125000	1.15625000	96.500000	46.7500000
4	1	3	4	2.14250000	0.43100000	0.37375000	1.28625000	1.08375000	102.250000	37.5000000
4	1	4	4	2.30250000	0.38775000	0.42250000	1.67625000	1.07125000	82.125000	50.5000000
4	1	5	4	2.10875000	0.37350000	0.44125000	1.84375000	0.97125000	185.875000	43.5000000
4	2	1	4	2.35250000	0.31275000	0.31625000	1.26375000	1.15000000	83.875000	51.6250000
4	2	2	4	2.12875000	0.34075000	0.34000000	1.46625000	1.13750000	83.000000	39.0000000
4	2	3	4	1.96875000	0.34425000	0.37000000	1.32250000	1.04625000	83.875000	30.0000000
4	2	4	4	2.10250000	0.32525000	0.44250000	1.59000000	1.00125000	76.250000	49.6250000
4	2	5	4	1.98500000	0.28875000	0.44625000	1.93500000	0.90750000	187.375000	39.5000000
4	3	1	4	2.57375000	0.37975000	0.32750000	1.27250000	1.23500000	81.500000	65.0000000
4	3	2	4	2.37875000	0.49925000	0.35500000	1.56250000	1.41500000	92.500000	39.2500000
4	3	3	4	2.10750000	0.43950000	0.36625000	1.33625000	1.26125000	87.875000	29.5000000
4	3	4	4	2.29000000	0.43875000	0.42000000	1.62625000	1.18125000	90.000000	45.5000000
4	3	5	4	2.18625000	0.37000000	0.40125000	1.73750000	1.05250000	141.250000	37.5000000
5	1	1	4	2.75625000	0.33425000	0.31375000	1.28125000	1.02125000	61.500000	78.8750000
5	1	2	4	2.68250000	0.41375000	0.38125000	1.47500000	1.19500000	86.875000	63.3750000
5	1	3	4	2.52250000	0.41325000	0.43000000	1.39000000	1.15250000	92.500000	45.3750000
5	1	4	4	2.54250000	0.38650000	0.49750000	1.48625000	1.12625000	67.375000	46.0000900
5	1	5	4	2.53125000	0.32700000	0.52125000	1.97500000	0.93875000	99.375000	47.2500000
5	2	1	4	2.55625000	0.28475000	0.35625000	1.28250000	1.05000000	60.375000	57.8750000
5	2	2	4	2.50500000	0.33375000	0.35875000	1.53375000	1.08625000	85.750000	60.7500000
5	2	3	4	2.40625000	0.37350000	0.41750000	1.25500000	1.16250000	106.500000	34.8750000
5	2	4	4	2.68500000	0.38800000	0.49000000	1.51250000	1.20125000	86.375000	46.2500000
5	2	5	4	2.62500000	0.31925000	0.50875000	1.61000000	1.01750000	104.875000	44.7500000
5	3	1	4	2.72875000	0.32325000	0.31125000	1.24000000	1.02125000	65.750000	51.3750000
5	3	2	4	2.67375000	0.43225000	0.35000000	1.66750000	1.24500000	86.750000	55.8750000
5	3	3	4	2.52875000	0.46300000	0.41500000	1.43250000	1.29750000	100.000000	35.6250000
5	3	4	4	2.72625000	0.41250000	0.46500000	1.62375000	1.19000000	83.875000	42.5000000
5	3	5	4	2.61000000	0.33125000	0.47125000	1.99375000	0.95875000	129.125000	35.3750000
6	1	1	4	2.75375000	0.41150000	0.29500000	1.26375000	1.11625000	88.250000	87.7500000
6	1	2	4	2.64500000	0.46550000	0.29125000	1.37125000	1.11000000	99.125000	78.7500000
6	1	3	4	2.56125000	0.39500000	0.42500000	1.31750000	1.12500000	95.500000	55.3750000
6	1	4	4	2.52625000	0.38575000	0.44375000	1.72375000	1.04625000	75.375000	56.1250000
6	1	5	4	2.32125000	0.31175000	0.49375000	1.96750000	1.04500000	95.125000	55.3750000
6	2	1	4	2.35250000	0.26775000	0.33250000	1.28000000	1.08125000	93.375000	53.2500000
6	2	2	4	2.35000000	0.33025000	0.35375000	1.51125000	1.04250000	106.500000	55.2500000
6	2	3	4	2.27625000	0.32412500	0.43875000	1.15250000	1.08375000	85.000000	33.3750000
6	2	4	4	2.45125000	0.29700000	0.49375000	1.61125000	0.98625000	92.500000	49.6250000
6	2	5	4	2.22750000	0.28025000	0.55500000	1.81750000	0.91500000	115.250000	48.8750000
6	3	1	4	2.64125000	0.33100000	0.35000000	1.28000000	1.04500000	90.000000	63.1250000
6	3	2	4	2.70000000	0.50050000	0.33375000	1.41250000	1.24875000	95.375000	56.3750000
6	3	3	4	2.40250000	0.35600000	0.39500000	1.28000000	1.15625000	131.250000	35.2500000
6	3	4	4	2.63500000	0.38775000	0.46500000	1.61125000	1.07625000	78.500000	48.2500000
6	3	5	4	2.37625000	0.32100000	0.49375000	1.68625000	0.96000000	117.625000	33.8750000

TABLE V (Continued)

TRT	CLONE	PICKD	N	ZN
1	1	1	4	15.000000
1	1	2	4	64.250000
1	1	3	4	33.125000
1	1	4	4	43.375000
1	1	5	4	33.750000
1	2	1	4	14.000000
1	2	2	4	116.250000
1	2	3	4	42.125000
1	2	4	4	37.625000
1	2	5	4	27.125000
1	3	1	4	13.875000
1	3	2	4	78.375000
1	3	3	4	61.875000
1	3	4	4	34.750000
1	3	5	4	25.875000
2	1	1	4	21.875000
2	1	2	4	78.000000
2	1	3	4	58.500000
2	1	4	4	27.750000
2	1	5	4	27.625000
2	2	1	4	44.375000
2	2	2	4	74.375000
2	2	3	4	50.625000
2	2	4	4	46.750000
2	2	5	4	32.500000
2	3	1	4	43.625000
2	3	2	4	98.625000
2	3	3	4	74.250000
2	3	4	4	41.125000
2	3	5	4	29.000000
3	1	1	4	18.625000
3	1	2	4	61.625000
3	1	3	4	67.375000
3	1	4	4	50.250000
3	1	5	4	22.500000
3	2	1	4	13.750000
3	2	2	4	78.375000
3	2	3	4	72.625000
3	2	4	4	33.125000
3	2	5	4	36.750000
3	3	1	4	12.125000
3	3	2	4	56.625000
3	3	3	4	69.375000
3	3	4	4	38.625000
3	3	5	4	34.000000
4	1	1	4	67.750000
4	1	2	4	79.000000
4	1	3	4	92.000000
4	1	4	4	71.625000
4	1	5	4	40.375000
4	2	1	4	86.750000
4	2	2	4	88.125000

TABLE V (Continued)

TRT	CLONE	PICKD	N	ZN
4	2	3	4	46.250000
4	2	4	4	55.000000
4	2	5	4	62.250000
4	3	1	4	43.500000
4	3	2	4	96.875000
4	3	3	4	55.375000
4	3	4	4	41.250000
4	3	5	4	40.250000
5	1	1	4	15.500000
5	1	2	4	122.750000
5	1	3	4	42.500000
5	1	4	4	44.000000
5	1	5	4	29.000000
5	2	1	4	13.000000
5	2	2	4	67.375000
5	2	3	4	74.500000
5	2	4	4	29.125000
5	2	5	4	24.000000
5	3	1	4	18.375000
5	3	2	4	78.750000
5	3	3	4	177.250000
5	3	4	4	44.625000
5	3	5	4	32.500000
6	1	1	4	22.875000
6	1	2	4	176.375000
6	1	3	4	93.375000
6	1	4	4	34.750000
6	1	5	4	45.375000
6	2	1	4	14.750000
6	2	2	4	65.375000
6	2	3	4	115.000000
6	2	4	4	32.625000
6	2	5	4	37.000000
6	3	1	4	24.875000
6	3	2	4	166.875000
6	3	3	4	53.125000
6	3	4	4	43.250000
6	3	5	4	41.250000

LEVEL	PICKD	N	N	P	MG	CA	K	FE	MN
1	1	36	2.74305556	0.37327778	0.31333333	1.26375000	1.15847222	73.305556	64.1666667
1	2	36	2.59416667	0.43855556	0.33958333	1.25847222	1.16430556	95.888889	48.5555556
1	3	36	2.43458333	0.47511111	0.38944444	0.89611111	1.22111111	95.361111	28.4722222
1	4	36	2.63680556	0.42363889	0.44555556	1.11194444	1.23750000	80.472222	43.9166667
1	5	36	2.48486111	0.35559333	0.47152778	1.35347222	1.13805556	124.236111	33.6944444
2	1	36	2.47833333	0.29947222	0.35375000	1.28625000	0.99819444	72.875000	73.3472222
2	2	36	2.38263889	0.33847222	0.37263889	1.75597222	1.11236111	96.638889	57.1527778
2	3	36	2.21361111	0.32451389	0.43791667	1.71944444	1.04291667	98.611111	47.4861111
2	4	36	2.33069444	0.30008333	0.49194444	2.07736111	0.93958333	90.763889	53.3194444
2	5	36	2.19194444	0.27530556	0.51027778	2.27444444	0.85166667	131.458333	48.1111111

