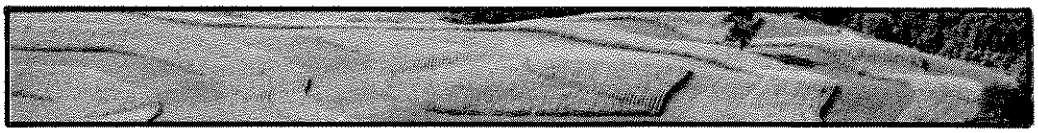

AGRONOMY GUIDE

PURDUE UNIVERSITY

AY-171
December 1968

Corn Fertilization

Marvin W. Phillips and Gary M. Lessman

Extension Agronomists

Growth of corn from the time it is two feet tall until it is physiologically mature -- an interval during which 90 percent or more of the total dry matter production occurs -- is essentially linear.

Iowa workers have observed that 65, 50 and 75 percent of the total accumulation of nitrogen, phosphorus and potassium, respectively, occurred by silking compared with only 44 percent of total dry matter production by that stage of growth. They concluded that the two-week period just before tasseling is extremely critical as far as mineral nutrition is concerned. During this period the rate of uptake was approximately 3.8 lb. nitrogen, 0.6 lb. phosphorus and 4.7 lb. potassium/acre per day.

Wide variations between nutrient uptake and yield may occur where the corn yield is measured in terms of grain produced rather than the total plant growth produced. The proportion of grain may vary from a low of 30 percent to a high above 60 percent. Late planted corn, low in percent grain, may utilize as many nutrients as early planted corn, high in grain content, even though the yield of the late planted corn is very much less.

Harvesting only the grain results in far less stress on the nutrient supply of the soil than harvesting the entire crop for silage. Table 1 gives approximate removals by grain and stover of a 150 bu/acre crop grown on a representative Corn Belt soil.

Nitrogen

Longtime experiments on several Corn Belt soils indicate that these soils supplied only enough nitrogen (approximately 40 lb. N/acre per year) under continuous corn culture to produce 30 to 40 bu. of corn annually. Since corn requires 150 to 300 lb. N/acre to produce a yield of 120 to 200 bu./acre, most of the nitrogen has to be supplied as fertilizer unless a previous legume crop has built up the soil's nitrogen supply.

Phosphorus

Corn does not require as much phosphorus as it does nitrogen. However, since phosphorus is relatively immobile in the soil, only 10 to 20 percent of the phosphorus added as fertilizer will be used by the immediate crop. The major portion remains in the soil to build up the phosphorus fertility level

Cooperative Extension Work in Agriculture and Home Economics, State of Indiana, Purdue University and U. S. Department of Agriculture Cooperating. H. G. Diesslin, Director, Lafayette, Ind. Issued in furtherance of the Acts of May 8 and June 30, 1914.

Table 1. Nutrients contained in the total aboveground plant material in an acre of 150-bushel corn.*

Element	Pounds of element in Stover	Grain	Total	% in Grain
Nitrogen (N)	55	115	170	68
Phosphorus (P)	7	28	35	80
Potassium (K)	140	35	175	20
Calcium (Ca)	35	1	36	4
Magnesium (Mg)	29	10	39	26
Sulfur (S)	8	11	19	58
Chlorine (Cl)	68	4	72	6
Iron (Fe)	1.80	0.10	1.90	5
Manganese (Mn)	0.25	0.05	0.30	17
Copper (Cu)	0.08	0.02	0.10	20
Zinc (Zn)	0.17	0.17	0.34	50
Boron (B)	0.12	0.04	0.16	25
Molybdenum (Mo)	0.003	0.005	0.008	63

* Derived from chemical composition data on corn from the Indiana, Iowa, Michigan and Nebraska Agricultural Experiment Stations.

Table 2. Recommended nitrogen rates for corn grown on medium-textured soils.*

Previous Crop	Yield levels (bu/A) 100-110	111-125	126-150	151-175	176-200
	pounds nitrogen per acre				
Good legume (Alfalfa, red clover, sweet clover)	40	70	100	120	150+
Average legume (Legume-grass mixture, or poor stand)	60	100	140	170	200+
Continuous corn (desired yield obtained)	100	120	160	200	240+
Corn, soybeans, small grain, grass sod	120	140	170	220	260+

* Previous crop and desired yield level must be specified.

Table 3. Recommended phosphorus rates for corn grown on medium-textured soils.

