FERTILITY LEVELS OF OKLAHOMA ROADSIDES

By

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CHAPTER I

INTRODUCTION

The Oklahoma highway system consists of over 15,000 miles of federal and state highways. Along with these highways there are over 826,000 acres of roadside area. This amount of area was once more or less stable with native vegetation until the advent of the highway system. These acres were then disturbed with much of the native vegetation being destroyed. As a result of this destruction severe erosion has occurred on much of the soil that was once stabilized.

This erosion costs the Oklahoma State Department of Highways many millions of dollars each year in maintenance of the highways and the roadside areas that accompany them. If a dense vegetative cover would be restored on these areas there would be a negligible amount of erosion along these highways.

Oklahoma is quite variable in the vegetation that can be utilized to stabilize roadside areas. There are several climatic factors present in Oklahoma. These factors play an important role in plant adaptation. The temperature extremes vary over Oklahoma from -27° F. to $+120^{\circ}$ F.. The moisture distribution across Oklahoma ranges from 8½ inches to 36 inches at Boise City to a maximum of 32 to 72 inches at Poteau annually. Wind velocities of 20 mph to 30 mph are quite normal and 60 mph winds are not uncommon in Oklahoma. The elevation of Oklahoma varies from under 5000 feet in the Panhandle to less than

400 feet in the southeast. This gives a gradient of 7 to 8 feet per mile traveling from northwest to southeast across the state (26). Therefore, it is a challenge to establish desirable roadside vegetation because of these variables.

The principle objective of this study was to determine the most economical and satisfactory means of controlling soil erosion along Oklahoma highways. In achieving part of this objective, soil analyses were made from samples taken from various experiments across the state. These soils were analyzed for levels of pH in a water paste and in 1 N KCl paste, phosphorus, potassium, sodium, calcium, and magnesium.

CHAPTER II

LITERATURE REVIEW

Soil erosion on backslopes and fillslopes of highways cause much damage each year. Therefore, if this erosion can be stopped or brought to a minimum, many dollars would be saved on maintenance of Oklahoma highways. One method of minimizing the soil erosion is by mulching these slopes with some protective material.

Erosion is caused by the unstable soil aggregates on the surface. This lack of stabilization can be caused by the soil surface being bare. The rapid wetting of the dry surface during a heavy rainstorm on the bare surface causes a destruction of the soil aggregates. In the course of this destruction, the soil surface is covered with a fine, loose material. This unconsolidated material reduces infiltration and the soil is easily transported by runoff water. If particles of crop residue, or a mulch, penetrate the surface crust they may act as channels or wicks through which water can infiltrate more rapidly as reported by Adams et al. (1).

Mulch on the surface of the soil can intercept the rainfall and dissipate the energy of the falling raindrops. Ekern (9) conducted experiments concerning the erosive capacity of a falling mass of water and he reported that erosion depends on the energy per unit area of the individual drop and the same mass of falling water may have its erosive capacity changed by altering any of three factors: (1) the mass of the drop, (2) the velocity of the drop, and (3) the horizontal cross section of the drop.

Mannering and Meyer (17) found that mulch on the soil will effect all three factors as stated above. The mulch will intercept the drop and upon impact the large drop will break up into smaller drops; as a result of the impact the velocity of the drop will change and the cross sectional area will become smaller because of the destruction of the larger drops. This will prevent detachment of soil particles and will also prevent the sealing of the soil surface. As a result of reduced surface sealing, the water is able to move into the soil profile instead of moving as surface runoff. The effectiveness of mulch in maintaining high infiltration rates was highly correlated with the percent of surface cover.

Once the water has moved into the soil profile, other forces start to act upon the water. Hide (13) found that the evaporative process occurs in three steps: (1) the brief period while the soil moisture content is above field capacity and the capillary flow to the surface occurs under a low tension gradient, (2) the period after the surface soil has dried to field capacity but before capillary conductivity becomes so slow that it no longer keeps the surface moist, and (3) the period when vaporization occurs principally below the surface and vapor must diffuse through a static layer of air within the pore space of the dry soil.

Lemon (16) concluded that evaporation loss can be decreased by decreasing the turbulent transfer of water vapor to the atmosphere by such procedures as allowing stubble to stand, adding a mulch material, increasing the soil roughness, decreasing the capillary continuity with employment of proper tillage methods or by chemical additives of the soil stabilizer type, and by decreasing capillary flow and moisture holding capacity of the surface soil layers using chemical additives of the surfactant type.

Hanks and Woodruff (12) found that by increasing the depths of the mulches the evaporation rates decreased. Most of the reduction is brought about by increasing the depth of the mulch from zero to 0.25 inch.

Types and Effects of Mulch

Many experiments have been conducted with many different types of mulches. These include excelsior, excelsior mat, asphalt, asphalt anchored mulches of prairie hay and woodshavings (8), straw, sawdust, wood cellulose fibers and elastic polymer emulsions (3), gravel (2), wheat straw and dioctadecyl dimethyl ammonium chloride--DDAC-- (5), and corn steep liquor (25).

Straw, prairie hay, sawdust, woodshavings, wood cellulose fibers, excelsior and excelsior mat fit into one category of mulches. These mulches are placed on the surface of the soil, usually, by a chopper-blower combination with the exception of the excelsior mat. Most generally the excelsior mat is placed on the soil by hand.

Meyer et al. (20) tested the erosion reducing effectiveness of six rates of straw mulch on slopes that averaged approximately fifteen percent. They found that mulch rates of only 0.56 metric ton per hectare and 1.12 metric tons per hectare reduced soil losses to less than thirty-three percent of those from unmulched areas during a series of intense simulated rainstorms. When a rate of 2.24 metric tons per hectare was used, the decrease of soil erosion was eighteen percent when compared to those plots with no mulch. Much heavier rates of 4.48 metric tons per hectare and 9.96 metric tons per hectare reduced the soil loss to less than five percent when compared to those plots with no mulch. The reason given for the reduced rate of soil erosion is the mulch reduced the runoff velocity of the water. With the rate of 0.56 metric ton per hectare, the runoff velocity was approximately one half as great as the velocity of the runoff water on those slopes which had no mulch. Heavier applications of straw reduced the runoff velocity rates only slightly more. Even though the small mulch rates greatly reduced erosion, more mulch was required to control erosion completely.

Tests using straw, sawdust, wood cellulose fibers, and elastic polymer emulsions as mulches were conducted by Barkley et al. (3). They concluded that the straw, sawdust, and wood cellulose fibers moderated the temperature of the seed zone causing improvements in germination, emergence, and growth of grass seedlings. The elastic polymer emulsion mulches were not beneficial to grass development. The straw mulch tended to moderate soil temperature and conserve more soil moisture than the other mulches, but not significantly more when compared with the wood cellulose fibers. One problem caused by the straw mulch was the introduction of weed and small grain seedlings which caused a reduction in grass seedling weights. Sawdust improved the turf establishment. However, it was easily washed off gentle slopes during hard rains. The wood cellulose fiber eliminated introduction of undesirable plant species and had a favorable influence on soil temperature and soil moisture. It also increased the rate of seedling germination, emergence, and growth. The elastic polymer emulsion mulch conserved more soil moisture than those where there was no mulch. The soil temperatures of unmulched soils were usually higher than those plots that were not mulched.

Clepil et al. (6) conducted experiments concerning mulches to control wind and water erosion. They applied prairie hay uniformly on a 3:1 slope at a rate of 2 tons per acre and anchored it with 400 gallons of asphalt emulsion per acre. This treatment was completely effective in controlling erosion on the slopes tested. On one experiment the organic emulsion was excessively diluted with water. It was determined that this practice was detrimental from the standpoint of erosion control. Kerosene was also used for the purpose of diluting the asphalt material, but it was found to be detrimental to seedling growth. Gravel was used to control wind erosion and of the sizes used, it was determined that the larger the gravel size, the greater the quantity that was required for controlling wind erosion.

According to Adams (2), surface covers of straw and gravel mulch increased water intake by reducing runoff which eliminates erosion. It is inferred that the rapid movement of water over the soil surface under the straw and gravel mulches may suggest some surface sealing which would limit water intake. This experiment indicated that the use of straw, gravel, or DDAC on soils helped reduce the rate of evaporation which allows the moisture to remain available in the soil longer for plant use.

Bowers and Hanks (5) studied the effects of DDAC on evaporation and infiltration of soil moisture. They concluded that DDAC effectively reduces evaporation on fine sandy loams and on silty clay loams. At the same time, the DDAC reduced the infiltration rates of the soils mentioned. This property of reduced infiltration prohibits the practical use of DDAC in evaporation control. This property of reduced infiltration results from a negative or repelling capillary force caused by the addition of DDAC.

Schmidt et al. (25) conducted experiments using corn steep liquor for erosion control. The corn steep liquor gave a stabilizing effect when it was supplemented by a lime slurry. Not only did this preparation help in controlling erosion, but it supplied lime for the control of the pH level of the soil. This method resulted in reduced rilling and surface erosion early in the growing season. Reduction in erosion helped to give the seedlings a chance to grow and then the production of roots and foliage helped stabilize the soil.

Soil temperature moderation can be caused by mulching the surface. White et al. (27) found that soil temperature on mulched surfaces fluctuated much less than nonmulched surfaces. Russell (24) describes three reasons for temperature controls: Mulches shade the soils from the direct radiation of the sun; mulches insulate from downward heat conduction; and mulches serve as a windbreak. McCalla and Duley (18) studied the effect of crop residues on soil temperatures. They found that the mulch reduces the temperature anywhere from three degrees centigrade to five degrees centigrade at the one inch depth with an application of two tons per acre of wheat straw.

Dudeck et al. (8) found that excelsior and excelsior mat has the greatest effect on moderating soil temperature. The soil beneath the excelsior mat retained the greatest amount of moisture of those materials tested. As a result of this effect, the temperature moderation was greatest under the excelsior mat. In addition to excelsior mat, they also tested loose excelsior, asphalt, asphalt anchored mulches of prairie hay and woodshavings. The moisture content under these mulches were high but not as high as those under the excelsior mat. They attributed the high moisture content of the soil beneath all of the mulches tested to the mulches' ability to intercept as well as retain natural precipitation.

McKee et al. (19) studied the microclimatic conditions found on highway slopes. They found that the microclimatic conditions on different slopes are strongly influenced by slope exposure, and they suggested this factor be considered in the selection of mulches, fertilizer, and species for turf establishment on roadsides.

Richardson et al. (23) concluded that mulch increases the survival and growth of plants by reducing soil erosion, frost damage, soil dessication, and fertilizer loss. Also mulches form an interwoven cover that resists raindrop impact, runoff and erosion, and it insulates against frost action in the winter and high temperatures in the summer.

Fertility

It is a common practice in Oklahoma to cover bare backslopes with topsoil taken from the surface as the road construction commenced. This practice is used to restore the cut slopes to their original fertility level. The problem is encountered as the soil lays on the slope without cover and erosion begins with its accompanying loss of fertility.

Reisch (22) believes that this loss in fertility is only a small part in the total amount of factors affecting plant growth. Other factors include soil characteristics, the amount of water available, air pollution, soil fills over tree roots, misuse of herbicides, poor drainage, poor planting practices, extreme soil temperatures, insects, diseases, and undersized root systems.

Foote and Kill (10) reports that there are other factors affecting the establishment and maintenance of turf along highways. The unfavorable factors include road-core material slightly below the soil surface, heavy flows of water from the surfaced roadways, concentrations of salt and sand applied to the highway for snow and ice control, concentration of wet snow that results in ice sheets and the consequent denial of oxygen to the plants, rapid and extreme changes in temperature resulting from the nearness of the surfaced area, high variable winds resulting from passing vehicles, and disturbances caused by vehicles leaving the surfaced areas.

As the winds begin to blow, dessication occurs, the soil aggregates disintegrate and this causes the soil to start blowing. Also, as rain begins to fall, water erosion takes place. Diseker et al. (7) report that 3:1 slopes will lose an average of 100 tons of soil per acre annually and 1:1 slopes will lose an average of 195 tons of soil per acre annually. Soil loss per unit area is 15 to 20 times greater for roadsides as compared to cultivated fields.

With this much loss of soil there is naturally a loss in fertility. Jackobs et al. (14) believe that nitrogen is the most frequent limiting element for the establishment of cover for bare slopes. When an application of nitrogen is used to fertilize grass-legume mixtures there is little stimulation of the legumes as compared to the stimulation of the grasses. The phosphorus is more important to legumes than the nitrogen. Adequate phosphorus nutrition is essential for early development of the seedling.

The bare soil that is exposed when roadsides are cut and filled are almost always very low in nitrogen and vary widely in phosphorus and potassium levels according to Beers (4). Those soils that are high in phosphorus in the plowlayer have almost no acid soluble phosphorus a foot or more deep into the soil. Those soils that have medium to high potassium contents in the surface layer may be low in potassium in the subsoil.

Friday (11) recommends that there be a blanket coverage of 100 pounds of nitrogen, 100 pounds of P_2O_5, and 100 pounds of K_2O applied per acre in Ohio. There is no nitrogen carryover from year to year and it should be replenished at some reasonable interval.

Zak (28) believes that the lack of fertilization during the second year of growth is a very poor practice. After the second year of growth there should be an application of 40 pounds of nitrogen per acre every three years for acceptable ground cover. Tests were conducted using 80 pounds of nitrogen per acre and this rate produced excessive growth requiring costly mowing operations. Tests using a complete fertilizer only performed slightly better than the 40 pounds of nitrogen per acre test which was the recommended rate.

Palmertree et al. (21) concluded that established turf on roadsides requires nitrogen refertilization to prevent degeneration. It makes little difference if ammonium nitrate or if ureaformaldehyde was used to supply the nitrogen provided there is adequate rainfall. If adequate rainfall is not recieved then volatilization of the ureaformaldehyde will cause a loss of nitrogen that is available to the plants.

CHAPTER III

METHODS AND MATERIALS

The purpose of this study was to find the fertility gradients of some selected fillslopes and backslopes along newly constructed highways located throughout Oklahoma. The locations include highway slopes near Cooperton, Copan, two separate locations near Sayre, Snyder, Tulsa, and Wister, Oklahoma.

The 5-S-11-71 and 5-S-12-71 experiments are located three miles north and two miles east of Cooperton, Oklahoma, along Oklahoma State Highway 19. The experiments are on two cut slopes with a north-south exposure. The south exposure has an incline of 17% while the north exposure has an incline of 21%. Each exposure was divided into two subplots. The lower half of the slope was called subplot A and the upper half of the slope was called subplot B. Each exposure was divided into twelve plots. Each of the twelve plots on the south exposure consisted of 1310 square feet and those plots on the north exposure consisted of 1750 square feet.

There were two soil samples taken at random locations in each plot. One soil sample was taken from subplot A and one soil sample was taken from subplot B. There were a total of 48 soil samples taken from the Cooperton experiments with 24 soil samples being taken from each side of the road.

The 8-S-3-72 and 8-S-4-72 experiments are on a cut slope approximately 1 mile south of Copan, Oklahoma, along U. S. Highway 75. These two slopes have an east-west exposure. Each slope was visually divided into four subplots. Subplot A is the bottom one-fourth of the experiment, subplot B is the second one-fourth, subplot C is the third one-fourth, and subplot D is the top one-fourth of the slope. Each slope was divided into 27 plots with the plots on the east-facing slope consisting of 1243 square feet and the west-facing slope consisting of 1870 square feet. The west exposure has an incline of 22% and the east exposure has an incline of 24%.

Soil samples were randomly taken from the top 5 inches of the soil. There were four soil samples taken from each plot with one sample taken from each subplot within the plot. As a result, there were 108 soil samples taken from each side with a total of 216 soil samples taken from the experiments.

The 5-S-3-71 and 5-S-4-71 experiments are located east of Sayre, Oklahoma along U. S. Interstate Highway 40 and is situated on two cut slopes. The experiments are on the north side of the C. R. I. and P. R. R. overpass. The west exposure has an incline of 26% and the east exposure has an angle of 33%. Each slope was divided into 21 plots and each plot was divided into 3 subplots for sampling. Subplot A is located at the bottom of the slope and subplots B and C are located upslope of subplot A. Each of the 21 plots were sampled from the top 5 inches of soil. There were 3 samples taken from each plot with one sample taken from each subplot. Each plot, on both sides of the highway, has 1000 square feet of area. Each of the 21 plots were divided into 3 smaller plots giving a total of 63 plots for each experiment.

The 5-S-13-71 and 5-S-14-71 experiments are located on two fillslopes six miles southwest of Sayre, Oklahoma. The experiment is located along U. S. Interstate Highway 40. The slopes of these experiments have a north-south exposure. There is only one plot sample in these experiments. Each experiment is divided into 9 plots and each plot has an area of 1776 square feet.

Experiments 5-S-9-71 and 5-S-10-71 are located southeast of Snyder, Oklahoma, along U. S. Highway 62. These cutslopes have a north-south exposure with an incline of 18% on the south exposure and a slope of 21% on the north exposure. The south exposure has plots with an area of 554 square feet and the plots of the north exposure have an area of 1230 square feet. Each slope is divided into 3 subplots with subplot A located along the bottom of the slope. Subplot B is in the middle of the slope and subplot C is along the top of the slope. Each experiment is divided into 36 plots. Soil was sampled with the samples being taken from the top 5 inches of the soil. Each subplot of each plot was sampled yielding a total of 216 samples for the experiments.

The 8-S-1-70 and 8-S-2-71 experiments are located in Tulsa, Oklahoma. They are on the east side of the Utica overpass that bridges the U. S. Interstate Highway 244 expressway located between north tenth and north eleventh streets. There are 18 plots in each experiment located on two opposing cutslopes that have a north-south exposure. The plots on both slopes each have an area of 2430 square feet. Each slope is divided into 4 subplots with subplot A located parallel to the bottom of the slope. Subplots B, C, and D are located above subplot A with subplot D at the top of the slope. The south exposure has an incline of 29% while the north exposure has an incline of 32%. Four soil samples were taken from each plot with one sample being taken from each subplot within the plot. As a result, there were 144 soil samples taken from the experimental areas.

The 2-S-1-71 and 2-S-2-71 experiments are located 0.5 mile northeast of Wister, Oklahoma, along U. S. Highway 271. The experiments are located on two opposing cutslopes with an incline of 34% for each slope. The cutslopes have a north-south exposure. The two slopes were divided into two subplots. Subplot A is at the bottom of the slope and subplot B is at the top of the slope. Each slope was divided into 24 plots with each plot occupying an area of 3069 square feet. One soil sample was taken from each subplot within each plot to give a total of 96 soil samples taken from the Wister experiments.

All samples from each experiment was processed prior to chemical analyses. The processing involved drying the samples to air dryness, grinding, screening the samples, and collecting that fraction that was smaller than 2 millimeters. All samples were then analyzed for pH-H_2O, pH-KCl, phosphorus, potassium, sodium, calcium, and magnesium.

The pH-H_2O was determined by using a 1:1 ratio, by weight, of soil and water; the pH-KCl was determined by using a 1:1 ratio, by weight, of soil and 1 N KCl. The phosphorus was extracted with the #1 Bray solution and then analyzed spectrophotometrically by the method explained by John (15). The results of the phosphorus analysis is reported in parts-per-million. The potassium, sodium, calcium, and magnesium were extracted with 1 N ammonium acetate in water. Analyses were made using an atomic absorption spectrophotometer. The results are also reported in parts-per-million.

These data were analyzed statistically as a two-way classification and the data processed for testing significant statistical differences in the fertility levels between the subplots in each exposure, plots in each exposure and differences between each exposure as a whole when comparing the exposures to each other. This was done on each experiment with the exception of experiments 5-S-13-71 and 5-S-14-71 which were set up as a one-way classification where each exposure was simply compared to each other.

CHAPTER IV

RESULTS AND DISCUSSION

Statistical analyses were made to determine fertility gradients on the slopes that were analyzed. Tests were made to determine if there were significant statistical differences in fertility levels among the subplots within the plots. The exposures of the experiments were compared to each other to determine if significant statistical differences exists between the exposures.

The Cooperton experiments show no significant statistical differences when comparing the exposures. The only significant statistical difference is in the amount of potassium found on the south exposure. The north exposure shows no significant statistical gradient in the amount of potassium found on the slope. Figure 1 shows how the two slopes compare to each other in potassium content.

The Copan experiments show many significant statistical differences within the experiments. On the east backslope, among the plots, there is a significant statistical difference of 5% in the value of pH-KCl. These data are shown in Figure 2. Among the subplots, on the east backslope, there are significant statistical differences of 1% in the value of pH-KCl, along with a significant statistical difference of 5% in the value of pH-H_2O as shown in Figures 3 and 4 respectively. The pH-H_2O decreases, or it becomes more acidic, as one proceeds from subplot A to subplot D as shown in Figure 4. The same results, but of

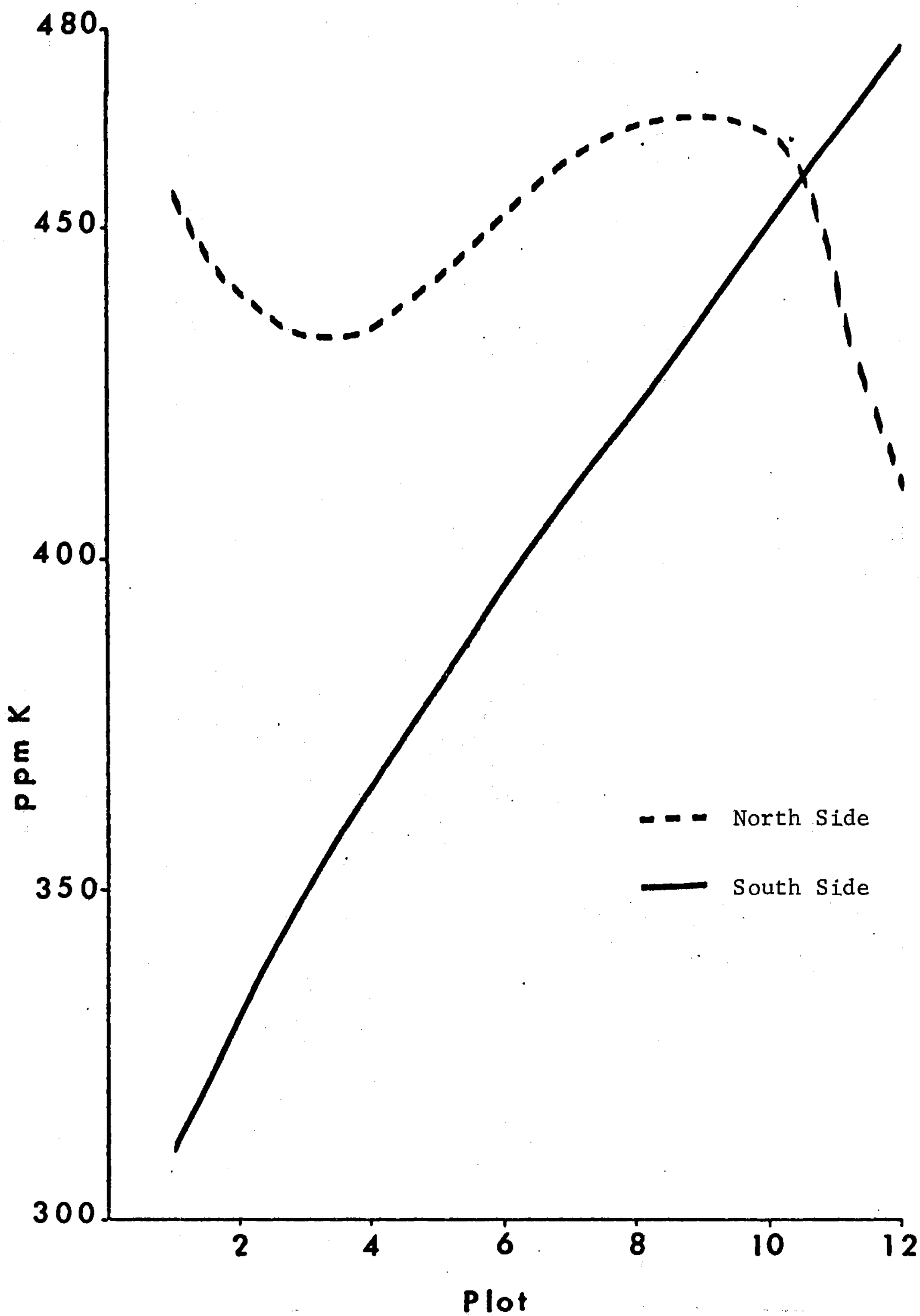

Figure 1. Average Available Potassium in the Experiments on Oklahoma State Highway 19 Near Cooperton