TABLE V (Continued)

LEVEL	PICKD	N	ZN
1	1	36	28.1944444
1	2	36	89.8055556
1	3	36	80.6666667
1	4	36	42.8750000
1	5	36	36.8750000
2	1	36	27.8750000
2	2	36	93.3055556
2	3	36	61.4722222
2	4	36	40.4166667
2	5	36	32.1388889

TRT	LEVEL	PICKD	N	N	P	MG	CA	K	FE	MN
1	1	1	6	2.83000000	0.38700000	0.31583333	1.27750000	1.15833333	58.166667	74.4166667
1	1	2	6	2.72083333	0.35033333	0.34416667	1.35000000	1.07833333	98.166667	53.6666667
1	1	3	6	2.47166667	0.41266667	0.41583333	0.94833333	1.18333333	92.000000	31.5833333
1	1	4	6	2.67583333	0.37550000	0.49083333	1.21750000	1.18583333	79.000000	45.8333333
1	1	5	6	2.43916667	0.31283333	0.51333333	1.50500000	1.04666667	119.833333	41.8333333
1	2	1	6	2.52500000	0.29183333	0.36750000	1.29833333	0.94916667	58.666667	86.4166667
1	2	2	6	2.41250000	0.31983333	0.40333333	1.94916667	1.08166667	104.666667	68.6666667
1	2	3	6	2.26166667	0.31133333	0.47916667	1.87416667	1.01416667	101.000000	52.9166667
1	2	4	6	2.26583333	0.27366667	0.51250000	2.04500000	0.88416667	121.666667	54.3333333
1	2	5	6	2.20333333	0.27150000	0.51500000	2.08416667	0.93250000	115.916667	56.4166667
2	1	1	6	2.68666667	0.39883333	0.30416667	1.25333333	1.15916667	77.500000	66.1666667
2	1	2	6	2.29083333	0.41516667	0.33000000	1.13583333	1.10416667	104.916667	45.0000000
2	1	3	6	2.26500000	0.44150000	0.38333333	0.93083333	1.16750000	83.666667	28.7500000
2	1	4	6	2.52333333	0.39200000	0.41916667	1.21583333	1.16333333	82.666667	42.6666667
2	1	5	6	2.38500000	0.35000000	0.46416667	1.31833333	1.11416667	124.666667	38.9166667
2	2	1	6	2.44750000	0.31916667	0.33583333	1.28500000	1.03666667	76.833333	72.3333333
2	2	2	6	2.23916667	0.32916667	0.35750000	1.66916667	1.10500000	91.750000	54.6666667
2	2	3	6	2.08916667	0.33866667	0.41083333	1.62333333	1.07166667	108.166667	42.9166667
2	2	4	6	2.28250000	0.31333333	0.45916667	1.81916667	0.99333333	75.333333	50.1666667
2	2	5	6	2.09500000	0.27816667	0.48500000	2.21750000	0.86750000	140.416667	44.1666667
3	1	1	6	2.75500000	0.33250000	0.33416667	1.27416667	1.10833333	65.916667	61.2500000
3	1	2	6	2.73583333	0.39850000	0.36416667	1.31000000	1.16833333	98.500000	35.8333333
3	1	3	6	2.53583333	0.55566667	0.39916667	0.91250000	1.18000000	87.416667	28.3333333
3	1	4	6	2.74500000	0.42783333	0.44750000	1.03916667	1.27750000	78.750000	42.7500000
3	1	5	6	2.56583333	0.35366667	0.47916667	1.36166667	1.20666667	106.583333	41.8333333
3	2	1	6	2.56833333	0.28583333	0.37666667	1.29333333	0.92916667	67.166667	72.6666667
3	2	2	6	2.49250000	0.32333333	0.41333333	1.79166667	1.03166667	101.583333	46.1666667
3	2	3	6	2.32166667	0.37816667	0.45500000	1.55583333	1.04833333	101.750000	46.6666667
3	2	4	6	2.47166667	0.28716667	0.53583333	2.15833333	0.97166667	101.750000	58.0833333
3	2	5	6	2.39166667	0.27066667	0.54583333	2.23666667	0.92666667	142.833333	46.3333333
4	1	1	6	2.61666667	0.41450000	0.31833333	1.24666667	1.25583333	86.750000	57.8333333
4	1	2	6	2.48083333	0.54366667	0.33750000	1.16500000	1.31416667	92.916667	37.9166667
4	1	3	6	2.25583333	0.50833333	0.36000000	0.79666667	1.28166667	90.333333	22.6666667
4	1	4	6	2.45000000	0.46483333	0.40666667	0.93833333	1.31000000	80.750000	43.3333333
4	1	5	6	2.30666667	0.41116667	0.42083333	1.17416667	1.21166667	166.583333	32.4166667
4	2	1	6	2.37333333	0.30516667	0.34416667	1.28666667	1.12000000	79.916667	72.5000000
4	2	2	6	2.11750000	0.33150000	0.34416667	1.73500000	1.15833333	88.416667	45.4166667
4	2	3	6	1.89000000	0.30150000	0.38000000	1.83333333	0.97916667	92.333333	42.0000000

TABLE V (Continued)

TRT	LEVEL	PICKD	N	N	P	MG	CA	K	FE	MN
4	2	4	6	2.01333333	0.30300000	0.45000000	2.32333333	0.85916667	84.833333	53.7500000
4	2	5	6	1.88000000	0.27700000	0.43833333	2.50333333	0.74250000	176.416667	47.9166667
5	1	1	6	2.87500000	0.35300000	0.30166667	1.26666667	1.10916667	62.416667	58.6666667
5	1	2	6	2.67916667	0.44466667	0.34416667	1.37083333	1.18000000	87.250000	57.7500000
5	1	3	6	2.56250000	0.52050000	0.39333333	0.95333333	1.30833333	104.750000	30.2500000
5	1	4	6	2.84583333	0.47783333	0.46083333	1.04000000	1.32500000	78.416667	41.1666667
5	1	5	6	2.75750000	0.36733333	0.47083333	1.41083333	1.08916667	116.500000	39.1666667
5	2	1	6	2.48583333	0.27516667	0.35250000	1.26916667	0.95250000	62.666667	56.7500000
5	2	2	6	2.56166667	0.34183333	0.38250000	1.74666667	1.17083333	86.333333	62.2500000
5	2	3	6	2.40916667	0.31266667	0.44833333	1.76500000	1.10000000	94.583333	47.0000000
5	2	4	6	2.45666667	0.31350000	0.50750000	2.04166667	1.02000000	80.000000	48.6666667
5	2	5	6	2.42000000	0.28433333	0.53000000	2.30833333	0.85416667	105.750000	45.7500000
6	1	1	6	2.69500000	0.35383333	0.30583333	1.26416667	1.16000000	89.083333	66.6666667
6	1	2	6	2.65750000	0.47900000	0.31750000	1.21916667	1.14083333	93.583333	61.1666667
6	1	3	6	2.51666667	0.41200000	0.38500000	0.83500000	1.20583333	114.000000	29.2500000
6	1	4	6	2.58083333	0.40383333	0.44833333	1.22083333	1.16333333	83.250000	47.7500000
6	1	5	6	2.45500000	0.33850000	0.48083333	1.35083333	1.16000000	111.250000	44.0000000
6	2	1	6	2.47000000	0.31966667	0.34583333	1.28500000	1.00166667	92.000000	69.4166667
6	2	2	6	2.47250000	0.38516667	0.33500000	1.64416667	1.12666667	107.083333	65.7500000
6	2	3	6	2.31000000	0.30475000	0.45416667	1.66500000	1.04416667	93.833333	53.4166667
6	2	4	6	2.49416667	0.30983333	0.48666667	2.07666667	0.90916667	81.000000	54.9166667
6	2	5	6	2.16166667	0.27016667	0.54750000	2.29666667	0.78666667	107.416667	48.0833333

TRT	LEVEL	PICKD	N	ZN
1	1	1	6	14.666667
1	1	2	6	81.916667
1	1	3	6	38.833333
1	1	4	6	37.916667
1	1	5	6	33.416667
1	2	1	6	13.916667
1	2	2	6	90.666667
1	2	3	6	52.583333
1	2	4	6	39.250000
1	2	5	6	24.416667
2	1	1	6	35.250000
2	1	2	6	79.666667
2	1	3	6	68.833333
2	1	4	6	41.250000
2	1	5	6	30.000000
2	2	1	6	38.000000
2	2	2	6	87.666667
2	2	3	6	53.416667
2	2	4	6	35.833333
2	2	5	6	29.416667
3	1	1	6	15.583333
3	1	2	6	65.250000
3	1	3	6	88.333333
3	1	4	6	46.250000
3	1	5	6	28.416667
3	2	1	6	14.083333

TABLE V (Continued)