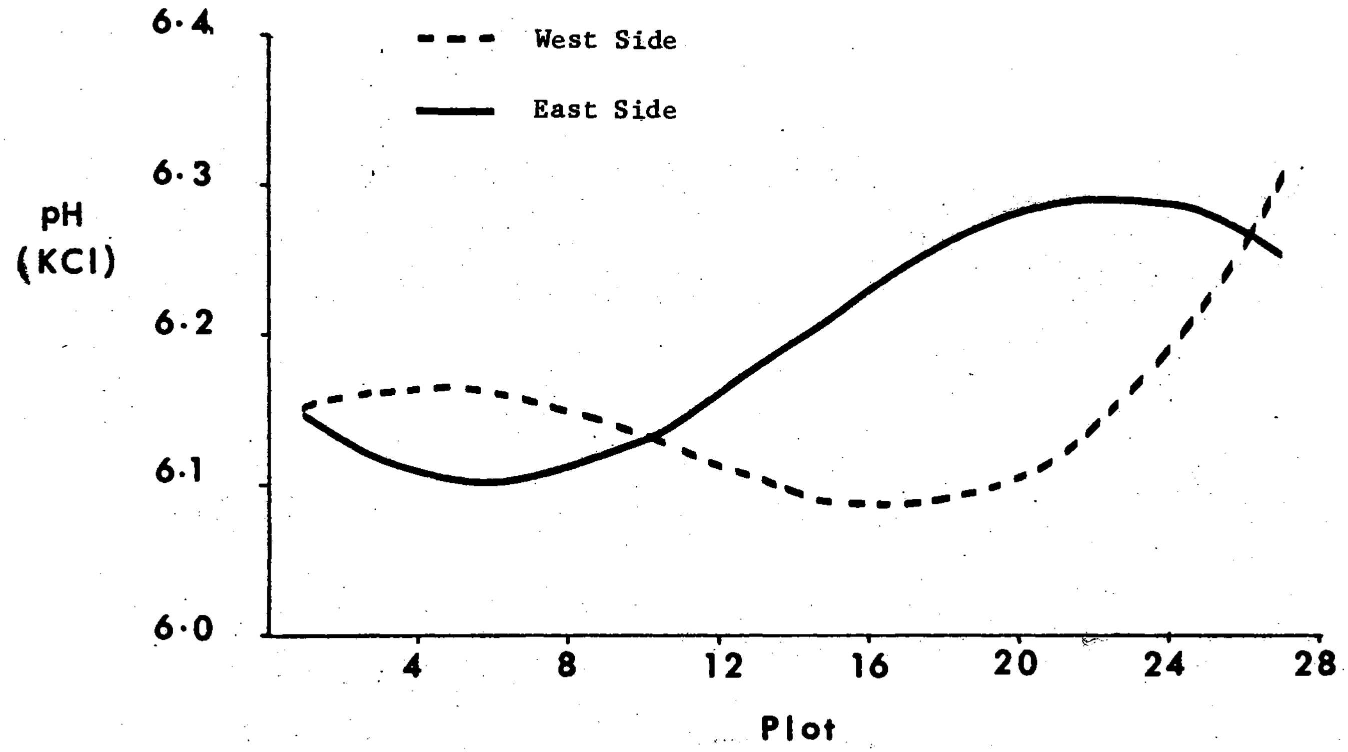

Figure 2. Average pH-KCl Levels in the Experiments on U. S. Highway 75 Near Copan

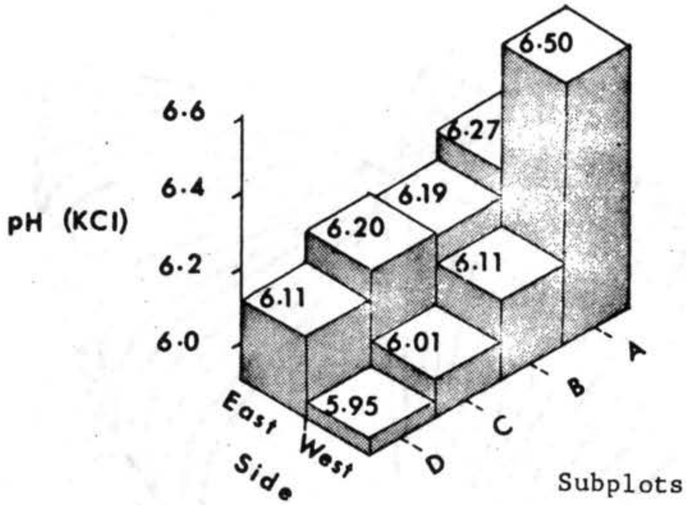

Figure 3. Average pH-KCl Levels Among the Subplots in the Experiments on U. S. Highway 75 South of Copan

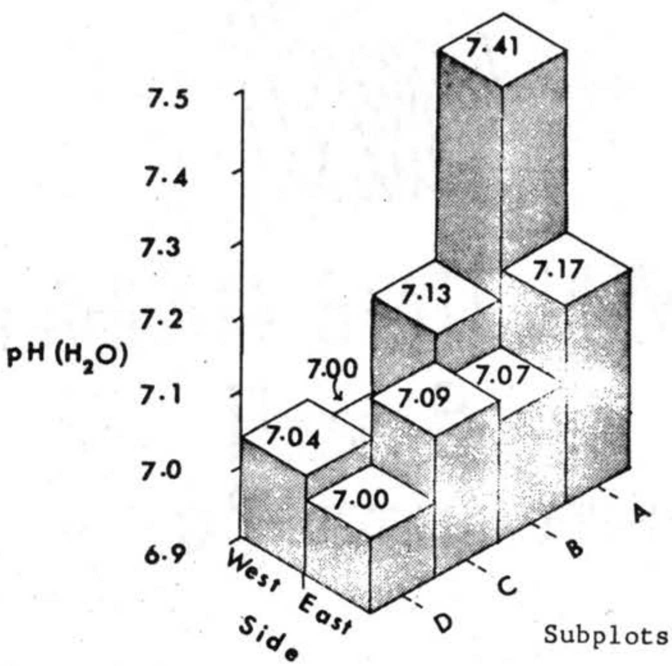

Figure 4. Average pH-H_2O Levels Among the Subplots in the Experiments on U. S. Highway 75 South of Copan

a different magnitude, are found in the pH-KCl data in Figure 3.

On the west backslope, among the plots, there are no significant statistical differences. Therefore, there are no fertility gradients over the length of the west backslope of the Copan project. There are fertility gradients, however, among the subplots of the west backslope. These fertility gradients occur with pH-H_2O and pH-KCl at significant statistical differences of 1%. Fertility gradients also occur with phosphorus and potassium at significant statistical differences of 5%. The pH-KCl and pH-H_2O levels are shown in Figures 3 and 4 respectively. The pH tends to decrease as one proceeds up the slope except when the pH-H_2O is considered in the D subplot, where there is a slight increase in pH-H_2O. The available phosphorus decreases up the slope as shown in Figure 6. The available phosphorus is quite low on the west side. One explanation may be that surface erosion has carried the phosphorus rich soil from the top of the slope toward the bottom. There is a sharp increase in potassium from the bottom of the slope to subplot C and then a decrease in available potassium in subplot D as shown in Figure 5. The difference is statistically significant but it is only a real difference of 10 part-per-million.

When comparing the two slope exposures of the Copan experiments there are significant statistical differences among the levels of pH-H_2O and pH-KCl. The west exposure has the higher average of pH-H_2O (7.15 for the west exposure and 7.10 for the east exposure) as shown in Figure 4. The east exposure of the Copan experiments has the higher average pH-KCl (6.20 for the east exposure and 6.15 for the west exposure) as shown in Figure 3.

The Sayre I experiments have significant statistical differences,

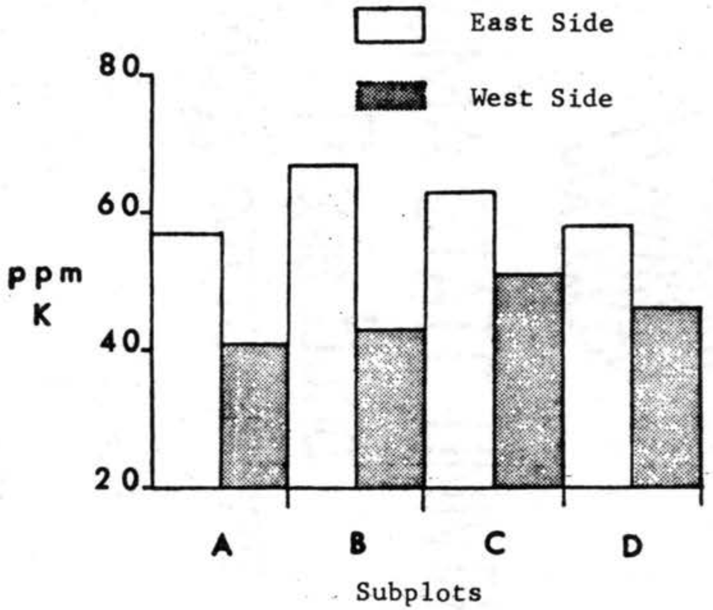

Figure 5. Average Available Potassium Levels Among the Subplots in the Experiments Along U. S. Highway 75 South of Copan

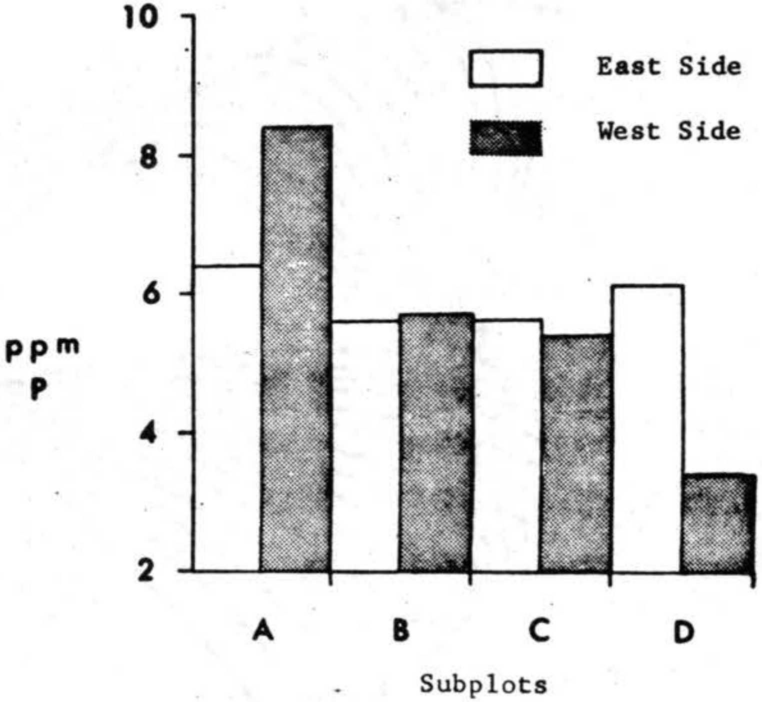

Figure 6. Average Available Phosphorus Levels Among the Subplots in the Experiments Along U. S. Highway 75 South of Copan

among the plots, in the levels of pH-H_2O, pH-KCl, phosphorus, and potassium on the east exposure. The phosphorus content of the east exposure experiments is shown in Figure 7. The phosphorus content next to the railroad overpass is very low and the fertility gradient increases from south to north possibly due to the decreasing depth of the cut. There is enough difference in the phosphorus levels to cause a significant statistical difference at the 1% level. As far as fertility is concerned, soil phosphorus is not adequate for good plant growth on the east exposure of these experiments. Among the subplots on the east backslope, significant statistical differences at the 1% level are encountered in pH-KCl, phosphorus, and potassium. The pH-KCl decreases from subplot A to subplot B and then increases from subplot B to subplot C as shown in Figure 8. The phosphorus content increases from subplot A to subplot B and decreases from subplot B to subplot C as shown in Figure 9. The decreases in phosphorus content on top of the slope could be due to increased surface erosion. Potassium shows a steady increase up the slope, as shown in Figure 10, possibly caused by more severe weathering of the potassium bearing minerals.

Among the plots of the west experimental backslope, there are no statistically significant differences at the 5% level of the Sayre I experiments.

Among the subplots, on the west backslope, there is a significant statistical difference of 5% in the value of pH-KCl. There is a significant statistical difference at the 1% level in the phosphorus value.

The values of pH-KCl that are statistically significant are shown in Figure 8. The pH-KCl level of subplot A is less than that of subplot

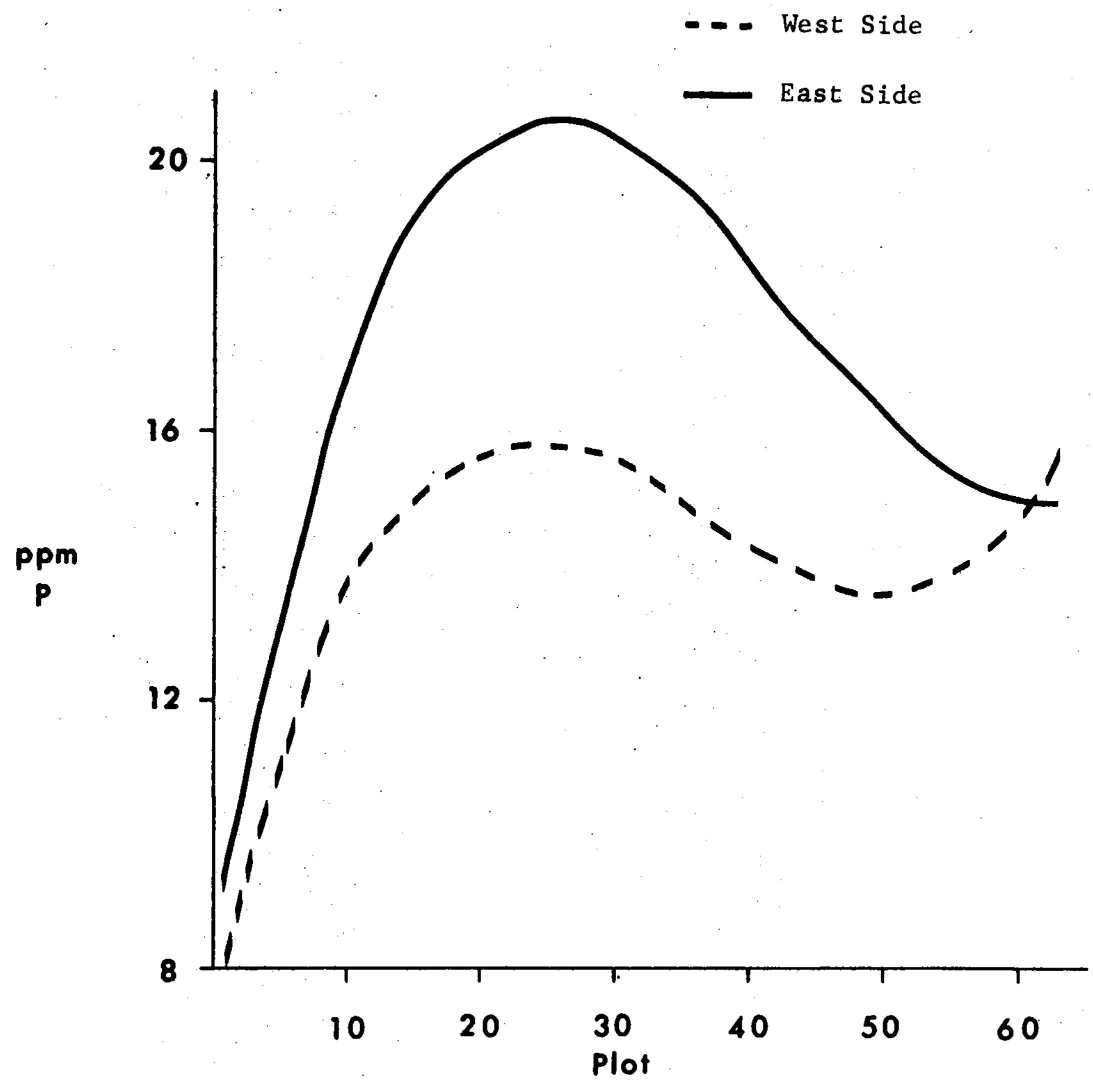

Figure 7. Average Phosphorus Levels of the Experiments Located East of Sayre on I-40

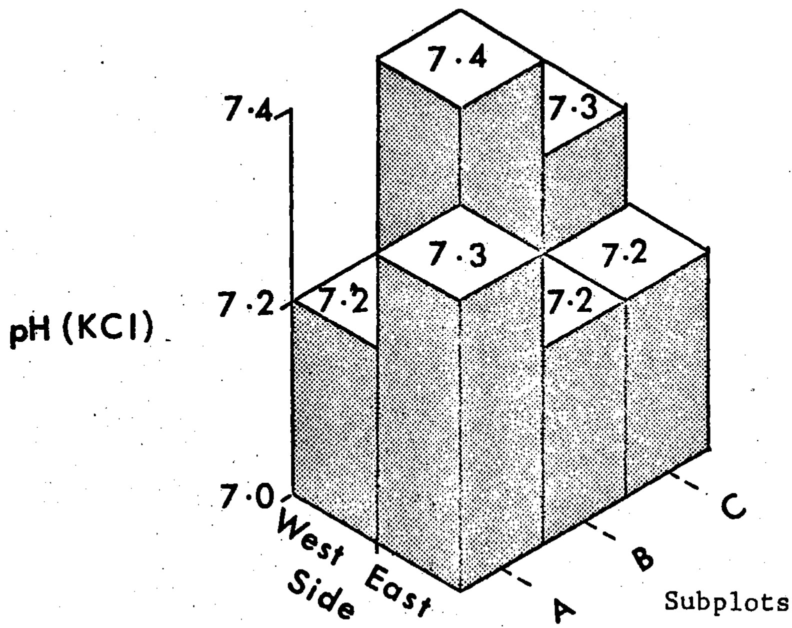

Figure 8. Average pH-KCl Levels Among the Subplots in the Experiments Located East of Sayre on I-40

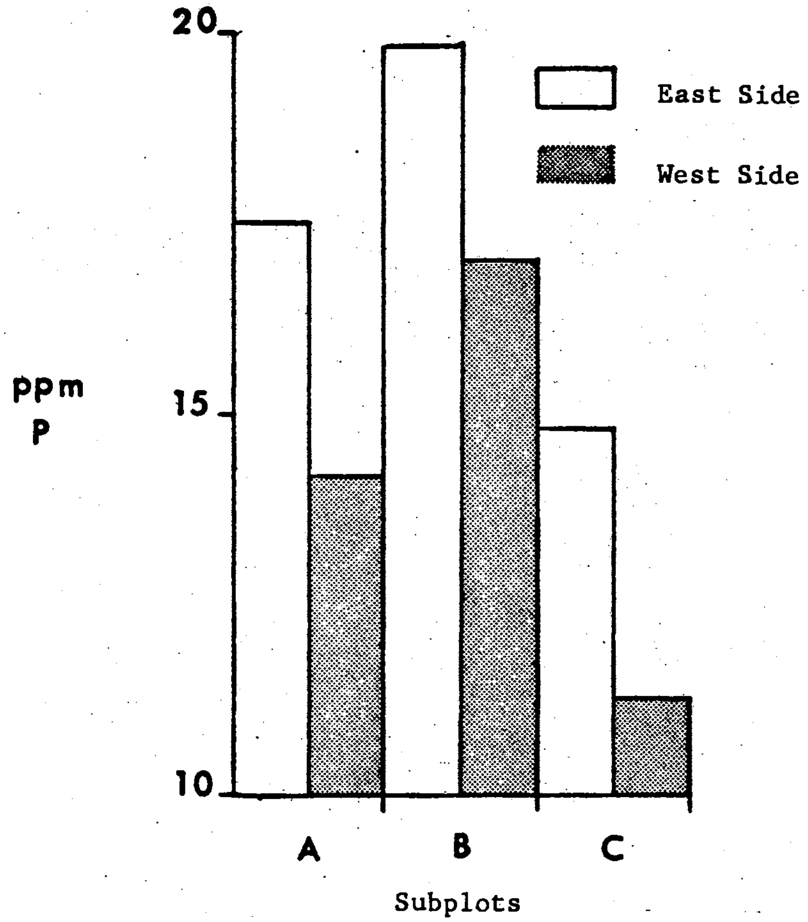

Figure 9. Average Phosphorus Levels Among the Subplots of the Experiments Located East of Sayre on I-40

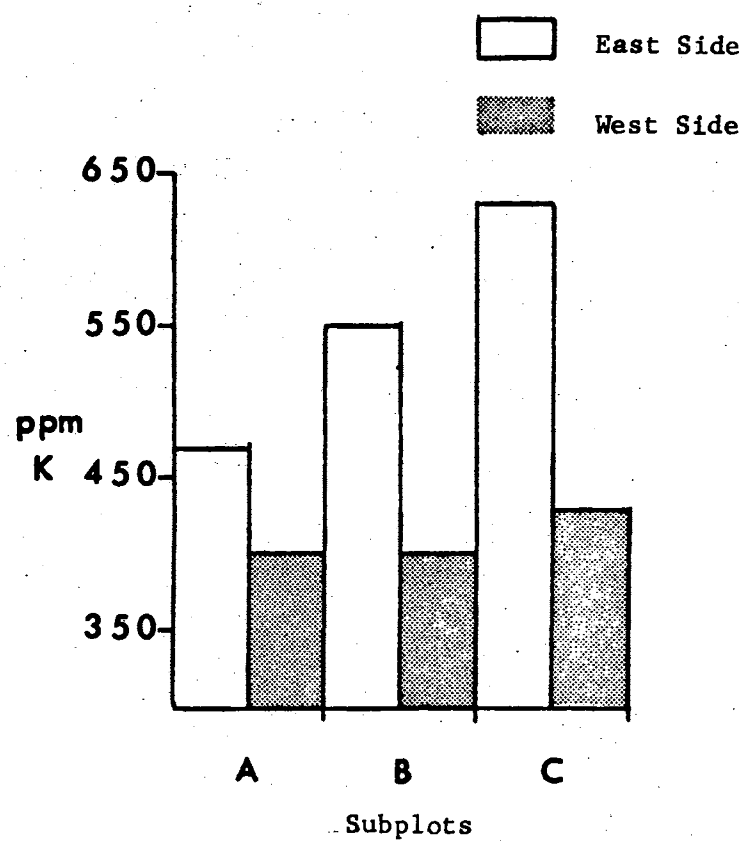

Figure 10. Average Potassium Levels Among the Subplots of the Experiments Located East of Sayre on I-40

B and the value of pH-KCl of subplot C is less than that of subplot B. However, the real differences are of little practical significance because there is no fertility problem due to differences in pH-KCl on these experimental locations. There are statistically significant differences in the amounts of phosphorus between the subplot on the west backslope. Subplot B contains more phosphorus than either subplots A or C as shown in Figure 9.

When comparing the two exposures against each other, among the subplots, there is only one statistically significant difference among the major components. The pH-KCl for the east backslope has a higher average (7.30) than does the west backslope (7.23) as shown in Figure 8.

In the Sayre IV experiments statistically significant differences appeared only in the pH-H_2O when comparing plots. The pH-H_2O level among the plots had a statistically significant difference at the 5% level as shown in Figure 11.

When comparing slope exposures against each other, a statistically significant difference was found for the pH-H_2O and the available potassium. Figure 11 graphically demonstrates the difference at the 1% level for the values of pH-H_2O. Figure 12 shows a significant statistical difference at the 5% level when comparing the exposures for available potassium levels.

At the experiments located along U. S. Highway 62 near Snyder, there are no statistically significant differences at the 5% level, in the fertility levels along the north exposure, among the plots. However, on the south experimental exposure statistically significant differences at the 1% level were found with pH-H_2O, pH-KCl, and phosphorus. Statistically significant differences at the 5% level appear in the

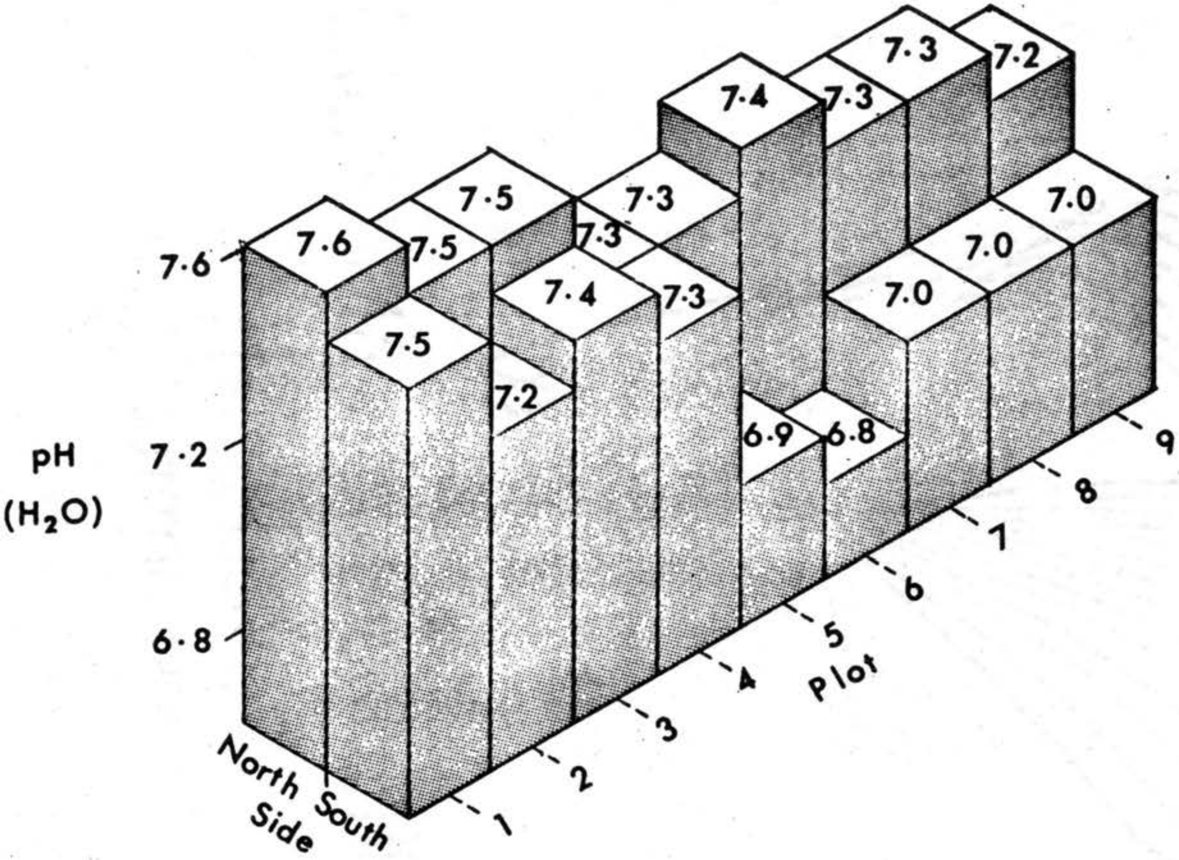

Figure 11. The pH-H_2O Levels of the Experiments Located Southwest of Sayre on I-40

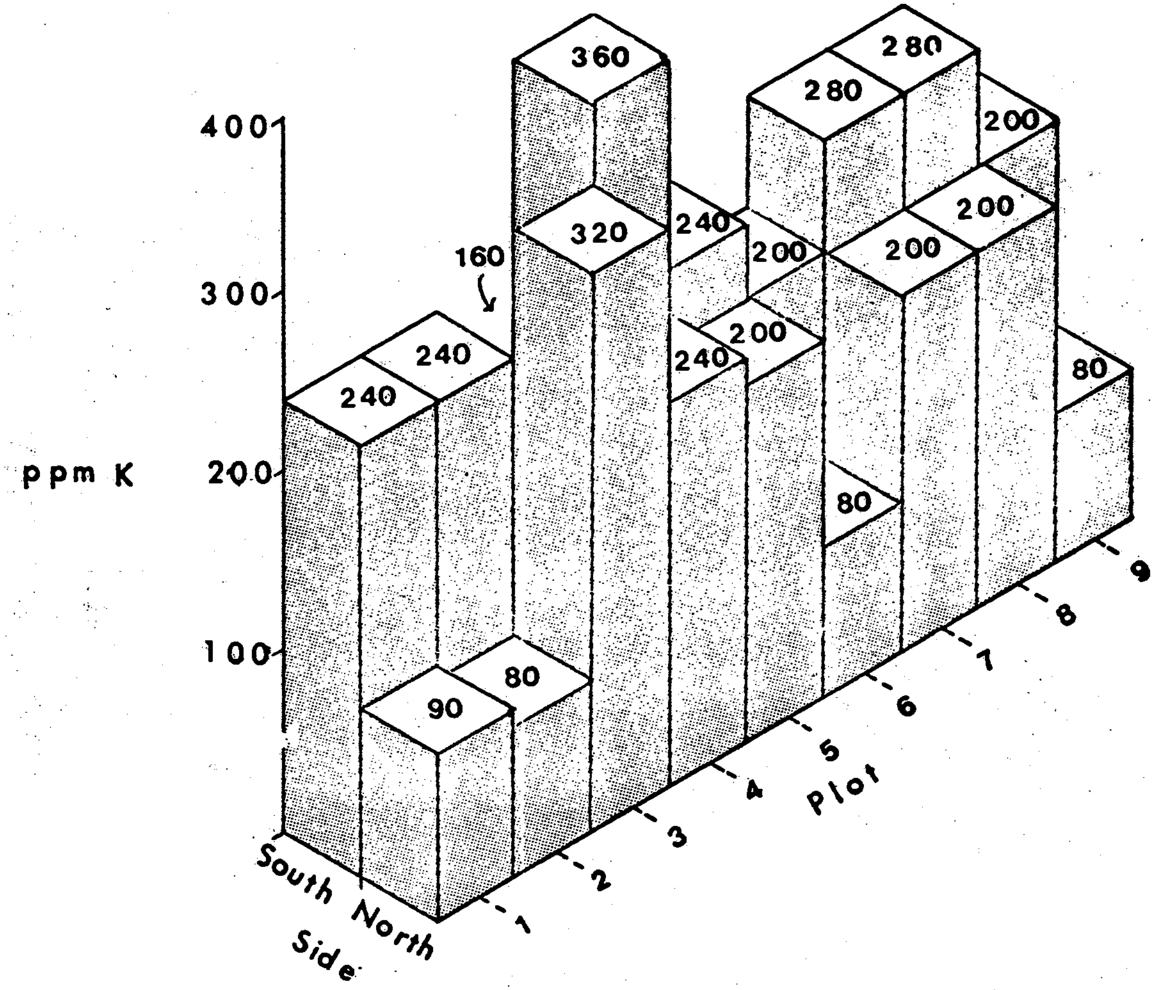

Figure 12. The Available Potassium Levels of the Experiments Located Southwest of Sayre on I-40

available potassium levels on the south exposure of the experiments.

The pH-H_2O ranges from an average value of 6.70 for a low to a high average value of 7.70. The low pH-H_2O values are on the east end of the experiments and the high values are on the west end as shown in Figure 13. The pH-KCl gradient is shown in Figure 14. The east end of the experiments has a low average value of 6.40 which increases to a value of 6.77 on the west end. The average phosphorus levels are adequate for plant growth throughout the experiment. The gradient goes from a low value on the west end of the experiment, to a higher value on the east end as shown in Figure 15. A gradient is found in the potassium levels and it is from a low on the west end to a high on the east end as shown in Figure 16.

In the experiments near Snyder on U. S. Highway 62, among the subplots, there are statistically significant differences at the 1% level in the values of pH-H_2O, pH-KCl, phosphorus, and potassium on the north exposure.

This experiment has the highest level of pH-H_2O in subplot A. Proceeding up the slope, the pH-H_2O tends to decrease as shown in Figure 17. The same results hold true for the pH-KCl as shown in Figure 18. The phosphorus content is at a minimum in subplot A, Figure 20, with a level of 17 ppm. The phosphorus level goes to a maximum of 31 ppm in subplot B and then decreases again to 28 ppm in subplot C.

On the south side of the Snyder experiments, among the subplots, there are statistically significant differences at the 1% level in the values of pH-H_2O, pH-KCl, and phosphorus. There was also a statistically significant difference at the 5% level in the potassium value. The pH-H_2O and pH-KCl, as shown in Figures 17 and 18 respectively,

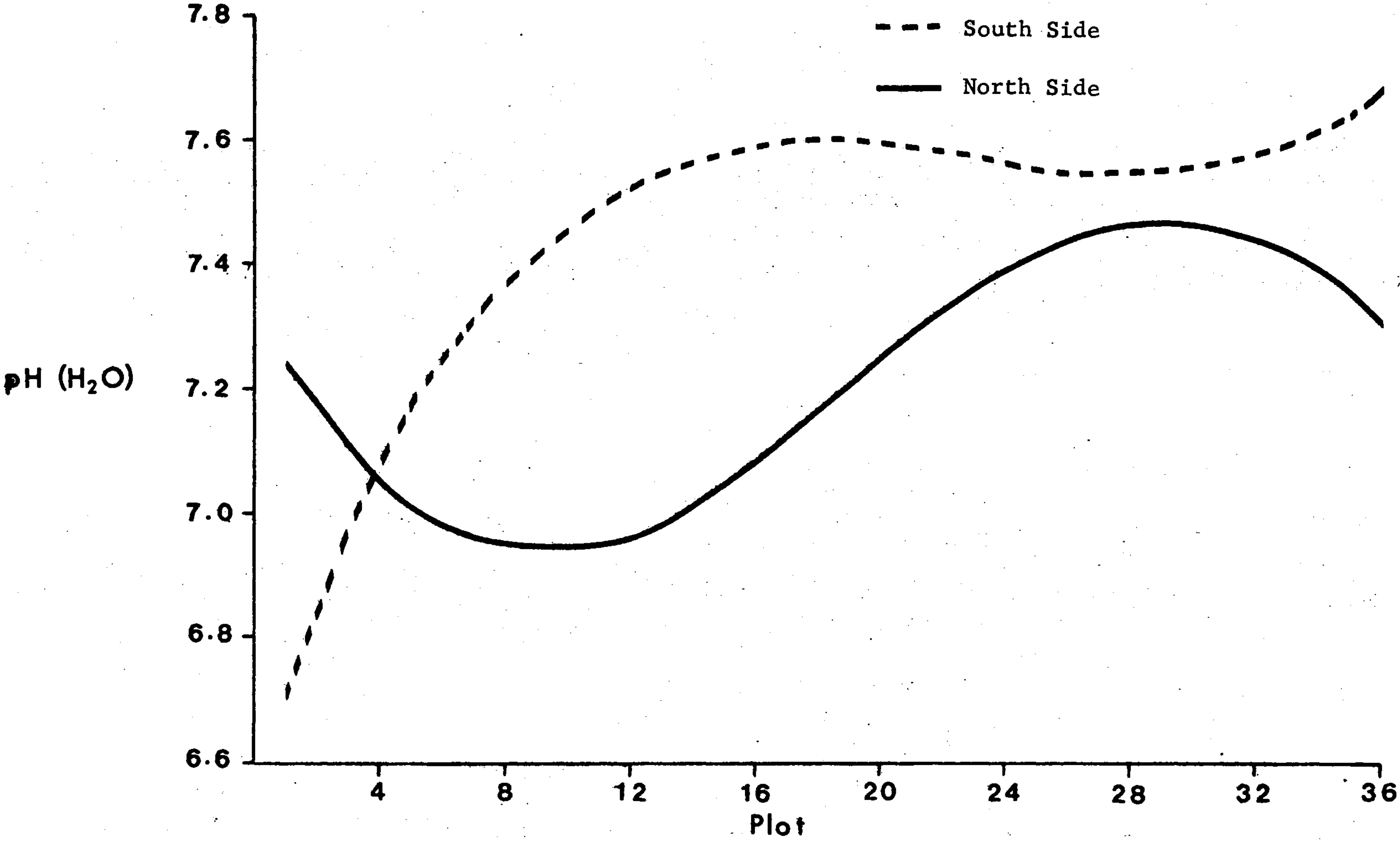

Figure 13. The pH-H_2O Levels of the Experiments Located Southeast of Snyder on U. S. Highway 62

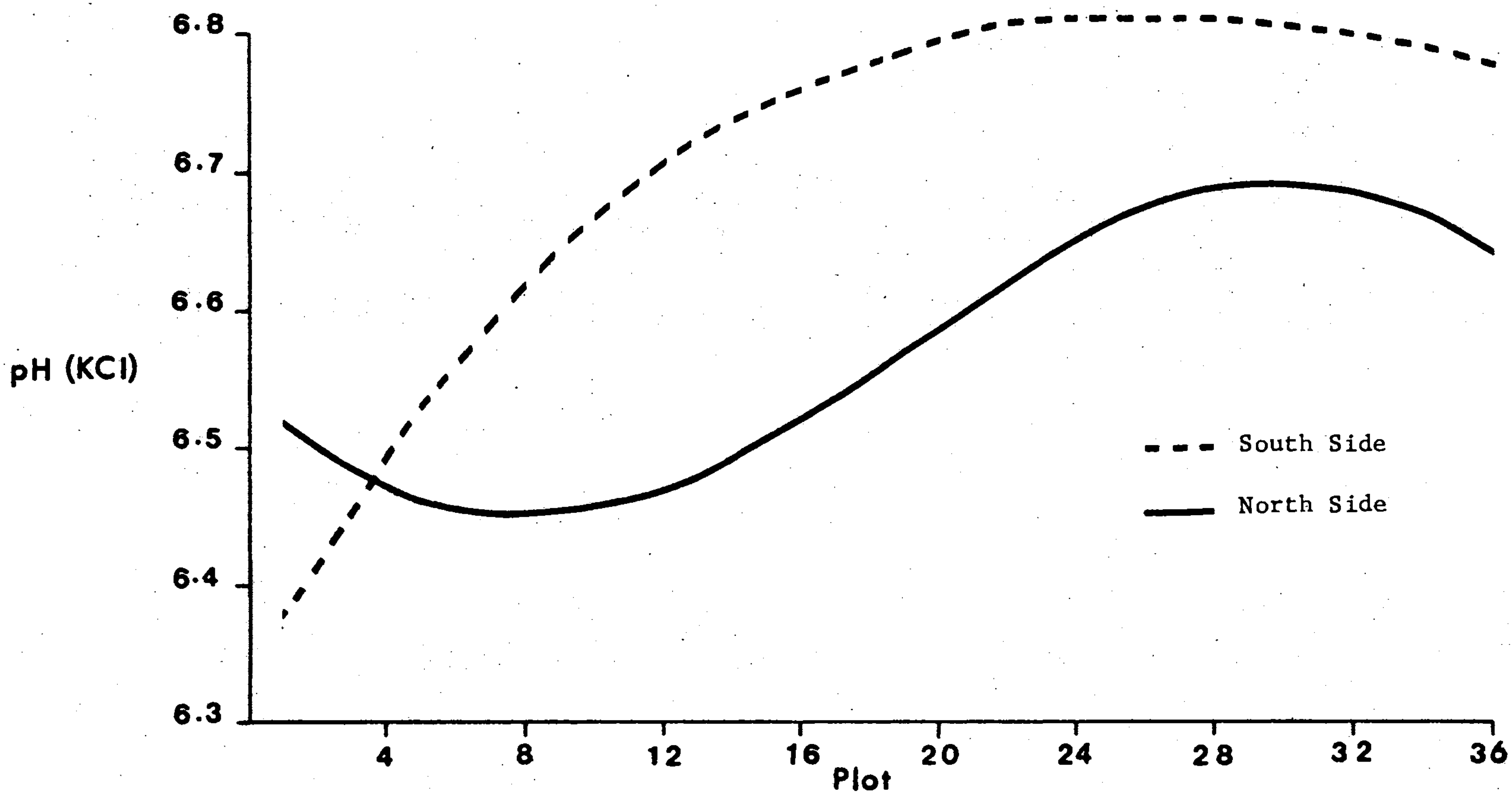

Figure 14. The pH-KCl Levels of the Experiments Located Southeast of Snyder on U. S. Highway 62

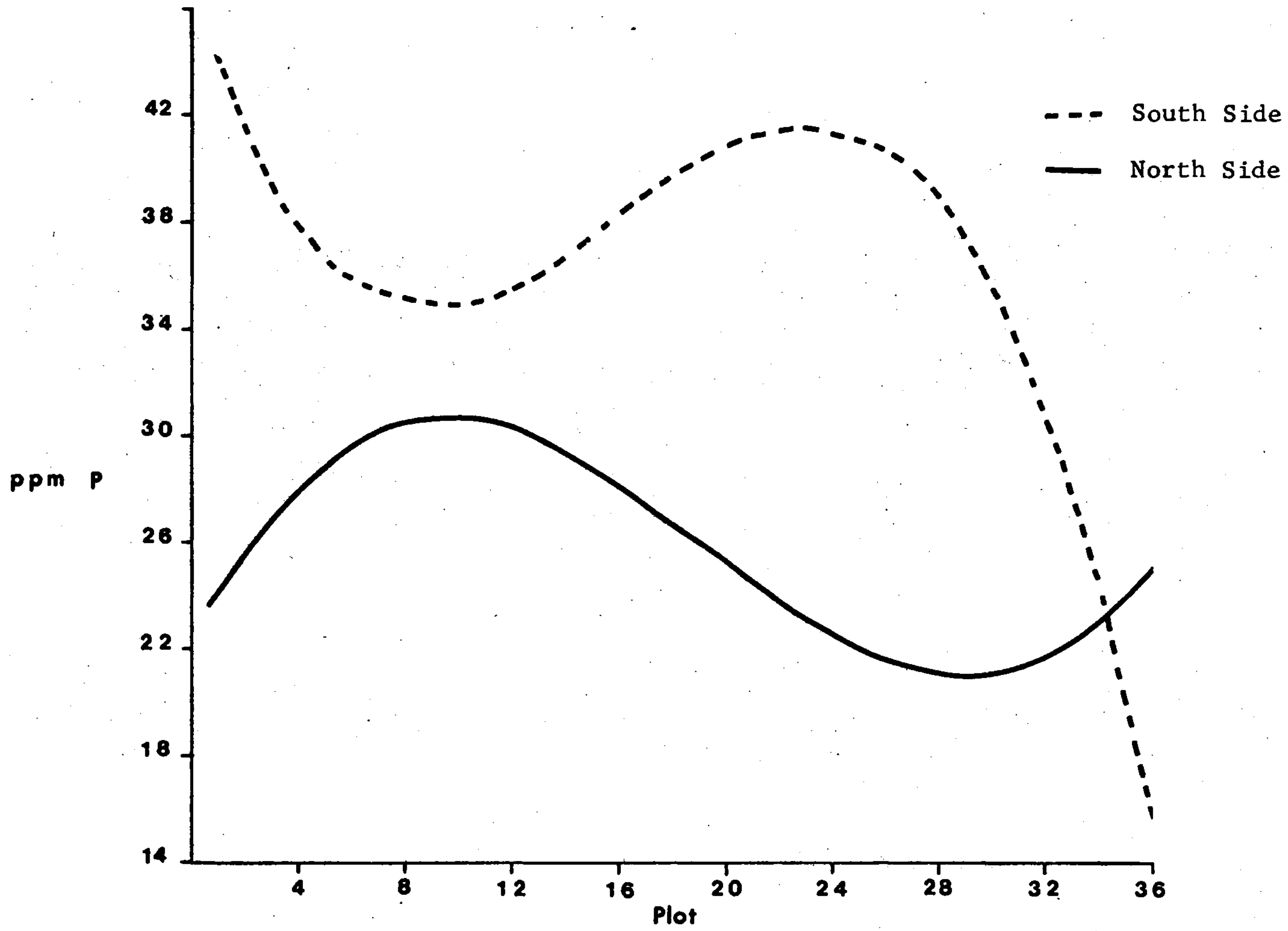

Figure 15. The Phosphorus Levels of the Experiments Located Southeast of Snyder on U. S. Highway 62

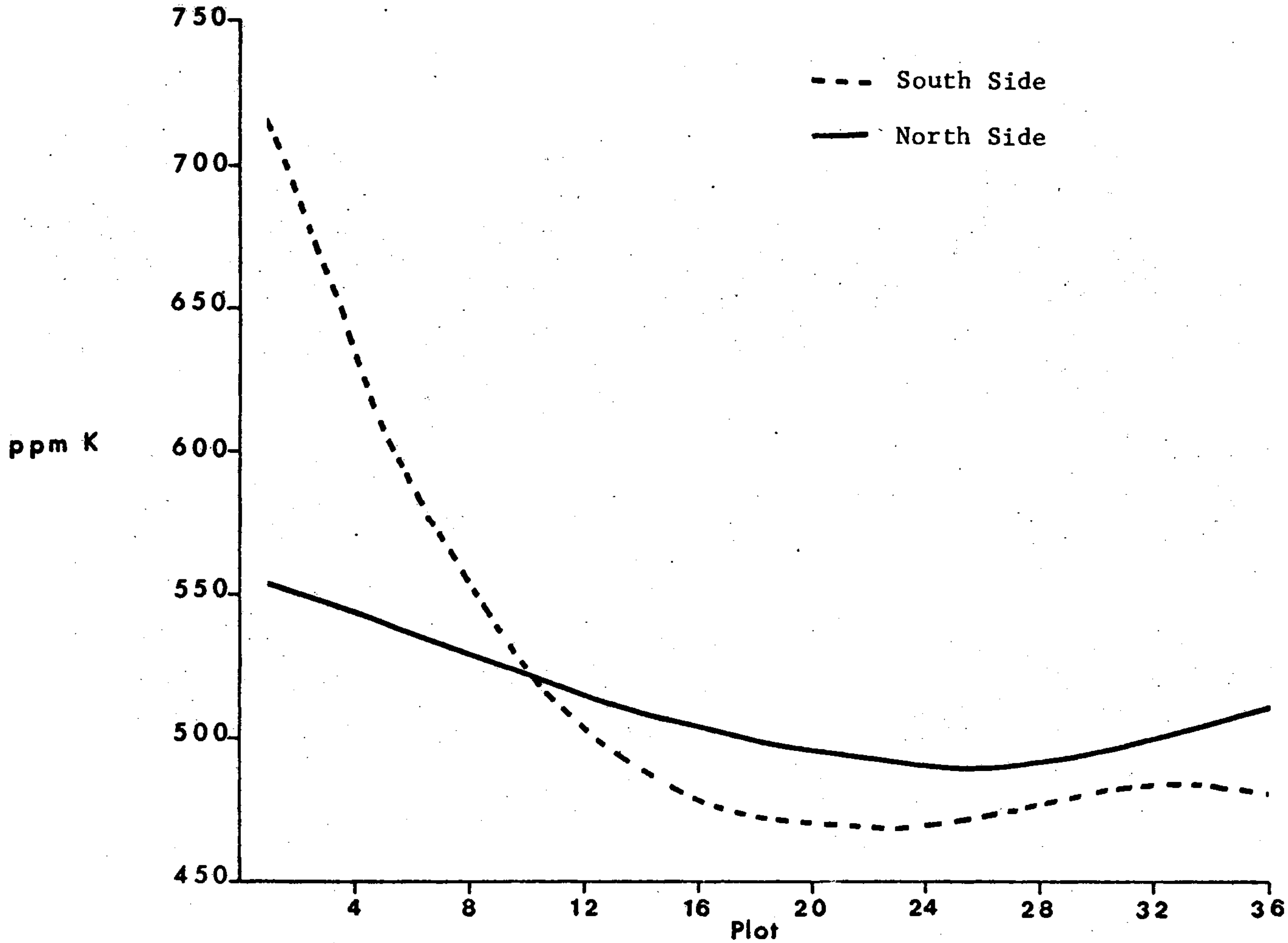

Figure 16. The Potassium Levels of the Experiments Located Southeast of Snyder on U. S. Highway 62

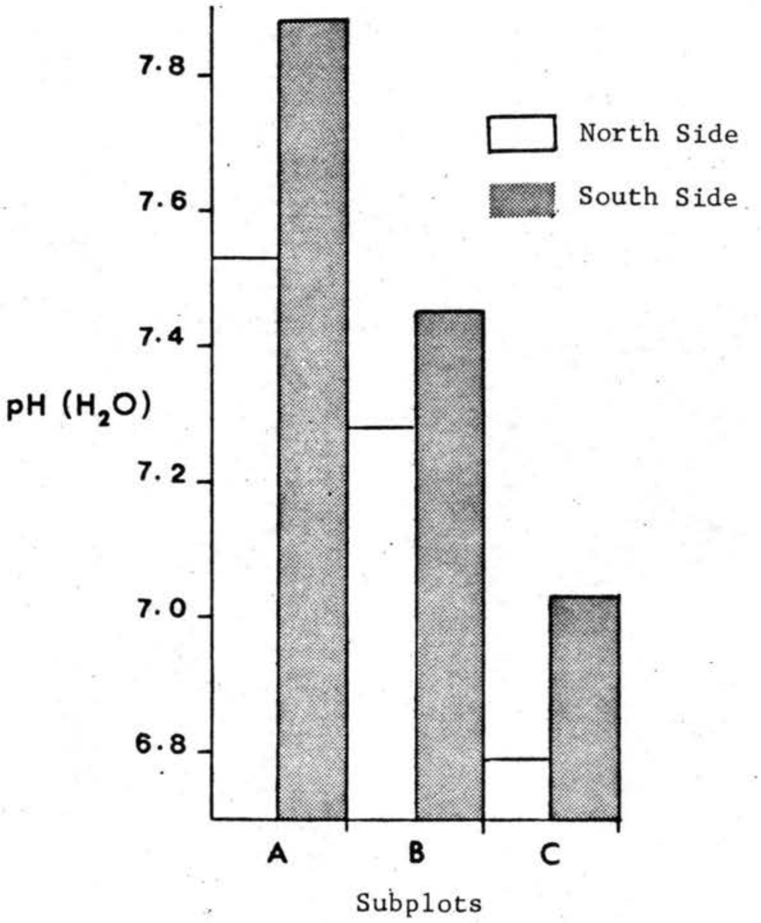

Figure 17. The Average pH-H_2O Levels Among the Subplots of the Experiments Located Southeast of Snyder on U. S. Highway 62

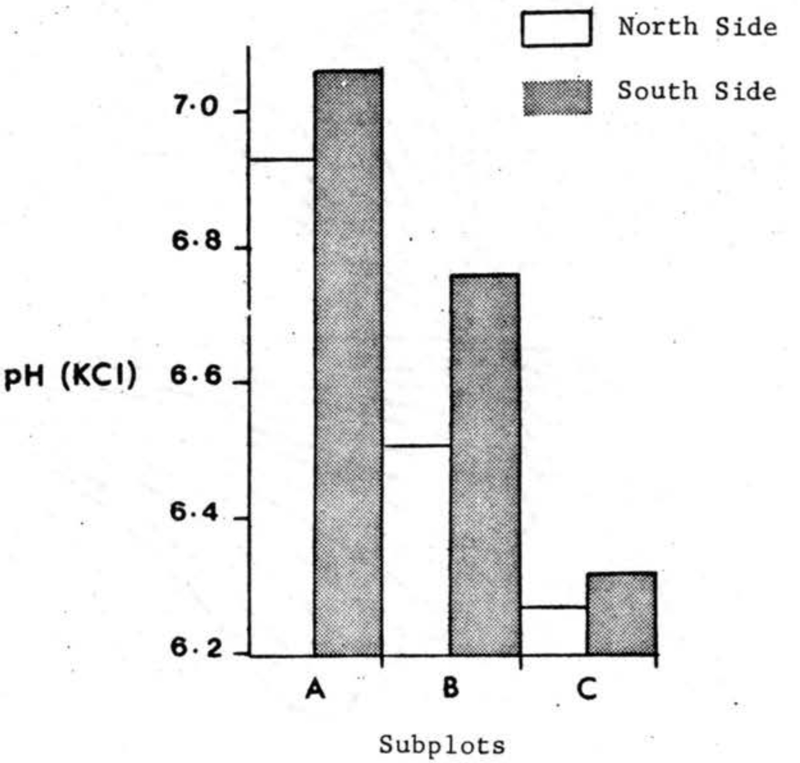

Figure 18. The Average pH-KCl Levels Among the Subplots of the Experiments Located Southeast of Snyder on U. S. Highway 62

have maximum values in subplot A and the values decline to a minimum in subplot C. The phosphorus levels, Figure 19, are at a minimum (26 ppm) in subplot A and increase to a maximum (53 ppm) in subplot C.