TRT	LEVEL	PICKD	N	ZN
3	2	2	6	65.833333
3	2	3	6	51.250000
3	2	4	6	35.083333
3	2	5	6	33.750000
4	1	1	6	64.583333
4	1	2	6	85.083333
4	1	3	6	66.833333
4	1	4	6	52.583333
4	1	5	6	55.583333
4	2	1	6	67.416667
4	2	2	6	90.916667
4	2	3	6	62.250000
4	2	4	6	59.333333
4	2	5	6	39.666667
5	1	1	6	17.666667
5	1	2	6	73.750000
5	1	3	6	135.000000
5	1	4	6	42.500000
5	1	5	6	28.833333
5	2	1	6	13.583333
5	2	2	6	105.500000
5	2	3	6	61.166667
5	2	4	6	36.000000
5	2	5	6	28.166667
6	1	1	6	21.416667
6	1	2	6	153.166667
6	1	3	6	86.166667
6	1	4	6	35.750000
6	1	5	6	45.000000
6	2	1	6	20.250000
6	2	2	6	119.250000
6	2	3	6	88.166667
6	2	4	6	37.000000
6	2	5	6	37.416667

CLONE	LEVEL	PICKD	N	N	P	MG	CA	K	FE	MN
1	1	1	12	2.89208333	0.41266667	0.30208333	1.25875000	1.16708333	76.000000	77.2916667
1	1	2	12	2.62166667	0.45600000	0.33500000	1.22333333	1.14333333	94.916667	56.1250000
1	1	3	12	2.46916667	0.50266667	0.39375000	0.90000000	1.22666667	89.708333	33.2083333
1	1	4	12	2.55500000	0.43783333	0.43875000	1.09416667	1.21958333	80.291667	45.2083333
1	1	5	12	2.48541667	0.36766667	0.47416667	1.40833333	1.13166667	129.083333	43.4583333
1	2	1	12	2.54750000	0.32000000	0.34500000	1.28958333	1.00000000	74.166667	91.2500000
1	2	2	12	2.49583333	0.36741667	0.34458333	1.60541667	1.10791667	100.083333	65.1666667
1	2	3	12	2.29125000	0.35650000	0.41416667	1.70083333	1.00375000	100.791667	53.0000000
1	2	4	12	2.38375000	0.31433333	0.46208333	2.05458333	0.93375000	97.416667	58.1666667
1	2	5	12	2.20333333	0.29075000	0.49208333	2.26208333	0.88041667	112.[illegible]	5[illegible]
2	1	1	12	2.54458333	0.31200000	0.30041667	1.26291667	1.11375000	70.166667	51.0416667
2	1	2	12	2.41291667	0.36058333	0.33416667	1.22958333	1.09791667	95.000000	44.2500000
2	1	3	12	2.35208333	0.44766667	0.37250000	0.84208333	1.12750000	88.208333	26.2916667
2	1	4	12	2.64625000	0.37783333	0.44125000	1.04791667	1.17875000	79.916667	43.2500000

TABLE V (Continued)

CLONE	LEVEL	PICKD	N	*N	P	MG	CA	K	FE	MN
2	1	5	12	2.42541667	0.32483333	0.46583333	1.23541667	1.10875000	120 791667	37 8750000
2	2	1	12	2.35625000	0.27150000	0.35208333	1.28541667	0.99416667	71.083333	57.5000000
2	2	2	12	2.26125000	0.29241667	0.38666667	1.72750000	1.07250000	99.916667	50.3750000
2	2	3	12	2.10416667	0.27537500	0.45875000	1.66583333	1.04291667	92.916667	39.4166667
2	2	4	12	2.22500000	0 26391667	0.53250000	2.05708333	0.90166667	90 291667	51.5833333
2	2	5	12	2 10291667	0.25200000	0.53833333	2.19708333	0.79208333	147 708333	46 9583333
3	1	1	12	2.79250000	0.39516667	0.33750000	1.26958333	1.19458333	73.750000	64 1666667
3	1	2	12	2.74791667	0.49908333	0.34958333	1.32250000	1.25166667	97.750000	45 2916667
3	1	3	12	2 48250000	0.47500000	0.40208333	0.94625000	1.30916667	108 166667	25 9166667
3	1	4	12	2 70916667	0.45525000	0.45666667	1.19375000	1.31416667	81.208333	43 2916667
3	1	5	12	2.54375000	0.37425000	0.47458333	1.41666667	1.17375000	122 833333	37.7500000
3	2	1	12	2.53125000	0.30691667	0.36416667	1.28375000	1.00041667	73 375000	71.2916667
3	2	2	12	2 39083333	0.35558333	0.38666667	1.93500000	1.15666667	89 916667	55.9166667
3	2	3	12	2.24541667	0.34166667	0.44083333	1.79166667	1.08208333	102.125000	44 0416667
3	2	4	12	2.38333333	0 32200000	0.48125000	2.12041667	0.98333333	84 583333	50 2083333
3	2	5	12	2.26958333	0 28316667	0.50041667	2.36416667	0.88250000	134.416667	38.8750000

CLONE	LEVEL	PICKD	N	ZN
1	1	1	12	28 208333
1	1	2	12	81 541667
1	1	3	12	65 958333
1	1	4	12	44.333333
1	1	5	12	37.208333
1	2	1	12	25.666667
1	2	2	12	112.458333
1	2	3	12	63 000000
1	2	4	12	46.250000
1	2	5	12	29.000000
2	1	1	12	33.000000
2	1	2	12	92 458333
2	1	3	12	70 125000
2	1	4	12	44.458333
2	1	5	12	36 291667
2	2	1	12	29 208333
2	2	2	12	70 833333
2	2	3	12	63 583333
2	2	4	12	33.625000
2	2	5	12	36 916667
3	1	1	12	23.375000
3	1	2	12	95.416667
3	1	3	12	105 916667
3	1	4	12	39.833333
3	1	5	12	37.125000
3	2	1	12	28 750000
3	2	2	12	96.625000
3	2	3	12	57.833333
3	2	4	12	41.375000
3	2	5	12	30.500000

TABLE V (Continued)

TRT	CLONE	LEVEL	PICKD	N	N	P	MG	CA	K	FE
1	1	1	1	2	2.95000000	0.43000000	0.29000000	1.26250000	1.18750000	65.750000
1	1	1	2	2	2.74250000	0.32650000	0.34250000	1.23500000	1.03500000	97.000000
1	1	1	3	2	2.36250000	0.41750000	0.38500000	0.86750000	1.17500000	88.500000
1	1	1	4	2	2.66000000	0.39500000	0.48750000	1.15750000	1.21000000	79.500000
1	1	1	5	2	2.30500000	0.30750000	0.48750000	1.50750000	1.03500000	141.250000
1	1	2	1	2	2.57000000	0.29450000	0.37250000	1.30000000	0.93250000	65.250000
1	1	2	2	2	2.40000000	0.36800000	0.37000000	1.81750000	1.13000000	110.000000
1	1	2	3	2	2.16000000	0.31250000	0.43000000	1.92500000	0.96000000	105.250000
1	1	2	4	2	2.20250000	0.28300000	0.45750000	1.97250000	0.86500000	153.750000
1	1	2	5	2	2.09750000	0.28150000	0.48750000	1.95000000	0.89000000	88.500000
1	2	1	1	2	2.45250000	0.28200000	0.30500000	1.28250000	1.03750000	51.750000
1	2	1	2	2	2.43750000	0.31750000	0.35250000	1.29750000	1.07750000	112.000000
1	2	1	3	2	2.36500000	0.37100000	0.40500000	0.96250000	1.09500000	91.750000
1	2	1	4	2	2.77750000	0.34650000	0.48750000	1.16750000	1.14750000	72.500000
1	2	1	5	2	2.53250000	0.32050000	0.48500000	1.24750000	1.09500000	95.000000
1	2	2	1	2	2.23750000	0.25700000	0.34500000	1.29500000	0.90000000	54.000000
1	2	2	2	2	2.29250000	0.28100000	0.40500000	1.79000000	1.03000000	111.750000
1	2	2	3	2	2.15250000	0.23150000	0.51500000	1.85000000	1.01750000	98.750000
1	2	2	4	2	2.13500000	0.24000000	0.59000000	2.19750000	0.77000000	106.500000
1	2	2	5	2	2.10500000	0.23650000	0.54250000	1.97000000	0.75750000	123.000000
1	3	1	1	2	3.08750000	0.44900000	0.35250000	1.28750000	1.25000000	57.000000
1	3	1	2	2	2.98250000	0.40700000	0.33750000	1.51750000	1.12250000	85.500000
1	3	1	3	2	2.68750000	0.44950000	0.45750000	1.01500000	1.28000000	95.750000
1	3	1	4	2	2.59000000	0.38500000	0.49750000	1.32750000	1.20000000	85.000000
1	3	1	5	2	2.48000000	0.31050000	0.56750000	1.76000000	1.01000000	123.250000
1	3	2	1	2	2.76750000	0.32400000	0.38500000	1.30000000	1.01500000	56.750000
1	3	2	2	2	2.54500000	0.31050000	0.43500000	2.24000000	1.08500000	92.250000
1	3	2	3	2	2.47250000	0.39000000	0.49250000	1.84750000	1.06500000	93.000000
1	3	2	4	2	2.40000000	0.29800000	0.49000000	1.96500000	1.01750000	104.750000
1	3	2	5	2	2.40750000	0.29650000	0.51500000	2.33250000	1.15000000	136.250000
2	1	1	1	2	2.90000000	0.43550000	0.28750000	1.24250000	1.21750000	79.250000
2	1	1	2	2	2.35500000	0.43800000	0.31250000	1.02500000	1.13500000	110.000000
2	1	1	3	2	2.20250000	0.46850000	0.40000000	0.96250000	1.19750000	82.750000
2	1	1	4	2	2.37000000	0.39050000	0.42500000	1.27500000	1.06750000	106.750000
2	1	1	5	2	2.43250000	0.33400000	0.48250000	1.38500000	1.08750000	117.500000
2	1	2	1	2	2.52750000	0.28750000	0.32000000	1.29000000	0.95250000	74.750000
2	1	2	2	2	2.28750000	0.34100000	0.33750000	1.61750000	1.08250000	82.250000
2	1	2	3	2	2.27250000	0.39400000	0.37750000	1.28750000	1.11500000	85.500000
2	1	2	4	2	2.47500000	0.33650000	0.44750000	1.51500000	1.00250000	75.000000
2	1	2	5	2	2.15250000	0.29450000	0.48250000	2.07500000	0.83500000	122.750000
2	2	1	1	2	2.58000000	0.32800000	0.28750000	1.24500000	1.07500000	73.250000
2	2	1	2	2	2.17500000	0.35500000	0.31750000	1.07750000	1.05500000	87.750000
2	2	1	3	2	2.34500000	0.43050000	0.34000000	0.75250000	1.13500000	81.750000
2	2	1	4	2	2.60250000	0.36800000	0.40500000	0.91500000	1.17250000	72.000000
2	2	1	5	2	2.29000000	0.33350000	0.44000000	1.09750000	1.06750000	135.250000
2	2	2	1	2	2.48250000	0.33600000	0.32500000	1.27250000	1.05000000	76.500000
2	2	2	2	2	2.24500000	0.28700000	0.36750000	1.69250000	1.05250000	94.500000
2	2	2	3	2	1.94000000	0.29600000	0.42000000	1.76000000	1.03000000	99.750000
2	2	2	4	2	2.09000000	0.27550000	0.48750000	1.94250000	0.92000000	83.500000
2	2	2	5	2	1.88750000	0.24900000	0.49250000	2.23500000	0.80250000	155.000000
2	3	1	1	2	2.58000000	0.43300000	0.33750000	1.27250000	1.18500000	80.000000
2	3	1	2	2	2.34250000	0.45250000	0.36000000	1.30500000	1.12250000	117.000000