When comparing the two sides of the experiments near Snyder, there are statistically significant differences at the 1% level in the phosphorus value. The average phosphorus level for the north side is 26 ppm while the average phosphorus level for the south side is 36 ppm. The data presented in Figure 19 demonstrates how these phosphorus levels are distributed among the subplots.

The experiments near Utica Street in Tulsa on U. S. Interstate Highway 44Q have statistically significant differences at the 5% level in the value of pH-H_2O among the plots on the north exposure. Among the subplots, on the north side, there were significant statistical differences at the 1% level in the values of pH-KCl and phosphorus.

The value of pH-H_2O is higher on both ends of the north exposure than what it is in the middle of the experiment, Figure 21. However, the difference is of no consequence in the practical fertility requirement of this soil. Among the subplots on the north exposure, the pH-KCl is at its maximum in subplot A. It declines and reaches its minimum in subplot D, Figure 23. The phosphorus level, Figure 24, is at its minimum in subplot A and increases to its maximum in subplot B, probably caused by surface erosion of the A subplot and depositing the phosphorus laden soil on the B subplot. From subplot B the level declines as it goes to subplot D.

On the south exposure of the experiments near Utica Street, among the plots, there are significant statistical differences at the 1% level in the values of pH-H_2O and phosphorus. Among the subplots

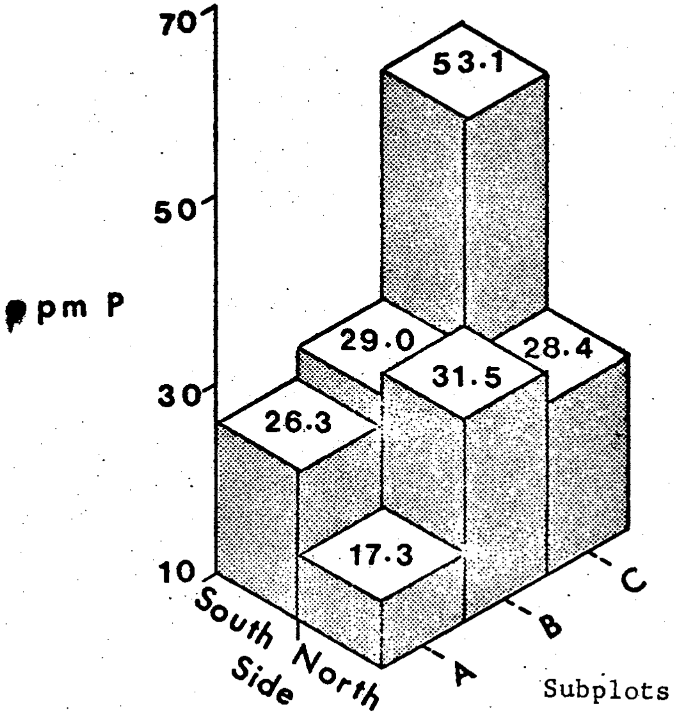

Figure 19. The Average Phosphorus Levels Among the Subplots of the Experiments Located Southeast of Snyder on U. S. Highway 62

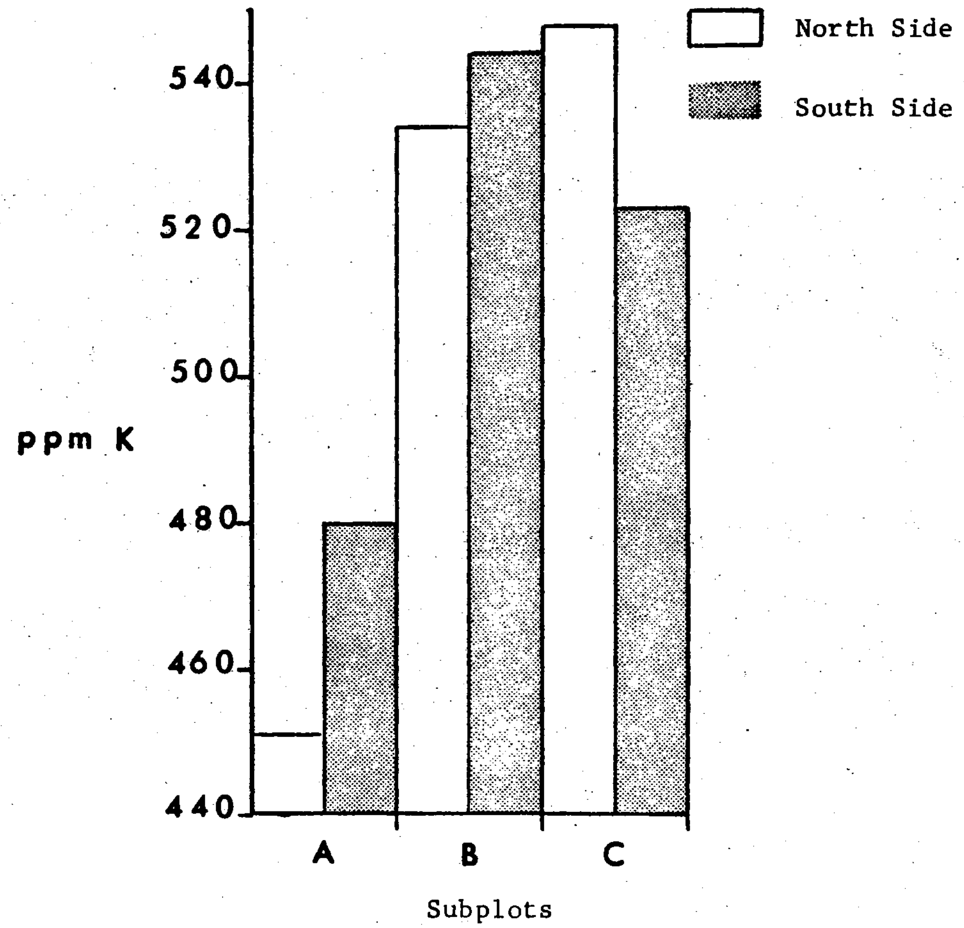

Figure 20. The Average Potassium Levels Among the Subplots of the Experiments Located Southeast of Snyder on U. S. Highway 62

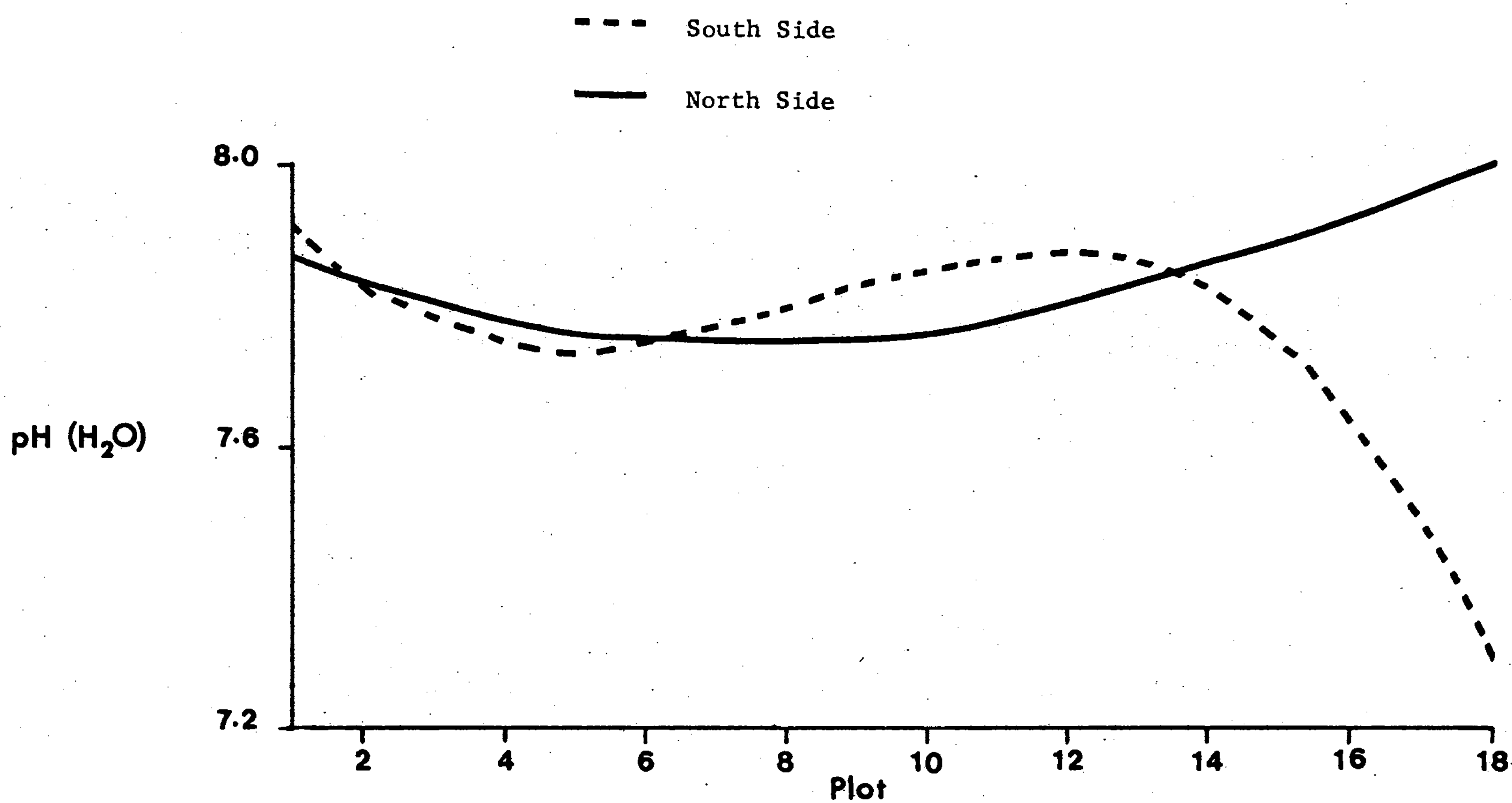

Figure 21. The pH-H_2O Levels of the Experiments in Tulsa on I-244

there is a significant statistical difference at the 1% level in the value of pH-KCl. A gradient in the value of pH-H_2O is found with a high on the west end of the experiment and declining to a low on the east end as shown in Figure 21. The phosphorus gradient shows a reverse trend as shown in Figure 22.

Among the subplots, on the south exposure, the pattern of pH-KCl follows closely the pattern shown for the north exposure with the highest value in subplot A and the lowest value in subplot D as shown in Figure 23.

When comparing the two sides of the experiments, the only statistically significant differences appear to be in the levels of phosphorus as shown in Figure 24. It is significant at the 5% level. The average phosphorus level for the north exposure is 7 ppm compared to the average phosphorus level of the south exposure is 9 ppm.

The experiments near Wister have statistically significant differences at the 1% level in the values of pH-H_2O, pH-KCl, and potassium among the plots on the north exposure. Between the subplots on the north exposure there are statistically significant differences in the levels of pH-H_2O, pH-KCl, and phosphorus.

The pH-H_2O is quite acidic on the east end and the acidity then decreases toward the west end of the experiment as shown in Figure 25. The same pattern, but of a different magnitude, is exhibited by the pH-KCl data as shown in Figure 26. The potassium content of the soil on the north exposure is higher on the east end than on the west end of the experiment. An average of 43^{o}ppm is found on the east end and the values decrease to a minimum of 30^{o}on the west end as shown in Figure 27. The pH-H_2O values on the north exposure is higher for

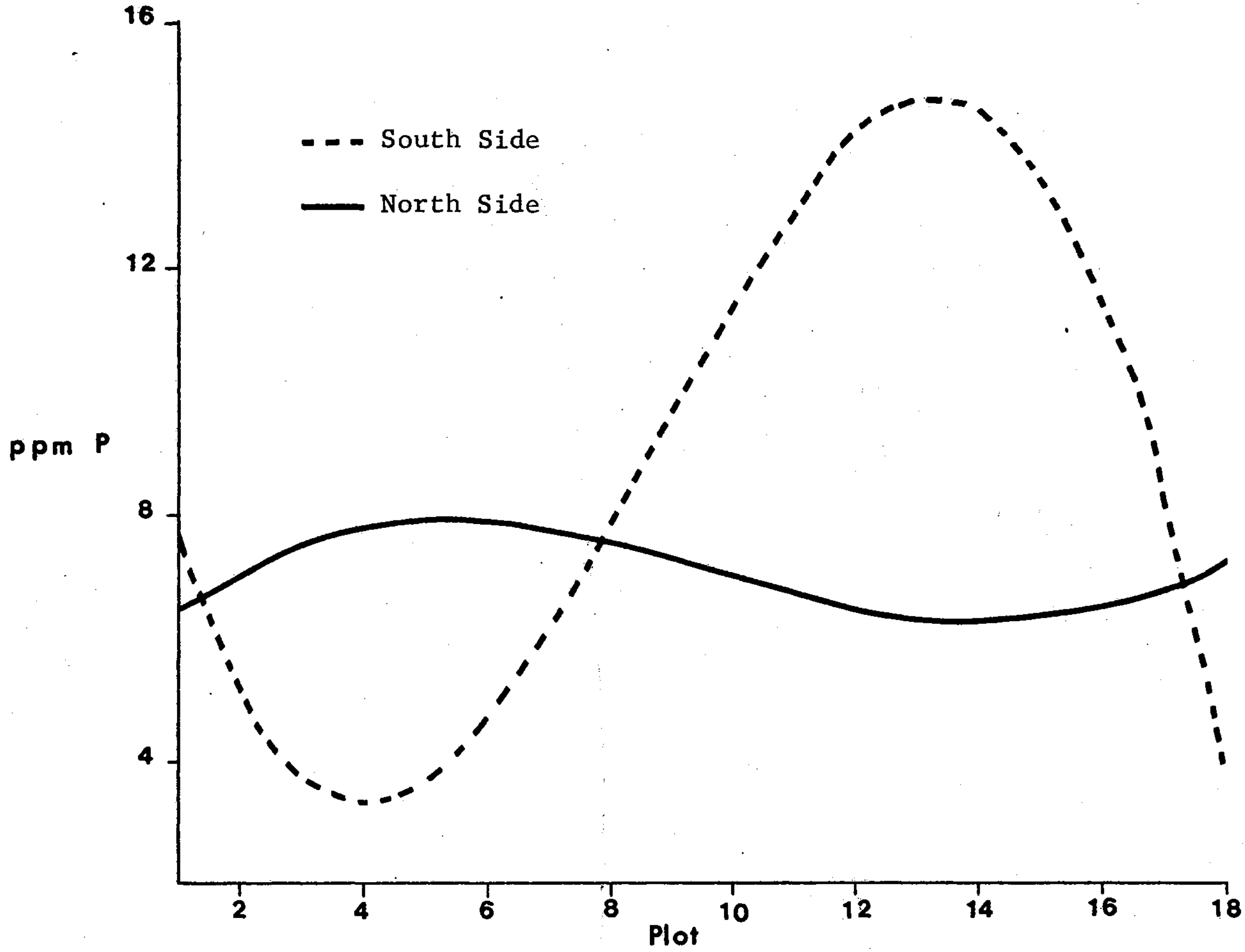

Figure 22. The Phosphorus Levels of the Experiments in Tulsa on I-244

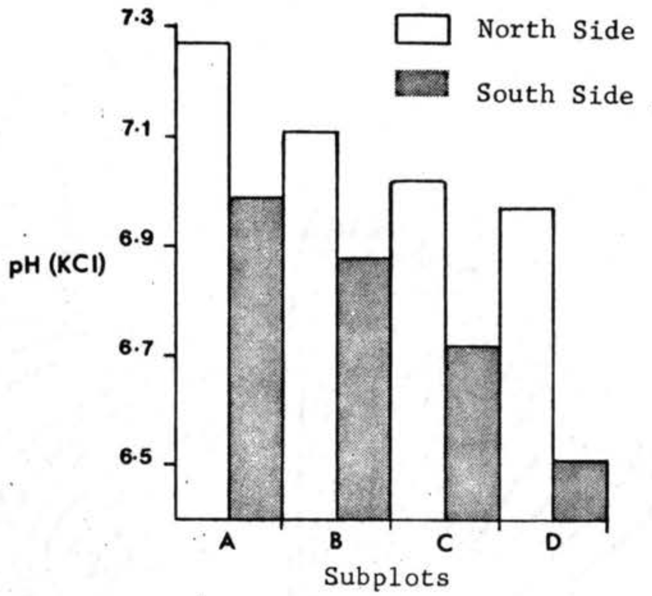

Figure 23. The Average pH-KCl Levels Among the Subplots of the Experiments in Tulsa on I-244

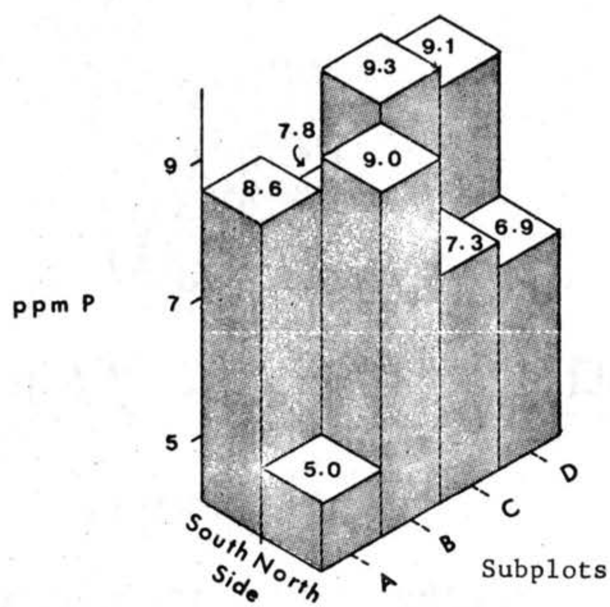

Figure 24. The Phosphorus Interaction Between the Two Experiments in Tulsa on I-244

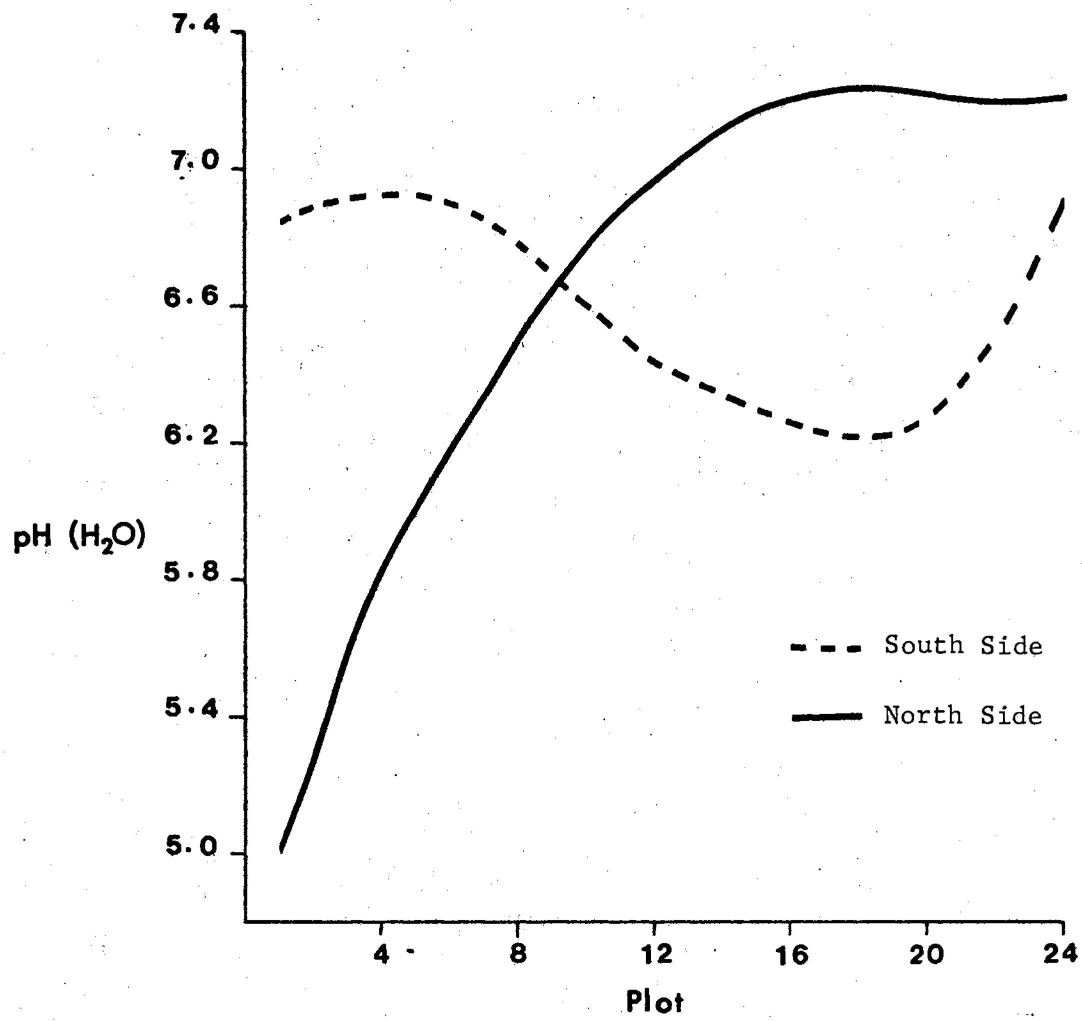

Figure 25. The pH-H_2O Levels of the Experiments Located Northeast of Wister on U. S. Highway 271

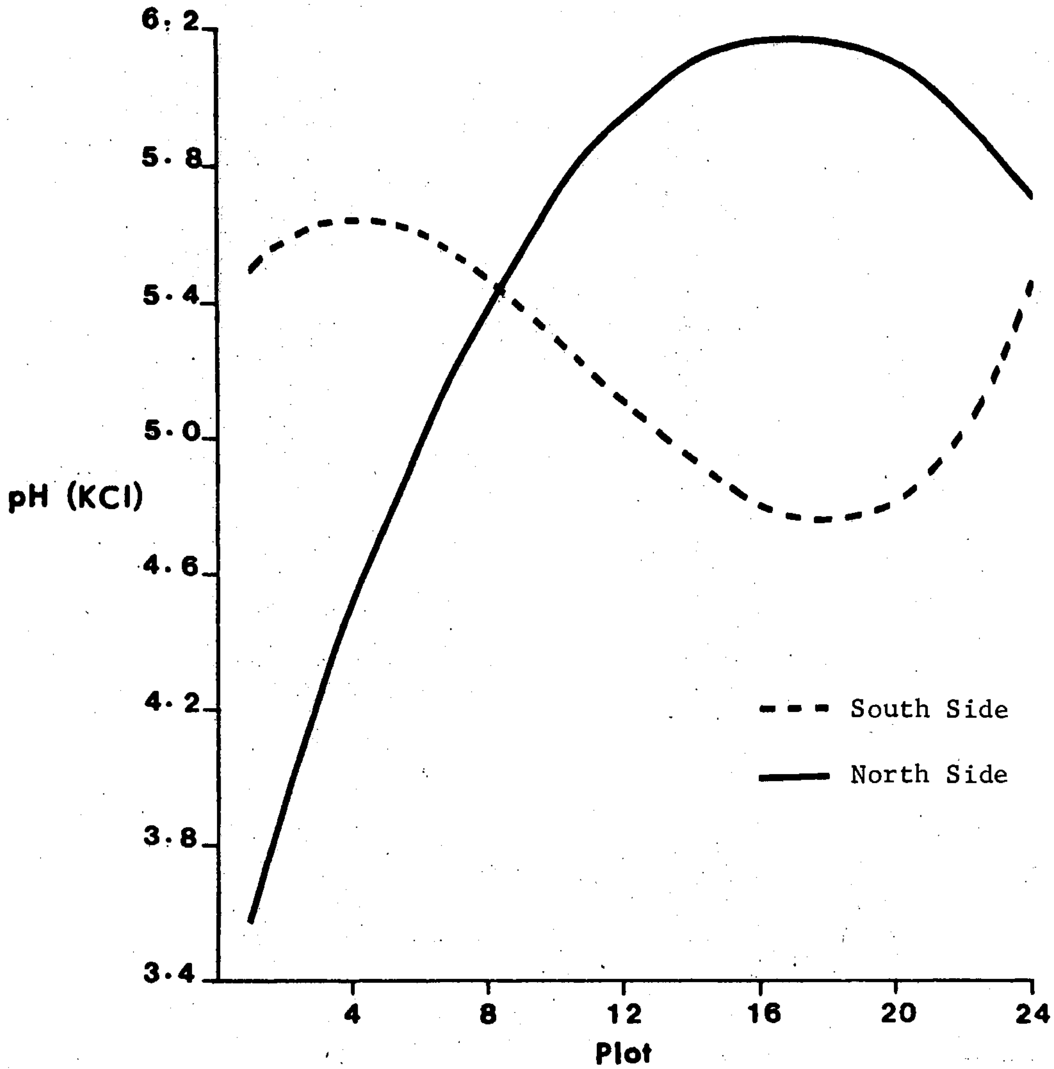

Figure 26. The pH-KCl Levels of the Experiments Located Northeast of Wister on U. S. Highway 271

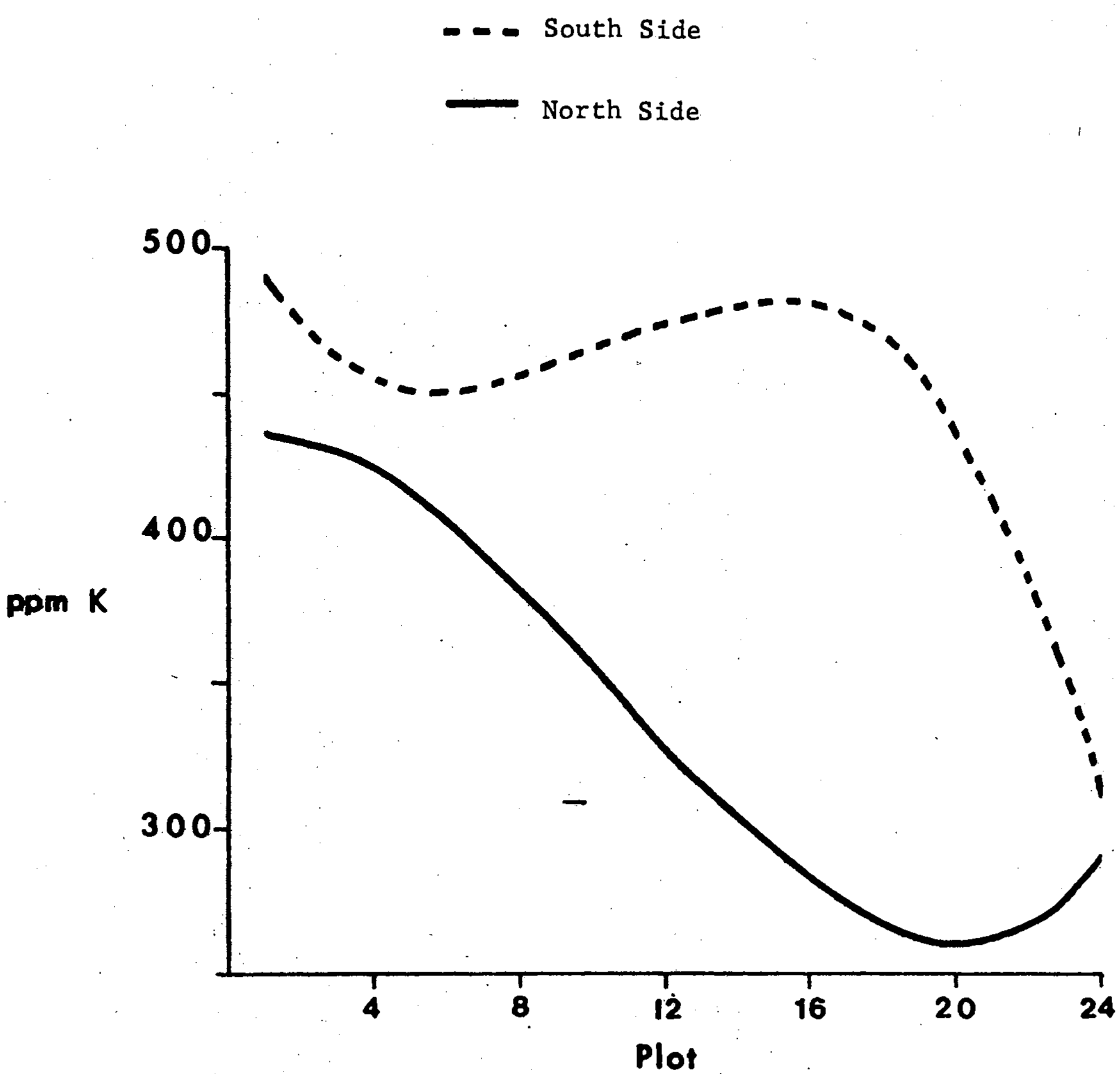

Figure 27. The Potassium Levels of the Experiments Located Northeast of Wister on U. S. Highway 271

subplot A than it is in subplot B as shown in Figure 28. The phosphorus level in subplot A, on the north side, is lower than the average phosphorus level in subplot B as shown in Figure 30.

On the south exposure of the experiments, near Wister, significant statistical differences at the 1% level was shown in the values of pH-KCl when measured among the plots. Between the subplots a significant statistical difference at the 5% level was found only for the values of pH-KCl.

The values of pH-KCl are higher at the ends of the experiment than they are towards the middle as shown in Figure 26. There is not enough difference to be of practical consequence for a fertility program. The fertility is uniformly low. Between the subplots, the pH-KCl of subplot A on the north exposure is much higher than is the value of subplot B as shown in Figure 29.

These results show that there are no practical significant statistical differences between the exposure in any of the components tested.

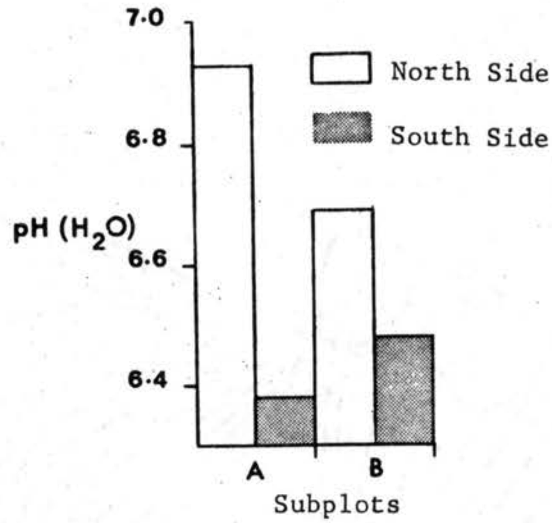

Figure 28. The Average pH-H_2O Levels Among the Subplots of the Experiments Located Northeast of Wister on U. S. Highway 271

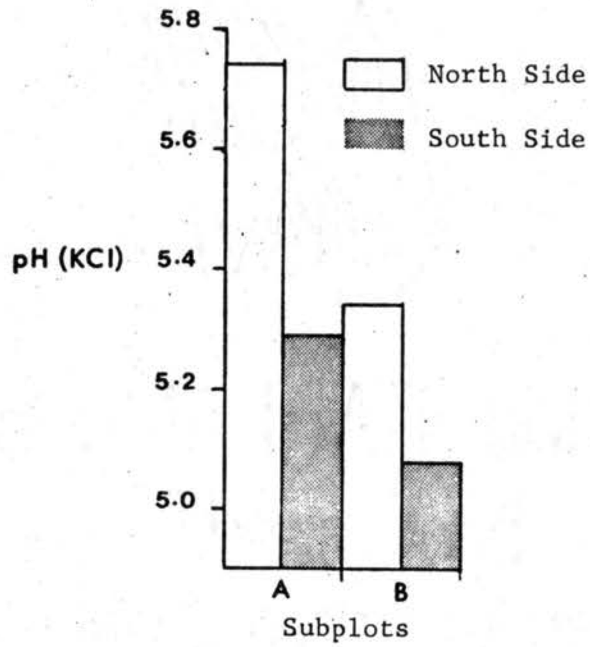

Figure 29. The Average pH-KCl Levels Among the Subplots of the Experiments Located Northeast of Wister on U. S. Highway 271

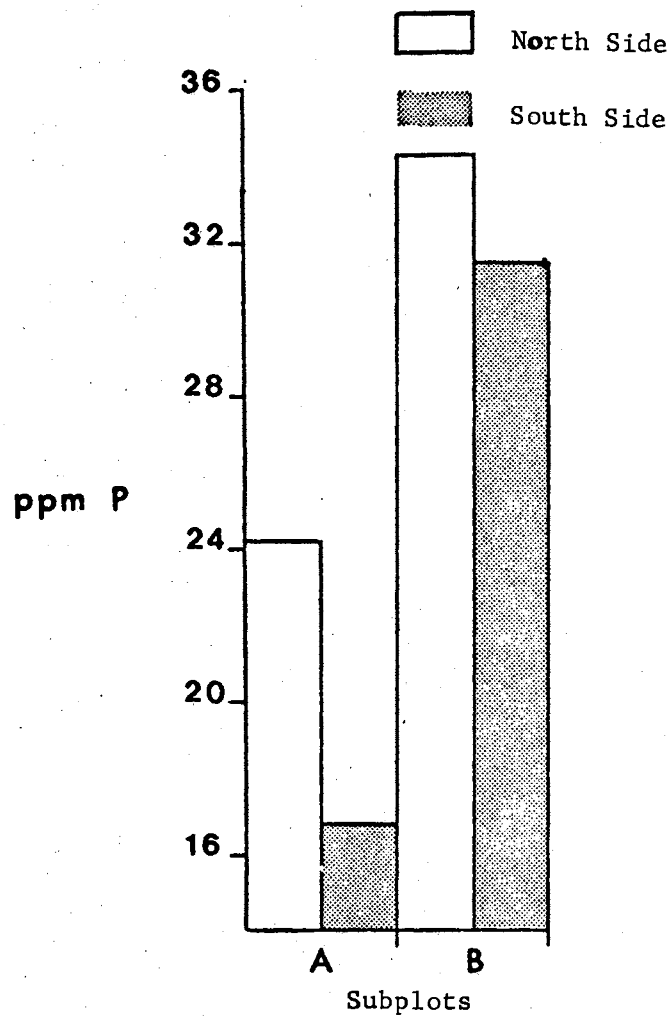

Figure 30. The Average Phosphorus Levels Among the Subplots of the Experiments Located Northeast of Wister on U. S. Highway 271

CHAPTER V

SUMMARY AND CONCLUSIONS

Soil samples were gathered from seven different experimental highway erosion control research sites across Oklahoma. The chemical properties of these soil samples were evaluated. Statistical analyses of the data were made to determine if there were fertility gradients over the length and across the subplots of the experiments.

There is a fertility gradient across the south exposure of the experiments near Cooperton in the amount of available potassium. However, the average amount of available potassium is probably not sufficient for the growth of desirable grasses. There are no fertility gradients between the subplots and between the exposures of these experiments.

Gradients in the values of pH-H_2O and pH-KCl occur across the east exposure of the experiments near Copan. There are no fertility gradients across the west exposure of these experiments. There are gradients in the value of pH-H_2O and pH-KCl among the subplots of the east exposure of the Copan experiments. These gradients also occur on the west exposure of the Copan experiments along with gradients in the levels of phosphorus and potassium among the subplots. Gradients occur in the value of pH-H_2O and pH-KCl when comparing the two exposures of the Copan experiments.

There is no fertility gradients across the west exposure and the east exposure of experiments 5-S-3-71 and 5-S-4-71 located east of Sayre. However, among the subplots on the west exposure there are gradients in the value of pH-KCl, phosphorus, and potassium. The east exposure has a gradient in the value of pH-KCl and phosphorus.

A gradient appears in the value of pH-H_2O when comparing the plots of the experiments southwest of Sayre. It is more pronounced on the south exposure than on the north. When comparing the exposures to each other, gradients occur in the value of pH-H_2O and available potassium.

No gradients occur across the north exposure of the experiments near Snyder. The south exposure of these experiments has gradients in the values of pH-H_2O, pH-KCl, phosphorus, and potassium on the north and south exposures of these experiments. Comparing the two exposures of these experiments there is a fertility difference in the amount of available phosphorus.

The experiments near Utica Street in Tulsa on I-244 has gradients across the plots in the values of pH-H_2O and phosphorus on the south exposure and only one gradient in the value of pH-H_2O on the north side. Among the strata on the north exposure, there are gradients in the values of pH-KCl and phosphorus. On the south exposure there is a gradient in the value of pH-KCl among the subplots. When comparing the two exposures of these experiments, there is a gradient in the value of phosphorus.

Gradients occur in the values of pH-H_2O, pH-KCl, and potassium across the plots of the north exposure of the experiments near Wister. Along the south exposure, across the plots, a gradient occurs in the values of pH-H_2O, pH-KCl, and phosphorus. On the south exposure a gradient occurs in the value of pH-KCl between the subplots. There are no differences in the fertility levels of the north and south exposures of these experiments when the two exposures are compared to each other.

The addition of nitrogen is necessary on all experiments to help establish ground cover. More nitrogen should be subsequently applied to help maintain a ground cover. However, the intervals and the amount of this subsequent nitrogen application is subject to more research. The growth of these desirable grasses is for ground cover and not for forage production.

Phosphorus should be added to all experiments with the exception of the experiments near Wister and Snyder where adequate phosphorus is naturally available. The experiments near Wister will probably require phosphorus fertilization due to the extremely rocky nature of the soil.

Potassium should be added to two experiments. However, not as much should be added as would normally be added for crop production. The potassium that is used by the plants will be returned to the soil since there is no forage removal.

Recommendations for all of the experimental sites may be found in Table I. These amounts of fertilizers will bring these soils up to minimum fertility levels for plant growth and soil erosion control.

TABLE I

FERTILIZER RECOMMENDATIONS FOR THE VARIOUS EXPERIMENTAL SITES

Experiment	lbs. Nitrogen as NH_4NO_3	lbs. P_2O_5 as Treblesuper-phosphate	lbs. K_2O as Muriate of Potash
5-S-11-71 and 5-S-12-71	300	100	None
8-S-3-72 and 8-S-4-72	300	150	200
5-S-3-71 and 5-S-4-71	300	50	None
5-S-13-71 and 5-S-14-71	300	50	None
5-S-9-71 and 5-S-10-71	300	None	None
8-S-1-70 and 8-S-2-70	300	75	None
2-S-1-71 and 2-S-2-71	300	None	None

LITERATURE CITED

1. Adams, John E., R. C. Henderson, and R. M. Smith. 1959. Interpretations of Runoff and Erosion From Field Scale Plots on Texas Blackland Soil. Soil Sci. 87: 232-238.

2. ______. 1966. Influence of Mulches on Runoff, Erosion, and Soil Moisture Depletion. Soil Sci. Soc. Amer. Proc. 30: 110-114.

3. Barkley, D. G., R. E. Blaser, and R. E. Schmidt. 1965. Effect of Mulches on Microclimate and Turf Establishment. Agron. J. 57: 189-192.

4. Beers, Z. H. 1962. Fertilizers an Important Factor in Establishing and Maintaining Roadside Turf. Twenty-first Short Course on Roadside Development. Ohio State University and Ohio Department of Highways. 94-95.

5. Bowers, S. A., and R. J. Hanks. 1961. Effects of DDAC on Evaporation and Infiltration of Soil Moisture. Soil Sci. 92: 340-346.

6. Clepil, W. S., N. P. Woodruff, F. H. Siddoway, E. W. Fryrear, and D. V. Armbrust. 1963. Vegetative and Non-vegetative Materials to Control Wind and Water Erosion. Soil Sci. Soc. Amer. Proc. 27: 86-89.

7. Diseker, E. G., E. C. Richardson, and B. H. Hendrickson. Roadside Erosion and its Control in the Piedmont Upland of Georgia. U. S. D. A. Bull. ARS. 41-73. August 1963.

8. Dudeck, A. E., N. P. Swanson, L. N. Mielke, and A. R. Dedrich. 1970. Mulches for Grass Establishment on Fill Slopes. Argon. J. 62: 810-812.

9. Ekern, P. C. 1951. Raindrop Impact as the Force Initiating Soil Erosion. Soil Sci. Soc. Amer. Proc. 15: 7-10.

10. Foote, L. E. and D. L. Kill. 1970. Erosion Prevention and Turf Establishment for Roadsides. Better Roads 40: 20-23.

11. Friday, D. T. 1961. Advancement in Erosion Control Protection by Fertilizer. Twentieth Short Course on Roadside Development. Ohio State University and Ohio Department of Highways. 106-113.

12. Hanks, R. J. and N. P. Woodruff. 1958. Influence of Wind on Water Vapor Transfer Through Soil, Gravel, and Straw Mulches. Soil Sci. 86: 160-164.

13. Hide, J. C. 1954. Observations on Factors Influencing the Evaporation of Soil Moisture. Soil Sci. Soc. Amer. Proc. 18: 234-239.

14. Jackobs, J. A., O. N. Andrews, Jr., C. L. Murdock, and L. E. Foote. 1967. Turf Establishment on Highway Right-of-Way Slopes--A Review. Highway Research Record. 161: 78-80.

15. John, M. K. 1970. Colorimetric Determination of Phosphorus in Soil and Plant Materials with Ascorbic Acid. Soil Sci. 109: 214-220.

16. Lemon, E. R. 1956. The Potentialities for Decreasing Soil Moisture Evaporation Loss. Soil Sci. Soc. Amer. Proc. 20: 120-125.

17. Mannering, J. V. and L. D. Meyer. 1963. Effects of Various Rates of Surface Mulch on Infiltration and Erosion. Soil Sci. Soc. Amer. Proc. 27: 84-86.

18. McCalla, T. M. and F. L. Duley. 1946. Effect of Crop Residues on Soil Temperatures. Agron. J. 38: 75-89.

19. McKee, W. H., Jr., A. J. Powell, Jr., R. B. Cooper, and R. E. Blaser. 1965. Microclimate Conditions found on Highway Slope Facings as Related to Adaptation of Species. Highway Research Record. 93: 38-43.

20. Meyer, L. D., W. H. Wischmeier, and G. R. Foster. 1970. Mulch Rates Required for Erosion Control on Steep Slopes. Soil Sci. Soc. Amer. Proc. 34: 928-931.

21. Palmertree, H. D., Coleman Y. Ward, and L. Kimbrough. 1965. Refertilization of Established Roadside Slopes in Mississippi. Twenty-fourth Short Course on Roadside Development. Ohio State University and Ohio Department of Highways. 70-75.

22. Reisch, K. M. 1969. Fact and Fancy in Fertilization. Twenty-eigth Short Course on Roadside Development. Ohio State University and Ohio Department of Highways. 84-86.

23. Richardson, E. C., E. G. Diseker, and B. H. Hendrickson. 1963. Crownvetch for Highway Bank Stabilization in the Piedmont Uplands of Georgia. Agron. J. 55: 213-215.

24. Russell, J. C. 1940. The Effect of Surface Cover on Soil Moisture Losses by Evaporation. Soil Sci. Soc. Amer. Proc. 4: 65-70.

25. Schmidt, B. L., G. S. Taylor, and R. W. Miller. 1969. Effect of Corn Steep Liquor for Erosion Control and Vegetative Establishment on Highway Backslopes. Agron. J. 61: 214-217.

26. Sutton, R. T. 1962. The Agronomist and the Highway Roadside. Twenty-first Short Course on Roadside Development. Ohio State University and Ohio Department of Highways. 64-69.

27. White. A. W., Jr., J. E. Giddens, and H. D. Morris. 1959. Sawdust as Mulch. Soil Sci. Soc. Amer. Proc. 23: 365-368.

28. Zak, J. M. 1968. Establishment and Management of Roadside Vegetable Cover In Massachusetts. Twenty-seventh Short Course on Roadside Development. Ohio State University and Ohio Department of Highways. 74-77.

APPENDIXES

TABLE II

AN ANALYSIS OF VARIANCE OF THE AVAILABLE POTASSIUM ON THE SOUTH EXPOSURE OF THE EXPERIMENTS ON OKLAHOMA STATE HIGHWAY 19 NEAR COOPERTON

Source	D. F.	S. S.	M. S.
Plot	11	298133.33	27103.03*
Subplot	1	4266.67	4266.67
Plot X Subplot	11	77333.33	7030.39
Total	23	379733.33	16510.14

*Indicates significance at the 5% level

TABLE III

AN ANALYSIS OF VARIANCE OF THE PH-KCL ON THE EAST EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 75 NEAR COPAN

Source	D. F.	S. S.	M. S.
Plot	26	1.32	0.05*
Subplot	3	0.36	0.12**
Plot X Subplot	78	2.08	0.03
Total	107	3.76	0.04

*Indicates significance at the 5% level
**Indicates significance at the 1% level

TABLE IV

AN ANALYSIS OF VARIANCE OF THE PH-H_2O LEVEL ON THE EAST EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 75 NEAR COPAN

Source	D. F.	S. S.	M. S.
Plot	26	1.72	0.07
Subplot	3	0.40	0.13*
Plot X Subplot	78	3.36	0.04
Total	107	5.47	0.05

*Indicates significance at the 5% level

TABLE V

AN ANALYSIS OF VARIANCE OF THE PH-H_2O ON THE WEST EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 75 NEAR COPAN

Source	D. F.	S. S.	M. S.
Plot	26	1.26	0.05
Subplot	3	2.86	0.95**
Plot X Subplot	78	3.85	0.05
Total	107	7.97	0.07

**Indicates significance at the 1% level

TABLE VI

AN ANALYSIS OF VARIANCE OF THE PH-KCL ON THE WEST EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 75 NEAR COPAN

Source	D. F.	S. S.	M. S.
Plot	26	1.15	0.04
Subplot	3	4.91	1.64**
Plot X Subplot	78	3.87	0.05
Total	107	9.93	0.09

**Indicates significance at the 1% level

TABLE VII

AN ANALYSIS OF VARIANCE OF THE PHOSPHORUS LEVELS OF THE WEST EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 75 NEAR COPAN

Source	D. F.	S. S.	M. S.
Plot	26	868.81	33.42
Subplot	3	340.08	113.36*
Plot X Subplot	78	2961.86	37.97
Total	107	4170.75	38.98

*Indicates significance at the 5% level

TABLE VIII

AN ANALYSIS OF VARIANCE OF THE POTASSIUM LEVELS OF THE WEST EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 75 NEAR COPAN

Source	D. F.	S. S.	M. S.
Plot	26	3216.67	123.72
Subplot	3	1713.89	571.30*
Plot X Subplot	78	14961.11	191.81
Total	107	19891.67	185.90

*Indicates significance at the 5% level

TABLE IX

AN ANALYSIS OF VARIANCE FOR THE PH-H_2O INTERACTION ON THE EXPERIMENTS ON U. S. HIGHWAY 75 NEAR COPAN

Source	D. F.	S. S.	M. S.
Plot	26	2.21	0.09
Side	1	0.22	0.22
Plot X Side	26	0.77	0.03
Subplot	3	2.52	0.84
Plot X Subplot	78	3.63	0.05
Side X Subplot	3	0.74	0.25**
Plot X Side X Subplot	78	3.57	0.05
Total	215	13.65	0.06

**Indicates significance at the 1% level

TABLE X

AN ANALYSIS OF VARIANCE FOR THE PH-KCL INTERACTION ON THE EXPERIMENTS ON U. S. HIGHWAY 75 NEAR COPAN

Source	D. F.	S. S.	M. S.
Plot	26	1.44	0.06
Side	1	0.13	0.13
Plot X Side	26	1.03	0.04
Subplot	3	3.78	1.26
Plot X Subplot	78	3.32	0.04
Side X Subplot	3	1.49	0.50**
Plot X Side X Subplot	215	13.82	0.06

**Indicates significance at the 1% level

TABLE XI

AN ANALYSIS OF VARIANCE OF THE PH-KCL ON THE WEST EXPOSURE OF THE EXPERIMENTS ON I-40 EAST OF SAYRE

Source	D. F.	S. S.	M. S.
Plot	62	5.89	0.10
Subplot	2	0.67	0.33*
Plot X Subplot	124	10.29	0.08
Total	188	16.85	0.09

*Indicates significance at the 5% level

TABLE XII

AN ANALYSIS OF VARIANCE OF THE PHOSPHORUS LEVELS
ON THE WEST EXPOSURE OF THE EXPERIMENTS
ON I-40 EAST OF SAYRE

Source	D. F.	S. S.	M. S.
Plot	62	1965.74	31.71
Subplot	2	1028.67	514.33**
Plot X Subplot	124	4514.33	36.41
Total	188	7508.74	39.94

**Indicates significance at the 1% level

TABLE XIII

AN ANALYSIS OF VARIANCE FOR THE PH-KCL INTERACTION
ON THE EXPERIMENTS ON I-40 EAST OF SAYRE

Source	D. F.	S. S.	M. S.
Side	1	0.47	0.47
Plot	62	6.47	0.10
Side X Plot	62	6.75	0.11
Subplot	2	0.04	0.02
Side X Subplot	2	1.73	0.86**
Plot X Subplot	124	12.25	0.10
Side X Plot X Subplot	124	11.29	0.09
Total	377	39.00	0.10

**Indicates significance at the 1% level

TABLE XIV

AN ANALYSIS OF VARIANCE OF THE PH-H_2O OF THE EXPERIMENTS ON I-40 SOUTHWEST OF SAYRE

Source	D. F.	S. S.	M. S.
Plot	8	0.48	0.06*
Side	1	0.27	0.27**
Plot X Side	8	0.13	0.02
Total	17	0.88	0.05