TABLE V (Continued)

TRT	CLONE	LEVEL	PICKD	N	N	P	MG	CA	K	FE
2	3	1	3	2	2.24750000	0.42550000	0.41000000	1.07750000	1.17000000	86.500000
2	3	1	4	2	2.59750000	0.41750000	0.42750000	1.45750000	1.25000000	69.250000
2	3	1	5	2	2.43250000	0.38250000	0.47000000	1.47250000	1.18750000	121.250000
2	3	2	1	2	2.33250000	0.33400000	0.36250000	1.29250000	1.10750000	79.250000
2	3	2	2	2	2.18500000	0.35950000	0.36750000	1.69750000	1.18000000	98.500000
2	3	2	3	2	2.05500000	0.32600000	0.43500000	1.82250000	1.07000000	139.250000
2	3	2	4	2	2.28250000	0.32800000	0.44250000	2.00000000	1.05750000	67.500000
2	3	2	5	2	2.24500000	0.29100000	0.48000000	2.34250000	0.90500000	143.500000
3	1	1	1	2	2.80000000	0.35500000	0.33750000	1.28500000	1.08250000	76.250000
3	1	1	2	2	2.85500000	0.38850000	0.35000000	1.36750000	1.10500000	87.000000
3	1	1	3	2	2.64250000	0.61900000	0.37500000	0.89750000	1.19250000	85.750000
3	1	1	4	2	2.65000000	0.47800000	0.41500000	0.97500000	1.27500000	80.500000
3	1	1	5	2	2.75000000	0.38950000	0.46750000	1.46000000	1.16750000	123.500000
3	1	2	1	2	2.75250000	0.32800000	0.35750000	1.29250000	0.99750000	71.000000
3	1	2	2	2	2.63000000	0.37450000	0.36500000	1.57500000	1.09750000	118.750000
3	1	2	3	2	2.47000000	0.46500000	0.42250000	1.67750000	1.02000000	114.750000
3	1	2	4	2	2.53250000	0.31000000	0.44500000	2.22500000	1.01250000	121.000000
3	1	2	5	2	2.47250000	0.31900000	0.47750000	2.07250000	1.08750000	93.750000
3	2	1	1	2	2.69000000	0.32750000	0.28750000	1.25250000	1.11250000	56.750000
3	2	1	2	2	2.54500000	0.38350000	0.34750000	1.12750000	1.19250000	111.750000
3	2	1	3	2	2.38250000	0.58950000	0.38750000	0.85750000	1.15000000	78.250000
3	2	1	4	2	2.75000000	0.35650000	0.43500000	0.93250000	1.20000000	78.750000
3	2	1	5	2	2.33750000	0.31000000	0.46250000	1.11750000	1.17500000	108.500000
3	2	2	1	2	2.44000000	0.24000000	0.35500000	1.29000000	0.91000000	60.000000
3	2	2	2	2	2.38250000	0.28450000	0.43000000	1.73500000	1.08250000	99.250000
3	2	2	3	2	2.25000000	0.33600000	0.46750000	1.40500000	1.01000000	85.750000
3	2	2	4	2	2.33500000	0.24350000	0.58500000	2.04750000	0.89500000	97.750000
3	2	2	5	2	2.34250000	0.23500000	0.58250000	2.20250000	0.82750000	179.250000
3	3	1	1	2	2.77500000	0.31500000	0.37750000	1.28500000	1.13000000	64.750000
3	3	1	2	2	2.80750000	0.42350000	0.39500000	1.43500000	1.20750000	96.750000
3	3	1	3	2	2.58250000	0.45850000	0.43500000	0.98250000	1.19750000	98.250000
3	3	1	4	2	2.83500000	0.44900000	0.49250000	1.21000000	1.35750000	77.000000
3	3	1	5	2	2.61000000	0.36150000	0.50750000	1.50750000	1.27750000	87.750000
3	3	2	1	2	2.51250000	0.28950000	0.41750000	1.29750000	0.88000000	70.500000
3	3	2	2	2	2.46500000	0.31100000	0.44500000	2.06500000	0.91500000	86.750000
3	3	2	3	2	2.24500000	0.33350000	0.47500000	1.58500000	1.11500000	104.750000
3	3	2	4	2	2.54750000	0.30800000	0.57750000	2.20250000	1.00750000	86.500000
3	3	2	5	2	2.36000000	0.25800000	0.57750000	2.43500000	0.86500000	155.500000
4	1	1	1	2	2.77750000	0.44150000	0.33250000	1.24000000	1.27250000	90.250000
4	1	1	2	2	2.55250000	0.61100000	0.34000000	1.04750000	1.26000000	92.000000
4	1	1	3	2	2.29750000	0.55900000	0.37750000	0.78000000	1.28750000	99.000000
4	1	1	4	2	2.53000000	0.45900000	0.41000000	0.91750000	1.33000000	74.500000
4	1	1	5	2	2.30750000	0.45650000	0.43750000	1.10750000	1.22750000	186.250000
4	1	2	1	2	2.34000000	0.33250000	0.36750000	1.28750000	1.08500000	79.000000
4	1	2	2	2	2.22750000	0.33450000	0.31500000	1.59500000	1.05250000	101.000000
4	1	2	3	2	1.98750000	0.30300000	0.37000000	1.79250000	0.88000000	106.500000
4	1	2	4	2	2.07500000	0.31650000	0.43500000	2.43500000	0.81250000	89.750000
4	1	2	5	2	1.91000000	0.29050000	0.44500000	2.58000000	0.71500000	185.500000
4	2	1	1	2	2.39500000	0.34800000	0.29500000	1.25250000	1.18000000	88.750000
4	2	1	2	2	2.28750000	0.39700000	0.31500000	1.17250000	1.21500000	84.500000
4	2	1	3	2	2.19250000	0.44450000	0.34000000	0.79000000	1.12500000	80.500000
4	2	1	4	2	2.32000000	0.39300000	0.39250000	0.91750000	1.19000000	68.250000

TABLE V (Continued)

TRT	CLONE	LEVEL	PICKD	N	N	P	MG	CA	K	FE
4	2	1	5	2	2.20500000	0.34200000	0.43250000	1.26500000	1.15500000	164.750000
4	2	2	1	2	2.31000000	0.27750000	0.33750000	1.27500000	1.12000000	79.000000
4	2	2	2	2	1.97000000	0.28450000	0.36500000	1.76000000	1.06000000	81.500000
4	2	2	3	2	1.74500000	0.24400000	0.40000000	1.85500000	0.96750000	87.250000
4	2	2	4	2	1.88500000	0.25750000	0.49250000	2.26250000	0.81250000	84.250000
4	2	2	5	2	1.76500000	0.23550000	0.46000000	2.60500000	0.66000000	210.000000
4	3	1	1	2	2.67750000	0.45400000	0.32750000	1.24750000	1.31500000	81.250000
4	3	1	2	2	2.60250000	0.62300000	0.35750000	1.27500000	1.46750000	102.250000
4	3	1	3	2	2.27750000	0.52150000	0.36250000	0.82000000	1.43250000	92.500000
4	3	1	4	2	2.50000000	0.54250000	0.41750000	0.98000000	1.41000000	99.500000
4	3	1	5	2	2.40750000	0.43500000	0.39250000	1.15000000	1.25250000	148.750000
4	3	2	1	2	2.47000000	0.30550000	0.32750000	1.29750000	1.15500000	81.750000
4	3	2	2	2	2.15500000	0.37550000	0.35250000	1.85000000	1.36250000	82.750000
4	3	2	3	2	1.93750000	0.35750000	0.37000000	1.85250000	1.09000000	83.250000
4	3	2	4	2	2.08000000	0.33500000	0.42250000	2.27250000	0.95250000	80.500000
4	3	2	5	2	1.96500000	0.30500000	0.41000000	2.32500000	0.85250000	133.750000
5	1	1	1	2	3.01250000	0.38200000	0.29000000	1.27000000	1.09750000	57.250000
5	1	1	2	2	2.53250000	0.41000000	0.38750000	1.57000000	1.10500000	83.750000
5	1	1	3	2	2.62000000	0.51500000	0.43000000	1.00250000	1.27250000	90.250000
5	1	1	4	2	2.66250000	0.46100000	0.48000000	1.01500000	1.24750000	66.250000
5	1	1	5	2	2.68250000	0.36850000	0.51000000	1.54750000	1.03750000	112.500000
5	1	2	1	2	2.50000000	0.28650000	0.33750000	1.29250000	0.94500000	65.750000
5	1	2	2	2	2.83250000	0.41750000	0.37500000	1.38000000	1.28500000	90.000000
5	1	2	3	2	2.42500000	0.31150000	0.43000000	1.77750000	1.03250000	94.750000
5	1	2	4	2	2.42250000	0.31200000	0.51500000	1.95750000	1.00500000	68.500000
5	1	2	5	2	2.38000000	0.28550000	0.53250000	2.40250000	0.84000000	86.250000
5	2	1	1	2	2.74000000	0.30300000	0.37000000	1.27250000	1.12250000	60.250000
5	2	1	2	2	2.67000000	0.38250000	0.32750000	1.31500000	1.09250000	88.500000
5	2	1	3	2	2.53250000	0.46000000	0.36250000	0.86750000	1.18750000	117.250000
5	2	1	4	2	2.92250000	0.47900000	0.45750000	1.03500000	1.32750000	87.000000
5	2	1	5	2	2.83250000	0.35450000	0.46750000	1.29000000	1.11250000	110.000000
5	2	2	1	2	2.37250000	0.26650000	0.39250000	1.29250000	0.97750000	60.500000
5	2	2	2	2	2.34000000	0.28500000	0.39000000	1.75250000	1.08000000	85.000000
5	2	2	3	2	2.28000000	0.28700000	0.47250000	1.64250000	1.13750000	95.750000
5	2	2	4	2	2.44750000	0.29700000	0.52250000	1.99000000	1.07500000	85.750000
5	2	2	5	2	2.41750000	0.28400000	0.55000000	1.93000000	0.92250000	99.750000
5	3	1	1	2	2.87250000	0.37400000	0.29500000	1.25750000	1.10750000	69.750000
5	3	1	2	2	2.83500000	0.54150000	0.31750000	1.22750000	1.34250000	89.500000
5	3	1	3	2	2.53500000	0.58650000	0.38750000	0.99000000	1.46500000	106.750000
5	3	1	4	2	2.95250000	0.49350000	0.44500000	1.07000000	1.40000000	82.000000
5	3	1	5	2	2.75750000	0.37900000	0.43500000	1.39500000	1.11750000	127.000000
5	3	2	1	2	2.58500000	0.27250000	0.32750000	1.22250000	0.93500000	61.750000
5	3	2	2	2	2.51250000	0.32200000	0.38250000	2.10750000	1.14750000	84.000000
5	3	2	3	2	2.52250000	0.33950000	0.44250000	1.87500000	1.13000000	93.250000
5	3	2	4	2	2.50000000	0.33150000	0.48500000	2.17750000	0.98000000	85.750000
5	3	2	5	2	2.46250000	0.28350000	0.50750000	2.59250000	0.80000000	131.250000
6	1	1	1	2	2.91250000	0.43200000	0.27500000	1.25250000	1.14500000	87.250000
6	1	1	2	2	2.69250000	0.56200000	0.27750000	1.09500000	1.22000000	99.750000
6	1	1	3	2	2.69000000	0.43700000	0.39500000	0.89000000	1.23500000	93.000000
6	1	1	4	2	2.45750000	0.44350000	0.41500000	1.22500000	1.18750000	74.250000
6	1	1	5	2	2.43500000	0.35000000	0.46000000	1.44250000	1.23500000	93.500000
6	1	2	1	2	2.59500000	0.39100000	0.31500000	1.27500000	1.08750000	89.250000

TABLE V (Continued)

TRT	CLONE	LEVEL	PICKD	N	N	P	MG	CA	K	FE
6	1	2	2	2	2.59750000	0.36900000	0.30500000	1.64750000	1.00000000	98.500000
6	1	2	3	2	2.43250000	0.35300000	0.45500000	1.74500000	1.01500000	98.000000
6	1	2	4	2	2.59500000	0.32800000	0.47250000	2.22250000	0.90500000	76.500000
6	1	2	5	2	2.20750000	0.27350000	0.52750000	2.49250000	0.85500000	96.750000
6	2	1	1	2	2.41000000	0.28350000	0.30750000	1.27250000	1.15500000	90.250000
6	2	1	2	2	2.36250000	0.32800000	0.34500000	1.38750000	0.95500000	85.500000
6	2	1	3	2	2.29500000	0.39050000	0.40000000	0.82250000	1.07250000	79.750000
6	2	1	4	2	2.50500000	0.32400000	0.47000000	1.32000000	1.03500000	101.000000
6	2	1	5	2	2.35500000	0.28850000	0.50750000	1.39500000	1.04750000	111.250000
6	2	2	1	2	2.29500000	0.25200000	0.35750000	1.28750000	1.00750000	96.500000
6	2	2	2	2	2.33750000	0.33250000	0.36250000	1.63500000	1.13000000	127.500000
6	2	2	3	2	2.25750000	0.25775000	0.47750000	1.48250000	1.09500000	99.250000
6	2	2	4	2	2.39750000	0.27000000	0.51750000	1.90250000	0.93750000	84.000000
6	2	2	5	2	2.10000000	0.27200000	0.60250000	2.24000000	0.78250000	119.250000
6	3	1	1	2	2.76250000	0.34600000	0.33500000	1.26750000	1.18000000	89.750000
6	3	1	2	2	2.91750000	0.54700000	0.33000000	1.17500000	1.24750000	95.500000
6	3	1	3	2	2.56500000	0.40850000	0.36000000	0.79250000	1.31000000	169.250000
6	3	1	4	2	2.78000000	0.44400000	0.46000000	1.11750000	1.26750000	74.500000
6	3	1	5	2	2.57500000	0.37700000	0.47500000	1.21500000	1.19750000	129.000000
6	3	2	1	2	2.52000000	0.31600000	0.36500000	1.29250000	0.91000000	90.250000
6	3	2	2	2	2.48250000	0.45400000	0.33750000	1.65000000	1.25000000	95.250000
6	3	2	3	2	2.24000000	0.30350000	0.43000000	1.76750000	1.02250000	93.250000
6	3	2	4	2	2.49000000	0.33150000	0.47000000	2.10500000	0.88500000	82.500000
6	3	2	5	2	2.17750000	0.26500000	0.51250000	2.15750000	0.72250000	106.250000

TRT	CLONE	LEVEL	PICKD	N	MN	ZN
1	1	1	1	2	76.500000	15.500000
1	1	1	2	2	54.250000	61.500000
1	1	1	3	2	31.750000	27.000000
1	1	1	4	2	47.000000	34.250000
1	1	1	5	2	42.250000	43.750000
1	1	2	1	2	106.000000	14.500000
1	1	2	2	2	73.000000	67.000000
1	1	2	3	2	62.250000	39.250000
1	1	2	4	2	56.500000	52.500000
1	1	2	5	2	83.000000	23.750000
1	2	1	1	2	61.750000	14.500000
1	2	1	2	2	49.500000	104.750000
1	2	1	3	2	32.750000	40.250000
1	2	1	4	2	43.750000	45.750000
1	2	1	5	2	40.250000	30.000000
1	2	2	1	2	61.250000	13.500000
1	2	2	2	2	57.000000	127.750000
1	2	2	3	2	47.500000	44.000000
1	2	2	4	2	54.500000	29.500000
1	2	2	5	2	47.750000	24.250000
1	3	1	1	2	85.000000	14.000000
1	3	1	2	2	57.250000	79.500000
1	3	1	3	2	30.250000	49.250000
1	3	1	4	2	46.750000	33.750000

TABLE V (Continued)