*Indicates significance at the 5% level
**Indicates significance at the 1% level

TABLE XV

AN ANALYSIS OF VARIANCE OF THE AVAILABLE POTASSIUM LEVELS OF THE EXPERIMENTS ON I-40 SOUTHWEST OF SAYRE

Source	D. F.	S. S.	M. S.
Plot	8	50000.00	6250.00
Side	1	28005.56	68005.56*
Plot X Side	8	37644.44	4705.56
Total	17	115650.00	6802.94

*Indicates significance at the 5% level

TABLE XVI

AN ANALYSIS OF VARIANCE OF THE PH-H_2O OF THE EXPERIMENTS ON THE SOUTH EXPOSURE ON U. S. HIGHWAY 62 NEAR SNYDER

Source	D. F.	S. S.	M. S.
Plot	35	7.69	0.22
Subplot	2	13.35	6.67**
Plot X Subplot	70	5.99	0.09
Total	107	27.03	0.25

**Indicates significance at the 1% level

TABLE XVII

AN ANALYSIS OF VARIANCE OF THE PH-KCL OF THE EXPERIMENTS ON THE SOUTH EXPOSURE ON U. S. HIGHWAY 62 NEAR SNYDER

Source	D. F.	S. S.	M. S.
Plot	35	3.63	0.10
Subplot	2	10.09	5.05**
Plot X Subplot	70	3.43	0.05
Total	107	17.15	0.16

**Indicates significance at the 1% level

TABLE XVIII

AN ANALYSIS OF VARIANCE OF THE AVAILABLE PHOSPHORUS LEVEL ON THE SOUTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 62 NEAR SNYDER

Source	D. F.	S. S.	M. S.
Plot	35	37143.50	1061.24
Subplot	2	15688.43	7844.22**
Plot X Subplot	70	28630.57	409.01
Total	107	81462.50	761.33

**Indicates significance at the 1% level

TABLE XIX

AN ANALYSIS OF VARIANCE OF THE AVAILABLE POTASSIUM LEVEL ON THE SOUTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 62 NEAR SNYDER

Source	D. F.	S. S.	M. S.
Plot	35	690787.96	19736.80
Subplot	2	77001.85	38500.93*
Plot X Subplot	70	787798.15	11254.25
Total	107	1555587.96	14538.21

*Indicates significance at the 5% level

TABLE XX

AN ANALYSIS OF VARIANCE OF THE PH-H_2O ON THE NORTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 62 NEAR SNYDER

Source	D. F.	S. S.	M. S.
Plot	35	6.59	0.19
Subplot	2	10.19	5.09**
Plot X Subplot	70	10.75	0.15
Total	107	27.53	0.26

**Indicates significance at the 1% level

TABLE XXI

AN ANALYSIS OF VARIANCE OF THE PH-KCL ON THE NORTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 62 NEAR SNYDER

Source	D. F.	S. S.	M. S.
Plot	35	3.17	0.09
Subplot	2	8.05	4.02**
Plot X Subplot	70	5.49	0.08
Total	107	16.71	0.16

**Indicates significance at the 1% level

TABLE XXII

AN ANALYSIS OF VARIANCE OF THE AVAILABLE PHOSPHORUS ON THE NORTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 62 NEAR SNYDER

Source	D. F.	S. S.	M. S.
Plot	35	4177.91	119.37
Subplot	2	4052.95	2026.47**
Plot X Subplot	70	14283.88	204.06
Total	107	22514.74	210.42

**Indicates significance at 1% level

TABLE XXIII

AN ANALYSIS OF VARIANCE OF THE AVAILABLE POTASSIUM ON THE NORTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 62 NEAR SNYDER

Source	D. F.	S. S.	M. S.
Plot	35	348587.96	9959.66
Subplot	2	197412.96	98706.48**
Plot X Subplot	70	995987.04	14228.39
Total	107	1541987.96	14411.10

**Indicates significance at the 1% level

TABLE XXIV

AN ANALYSIS OF VARIANCE FOR THE AVAILABLE PHOSPHORUS INTERACTION ON THE EXPERIMENTS ON U. S. HIGHWAY 62 NEAR SNYDER

Source	D. F.	S. S.	M. S.
Side	1	5869.80	5869.80
Plot	35	20138.87	575.40
Side X Plot	35	21182.54	605.22
Subplot	2	13034.84	6517.42
Side X Subplot	2	6706.54	3353.27**
Plot X Subplot	70	25911.58	370.17
Side X Plot X Subplot	70	17002.87	242.90
Total	215	109847.04	510.92

**Indicates significance at the 1% level

TABLE XXV

AN ANALYSIS OF VARIANCE OF THE PH-H_2O ON THE NORTH EXPOSURE OF THE EXPERIMENTS ON I-244 IN TULSA

Source	D. F.	S. S.	M. S.
Plot	17	1.03	0.06*
Subplot	3	0.02	0.01
Plot X Subplot	51	1.47	0.03
Total	71	2.52	0.04

*Indicates significance at the 5% level

TABLE XXVI

AN ANALYSIS OF VARIANCE OF THE PH-KCL ON THE NORTH EXPOSURE OF THE EXPERIMENTS ON I-244 IN TULSA

Source	D. F.	S. S.	M. S.
Plot	17	0.80	0.05
Subplot	3	0.97	0.32**
Plot X Subplot	51	1.55	0.03
Total	71	3.32	0.05

**Indicates significance at the 1% level

TABLE XXVII

AN ANALYSIS OF VARIANCE OF THE AVAILABLE PHOSPHORUS LEVELS ON THE NORTH EXPOSURE OF THE EXPERIMENTS ON I-244 IN TULSA

Source	D. F.	S. S.	M. S.
Plot	17	229.78	13.52
Subplot	3	146.00	48.67**
Plot X Subplot	51	576.00	11.29
Total	71	951.78	13.41

**Indicates significance at the 1% level

TABLE XXVIII

AN ANALYSIS OF VARIANCE OF THE PH-H_2O ON THE SOUTH EXPOSURE OF THE EXPERIMENTS ON I-244 IN TULSA

Source	D. F.	S. S.	M. S.
Plot	17	2.78	0.16**
Subplot	3	0.11	0.04
Plot X Subplot	51	2.95	0.06
Total	71	5.84	0.08

**Indicates significance at the 1% level

TABLE XXIX

AN ANALYSIS OF VARIANCE OF THE AVAILABLE PHOSPHORUS LEVELS ON THE SOUTH EXPOSURE OF THE EXPERIMENTS ON I-244 IN TULSA

Source	D. F.	S. S.	M. S.
Plot	17	2489.90	146.46**
Subplot	3	22.15	7.38
Plot X Subplot	51	513.60	10.07
Total	71	3025.65	42.61

**Indicates significance at the 1% level

TABLE XXX

AN ANALYSIS OF VARIANCE OF THE PH-KCL ON THE SOUTH EXPOSURE OF THE EXPERIMENTS ON I-244 IN TULSA

Source	D. F.	S. S.	M. S.
Plot	17	2.53	0.15
Subplot	3	2.45	0.81**
Plot X Subplot	51	5.14	0.10
Total	71	10.12	0.14

**Indicates significance at the 1% level

TABLE XXXI

AN ANALYSIS OF VARIANCE FOR THE AVAILABLE PHOSPHORUS INTERACTION ON THE EXPERIMENTS ON I-244 IN TULSA

Source	D. F.	S. S.	M. S.
Plot	17	1059.62	62.33
Side	1	95.06	95.06
Plot X Side	17	1660.06	97.65
Subplot	3	60.91	20.30
Plot X Subplot	51	611.47	11.99
Side X Subplot	3	107.24	35.75*
Plot X Side X Subplot	51	478.13	9.38
Total	143	4072.49	28.48

*Indicates significance at the 5% level

TABLE XXXII

AN ANALYSIS OF VARIANCE OF THE PH-KCL ON THE SOUTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 271 NEAR WISTER

Source	D. F.	S. S.	M. S.
Plot	23	8.03	0.35**
Subplot	1	0.80	0.80*
Plot X Subplot	23	2.50	0.11
Total	47	11.33	0.24

*Indicates significance at the 5% level
**Indicates significance at the 1% level

TABLE XXXIII

AN ANALYSIS OF VARIANCE OF THE PH-H_2O ON THE NORTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 271 NEAR WISTER

Source	D. F.	S. S.	M. S.
Plot	23	24.49	1.06**
Subplot	1	3.69	3.69**
Plot X Subplot	23	6.36	0.28
Total	47	34.54	0.73

**Indicates significance at the 5% level

TABLE XXXIV

AN ANALYSIS OF VARIANCE OF THE PH-KCL ON THE NORTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 271 NEAR WISTER

Source	D. F.	S. S.	M. S.
Plot	23	32.96	1.43**
Subplot	1	2.43	2.43**
Plot X Subplot	23	5.82	0.25
Total	47	41.21	0.88

**Indicates significance at the 1% level

TABLE XXXV

AN ANALYSIS OF VARIANCE OF THE AVAILABLE PHOSPHORUS LEVELS ON THE NORTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 271 NEAR WISTER

Source	D. F.	S. S.	M. S.
Plot	23	2160.23	93.92
Subplot	1	660.08	660.08**
Plot X Subplot	23	1600.17	69.57
Total	47	4420.48	94.05

**Indicates significance at the 1% level

TABLE XXXVI

AN ANALYSIS OF VARIANCE OF THE AVAILABLE POTASSIUM LEVELS ON THE NORTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 271 NEAR WISTER

Source	D. F.	S. S.	M. S.
Plot	23	435166.67	18920.29**
Subplot	1	833.33	833.33
Plot X Subplot	23	113566.67	4937.68
Total	47	549566.67	11692.91

**Indicates significance at the 1% level

TABLE XXXVII

SOIL ANALYSES OF THE SOUTH EXPOSURE OF THE EXPERIMENTS
NEAR COOPERTON ON OKLAHOMA STATE HIGHWAY 19

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	ppm K	ppm Na	ppm Ca	ppm Mg
1	A	7.7	7.1	20	600	120	3480	640
1	B	8.6	7.4	14	400	32	3040	480
2	A	8.1	7.6	29	360	168	3000	640
2	B	8.1	7.5	16	440	64	3520	560
3	A	7.9	7.7	19	480	532	3080	920
3	B	8.2	7.5	21	360	192	2920	680
4	A	8.2	7.4	26	400	80	3080	600
4	B	8.0	7.5	11	560	208	6640	840
5	A	7.9	7.7	10	280	136	2520	480
5	B	8.0	7.1	16	200	56	2840	600
6	A	8.1	7.8	31	520	304	3880	1200
6	B	8.3	7.5	11	440	56	3280	480
7	A	8.2	7.8	14	720	208	3400	800
7	B	8.1	7.3	21	760	152	5640	800
8	A	7.9	7.4	103	440	288	2400	920
8	B	8.1	7.5	19	480	320	4120	880
9	A	8.1	7.4	19	480	88	3960	720
9	B	8.4	7.5	41	280	32	2400	600
10	A	8.3	7.4	8	320	48	3280	480
10	B	8.2	7.4	25	440	192	3080	760
11	A	8.2	7.6	11	400	40	4120	240
11	B	8.2	7.4	14	400	72	2760	600
12	A	8.2	7.4	19	520	128	3640	640
12	B	8.3	7.7	18	440	424	3080	1120

TABLE XXXVIII

SOIL ANALYSES OF THE NORTH EXPOSURE OF THE EXPERIMENTS NEAR COOPERTON ON OKLAHOMA STATE HIGHWAY 19

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	ppm K	ppm Na	ppm Ca	ppm Mg
1	A	7.9	7.8	11	120	48	880	160
1	B	9.0	7.2	13	400	40	4120	480
2	A	8.4	7.4	24	520	422	7040	1280
2	B	8.6	7.5	9	400	64	2280	480
3	A	8.1	7.5	34	440	128	5440	760
3	B	8.2	7.3	18	80	64	520	280
4	A	8.2	7.5	11	320	80	3760	560
4	B	8.2	7.6	16	400	272	3840	800
5	A	8.4	7.7	13	480	80	3960	680
5	B	8.0	7.6	14	400	72	3600	480
6	A	8.4	7.5	11	240	80	2840	440
6	B	8.2	7.3	9	360	56	3440	240
7	A	8.3	7.8	85	360	208	3000	640
7	B	8.1	7.4	14	520	104	4000	520
8	A	7.9	7.1	18	400	112	3680	560
8	B	8.3	7.6	16	480	80	3960	680
9	A	8.0	7.9	18	440	240	4200	760
9	B	8.0	7.4	21	480	296	4320	920
10	A	8.3	7.3	35	440	224	3440	880
10	B	8.2	7.5	18	400	240	3040	920
11	A	8.1	7.6	8	400	392	3440	1560
11	B	8.3	7.3	18	520	216	4240	840
12	A	8.5	7.6	31	440	240	3720	840
12	B	8.4	7.8	16	520	136	4040	760

TABLE XXXIX

SOIL ANALYSES OF THE EAST EXPOSURE OF THE EXPERIMENTS NEAR COPAN U. S. HIGHWAY 75

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
1	A	6.8	6.1	9	40	10	1213	100
1	B	7.0	6.2	8	70	10	1950	138
1	C	7.0	6.1	8	80	10	1800	100
1	D	7.1	5.9	10	60	10	1613	150
2	A	7.1	6.4	9	60	20	1663	113
2	B	6.8	6.2	9	60	10	1675	88
2	C	7.0	6.2	8	60	30	1800	125
2	D	6.9	6.1	9	60	20	1463	88
3	A	6.8	5.9	8	40	20	1238	88
3	B	7.1	6.1	8	50	20	1575	113
3	C	6.9	6.2	8	80	20	1938	163
3	D	7.3	6.1	5	40	20	1688	50
4	A	7.0	6.1	10	60	20	1800	100
4	B	7.3	6.2	14	60	20	1738	113
4	C	7.1	6.3	6	40	10	1275	100
4	D	6.8	6.1	8	60	5	1638	113
5	A	7.1	6.4	33	50	10	1325	88
5	B	6.9	6.0	8	70	10	1613	138
5	C	6.9	6.3	10	60	10	1213	125
5	D	6.9	6.0	6	50	10	1425	63
6	A	6.9	6.1	10	60	10	1463	125
6	B	7.0	6.1	9	60	10	1613	100
6	C	7.0	6.2	8	70	10	1600	125
6	D	7.1	6.1	6	70	10	1888	88
7	A	6.9	5.9	24	30	5	988	50
7	B	6.8	5.9	19	60	10	1450	113
7	C	6.9	5.9	6	60	10	1450	38
7	D	6.9	6.0	11	60	10	1600	125
8	A	6.9	6.0	8	70	10	1438	88
8	B	6.8	6.2	10	90	5	1275	100
8	C	7.0	6.0	8	40	10	1975	50
8	D	7.1	6.2	8	60	10	1700	100
9	A	6.8	6.0	9	60	10	1375	88
9	B	7.0	6.0	6	60	10	1463	100
9	C	7.1	6.2	14	70	10	1913	113
9	D	7.2	6.3	8	70	20	2288	138
10	A	7.1	6.1	10	60	10	1363	163
10	B	6.8	5.9	9	60	10	1600	150
10	C	6.9	6.4	13	50	5	1263	50
10	D	6.9	6.1	100	60	10	1763	88
11	A	7.0	6.2	10	40	10	1475	100
11	B	7.0	6.2	11	60	20	2000	88
11	C	7.1	6.1	8	60	10	1963	113
11	D	7.1	6.0	5	70	20	1738	150

TABLE XXXIX (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
12	A	7.4	6.1	8	60	10	1475	75
12	B	7.2	6.2	11	70	10	1675	200
12	C	7.0	6.2	9	60	5	1700	88
12	D	7.5	6.2	19	70	20	1625	288
13	A	7.2	6.2	13	50	20	1625	263
13	B	7.2	6.4	9	60	1	1800	113
13	C	7.0	6.2	10	60	10	1938	100
14	B	7.1	6.1	8	70	20	1975	188
14	A	6.8	6.3	10	60	20	2000	113
13	D	6.8	6.1	10	50	5	1850	63
14	C	6.8	5.9	19	80	10	1725	250
14	D	7.0	6.3	8	70	20	2438	125
15	A	7.2	6.3	16	70	20	1725	175
15	B	6.9	5.9	10	80	30	1663	475
15	C	7.2	6.1	11	160	20	3250	588
15	D	7.0	5.9	6	50	10	1950	75
16	A	7.6	6.5	18	70	30	1425	113
16	B	7.4	6.3	11	80	20	1700	313
16	C	7.2	6.2	9	60	10	1775	175
16	D	7.0	6.3	6	50	10	1825	113
17	A	7.3	6.3	33	90	10	1725	288
17	B	7.2	6.3	10	70	3	2125	75
17	C	7.0	6.2	8	70	20	2075	250
17	D	7.0	6.3	15	70	10	2013	100
18	A	7.3	6.5	8	60	20	2000	238
18	B	7.2	6.7	11	60	10	1500	175
18	C	7.5	6.7	49	110	20	2350	138
18	D	6.8	6.0	10	30	40	1763	37
19	A	7.5	6.2	15	80	30	1725	325
19	B	7.2	6.2	15	130	3	2500	588
19	C	7.2	6.4	10	60	5	2213	113
19	D	7.1	6.2	10	60	5	1588	88
20	A	7.3	6.3	10	50	10	1463	113
20	B	7.2	6.3	19	70	20	2025	188
20	C	6.9	6.2	8	60	10	2363	138
20	D	7.2	6.2	8	60	10	2275	113
21	A	7.5	6.5	13	80	20	1888	188
21	B	6.6	6.0	9	70	20	1825	150
21	C	7.0	6.2	10	20	20	1725	50
21	D	6.9	6.0	15	60	20	1925	113
22	A	7.4	6.5	15	70	10	2000	238
22	B	7.1	6.2	10	70	10	2025	163
22	C	7.2	6.5	8	40	5	1575	63
22	D	7.0	6.2	10	30	20	938	88

TABLE XXXIX (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
23	A	7.3	6.3	9	20	10	2025	50
23	B	7.1	6.2	8	50	10	1388	63
23	C	7.3	6.3	6	40	4	1575	88
23	D	6.9	6.0	8	70	5	2200	138
24	A	7.2	6.5	10	60	4	1750	88
24	B	7.3	6.3	8	50	10	1725	125
24	C	7.2	6.2	21	60	20	1813	125
24	D	7.2	6.4	5	60	50	1963	100
25	A	7.6	6.8	9	70	20	1850	200
25	B	6.9	6.3	8	70	2	2225	150
25	C	6.8	6.0	10	40	5	1625	75
25	D	6.8	5.9	9	60	5	2088	113
26	A	7.4	6.6	10	30	20	1313	188
26	B	7.2	6.3	21	60	10	1913	88
26	C	7.9	6.2	8	60	10	2075	125
26	D	6.8	5.9	8	50	5	1825	100
27	A	7.3	6.3	10	50	40	1350	125
27	B	7.6	6.5	21	40	5	1138	163
27	C	7.2	6.2	11	60	10	2263	111
27	D	6.8	6.2	6	60	10	1925	125

TABLE XL

SOILS ANALYSES OF THE WEST EXPOSURE OF THE EXPERIMENTS NEAR COPAN U.S. HIGHWAY 75

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	ppm K	ppm Na	ppm Ca	ppm Mg
1	A	7.4	6.5	10	50	10	1313	138
1	B	7.3	6.3	5	50	20	1800	100
1	C	7.1	6.2	5	40	10	1388	63
1	D	6.9	6.0	6	60	10	1288	150
2	A	7.6	6.9	44	20	5	1350	63
2	B	7.1	6.3	6	40	20	1213	125
2	C	6.5	5.9	5	60	10	1562	113
2	D	7.1	5.8	6	50	4	1575	75
3	A	7.2	6.1	8	20	30	788	50
3	B	7.5	6.1	29	40	20	1025	88
3	C	7.0	5.9	5	60	5	1400	125
3	D	7.2	6.1	5	50	10	1575	88
4	A	7.1	6.2	8	70	3	1500	88
4	B	7.1	6.2	10	50	40	1225	88
4	C	7.2	6.3	21	70	5	1350	88
4	D	6.9	5.9	5	40	5	963	100
5	A	7.2	6.5	36	20	20	1325	88
5	B	7.2	6.2	13	40	20	1363	88
5	C	7.1	5.9	5	60	10	1700	125
5	D	6.8	5.9	6	60	5	1325	100
6	A	7.2	6.3	24	30	10	1575	88
6	B	7.0	5.9	5	50	10	1550	88
6	C	6.9	5.9	5	50	10	1325	75
6	D	7.0	5.8	5	50	20	950	63
7	A	7.2	6.3	13	30	3	1625	50
7	B	7.0	6.3	5	50	20	1450	150
7	C	7.0	6.2	5	70	10	2038	113
7	D	6.8	5.7	8	50	10	1263	113
8	A	6.9	6.1	10	70	30	1875	125
8	B	6.9	6.1	5	30	10	1738	75
8	C	7.1	6.3	6	50	5	1450	113
8	D	7.2	6.2	5	60	10	1650	110
9	A	7.2	6.6	13	40	10	1625	75
9	B	7.2	5.8	5	40	10	1875	75
9	C	6.9	6.0	5	40	10	1725	50
9	D	7.0	6.0	8	60	10	1488	113
10	A	7.7	6.8	28	40	20	1600	138
10	B	6.8	6.0	5	60	10	1450	113
10	C	6.8	5.9	5	60	10	1663	150
10	D	7.0	6.1	8	50	3	1750	63
11	A	7.5	6.5	21	20	20	1625	150
11	B	7.0	6.0	5	50	10	1400	75
11	C	6.8	6.4	110	50	10	1725	175
11	D	6.8	6.6	6	50	10	1513	63

TABLE XL (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
12	A	7.4	6.5	18	40	20	1513	100
12	B	7.2	6.1	18	40	10	1325	88
12	C	7.0	6.1	5	40	3	1363	63
12	D	7.2	5.8	5	60	10	1738	125
13	A	7.6	6.9	16	30	10	1538	75
13	B	7.2	6.1	34	50	10	1663	88
13	C	7.0	6.0	6	60	5	1375	88
13	D	7.2	6.0	5	40	10	1475	63
14	A	7.6	6.5	4	50	30	1338	175
14	B	7.1	6.1	14	50	10	1463	138
14	C	6.7	5.7	5	50	10	1838	188
14	D	6.9	5.9	5	40	10	1875	75
15	A	7.2	6.4	16	80	20	2350	225
15	B	7.1	6.2	13	30	10	963	37
15	C	7.0	5.5	5	30	10	1163	50
15	D	7.1	5.9	5	70	4	1787	75
16	A	7.1	6.3	10	40	20	1550	138
16	B	7.0	6.0	9	40	5	1038	88
16	C	6.9	5.6	5	40	30	1550	100
16	D	7.2	6.1	6	30	10	1125	50
17	A	7.3	6.3	13	60	20	1800	163
17	B	7.2	6.1	18	40	20	1400	100
17	C	7.1	5.8	10	50	20	1388	125
17	D	7.0	6.1	5	40	10	1500	113
18	A	7.3	6.4	10	20	20	1425	50
18	B	7.2	6.1	5	40	40	975	88
18	C	7.1	6.1	9	80	20	2100	113
18	D	7.1	6.1	10	50	10	1325	113
19	A	7.3	6.1	9	60	30	1700	150
19	B	7.1	6.2	5	20	20	1688	50
19	C	7.4	6.1	5	50	30	1663	75
19	D	7.2	6.1	5	40	30	1475	75
20	A	7.8	6.7	11	40	10	1750	75
20	B	7.2	5.9	5	40	5	1563	75
20	C	7.2	6.0	5	50	20	1700	113
20	D	6.4	5.5	18	50	20	1713	113
21	A	7.3	6.0	20	50	20	1325	138
21	B	7.4	6.1	18	40	10	2150	138
21	C	7.1	6.1	5	50	20	1725	88
21	D	7.4	5.9	16	50	10	1788	88
22	A	7.5	6.6	24	40	20	1563	75
22	B	7.3	6.5	39	50	20	1400	50
22	C	7.1	6.1	5	50	20	1500	88
22	D	6.7	5.5	6	40	5	800	113

TABLE XL (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
23	A	7.5	6.7	25	50	10	1850	150
23	B	7.1	6.1	9	30	10	1500	125
23	C	6.8	6.0	9	40	40	1500	88
23	D	6.9	5.9	8	10	10	1400	38
24	A	7.7	6.8	16	20	10	1500	88
24	B	7.1	6.1	8	50	10	1438	88
24	C	7.0	6.2	16	20	10	1463	63
24	D	6.9	5.8	5	40	10	1388	50
25	A	7.8	6.9	18	40	10	1913	188
25	B	7.0	5.9	6	30	10	1375	50
25	C	6.9	5.9	14	50	30	1788	125
25	D	7.2	5.9	9	50	20	1575	100
26	A	7.9	6.8	9	30	10	2025	50
26	B	7.0	6.3	6	50	20	2150	75
26	C	7.3	6.1	6	60	40	1563	125
26	D	7.1	6.2	5	30	5	738	88
27	A	7.8	6.9	21	50	20	1450	200
27	B	7.1	6.1	8	50	20	1225	100
27	C	7.1	6.1	5	60	20	1900	163
27	D	7.9	6.1	5	20	4	1400	50