TRT	CLONE	LEVEL	PICKD	N	MN	ZN
1	3	1	5	2	43.000000	26.500000
1	3	2	1	2	92.000000	13.750000
1	3	2	2	2	76.000000	77.250000
1	3	2	3	2	49.000000	74.500000
1	3	2	4	2	52.000000	35.750000
1	3	2	5	2	38.500000	25.250000
2	1	1	1	2	72.000000	25.750000
2	1	1	2	2	55.750000	59.500000
2	1	1	3	2	32.000000	58.750000
2	1	1	4	2	46.750000	27.750000
2	1	1	5	2	45.250000	31.000000
2	1	2	1	2	81.500000	18.000000
2	1	2	2	2	65.000000	96.500000
2	1	2	3	2	45.500000	58.250000
2	1	2	4	2	53.250000	27.750000
2	1	2	5	2	51.750000	24.250000
2	2	1	1	2	54.000000	47.750000
2	2	1	2	2	40.750000	113.750000
2	2	1	3	2	25.500000	57.250000
2	2	1	4	2	38.000000	49.250000
2	2	1	5	2	34.250000	27.000000
2	2	2	1	2	58.000000	41.000000
2	2	2	2	2	49.000000	35.000000
2	2	2	3	2	36.750000	44.000000
2	2	2	4	2	50.250000	44.250000
2	2	2	5	2	41.000000	38.000000
2	3	1	1	2	72.500000	32.250000
2	3	1	2	2	38.500000	65.750000
2	3	1	3	2	28.750000	90.500000
2	3	1	4	2	43.250000	46.750000
2	3	1	5	2	37.250000	32.000000
2	3	2	1	2	77.500000	55.000000
2	3	2	2	2	50.000000	131.500000
2	3	2	3	2	46.500000	58.000000
2	3	2	4	2	47.000000	35.500000
2	3	2	5	2	39.750000	26.000000
3	1	1	1	2	86.250000	21.250000
3	1	1	2	2	48.750000	35.000000
3	1	1	3	2	36.750000	84.500000
3	1	1	4	2	43.000000	61.500000
3	1	1	5	2	47.750000	23.000000
3	1	2	1	2	98.000000	16.000000
3	1	2	2	2	53.250000	88.250000
3	1	2	3	2	68.500000	50.250000
3	1	2	4	2	68.500000	39.000000
3	1	2	5	2	49.500000	22.000000
3	2	1	1	2	37.750000	14.000000
3	2	1	2	2	23.750000	101.000000
3	2	1	3	2	24.000000	102.250000
3	2	1	4	2	40.750000	36.000000
3	2	1	5	2	34.750000	29.750000
3	2	2	1	2	53.000000	13.500000

TABLE V (Continued)

TRT	CLONE	LEVEL	PICKD	N*	MN	ZN
3	2	2	2	2	37.750000	55.750000
3	2	2	3	2	31.250000	43.000000
3	2	2	4	2	50.750000	30.250000
3	2	2	5	2	44.750000	43.750000
3	3	1	1	2	59.750000	11.500000
3	3	1	2	2	35.000000	59.750000
3	3	1	3	2	24.250000	78.250000
3	3	1	4	2	44.500000	41.250000
3	3	1	5	2	43.000000	32.500000
3	3	2	1	2	67.000000	12.750000
3	3	2	2	2	47.500000	53.500000
3	3	2	3	2	40.250000	60.500000
3	3	2	4	2	55.000000	36.000000
3	3	2	5	2	44.750000	35.500000
4	1	1	1	2	71.250000	59.500000
4	1	1	2	2	42.250000	111.250000
4	1	1	3	2	25.000000	80.250000
4	1	1	4	2	43.750000	46.000000
4	1	1	5	2	30.750000	42.500000
4	1	2	1	2	86.500000	76.000000
4	1	2	2	2	51.250000	46.750000
4	1	2	3	2	50.000000	103.750000
4	1	2	4	2	57.250000	97.250000
4	1	2	5	2	56.250000	38.250000
4	2	1	1	2	43.750000	94.500000
4	2	1	2	2	35.500000	82.750000
4	2	1	3	2	22.000000	48.250000
4	2	1	4	2	45.500000	74.000000
4	2	1	5	2	32.250000	69.750000
4	2	2	1	2	59.500000	79.000000
4	2	2	2	2	42.500000	93.500000
4	2	2	3	2	38.000000	44.250000
4	2	2	4	2	53.750000	36.000000
4	2	2	5	2	46.750000	54.750000
4	3	1	1	2	58.500000	39.750000
4	3	1	2	2	36.000000	61.250000
4	3	1	3	2	21.000000	72.000000
4	3	1	4	2	40.750000	37.750000
4	3	1	5	2	34.250000	54.500000
4	3	2	1	2	71.500000	47.250000
4	3	2	2	2	42.500000	132.500000
4	3	2	3	2	38.000000	36.750000
4	3	2	4	2	50.250000	44.750000
4	3	2	5	2	40.750000	26.000000
5	1	1	1	2	71.250000	17.000000
5	1	1	2	2	63.500000	51.250000
5	1	1	3	2	32.750000	48.750000
5	1	1	4	2	40.000000	60.000000
5	1	1	5	2	42.750000	32.750000
5	1	2	1	2	86.500000	14.000000
5	1	2	2	2	63.250000	194.250000
5	1	2	3	2	58.000000	36.250000

TABLE V (Continued)

TRT	CLONE	LEVEL	PICKD	N	MN	ZN
5	1	2	4	2	52.000000	28.000000
5	1	2	5	2	51.750000	25.250000
5	2	1	1	2	55.750000	13.750000
5	2	1	2	2	58.250000	74.250000
5	2	1	3	2	27.750000	64.500000
5	2	1	4	2	44.250000	32.250000
5	2	1	5	2	40.250000	23.000000
5	2	2	1	2	60.000000	12.250000
5	2	2	2	2	63.250000	60.500000
5	2	2	3	2	42.000000	84.500000
5	2	2	4	2	49.250000	26.000000
5	2	2	5	2	49.250000	25.000000
5	3	1	1	2	49.000000	22.250000
5	3	1	2	2	51.500000	95.750000
5	3	1	3	2	30.250000	291.750000
5	3	1	4	2	39.250000	35.250000
5	3	1	5	2	34.500000	30.750000
5	3	2	1	2	53.750000	14.500000
5	3	2	2	2	60.250000	61.750000
5	3	2	3	2	41.000000	62.750000
5	3	2	4	2	45.750000	54.000000
5	3	2	5	2	36.250000	34.250000
6	1	1	1	2	86.500000	30.250000
6	1	1	2	2	72.250000	170.750000
6	1	1	3	2	41.000000	96.500000
6	1	1	4	2	50.750000	36.500000
6	1	1	5	2	52.000000	50.250000
6	1	2	1	2	89.000000	15.500000
6	1	2	2	2	85.250000	182.000000
6	1	2	3	2	69.750000	90.250000
6	1	2	4	2	61.500000	33.000000
6	1	2	5	2	58.750000	40.500000
6	2	1	1	2	53.250000	13.500000
6	2	1	2	2	57.750000	78.250000
6	2	1	3	2	25.750000	108.250000
6	2	1	4	2	47.250000	29.500000
6	2	1	5	2	45.500000	38.250000
6	2	2	1	2	53.250000	16.000000
6	2	2	2	2	52.750000	52.500000
6	2	2	3	2	41.000000	121.750000
6	2	2	4	2	52.000000	35.750000
6	2	2	5	2	52.250000	35.750000
6	3	1	1	2	60.250000	20.500000
6	3	1	2	2	53.500000	210.500000
6	3	1	3	2	21.000000	53.750000
6	3	1	4	2	45.250000	44.250000
6	3	1	5	2	34.500000	46.500000
6	3	2	1	2	66.000000	29.250000
6	3	2	2	2	59.250000	123.250000
6	3	2	3	2	49.500000	52.500000
6	3	2	4	2	51.250000	42.250000
6	3	2	5	2	33.250000	36.000000

TABLE VI

STATISTICAL ANALYSIS OF FOLIAR NITROGEN

DEPENDENT VARIABLE: N

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	197	24.69166951	0.12533842	3.85	0.0001	0.823839	7.3714
ERROR	162	5.27979375	0.03259132		STD DEV		N MEAN
CORRECTED TOTAL	359	29.97146326			0.18053066		2.44906944

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	5.81064951	35.66	0.0001
PLOT(TRT)	6	0.90063792	4.61	0.0002
CLONE	2	2.03567597	31.23	0.0001
TRT*CLONE	10	0.74005153	2.27	0.0163
PLOT*CLONE(TRT)	12	0.47098083	1.20	0.2842
LEVEL	1	6.04895063	185.60	0.0001
TRT*LEVEL	5	0.33004896	2.03	0.0770
CLONE*LEVEL	2	0.07734125	1.19	0.3079
TRT*CLONE*LEVEL	10	0.28571792	0.88	0.5563
PICKD	4	4.08511153	31.34	0.0001
TRT*PICKD	20	0.91625847	1.41	0.1262
CLONE*PICKD	8	0.48905181	1.88	0.0671
TRT*CLONE*PICKD	40	0.83790819	0.64	0.9490
LEVEL*PICKD	4	0.12783514	0.98	0.4198
TRT*LEVEL*PICKD	20	0.41352986	0.63	0.8823
CLONE*LEVEL*PICKD	8	0.40479069	1.55	0.1431
TRT*CLONE*LEVEL*PICK	40	0.71712931	0.55	0.9858

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	5.81064951	7.74	0.0135

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT*CLONE(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
CLONE	2	2.03567597	25.93	0.0001
TRT*CLONE	10	0.74005153	1.89	0.1483

TABLE VII

STATISTICAL ANALYSIS OF FOLIAR PHOSPHORUS

DEPENDENT VARIABLE: P

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	197	2.70422779	0.01372704	3.60	0.0001	0.813999	17.1366
ERROR	162	0.61792446	0.00381435		STD DEV		P MEAN
CORRECTED TOTAL	359	3.32215225			0.06176041		0.36040139

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	0.09812264	5.14	0.0002
PLOT(TRT)	6	0.08484484	3.71	0.0018
CLONE	2	0.32667546	42.82	0.0001
TRT•CLONE	10	0.07189697	1.88	0.0507
PLOT•CLONE(TRT)	12	0.08746132	1.91	0.0365
LEVEL	1	1.00483717	263.44	0.0001
TRT•LEVEL	5	0.09196004	4.82	0.0004
CLONE•LEVEL	2	0.00888818	1.17	0.3145
TRT•CLONE•LEVEL	10	0.02801178	0.73	0.6913
PICKD	4	0.35597328	23.33	0.0001
TRT•PICKD	20	0.18179577	2.38	0.0015
CLONE•PICKD	8	0.03606369	1.18	0.3130
TRT•CLONE•PICKD	40	0.09383176	0.61	0.9637
LEVEL•PICKD	4	0.07253400	4.75	0.0012
TRT•LEVEL•PICKD	20	0.05062215	0.66	0.8571
CLONE•LEVEL•PICKD	8	0.02632141	0.86	0.5494
TRT•CLONE•LEVEL•PICK	40	0.08438734	0.55	0.9851

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	0.09812264	1.39	0.3471

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT•CLONE(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
CLONE	2	0.32667546	22.41	0.0001
TRT•CLONE	10	0.07189697	0.99	0.5014

TABLE VIII

STATISTICAL ANALYSIS OF FOLIAR POTASSIUM

DEPENDENT VARIABLE: K

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	197	8.87297250	0.04504047	3.92	0.0001	0.826432	9.8721
ERROR	162	1.86350500	0.01150312		STD DEV		K MEAN
CORRECTED TOTAL	359	10.73647750			0.10725259		1.08641667

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	0.21156917	3.68	0.0037
PLOT(TRT)	6	0.27399333	3.97	0.0010
CLONE	2	0.51050167	22.19	0.0001
TRT*CLONE	10	0.21406167	1.86	0.0542
PLOT*CLONE(TRT)	12	0.31632667	2.29	0.0102
LEVEL	1	3.42030028	297.34	0.0001
TRT*LEVEL	5	0.26883972	4.67	0.0006
CLONE*LEVEL	2	0.05980389	2.60	0.0774
TRT*CLONE*LEVEL	10	0.27571111	2.40	0.0111
PICKD	4	0.95232403	20.70	0.0001
TRT*PICKD	20	0.54716764	2.38	0.0015
CLONE*PICKD	8	0.06873722	0.75	0.6499
TRT*CLONE*PICKD	40	0.31521611	0.69	0.9195
LEVEL*PICKD	4	0.73614069	16.00	0.0001
TRT*LEVEL*PICKD	20	0.25374431	1.10	0.3512
CLONE*LEVEL*PICKD	8	0.07623639	0.83	0.5787
TRT*CLONE*LEVEL*PICK	40	0.37229861	0.81	0.7815

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	0.21156917	0.93	0.5233

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT*CLONE(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
CLONE	2	0.51050167	9.68	0.0031
TRT*CLONE	10	0.21406167	0.81	0.6241

TABLE IX

STATISTICAL ANALYSIS OF FOLIAR CALCIUM

DEPENDENT VARIABLE: CA

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	197	73.99776472	0.37562317	7.11	0.0001	0.896359	15.3238
ERROR	162	8.55595750	0.05281455		STD DEV		CA MEAN
CORRECTED TOTAL	359	82.55372222			0.22981417		1.49972222

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	0.38323222	1.45	0.2077
PLOT(TRT)	6	1.34907500	4.26	0.0005
CLONE	2	0.78878014	7.47	0.0008
TRT*CLONE	10	0.76055236	1.44	0.1670
PLOT*CLONE(TRT)	12	1.11494250	1.76	0.0591
LEVEL	1	37.55198028	711.02	0.0001
TRT*LEVEL	5	0.97690972	3.70	0.0035
CLONE*LEVEL	2	0.07389181	0.70	0.4983
TRT*CLONE*LEVEL	10	0.81587069	1.54	0.1279
PICKD	4	14.05117014	66.51	0.0001
TRT*PICKD	20	0.67536153	0.64	0.8782
CLONE*PICKD	8	0.47938236	1.13	0.3428
TRT*CLONE*PICKD	40	1.08314347	0.51	0.9926
LEVEL*PICKD	4	11.15798986	52.82	0.0001
TRT*LEVEL*PICKD	20	1.40526181	1.33	0.1667
CLONE*LEVEL*PICKD	8	0.15409847	0.36	0.9378
TRT*CLONE*LEVEL*PICK	40	1.17612236	0.56	0.9842

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	0.38323222	0.34	0.8711

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT*CLONE(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
CLONE	2	0.78878014	4.24	0.0404
TRT*CLONE	10	0.76055236	0.82	0.6192

TABLE X

STATISTICAL ANALYSIS OF FOLIAR MAGNESIUM

DEPENDENT VARIABLE: MG

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	197	2.14274535	0.01087688	9.27	0.0001	0.918550	8.3003
ERROR	162	0.19000125	0.00117285		STD DEV		MG MEAN
CORRECTED TOTAL	359	2.33274660			0.03424686		0.41259722

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	0.14782451	25.21	0.0001
PLOT(TRT)	6	0.06723625	9.55	0.0001
CLONE	2	0.02788931	11.89	0.0001
TRT*CLONE	10	0.07493903	6.39	0.0001
PLOT*CLONE(TRT)	12	0.08652500	6.15	0.0001
LEVEL	1	0.15438063	131.63	0.0001
TRT*LEVEL	5	0.01438896	2.45	0.0354
CLONE*LEVEL	2	0.03984125	16.98	0.0001
TRT*CLONE*LEVEL	10	0.00927542	0.79	0.6376
PICKD	4	1.34831014	287.40	0.0001
TRT*PICKD	20	0.05804736	2.47	0.0009
CLONE*PICKD	8	0.01775653	1.89	0.0644
TRT*CLONE*PICKD	40	0.04376097	0.93	0.5892
LEVEL*PICKD	4	0.00274542	0.59	0.6738
TRT*LEVEL*PICKD	20	0.01882875	0.80	0.7078
CLONE*LEVEL*PICKD	8	0.01017125	1.08	0.3769
TRT*CLONE*LEVEL*PICK	40	0.02082458	0.44	0.9983

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	0.14782451	2.64	0.1346

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT*CLONE(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
CLONE	2	0.02788931	1.93	0.1871
TRT*CLONE	10	0.07493903	1.04	0.4678

TABLE XI

STATISTICAL ANALYSIS OF FOLIAR IRON

DEPENDENT VARIABLE: FE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	197	269598.63055555	1368.52096729	2.31	0.0001	0.737572	25.3577
ERROR	162	95923.32500000	592.11929012		STD DEV		FE MEAN
CORRECTED TOTAL	359	365521.95555556			24.33350139		95.96111111

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	7959.15555556	2.69	0.0230
PLOT(TRT)	6	17727.13333333	4.99	0.0001
CLONE	2	131.47638889	0.11	0.8950
TRT*CLONE	10	5392.24861111	0.91	0.5249
PLOT*CLONE(TRT)	12	6266.79166666	0.88	0.5665
LEVEL	1	1600.22500000	2.70	0.1021
TRT*LEVEL	5	4370.04166667	1.48	0.1993
CLONE*LEVEL	2	1405.61250000	1.19	0.3078
TRT*CLONE*LEVEL	10	4081.39583333	0.69	0.7334
PICKD	4	118650.25416667	50.10	0.0001
TRT*PICKD	20	40940.46250000	3.46	0.0001
CLONE*PICKD	8	5659.74583333	1.19	0.3052
TRT*CLONE*PICKD	40	19905.86250000	0.84	0.7361
LEVEL*PICKD	4	1448.78194444	0.61	0.6548
TRT*LEVEL*PICKD	20	10936.78472222	0.92	0.5582
CLONE*LEVEL*PICKD	8	6659.90138889	1.41	0.1976
TRT*CLONE*LEVEL*PICK	40	16462.75694445	0.70	0.9112

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	7959.15555556	0.54	0.7430

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT*CLONE(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
CLONE	2	131.47638889	0.13	0.8829
TRT*CLONE	10	5392.24861111	1.03	0.4720

TABLE XII

STATISTICAL ANALYSIS OF FOLIAR ZINC

DEPENDENT VARIABLE: ZN

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	197	579945.20625000	2943.88429569	2.46	0.0001	0.749357	64.8459
ERROR	162	193978.23750000	1197.39652778		STD DEV		ZN MEAN
CORRECTED TOTAL	359	773923.44375000			34.60341786		53.36250000