TABLE XLI

SOIL ANALYSES OF THE WEST EXPOSURE OF THE EXPERIMENTS LOCATED EAST OF SAYRE ON I-40

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
1	A	7.9	6.9	28	640	160	5120	360
1	B	7.9	6.9	21	520	160	3640	280
1	C	8.1	7.6	6	360	120	5320	390
2	A	7.9	6.9	28	640	160	5120	360
2	B	7.9	6.9	21	520	160	3640	280
2	C	8.1	7.6	6	360	120	5320	390
3	A	7.9	6.9	28	640	160	5120	360
3	B	7.9	6.9	21	520	160	3640	280
3	C	8.1	7.6	6	360	120	5320	390
4	A	7.7	6.9	20	400	240	8600	240
4	B	8.8	7.1	25	320	160	5800	120
4	C	7.8	7.9	25	640	120	4080	240
5	A	7.7	6.9	20	400	240	8600	240
5	B	8.8	7.1	25	320	160	5800	120
5	C	7.8	7.9	25	640	120	4080	240
6	A	7.7	6.9	20	400	240	8600	240
6	B	8.8	7.1	25	320	160	5800	120
6	C	7.8	7.9	25	640	120	4080	240
7	A	8.0	7.2	33	680	160	5800	430
7	B	8.0	8.0	24	280	80	3320	380
7	C	7.9	7.3	23	480	120	4560	430
8	A	8.0	7.2	33	680	160	5800	430
8	B	8.0	8.0	24	280	80	3320	380
8	C	7.9	7.3	23	480	120	4560	430
9	A	8.0	7.2	33	680	160	5800	430
9	B	8.0	8.0	24	280	80	3320	380
9	C	7.9	7.3	23	480	120	4560	430
10	A	7.8	7.3	19	400	200	6120	400
10	B	7.9	7.2	31	400	120	6040	230
10	C	8.1	7.3	21	400	160	5760	850
11	A	7.8	7.3	19	400	200	6120	400
11	B	7.9	7.2	31	400	120	6040	230
11	C	8.1	7.3	21	400	160	5760	850
12	A	7.8	7.3	19	400	200	6120	400
12	B	7.9	7.2	31	400	120	6040	230
12	C	8.1	7.3	21	400	160	5760	850
13	A	7.5	7.4	23	440	120	7520	220
13	B	8.4	7.4	34	320	160	4240	670
13	C	8.4	7.3	23	520	160	5000	450
14	A	7.5	7.4	23	440	120	7520	220
14	B	8.4	7.4	34	320	160	4240	670
14	C	8.4	7.3	23	520	160	5000	450

TABLE XLI (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
15	A	7.5	7.4	23	440	120	7520	220
15	B	8.4	7.4	34	320	160	4240	670
15	C	8.4	7.3	23	520	160	5000	450
16	A	8.3	7.4	23	240	40	5000	350
16	B	8.1	7.1	51	360	40	6280	220
16	C	8.0	7.3	16	480	80	6120	190
17	A	8.3	7.4	23	240	40	5000	350
17	B	8.1	7.1	51	360	40	6280	220
17	C	8.0	7.3	16	480	80	6120	190
18	A	8.3	7.4	23	240	40	5000	350
18	B	8.1	7.1	51	360	40	6280	220
18	C	8.0	7.3	16	480	80	6120	190
19	A	8.0	7.3	20	320	120	5120	300
19	B	8.3	7.4	31	280	120	4280	310
19	C	8.2	7.5	31	300	120	4700	310
20	A	8.0	7.3	20	320	120	5120	300
20	B	8.3	7.4	31	280	120	4280	310
20	C	8.2	7.5	31	300	120	4700	310
21	A	8.0	7.3	20	320	120	5120	300
21	B	8.3	7.4	31	280	120	4280	310
21	C	8.2	7.5	31	300	120	4700	310
22	A	8.5	7.6	68	160	120	1800	350
22	B	8.2	7.9	38	560	120	2480	300
22	C	8.1	7.7	29	440	160	3160	260
23	A	8.5	7.6	68	160	120	1800	350
23	B	8.2	7.9	38	560	120	2480	300
23	C	8.1	7.7	29	440	160	3160	260
24	A	8.5	7.6	68	160	120	1800	350
24	B	8.2	7.9	38	560	120	2480	300
24	C	8.1	7.7	29	440	160	3160	260
25	A	8.2	7.7	29	280	160	4040	430
25	B	8.1	7.9	33	520	200	4400	460
25	C	8.1	7.3	23	560	40	4360	180
26	A	8.2	7.7	29	280	160	4040	430
26	B	8.1	7.9	33	520	200	4400	460
26	C	8.1	7.3	23	560	40	4360	180
27	A	8.2	7.7	29	280	160	4040	430
27	B	8.1	7.9	33	520	200	4400	460
27	C	8.1	7.3	23	560	40	4360	180
28	A	8.3	7.4	26	320	280	4080	460
28	B	8.0	7.3	29	480	120	4280	360
28	C	8.2	7.1	24	320	120	5640	350

TABLE XLI (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
29	A	8.3	7.4	26	320	280	4080	460
29	B	8.0	7.3	29	480	120	4280	360
29	C	8.2	7.1	24	320	120	5640	350
30	A	8.3	7.4	26	320	280	4080	460
30	B	8.0	7.3	29	480	120	4280	360
30	C	8.2	7.1	24	320	120	5640	350
31	A	8.3	7.4	34	640	240	7880	590
31	B	8.0	7.3	18	480	200	6120	90
31	C	8.2	7.1	24	320	120	5640	350
32	A	8.3	7.4	34	640	240	7880	590
32	B	8.0	7.3	18	480	200	6120	90
32	C	8.2	7.1	24	320	120	5640	350
33	A	8.3	7.4	34	640	240	7880	590
33	B	8.0	7.3	18	480	200	6120	90
33	C	8.2	7.1	24	320	120	5640	350
34	A	8.6	7.0	85	120	240	2040	310
34	B	8.2	7.8	36	360	320	3840	550
34	C	8.0	7.3	16	360	80	3960	270
35	A	8.6	7.0	85	120	240	2040	310
35	B	8.2	7.8	36	360	320	3840	550
35	C	8.0	7.3	16	360	80	3960	270
36	A	8.6	7.0	85	120	240	2040	310
36	B	8.2	7.8	36	360	320	3840	550
36	C	8.0	7.3	16	360	80	3960	270
37	A	8.1	7.3	21	440	200	7560	450
37	B	8.1	7.2	39	320	200	5400	360
37	C	8.1	7.0	16	480	200	4520	390
38	A	8.1	7.3	21	440	200	7560	450
38	B	8.1	7.2	39	320	200	5400	360
38	C	8.1	7.0	16	480	200	4520	390
39	A	8.1	7.3	21	440	200	7560	450
39	B	8.1	7.2	39	320	200	5400	360
39	C	8.1	7.0	16	480	200	4520	390
40	A	8.5	7.3	25	600	120	7600	450
40	B	8.5	7.2	28	520	200	4840	400
40	C	8.2	7.3	33	480	160	4280	240
41	A	8.5	7.3	25	600	120	7600	450
41	B	8.5	7.2	28	520	200	4840	400
41	C	8.2	7.3	33	480	160	4280	240
42	A	8.5	7.3	25	600	120	7600	450
42	B	8.5	7.2	28	520	200	4840	400
42	C	8.2	7.3	33	480	160	4280	240

TABLE XLI (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
43	A	7.9	6.9	21	400	200	4280	310
43	B	7.6	7.1	39	280	320	2440	720
43	C	8.3	7.1	20	680	200	7520	370
44	A	7.9	6.9	21	400	200	4280	310
44	B	7.6	7.1	39	280	320	2440	720
44	C	8.3	7.1	20	680	200	7520	370
45	A	7.9	6.9	21	400	200	4280	310
45	B	7.6	7.1	39	280	320	2440	720
45	C	8.3	7.1	20	680	200	7520	370
46	A	8.4	6.7	20	480	160	3840	450
46	B	7.9	6.7	28	400	240	6280	320
46	C	8.1	8.0	23	400	160	5120	630
47	A	8.4	6.7	20	480	160	3840	450
47	B	7.9	6.7	28	400	240	6280	320
47	C	8.1	8.0	23	400	160	5120	630
48	A	8.4	6.7	20	480	160	3840	450
48	B	7.9	6.7	28	400	240	6280	320
48	C	8.1	8.0	23	400	160	5120	630
49	A	7.9	7.5	26	400	200	3800	510
49	B	7.8	7.4	46	400	200	3600	510
49	C	8.3	7.2	19	340	80	5520	280
50	A	7.9	7.5	26	400	200	3800	510
50	B	7.8	7.4	46	400	200	3600	510
50	C	8.3	7.2	19	340	80	5520	280
51	A	7.9	7.5	26	400	200	3800	510
51	B	7.8	7.4	46	400	200	3600	510
51	C	8.3	7.2	19	340	80	5520	280
52	A	8.7	7.3	24	240	180	1120	450
52	B	7.9	7.8	33	520	160	6320	410
52	C	7.9	7.2	28	480	120	6320	270
53	A	8.7	7.3	24	240	180	1120	450
53	B	7.9	7.8	33	520	160	6320	410
53	C	7.9	7.2	28	480	120	6320	270
54	A	8.7	7.3	24	240	180	1120	450
54	B	7.9	7.8	33	520	160	6320	410
54	C	7.9	7.2	28	480	120	6320	270
55	A	8.6	7.2	19	440	40	5200	490
55	B	8.2	7.2	31	280	200	1880	550
55	C	8.4	7.2	25	320	200	4080	330
56	A	8.6	7.2	19	440	40	5200	490
56	B	8.2	7.2	31	280	200	1880	550
56	C	8.4	7.2	25	320	200	4080	330

TABLE XLI (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
57	A	8.6	7.2	19	440	40	5200	490
57	B	8.2	7.2	31	280	200	1880	550
57	C	8.4	7.2	25	320	200	4080	330
58	A	8.2	7.1	4	400	80	5320	310
58	B	7.5	7.7	40	360	40	4280	470
58	C	8.0	7.3	28	320	120	5760	370
59	A	8.2	7.1	4	400	80	5320	310
59	B	7.5	7.7	40	360	40	4280	470
59	C	8.0	7.3	28	320	120	5760	370
60	A	8.2	7.1	4	400	80	5320	310
60	B	7.5	7.7	40	360	40	4280	470
60	C	8.0	7.3	28	320	120	5760	370
61	A	7.8	6.9	28	360	200	4360	360
61	B	7.8	7.0	59	440	160	4360	440
61	C	8.1	7.0	21	400	120	3960	410
62	A	7.8	6.9	28	360	200	4360	360
62	B	7.8	7.0	59	400	160	4360	440
62	C	8.1	7.0	21	400	120	3960	410
63	A	7.8	6.9	28	360	200	4360	360
63	B	7.8	7.0	59	400	160	4360	440
63	C	8.1	7.0	21	400	120	3960	410

TABLE XLII

SOIL ANALYSES OF THE EAST EXPOSURE OF THE EXPERIMENTS LOCATED EAST OF SAYRE ON I-40

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
1	A	8.3	7.3	30	360	360	5320	600
1	B	7.9	7.0	29	600	160	4080	600
1	C	7.2	7.1	1	280	240	4600	460
2	A	8.3	7.3	30	360	360	5320	600
2	B	7.9	7.0	29	600	160	4080	600
2	C	7.2	7.1	1	280	240	4600	460
3	A	8.3	7.3	30	360	360	5320	600
3	B	7.9	7.0	29	600	160	4080	600
3	C	7.2	7.1	1	280	240	4600	460
4	A	7.7	7.1	23	280	400	4680	210
4	B	7.8	7.3	30	640	240	4000	450
4	C	8.4	7.1	21	280	200	4240	780
5	A	7.7	7.1	23	280	400	4680	210
5	B	7.8	7.3	30	640	240	4000	450
5	C	8.4	7.1	21	280	200	4240	780
6	A	7.7	7.1	23	280	400	4680	210
6	B	7.8	7.3	30	640	240	4000	450
6	C	8.4	7.1	21	280	200	4240	780
7	A	7.9	7.8	50	680	400	8040	530
7	B	8.0	7.9	35	520	160	4840	580
7	C	7.9	7.4	24	480	160	5760	680
8	A	7.9	7.8	50	680	400	8040	530
8	B	8.0	7.9	35	520	160	4840	580
8	C	7.9	7.4	24	480	160	5760	680
9	A	7.9	7.8	50	680	400	8040	530
9	B	8.0	7.9	35	520	160	4840	580
9	C	7.9	7.4	24	480	160	5760	680
10	A	8.2	7.5	43	1280	120	5200	390
10	B	7.7	7.4	39	1080	120	4520	310
10	C	7.8	7.2	28	520	160	7920	780
11	A	8.2	7.5	43	1280	120	5200	390
11	B	7.7	7.4	39	1080	120	4520	310
11	C	7.8	7.2	28	520	160	7920	780
12	A	8.2	7.5	43	1280	120	5200	390
12	B	7.7	7.4	39	1080	120	4520	310
12	C	7.8	7.2	28	520	160	7920	780
13	A	8.1	7.4	39	400	120	3400	270
13	B	7.7	6.7	39	920	120	3080	250
13	C	8.0	7.3	29	440	200	3240	850
14	A	8.2	7.5	43	1280	120	5200	390
14	B	7.7	7.4	39	1080	120	4520	310
14	C	7.8	7.2	28	520	160	7920	780

TABLE XLII (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
15	A	8.1	7.4	39	400	120	3400	270
15	B	7.7	6.7	39	920	120	3080	250
15	C	8.0	7.3	29	440	200	3240	850
16	A	8.1	7.4	39	400	120	3400	270
16	B	7.7	6.7	39	920	120	3080	250
16	C	8.0	7.3	29	440	200	3240	850
17	A	8.1	7.4	39	400	120	3400	270
17	B	7.7	6.7	39	920	120	3080	250
17	C	8.0	7.3	29	440	200	3240	850
18	A	7.6	6.5	26	240	240	7960	180
18	B	8.2	6.7	34	480	160	3800	350
18	C	8.3	6.8	14	720	480	4280	330
19	A	7.6	6.5	26	240	240	7960	180
19	B	8.2	6.7	34	480	160	3800	350
19	C	8.3	6.8	14	720	480	4280	330
20	A	7.6	6.5	26	240	240	7960	180
20	B	8.2	6.7	34	480	160	3800	350
20	C	8.3	6.8	14	720	480	4280	330
21	A	7.4	7.3	31	760	160	5200	110
21	B	7.9	6.7	44	760	120	4080	290
21	C	7.9	7.8	31	600	200	4080	630
22	A	7.4	7.3	31	760	160	5200	110
22	B	7.9	6.7	44	760	120	4080	290
22	C	7.9	7.8	31	600	200	4080	630
23	A	7.4	7.3	31	760	160	5200	110
23	B	7.9	6.7	44	760	120	4080	290
23	C	7.9	7.8	31	600	200	4080	630
24	A	8.0	6.8	43	400	160	3720	280
24	B	8.0	6.9	73	520	200	4240	430
24	C	7.5	7.6	36	520	200	4760	630
25	A	8.0	6.8	43	400	160	3720	280
25	B	8.0	6.9	73	520	200	4240	430
25	C	7.5	7.6	36	520	200	4760	630
26	A	8.0	6.8	43	400	160	3720	280
26	B	8.0	6.9	73	520	200	4240	430
26	C	7.5	7.6	36	520	200	4760	630
27	A	7.5	7.7	64	320	160	3600	430
27	B	7.7	7.1	73	160	120	4240	590
27	C	8.0	7.2	40	960	170	3960	400
28	A	7.5	7.7	64	320	160	3600	430
28	B	7.7	7.1	73	160	120	4240	590
28	C	8.0	7.2	40	960	170	3960	400

TABLE XLII (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
29	A	7.5	7.7	64	320	160	3600	430
29	B	7.7	7.1	73	160	120	4240	590
29	C	8.0	7.2	40	960	170	3960	400
30	A	7.8	7.6	40	320	240	4760	570
30	B	7.7	7.0	30	320	200	8400	390
30	C	7.8	7.1	44	920	120	5000	630
31	A	7.8	7.6	40	320	240	4760	570
31	B	7.7	7.0	30	320	200	8400	390
31	C	7.8	7.1	44	920	120	5000	630
32	A	7.8	7.6	40	320	240	4760	570
32	B	7.7	7.0	30	320	200	8400	390
32	C	7.8	7.1	44	920	120	5000	630
33	A	8.2	8.1	41	280	160	3800	590
33	B	7.9	7.2	41	440	240	2920	410
33	C	7.9	7.2	31	800	160	3840	290
34	A	8.2	8.1	41	280	160	3800	590
34	B	7.9	7.2	41	440	240	2920	410
34	C	7.9	7.2	31	800	160	3840	290
35	A	8.2	8.1	41	280	160	3800	590
35	B	7.9	7.2	41	440	240	2920	410
35	C	7.9	7.2	31	800	160	3840	290
36	A	7.9	7.5	35	680	120	4680	590
36	B	8.2	7.0	35	400	160	2440	410
36	C	7.7	6.8	39	480	120	3720	410
37	A	7.9	7.5	35	680	120	4680	590
37	B	8.2	7.0	35	400	160	2440	410
37	C	7.7	6.8	39	480	120	3720	410
38	A	7.9	7.5	35	680	120	4680	590
38	B	8.2	7.0	35	400	160	2440	410
38	C	7.7	6.8	39	480	120	3720	410
39	A	8.1	7.2	31	760	200	6600	240
39	B	8.1	6.9	59	640	240	4760	440
39	C	8.1	7.4	40	680	120	3240	310
40	A	8.1	7.2	31	760	200	6600	240
40	B	8.1	6.9	59	640	240	4760	440
40	C	8.1	7.4	40	680	120	3240	310
41	A	8.1	7.2	31	760	200	6600	240
41	B	8.1	6.9	59	640	240	4760	440
41	C	8.1	7.4	40	680	120	3240	310
42	A	8.1	7.3	24	240	120	4760	590
42	B	8.1	7.2	31	480	120	2800	310
42	C	7.6	7.0	33	880	240	5760	390

TABLE XLII (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
43	A	8.1	7.3	24	240	120	4760	590
43	B	8.1	7.2	31	480	120	2800	310
43	C	7.6	7.0	33	880	240	5760	390
44	A	8.1	7.3	24	240	120	4760	590
44	B	8.1	7.2	31	480	120	2800	310
44	C	7.6	7.0	33	880	240	5760	390
45	A	7.6	6.9	25	520	160	4280	370
45	B	7.8	7.9	33	520	160	3320	680
45	C	8.2	7.6	39	640	120	3800	320
46	A	7.6	6.9	25	520	160	4280	370
46	B	7.8	7.9	33	520	160	3320	680
46	C	8.2	7.6	39	640	120	3800	320
47	A	7.6	6.9	25	520	160	4280	370
47	B	7.8	7.9	33	520	160	3320	680
47	C	8.2	7.6	39	640	120	3800	320
48	A	8.2	7.8	21	160	200	5320	550
48	B	7.9	7.3	43	480	160	4040	130
48	C	8.0	6.9	25	720	120	4040	240
49	A	8.2	7.8	21	100	200	5320	550
49	B	7.9	7.3	43	480	160	4040	130
49	C	8.0	6.9	25	720	120	4040	240
50	A	8.2	7.8	21	100	200	5320	550
50	B	7.9	7.3	43	480	160	4040	130
50	C	8.0	6.9	25	720	120	4040	240
51	A	8.3	7.0	25	280	160	4080	810
51	B	8.2	7.1	35	360	120	2660	850
51	C	8.0	7.4	33	840	160	5800	250
52	A	8.3	7.0	25	280	160	4080	810
52	B	8.2	7.1	35	360	120	2660	850
52	C	8.0	7.4	33	840	160	5800	250
53	A	8.3	7.0	25	280	160	4080	810
53	B	8.2	7.1	35	360	120	2660	850
53	C	8.0	7.4	33	840	160	5800	250
54	A	8.1	7.0	35	480	200	5080	190
54	B	8.0	7.5	45	240	240	2120	190
54	C	8.0	7.1	30	600	200	4680	190
55	A	8.1	7.0	35	480	200	5080	190
55	B	8.0	7.5	45	240	240	2120	190
55	C	8.0	7.1	30	600	200	4680	190
56	A	8.1	7.0	35	480	200	5080	190
56	B	8.0	7.5	45	240	240	2120	190
56	C	8.0	7.1	30	600	200	4680	190

TABLE XLII (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
57	A	7.9	7.5	40	200	160	4080	320
57	B	8.4	6.9	34	240	80	2280	580
57	C	8.1	6.8	25	400	160	3720	230
58	A	8.3	7.5	33	280	160	3720	350
58	B	8.1	7.3	8	640	240	5400	650
58	C	8.0	6.8	31	760	160	6200	320
59	A	8.3	7.5	33	280	160	3720	350
59	B	8.1	7.3	8	640	240	5400	650
59	C	8.0	6.8	31	760	160	6200	320
60	A	8.3	7.5	33	280	160	3720	350
60	B	8.1	7.3	8	640	240	5400	650
60	C	8.0	6.8	31	760	160	6200	320
61	A	8.3	7.3	36	560	240	3240	450
61	B	8.0	7.1	38	640	160	3400	120
61	C	8.2	7.7	25	680	200	5200	240
62	A	8.3	7.3	36	560	240	3240	450
62	B	8.0	7.1	38	640	160	3400	120
62	C	8.2	7.7	25	680	200	5200	240
63	A	8.3	7.3	36	560	240	3240	450
63	B	8.0	7.1	38	640	160	3400	120
63	C	8.2	7.7	25	680	200	5200	240

TABLE XLIII

SOIL ANALYSES OF THE NORTH EXPOSURE OF THE EXPERIMENTS LOCATED SOUTHWEST OF SAYRE ON I-40

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
1	A	7.6	7.0	25	90	20	880	25
2	A	7.5	6.5	30	80	10	540	38
3	A	7.5	6.6	36	320	40	800	80
4	A	7.3	6.5	26	240	32	920	80
5	A	7.3	6.8	36	200	40	920	80
6	A	7.4	6.7	18	80	4	200	13
7	A	7.3	6.3	25	200	32	840	80
8	A	7.3	6.4	20	200	32	840	80
9	A	7.2	6.4	25	80	10	410	13

TABLE XLIV

SOIL ANALYSES OF THE SOUTH EXPOSURE OF THE EXPERIMENTS LOCATED SOUTHWEST OF SAYRE ON I-40

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
1	A	7.5	6.5	25	240	32	880	80
2	A	7.3	6.1	30	240	40	800	80
3	A	7.4	6.4	24	160	20	500	25
4	A	7.3	6.9	61	360	40	880	120
5	A	6.9	6.2	31	240	24	720	80
6	A	6.8	6.1	29	200	32	800	80
7	A	7.0	6.3	33	280	40	720	80
8	A	7.0	6.5	33	280	32	840	80
9	A	7.0	6.3	30	200	32	600	80

TABLE XLV

SOIL ANALYSES OF THE NORTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 62 NEAR SNYDER

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
1	A	7.1	6.9	40	520	64	2880	360
1	B	7.6	6.5	38	400	120	3080	480
1	C	6.8	6.4	43	840	32	3160	240
2	A	7.6	6.7	35	400	64	2360	200
2	B	6.9	6.4	62	440	48	2080	320
2	C	7.3	6.2	44	720	32	2600	320
3	A	7.4	6.8	38	460	64	2620	280
3	B	7.3	6.5	50	420	84	3580	400
3	C	7.1	6.3	44	760	32	2880	280
4	A	7.4	7.0	79	520	80	3600	240
4	B	7.1	6.2	83	360	40	1400	160
4	C	6.4	6.6	46	600	40	2120	240
5	A	7.6	7.0	30	520	456	3920	440
5	B	6.8	6.2	61	640	48	2520	240
5	C	6.7	5.9	94	520	16	2200	160
6	A	7.5	7.0	55	520	267	3760	340
6	B	7.0	6.2	72	450	44	1960	200
6	C	6.6	6.3	70	560	28	2160	200
7	A	7.5	6.7	26	480	61	3280	320
7	B	6.7	6.5	131	520	48	2360	32
7	C	6.6	6.0	53	720	40	3520	400
8	A	6.1	6.7	31	400	64	2800	320
8	B	7.2	6.5	65	640	56	2200	240
8	C	6.5	6.1	58	440	40	2880	400
9	A	6.8	6.7	29	440	63	3040	320
9	B	7.0	6.5	98	580	52	2280	136
9	C	6.6	6.1	56	580	40	3200	400
10	A	7.7	7.0	51	480	48	2800	280
10	B	6.9	6.3	175	560	24	2680	280
10	C	6.8	5.5	25	520	40	3240	480
11	A	7.7	6.9	33	360	56	2360	240
11	B	6.9	6.4	131	680	43	2880	305
11	C	7.0	6.6	36	640	40	2680	240
12	A	7.7	7.0	42	420	52	2580	260
12	B	6.9	6.4	158	620	34	2780	293
12	C	6.9	6.1	31	560	40	3000	360
13	A	7.0	7.2	29	480	40	3400	240
13	B	6.3	6.1	64	690	38	3107	328
13	C	6.5	5.4	49	520	32	2960	280
14	A	5.9	5.9	71	600	40	3240	400
14	B	7.2	6.4	28	840	48	3760	400
14	C	7.7	6.7	44	360	40	2600	280