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	27063.53958333	4.52	0.0008
PLOT(TRT)	6	26804.46250000	3.73	0.0017
CLONE	2	1283.43750000	0.54	0.5862
TRT*CLONE	10	17782.40416667	1.49	0.1491
PLOT*CLONE(TRT)	12	14774.67500000	1.03	0.4255
LEVEL	1	1939.05625000	1.62	0.2050
TRT*LEVEL	5	2103.30625000	0.35	0.8812
CLONE*LEVEL	2	3237.50416667	1.35	0.2617
TRT*CLONE*LEVEL	10	13705.52083333	1.14	0.3324
PICKD	4	209271.88472222	43.69	0.0001
TRT*PICKD	20	59440.37361111	2.48	0.0009
CLONE*PICKD	8	7554.94444444	0.79	0.6133
TRT*CLONE*PICKD	40	86427.67222222	1.80	0.0055
LEVEL*PICKD	4	5427.49583333	1.13	0.3428
TRT*LEVEL*PICKD	20	21468.57916667	0.90	0.5919
CLONE*LEVEL*PICKD	8	13835.68333333	1.44	0.1818
TRT*CLONE*LEVEL*PICK	40	67824.66666667	1.42	0.0685

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	27063.53958333	1.21	0.4047

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT*CLONE(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
CLONE	2	1283.43750000	0.52	0.6067
TRT*CLONE	10	17782.40416667	1.44	0.2697

TABLE XIII

STATISTICAL ANALYSIS OF FOLIAR MANGANESE

DEPENDENT VARIABLE: MN

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	197	102059.87222222	518.07041737	7.20	0.0001	0.897440	16.8281
ERROR	162	11663.45000000	71.99660494		STD DEV		MN MEAN
CORRECTED TOTAL	359	113723.32222222			8.48508132		50.42222222

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	5078.81388889	14.11	0.0001
PLOT(TRT)	6	7849.69166667	18.17	0.0001
CLONE	2	12923.31805556	89.75	0.0001
TRT*CLONE	10	2751.99027778	3.82	0.0001
PLOT*CLONE(TRT)	12	4390.60833333	5.08	0.0001
LEVEL	1	10736.54444444	149.13	0.0001
TRT*LEVEL	5	528.74722222	1.47	0.2017
CLONE*LEVEL	2	885.93472222	6.15	0.0027
TRT*CLONE*LEVEL	10	588.12361111	0.82	0.6128
PICKD	4	39071.82222222	135.67	0.0001
TRT*PICKD	20	5100.22777778	3.54	0.0001
CLONE*PICKD	8	5010.39027778	8.70	0.0001
TRT*CLONE*PICKD	40	2975.88472222	1.03	0.4279
LEVEL*PICKD	4	1485.01111111	5.16	0.0006
TRT*LEVEL*PICKD	20	731.32222222	0.51	0.9605
CLONE*LEVEL*PICKD	8	576.63472222	1.00	0.4373
TRT*CLONE*LEVEL*PICK	40	1374.80694444	0.48	0.9963

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
TRT	5	5078.81388889	0.78	0.6005

TESTS OF HYPOTHESES USING THE ANOVA MS FOR PLOT*CLONE(TRT) AS AN ERROR TERM

SOURCE	DF	ANOVA SS	F VALUE	PR > F
CLONE	2	12923.31805556	17.66	0.0003
TRT*CLONE	10	2751.99027778	0.75	0.6695

TABLE XIV

STATISTICAL ANALYSIS OF SOIL MOISTURE

SOURCE	DF	SS	F	OSL
TRT[1]	5	90.14	0.75	0.6138
PLOT (TRT)	6	143.77	2.15	0.0493
LEVEL	2	49.06	2.20	0.1132
TRT*LEVEL	10	558.96	5.02	0.0001
SAMPLE DATE	10	10162.65	91.30	0.0001
TRT*SAMPLE DATE	50	602.09	1.08	0.3461
LEVEL*SAMPLE DATE	20	916.43	4.12	0.0001
TRT*LEVEL*SAMPLE DATE	100	979.61	0.88	0.7606
MODEL	203	13502.69	5.98	0.0001
ERROR	192	2137.22		
CORRECTED TOTAL	395	15639.92		

R-SQUARE = 0.86

C.V. = 36.32

STD DEV = 3.34

SOIL MOISTURE MEAN = 9.19

[1]TEST OF HYPOTHESES USING THE MS FOR PLOT(TRT) AS AN ERROR TERM.

APPENDIX B

LABORATORY PROCEDURES

TOTAL PHOSPHORUS IN PLANT MATERIAL

A colorimetric procedure is usually recommended for the determination of total phosphorus in plant material. The procedure involves the combination of molybdate ion complex with the orthophosphate in acid solution which is then reduced with hydrazine sulfate to form a blue-colored phosphomolybdate complex. The intensity of the blue color increases in proportion to the quantity of phosphorus present in the sample (37).

Material and Method

Weight one gram of finely ground plant sample into a 200 ml. tall form beaker. Add 10 ml. of a solution containing 3 parts of concentrated nitric acid (70%) and 1 part of perchloric acid (72%). Cover the beaker with a ribbed watch glass and allow to stand for 4 to 24 hours to assure nitric acid digestion. Next place the beaker on an electric hot plate and digest at high heat for 10 minutes, then reduce heat to low setting and continue to heat until nitrous oxides have been expelled. Continue heating gently until dense white fumes of perchloric acid appear. Continue heating gently until the solution is colorless and the dehydrated silica residue is white. The bottom of the beaker should contain a slurry of acid and the dehyrdrated silica.

Remove the beaker from the hot plate and cool to room temperature. Rinse the cover glass with a thin stream of distilled water from a wash bottle into the beaker and then filter the solution through a #2 or #30 Whatman 12.5 cm. filter paper fitted to a 75 mm. fluted pryrex funnel. After filtering transfer the contents and washings to a 100 ml. volumetric flask and dilute to the mark.

Transfer 10 ml. of the filtrate to a 200 ml. flask. Add 100 ml. of distilled water and mix, then add 5 ml. of 2% sodium molybdate and mix. Finally, add 5 ml. of the 2% hydrazine sulfate reducing solution and mix. Place flask with contents on a hotplate and heat bringing it to a gentle boil for one minute. If blue color does not appear within one minute after it begins to boil, add more hydrazine sulfate and boil for an additional one minute. If no blue appears the starting aliquot is too small and the procedure must be repeated with a larger qliquot. After boiling, the solution is removed from the hotplate and cooled to room temperature and brought to volume in a 200 ml. volumetric flask with distilled water. Mix the solution by pouring back into another flask and obtain a light absorption, transmission, or concentration reading on a calibrated spectrophotometer with the spectrophotometer set at 660 nanometers. Finally, correct the reading for volume.

ATOMIC ABSORPTION SPECTROPHOTOMETRY

Using atomic absorption spectrophotometry, comparisons of unknown solutions can be made against known standards to determine elemental concentrations of the solutions. This method gives a very accurate quantitative determination of such metals as potassium, calcium, magnesium, iron, zinc, manganese, and many others. Modern commercial atomic absorption spectrophotometers provide a quick and easy method for elemental concentration determination in extracts from such things as soil, rock, runoff, and plants (9, 41, 42).

Material and Method

Using a prepared series of working standards for each element of interest within the concentration ranges expected, calibrate the atomic absorption spectrophotometer. Always use a 1% $LaCl_3$ solution when preparing calcium and magnesium standards.

The next step is to take absorbance or concentration readings using the 100 ml. dilution of 3 to 1 nitric perchloric acid digested plant material, being sure to use a 1% $LaCl_3$ solution when measuring calcium and magnesium content.

APPENDIX C

SOIL NUTRIENT SURVEY

TABLE XV

SUMMARY OF SOIL TESTING RESULTS BEFORE THE STUDY FOR OKLARED VERY FINE SANDY LOAM*

Depth (cm)	pH	kgs/ha					ppm		
		NO_3	P	K	Ca	Mg	Fe	Zn	Mn
0-30	7.7	12	37	137	4154	114	18.5	0.24	5.5
31-60	8.2	7	19	80	3926	85	11.0	0.14	2.6
61-90	8.1	6	20	78	4009	84	9.7	0.20	2.1
91-120	8.3	3	17	81	4116	87	10.0	0.22	1.9

*Each value in the table is the mean of four composite soil samples.

TABLE XVI

SUMMARY OF SOIL TESTING RESULTS AFTER THE STUDY FOR OKLARED VERY FINE SANDY LOAM*

Depth (cm)	pH	kgs/ha					ppm		
		NO_3	P	K	Ca	Mg	Fe	Zn	Mn
0-30	8.1	11	20	72	2346	48	11.4	0.71	3.1
31-60	8.2	13	16	57	2553	71	13.0	0.20	2.9
61-90	8.3	15	17	66	3519	71	13.0	0.07	2.7
91-120	8.2	16	15	66	3219	63	10.0	0.22	1.9

*Each value in the table is the mean of four composite soil samples.

VITA [2]

Robert Alan Heinemann

Candidate for the Degree of

Master of Science

Thesis: FOLIAR NUTRIENT ANALYSIS OF COTTONWOOD ON A MARGINAL SITE UNDER VARIOUS CULTURAL TREATMENTS

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