TABLE XLV (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
15	A	6.5	6.6	50	520	40	3320	320
15	B	6.8	6.3	46	765	43	3435	364
15	C	7.1	6.0	47	440	36	2780	280
16	A	7.5	7.4	25	400	56	3640	280
16	B	7.2	6.8	131	480	32	3400	320
16	C	6.1	6.3	51	400	32	3080	280
17	A	8.1	7.0	26	360	56	4120	360
17	B	7.6	6.2	40	400	296	3160	360
17	C	7.0	6.6	21	520	32	2800	320
18	A	7.8	7.2	26	380	56	3880	320
18	B	7.4	6.5	86	440	164	3280	340
18	C	6.6	6.5	36	460	32	2940	300
19	A	7.2	7.0	36	640	64	4680	240
19	B	7.5	6.6	58	440	44	3947	280
19	C	7.0	6.4	48	560	56	3160	240
20	A	8.0	7.4	36	400	80	3640	280
20	B	7.1	6.4	40	640	48	2960	160
20	C	6.8	5.7	59	560	24	2280	200
21	A	7.6	7.2	34	520	72	5160	260
21	B	7.3	6.5	49	540	46	3450	220
21	C	6.9	6.1	54	560	40	2720	220
22	A	7.8	7.0	25	360	80	3320	240
22	B	7.7	6.7	24	400	104	2960	320
22	C	6.2	6.4	36	360	64	2960	520
23	A	7.9	6.7	30	520	184	4000	360
23	B	7.4	6.8	33	560	400	2960	360
23	C	7.5	6.9	144	360	48	1760	200
24	A	7.9	6.9	28	440	132	3660	300
24	B	7.6	6.8	29	480	252	2960	340
24	C	6.9	6.7	90	360	56	2360	360
25	A	7.9	6.7	26	440	216	3720	360
25	B	7.6	6.5	53	640	80	2120	280
25	C	7.0	6.3	63	427	45	2680	320
26	A	7.9	7.0	19	360	72	3080	280
26	B	7.5	6.7	36	520	80	2720	320
26	C	6.6	6.7	84	382	52	2466	344
27	A	7.9	6.9	23	400	144	3300	320
27	B	7.6	6.6	45	580	80	2420	300
27	C	6.8	6.5	74	405	49	2574	332
28	A	8.0	7.2	24	440	176	3600	280
28	B	7.6	6.5	40	560	96	3080	280
28	C	6.5	6.4	54	527	52	2902	288

TABLE XLV (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
29	A	7.7	6.5	33	400	208	2960	280
29	B	7.5	6.6	45	400	296	2120	240
29	C	6.8	6.0	63	840	32	3160	240
30	A	7.9	6.9	29	420	192	3280	280
30	B	7.6	6.6	43	480	196	2600	260
30	C	6.7	6.2	59	684	42	3032	264
31	A	7.4	7.5	46	560	352	4040	400
31	B	7.7	7.0	50	560	56	2120	400
31	C	7.1	6.0	46	640	48	2960	360
32	A	7.7	6.5	33	400	208	2960	280
32	B	7.5	6.6	45	400	296	2120	240
32	C	6.8	6.0	63	840	32	3160	240
33	A	7.6	7.0	40	480	280	3500	340
33	B	7.6	6.8	47	480	176	2120	320
33	C	7.0	6.0	55	740	40	3060	300
34	A	8.0	7.2	24	440	176	3600	280
34	B	7.6	6.5	40	560	96	3080	280
34	C	6.5	6.4	54	527	52	2902	288
35	A	7.9	7.0	19	360	72	3080	280
35	B	7.5	6.7	36	520	80	2720	320
35	C	6.6	6.7	84	382	52	2466	344
36	A	8.0	7.1	22	400	124	3340	280
36	B	7.6	6.6	38	540	88	2900	300
36	C	6.6	6.6	69	455	52	2684	316

TABLE XLVI

SOIL ANALYSES OF THE SOUTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 62 NEAR SNYDER

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
1	A	7.4	6.9	78	1080	64	3600	360
1	B	7.1	6.4	98	560	64	2120	200
1	C	5.8	5.4	140	600	32	2520	280
2	A	7.6	6.7	56	480	80	2200	280
2	B	6.9	6.8	79	760	40	2520	320
2	C	5.5	5.7	31	720	48	2440	400
3	A	7.5	6.8	67	780	72	2900	320
3	B	7.0	6.6	89	660	52	2320	260
3	C	5.7	5.6	85	660	40	2480	340
4	A	7.6	6.8	58	640	144	2840	400
4	B	7.8	7.1	105	480	600	3240	480
4	C	7.0	6.1	60	680	80	2880	480
5	A	7.8	7.0	61	640	496	3640	240
5	B	6.8	6.7	64	560	152	2720	280
5	C	6.8	6.5	169	640	72	3080	320
6	A	7.7	6.9	60	640	320	3240	320
6	B	7.3	6.9	85	520	376	3160	400
6	C	6.9	6.3	115	660	76	2980	400
7	A	7.6	7.3	44	440	176	2680	320
7	B	7.5	6.8	43	720	248	3080	400
7	C	6.8	6.4	169	560	56	2200	320
8	A	7.7	7.0	41	400	320	2680	360
8	B	7.6	6.3	44	480	136	2520	360
8	C	7.0	5.6	50	680	48	2720	400
9	A	7.7	7.2	43	420	248	2680	340
9	B	7.6	6.6	44	600	192	2800	380
9	C	6.9	6.0	110	620	52	2460	360
10	A	7.8	7.3	55	480	296	4120	520
10	B	7.1	6.3	90	520	80	3160	480
10	C	6.9	6.0	29	200	96	920	120
11	A	8.0	7.0	78	480	512	3760	320
11	B	7.1	6.6	75	600	368	3240	440
11	C	7.2	6.4	29	580	96	2960	400
12	A	7.9	7.2	67	480	404	3940	420
12	B	7.1	6.5	83	560	224	3200	460
12	C	7.1	6.2	29	390	96	1940	260
13	A	8.0	7.2	30	440	680	4040	440
13	B	7.4	6.8	36	760	520	3920	480
13	C	7.4	6.5	39	600	176	3480	320
14	A	8.1	7.1	44	413	520	4010	440
14	B	7.5	6.6	55	520	296	2800	320
14	C	7.1	6.4	138	480	240	3040	400

TABLE XLVI (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
15	A	8.1	7.2	37	427	600	4025	440
15	B	7.5	6.7	46	640	408	3360	400
15	C	7.3	6.5	89	540	208	3200	360
16	A	8.5	7.5	15	360	320	3600	440
16	B	7.4	6.5	40	520	360	4480	520
16	C	7.3	6.4	36	600	64	2960	320
17	A	7.7	7.1	31	440	560	4400	440
17	B	8.2	6.8	59	400	512	4960	560
17	C	7.0	6.6	131	520	112	3320	360
18	A	8.1	7.3	23	400	440	4000	440
18	B	7.8	6.7	50	460	436	4720	540
18	C	7.2	6.5	84	560	88	3140	340
19	A	8.2	7.1	300	387	392	4130	387
19	B	7.4	6.9	54	720	176	2800	360
19	C	6.8	6.1	356	507	85	3120	347
20	A	8.3	6.9	14	360	296	4400	280
20	B	7.5	6.7	81	280	56	2280	240
20	C	7.2	6.4	156	400	80	3080	360
21	A	8.3	7.0	157	374	344	4280	334
21	B	7.5	6.8	68	500	116	2540	300
21	C	7.0	6.3	256	454	83	3100	354
22	A	8.0	7.3	29	360	128	2520	200
22	B	7.7	6.9	69	600	64	3520	400
22	C	7.5	6.7	144	480	64	3320	360
23	A	8.0	6.9	73	440	248	3480	440
23	B	6.8	6.9	83	640	56	3760	480
23	C	6.8	6.5	144	560	40	3320	440
24	A	8.0	7.1	51	400	188	3000	320
24	B	7.3	6.9	76	620	60	3640	440
24	C	7.2	6.6	144	520	52	3320	400
25	A	7.5	7.2	39	400	40	3240	440
25	B	7.6	6.5	46	640	56	3160	320
25	C	7.2	6.6	81	360	48	2880	280
26	A	7.8	6.9	21	466	269	3693	440
26	B	7.8	6.8	33	520	48	2600	280
26	C	7.0	6.1	53	520	56	3240	520
27	A	7.7	7.1	30	433	155	3467	440
27	B	7.7	6.7	40	560	52	2880	300
27	C	7.1	6.4	67	440	52	3110	400
28	A	8.0	6.9	41	560	520	4360	440
28	B	7.5	6.6	45	480	104	2933	280
28	C	7.6	6.7	69	400	80	2600	320

TABLE XLVI (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
29	A	7.7	7.1	36	400	296	4280	400
29	B	7.6	7.1	38	400	80	1920	240
29	C	7.5	6.4	113	520	232	3160	360
30	A	7.9	7.0	39	480	408	4320	420
30	B	7.6	6.9	42	440	92	2427	260
30	C	7.6	6.6	92	460	156	2880	340
31	A	8.3	7.2	20	400	520	600	480
31	B	7.5	7.4	38	520	184	4280	320
31	C	6.9	6.7	144	520	64	3040	360
32	A	7.7	7.1	36	400	296	4280	400
32	B	7.6	7.1	38	400	80	1920	240
32	C	7.5	6.4	113	520	232	3160	360
33	A	8.0	7.2	28	400	408	2440	440
33	B	7.6	7.3	38	460	132	3100	280
33	C	7.2	6.6	178	520	148	3100	360
34	A	8.0	6.9	41	560	520	4360	440
34	B	7.5	6.6	45	480	104	2933	280
34	C	7.6	6.7	69	400	80	2600	320
35	A	7.8	6.9	21	466	269	3693	440
35	B	7.8	6.8	33	520	48	2600	280
35	C	7.0	6.1	53	520	56	3240	520
36	A	7.9	6.9	31	607	395	4027	440
36	B	7.7	6.7	39	500	76	2757	280
36	C	7.3	6.4	61	460	68	2920	420

TABLE XLVII

SOIL ANALYSES OF THE NORTH EXPOSURE OF THE EXPERIMENTS ON I-244 IN TULSA

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
1	A	8.1	7.1	4	240	80	2680	320
1	B	8.0	7.0	6	253	280	4200	573
1	C	7.7	6.9	8	240	320	3760	360
1	D	8.0	7.1	4	240	320	4880	440
2	A	7.6	7.0	6	200	200	3120	520
2	B	7.9	6.7	6	120	168	3080	360
2	C	8.0	6.9	9	160	128	3640	320
2	D	7.9	6.8	10	160	320	3880	480
3	A	7.6	7.2	4	200	240	3960	440
3	B	7.6	6.8	11	240	128	4680	640
3	C	7.9	7.0	8	400	320	5600	720
3	D	7.5	6.8	9	160	144	4360	520
4	A	7.9	7.2	6	120	72	1840	200
4	B	7.6	7.1	6	40	48	1000	80
4	C	8.0	6.9	8	280	200	3560	520
4	D	7.7	7.1	6	360	384	5200	560
5	A	7.8	7.3	10	40	24	480	40
5	B	7.7	7.0	9	200	152	3840	360
5	C	7.9	7.1	8	240	104	4120	480
5	D	7.8	6.9	8	440	330	4880	1240
6	A	7.4	7.3	6	200	88	4360	360
6	B	7.7	6.9	20	320	360	5600	840
6	C	7.6	7.0	8	360	360	5240	800
6	D	7.6	6.9	9	200	280	4560	480
7	A	7.9	7.5	4	200	48	880	120
7	B	7.9	7.2	9	200	492	3240	280
7	C	7.9	7.0	8	120	72	1840	120
7	D	7.7	6.7	9	240	384	6440	600
8	A	7.8	7.4	3	200	64	3080	320
8	B	7.9	7.2	6	80	72	1520	160
8	C	7.6	7.2	8	440	416	7800	760
8	D	7.9	7.0	8	120	96	3240	240
9	A	7.5	7.1	8	240	72	3920	320
9	B	7.8	7.3	4	200	200	3560	360
9	C	7.9	7.2	9	160	80	3110	280
9	D	7.8	6.8	8	200	240	3800	440
10	A	8.1	7.7	4	440	216	5200	520
10	B	7.6	7.0	9	520	236	7520	560
10	C	8.0	7.2	5	240	392	5360	600
10	D	7.7	6.9	6	307	200	4337	413
11	A	8.0	7.6	3	360	80	3920	440
11	B	7.6	7.5	5	280	208	2800	480
11	C	7.7	7.0	6	200	120	3720	320
11	D	7.8	7.3	8	80	72	1320	160

TABLE XLVII (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
12	A	7.9	7.4	5	240	80	3480	360
12	B	8.0	7.3	5	280	264	4120	400
12	C	7.8	6.9	8	240	240	2760	440
12	D	7.9	6.9	6	280	360	4360	720
13	A	8.0	7.3	5	280	104	4040	400
13	B	7.9	7.2	6	360	320	5040	720
13	C	7.7	6.9	5	160	96	2600	240
13	D	7.8	7.0	6	320	208	4480	440
14	A	7.7	7.3	6	360	344	6360	600
14	B	7.8	7.4	5	280	72	4360	360
14	C	7.8	6.6	6	200	160	3560	280
14	D	7.8	7.0	8	80	48	1480	120
15	A	7.7	7.3	4	307	170	4160	320
15	B	7.9	7.2	25	240	88	3840	320
15	C	8.0	7.1	6	80	80	1680	160
15	D	7.9	7.0	6	80	64	1840	200
16	A	7.8	7.0	4	200	88	3640	320
16	B	8.0	7.3	6	320	88	5120	520
16	C	7.9	7.1	6	360	384	6280	400
16	D	7.8	7.0	4	320	400	6080	1040
17	A	8.0	7.3	4	200	360	3200	600
17	B	7.3	7.0	20	200	120	3520	280
17	C	7.9	7.1	10	400	504	6200	600
17	D	8.0	7.2	5	160	104	2360	200
18	A	8.3	6.9	4	440	160	5600	480
18	B	8.4	6.8	4	240	800	3360	680
18	C	8.0	7.2	6	120	116	1940	220
18	D	8.0	7.0	4	400	170	7240	840

TABLE XLVIII

SOIL ANALYSES OF THE SOUTH EXPOSURE OF THE EXPERIMENTS ON I-244 IN TULSA

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	ppm K	ppm Na	ppm Ca	ppm Mg
1	A	8.0	7.1	6	80	64	1320	160
1	B	8.0	7.8	5	160	64	2680	240
1	C	8.0	6.6	4	120	504	1520	200
1	D	8.3	6.6	6	160	280	3520	560
2	A	7.6	7.3	5	280	200	4200	680
2	B	7.9	7.0	9	80	32	880	80
2	C	7.8	6.3	5	160	88	2520	520
2	D	7.4	6.2	4	160	120	1840	600
3	A	7.9	7.3	5	360	152	5120	520
3	B	7.9	7.4	8	320	160	4760	480
3	C	7.5	6.4	8	240	240	4200	920
3	D	7.7	6.8	6	240	72	3580	320
4	A	7.6	6.9	15	80	32	920	120
4	B	7.5	6.7	6	80	32	1240	120
4	C	7.5	6.7	6	200	104	3160	480
4	D	7.6	6.3	3	240	504	4280	560
5	A	7.7	6.9	5	200	48	2880	320
5	B	7.8	6.6	3	440	64	3160	480
5	C	7.9	6.4	4	120	64	1920	280
5	D	7.9	7.1	1	120	64	2080	200
6	A	7.9	7.1	4	160	64	2360	360
6	B	7.9	6.6	1	240	160	2240	520
6	C	8.4	7.0	4	200	80	3080	340
6	D	7.5	6.4	5	160	200	2720	600
7	A	8.0	7.4	3	320	200	4120	760
7	B	7.6	7.3	3	240	88	3540	390
7	C	7.9	6.8	4	200	96	5120	320
7	D	7.7	5.9	3	160	72	2680	480
8	A	8.0	6.6	3	280	96	4000	440
8	B	7.6	6.7	4	280	80	3480	520
8	C	7.6	6.5	3	240	240	4200	440
8	D	7.2	6.0	3	120	80	1760	400
9	A	7.8	7.0	4	120	56	2360	240
9	B	7.3	6.2	3	400	72	4040	760
9	C	7.6	6.8	4	160	400	2880	240
9	D	8.2	6.2	6	160	352	3160	280
10	A	8.1	6.6	12	360	64	4120	480
10	B	8.2	6.7	12	200	72	4280	400
10	C	7.9	6.5	17	160	432	2520	360
10	D	8.2	6.0	23	160	480	2120	320
11	A	7.8	7.0	17	320	440	4280	680
11	B	7.9	6.2	12	280	3992	4560	560
11	C	7.9	6.8	12	280	280	3040	680
11	D	8.3	6.2	12	240	324	2060	500

TABLE XLVIII (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
12	A	7.7	7.4	17	200	104	3240	280
12	B	7.5	7.5	12	240	240	2680	720
12	C	7.8	6.5	29	160	208	1840	320
12	D	8.0	6.9	29	160	662	2440	520
13	A	8.0	7.1	17	320	88	1520	400
13	B	7.9	7.0	12	400	228	5520	1080
13	C	7.7	6.7	12	160	352	2600	400
13	D	8.0	7.0	17	240	1000	3120	1000
14	A	8.1	7.2	17	120	64	1360	160
14	B	7.7	6.7	23	240	216	3400	560
14	C	8.2	7.2	23	200	264	3240	280
14	D	7.4	7.0	23	280	520	4280	960
15	A	7.7	6.8	6	240	56	4600	680
15	B	7.8	6.9	8	200	296	3920	400
15	C	7.6	7.0	6	40	64	880	120
15	D	7.5	6.7	4	240	480	3200	680
16	A	7.8	6.8	6	160	48	2280	160
16	B	7.5	6.9	6	360	468	6350	760
16	C	7.5	6.9	8	400	416	6840	680
16	D	7.8	6.6	4	200	280	3320	480
17	A	7.7	6.6	6	280	300	4060	650
17	B	7.5	7.1	8	240	640	4080	640
17	C	7.3	6.9	8	200	76	3160	320
17	D	6.8	6.5	8	280	80	3840	440
18	A	7.3	6.8	6	240	400	3840	480
18	B	7.5	6.6	6	240	104	4040	480
18	C	7.6	6.9	10	160	80	7440	200
18	D	7.5	6.7	6	280	232	4280	560

TABLE XLIX

SOIL ANALYSES OF THE NORTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 271 NEAR WISTER

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	ppm K	ppm Na	ppm Ca	ppm Mg
1	A	4.8	3.4	6	440	64	160	800
1	B	5.0	3.4	9	480	200	320	1120
2	A	5.1	3.8	20	640	288	960	1320
2	B	5.1	3.7	15	520	152	280	1120
3	A	6.4	4.5	26	240	100	560	680
3	B	5.1	3.6	16	400	312	480	920
4	A	7.0	5.6	54	320	96	920	1000
4	B	4.8	4.1	14	240	188	320	400
5	A	7.1	6.7	96	400	72	1040	1040
5	B	5.5	4.6	33	240	80	560	600
6	A	7.1	5.6	51	520	48	1200	1040
6	B	5.3	4.2	20	560	368	1040	1120
7	A	6.5	5.8	84	440	112	1320	920
7	B	5.0	3.7	13	240	28	320	400
8	A	7.0	6.2	40	400	24	1120	800
8	B	6.7	5.5	35	400	400	960	800
9	A	7.2	5.8	69	440	88	1200	1000
9	B	5.8	4.6	16	520	24	760	520
10	A	6.9	5.3	48	400	44	920	880
10	B	6.4	5.5	35	320	68	720	720
11	A	6.8	5.7	54	400	84	1240	1000
11	B	6.2	5.6	55	400	40	1120	880
12	A	7.4	6.3	55	320	20	1160	760
12	B	7.6	6.2	54	360	20	920	560
13	A	6.9	5.7	53	360	28	960	640
13	B	7.1	6.0	35	240	16	560	280
14	A	7.0	6.4	60	360	56	1400	800
14	B	7.1	6.3	34	200	16	560	240
15	A	7.2	6.2	49	240	20	640	280
15	B	7.2	6.0	51	200	16	600	280
16	A	7.5	6.1	35	200	16	560	280
16	B	6.8	6.2	45	200	20	640	320
17	A	7.1	6.0	45	240	96	880	640
17	B	7.2	6.1	39	400	20	1240	760
18	A	7.0	6.3	60	280	28	960	520
18	B	7.2	6.2	60	320	24	1200	680
19	A	7.8	6.1	53	200	16	720	320
19	B	7.4	6.0	40	320	16	1200	640
20	A	6.9	6.2	49	240	16	800	360
20	B	7.1	6.3	50	280	20	800	440
21	A	7.3	6.1	68	320	24	840	440
21	B	6.9	6.0	25	240	16	640	280

TABLE XLIX (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	ppm K	ppm Na	ppm Ca	ppm Mg
22	A	7.5	6.3	34	240	20	640	280
22	B	7.2	6.0	44	280	20	800	440
23	A	7.4	6.2	38	200	20	600	280
23	B	7.2	6.3	46	280	200	640	360
24	A	7.5	5.5	14	320	60	1240	880
24	B	6.2	4.9	21	320	52	760	560

TABLE L

SOIL ANALYSES OF THE SOUTH EXPOSURE OF THE EXPERIMENTS ON U. S. HIGHWAY 271 NEAR WISTER

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm				
				P	K	Na	Ca	Mg
1	A	7.0	5.7	73	280	36	960	840
1	B	6.6	4.9	84	200	68	760	560
2	A	7.2	5.4	43	400	36	1040	920
2	B	6.6	5.0	35	520	96	1640	1520
3	A	7.0	5.3	34	320	56	840	800
3	B	5.7	4.3	33	480	100	1200	1120
4	A	6.5	5.8	58	440	56	960	880
4	B	5.8	4.6	41	440	116	1200	960
5	A	6.7	5.4	60	560	152	2000	1560
5	B	6.8	5.3	48	240	44	720	640
6	A	6.5	5.2	63	440	40	1040	760
6	B	5.9	4.6	25	440	56	1720	960
7	A	6.8	5.0	45	560	88	1320	1460
7	B	5.9	4.6	26	440	44	1000	920
8	A	6.6	5.2	44	560	176	2080	1800
8	B	6.3	4.5	36	200	68	640	600
9	A	6.4	5.0	48	600	180	1480	1520
9	B	5.9	4.4	31	400	32	600	600
10	A	6.1	4.6	38	400	76	960	880
10	B	6.1	4.8	38	440	76	880	1000
11	A	6.2	5.0	29	560	56	1320	1160
11	B	6.2	4.7	38	560	88	1240	1400
12	A	6.3	4.6	175	440	32	1000	1080
12	B	6.5	5.2	44	560	100	1640	1680
13	A	6.6	5.1	30	480	120	1240	1400
13	B	6.3	4.5	30	520	104	1120	1160
14	A	6.7	5.0	101	400	84	1560	1560
14	B	6.0	4.5	64	520	72	1560	1240
15	A	6.8	5.8	71	400	76	1320	1160
15	B	6.6	5.6	123	560	56	1560	1400
16	A	5.7	4.8	51	520	80	1400	1360
16	B	6.8	5.1	40	400	56	1400	1440
17	A	6.7	5.7	50	520	52	1560	1400
17	B	7.3	6.1	51	400	28	1240	1000
18	A	7.1	6.0	46	480	36	1240	1040
18	B	6.8	5.6	58	280	20	800	760
19	A	7.4	6.1	188	480	44	1280	1040
19	B	6.7	5.9	81	440	32	1120	1000
20	A	7.2	5.5	39	480	40	1240	1120
20	B	7.1	5.7	84	640	56	1760	1680
21	A	6.7	5.7	116	520	76	1480	1360
21	B	6.7	5.3	109	400	36	960	1040

TABLE L (Continued)

Plot	Subplot	pH (H_2O)	pH (KCl)	ppm P	K	Na	Ca	Mg
22	A	6.8	5.5	103	320	32	920	880
22	B	7.2	5.8	33	360	24	920	880
23	A	6.9	5.5	84	440	52	1280	1280
23	B	6.9	5.4	116	560	84	1640	1680
24	A	6.7	5.3	59	600	124	1560	1760
24	B	6.8	5.6	244	440	76	1120	1240

VITA

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Major Field: Agronomy

Biographical:

Personal Data: Born at Fairview, Oklahoma, April 28, 1946, the son of W. H. and Carrie Mae Ensminger.

Education: Graduated from Okeene High School, Okeene, Oklahoma in May 1964; received Bachelor of Science degree in Chemistry at Bethany Nazarene College, Bethany, Oklahoma in May 1968; completed the requirements for a Master of Science degree in July, 1972.

Experience: Reared on a wheat and cattle farm near Isabella, Oklahoma; worked as a farm laborer during the summers of 1964 through 1968; employed as a science teacher of Okeene Public Schools during the year of 1968-1969; employed as a teaching assistant for the spring semester of 1970 at Oklahoma State University in the Department of Agronomy; employed as a research assistant by the Department of Agronomy while a graduate student at Oklahoma State University from June, 1970 to June, 1972.