Soil test level	Bray P_1 Test*	Yield levels (bu/A)				
		100-110	111-125	126-150	151-175	176-200
	lb P/A	pounds P_2O_5 per acre				
Very low	0-10	100	110	120	130	150
Low	11-20	70	80	90	100	120
Medium	21-30	40	50	50	60	70
High	31-45	30	30	40	50	50
Very high	45+	10	10	20	20	20

* Based on a 7-inch plow layer or 2,000,000 pounds of soil.

for subsequent crops. A reliable soil test is important in determining the most economical rate of phosphorus fertilization.

With a Bray P_1 test of 40, relative corn yields of approximately 98 percent can be expected. Thus, it would not be economically feasible to build the soil level further with large annual applications of phosphorus.

Potassium

Potassium is required in such large amounts by corn that most soils are unable to supply the quantity needed. Although corn harvested for grain only removes about 0.25 lb. K/bu., corn harvested for silage removes 150 to 200 lb. K/acre. The amount of potassium fertilization required for most economic production varies from 0 to 200 lb/acre depending on the available potassium level in the soil. Once again, a soil test is a good way to determine the relative need for potassium fertilization.

With a potassium test of 300, relative corn yields of approximately 98 percent can be expected. Again, yield responses would be difficult to demonstrate with supplemental potassium at this soil test level.

Fall and Winter Fertilization

The necessity of timely planting to obtain high yields has resulted in increased

Table 4. Recommended potassium rates for corn grown on medium-textured soils.

Soil test level	Potassium Test *	Yield levels (bu/A)				
		100-110	111-125	126-150	151-175	176-200
	lb K/A	pounds K_2O per acre				
Very low	0-80	100	120	150	180	200
Low	81-150	70	90	120	140	160
Medium	151-210	40	60	70	90	120
High	211-300	30	30	40	60	80
Very high	301+	0	0	0	0	0

* Based on a 7-inch plow layer or 2,000,000 pounds of soil.

interest in fall and winter application of both phosphorus and potassium. Losses are at a minimum when the materials are plowed down in the fall on non-erosive soils. However, when the materials are left on the surface during the winter the possibility of wash-off and erosion loss increases. On soils with only thin cover, slopes up to four percent gradient are probably safe for fall and winter applications. With good cover of residues, such as heavy corn, small grain or forage stubble, the short slopes in the four to ten percent range may be safe. For long slopes with good cover a practical upper limit might be eight percent, and somewhat less for seepy, often-thawed slopes in southern areas of the state. Surface roughness increases efficiency of the residues in protecting against wash-off and erosion.

Nitrogen Application Methods

Nitrogen may be applied fall-preplant, spring-preplant, at planting, or side-dressed after planting. The most efficient time for application depends on the soil, the climate, the form of nitrogen used, and timeliness of the operation. Fall application will be effective where soils remain cold all winter (especially where they are frozen since this prevents leaching), where the nitrogen remains in the ammonium form in the soil, and where leaching, volatilization or denitrification losses are at a minimum. It is not recommended on sandy soils due to excess leaching losses nor on soils where ponding occurs because of volatilization or gaseous nitrogen loss to the atmosphere.

An ammonium form of nitrogen is recommended for fall application. It should not be applied until the soil temperature drops below 50° F at a depth of four inches. Placement of nitrogen six to eight inches deep in moist soil is preferable to shallow or surface application because the nitrogen is more likely to be in moist soil when needed by the crop.

Phosphorus Application Methods

Phosphate fertilizers are applied broadcast and plowed under, as a band two inches to the side and two inches below the seed and as a band near or with the seed. The efficiency of each placement is related to the rate of application. When placed with the seed in a complete fertilizer the application rate should be determined by the amount of nitrogen and potassium in the fertilizer. The $N + K_2O$ content should not exceed 5 lb/A on sands or 8 lb/A on clays. The phosphorus rate usually will not exceed 10-15 lb of P_2O_5/acre. When placed two inches to the side and below at planting higher rates of phosphorus may be used; however, this is most efficient for rates between 10 and 50 lb/acre of P_2O_5. When rates exceed 50 lb/acre of P_2O_5 part or all of the phosphorus should be broadcast and plowed under. Broadcast applications may be necessary only once every two or three years on many soils, particularly where the soil pH is above 6.0. Maintaining a pH between 6.0 and 6.5 is recommended for continuous corn.

Potassium Application Methods

Potassium is readily fixed in a relatively unavailable form on some soils, particularly Brookston silty clay loam, and as a result it is often difficult to increase the soil test value. In order to maintain the potassium fertility level of these soils, more potassium must be applied than the crop will use. Normally large applications of potassium may be made once every two or three years when corn is grown continuously for grain. However, on soils where potassium fixation is a problem an annual application is recommended.

Potassium may be applied either by broadcasting and plowing under ahead of planting or as a band two inches to the side and below the seed at planting. Both method will effectively supply potassium to the corn

plant in most instances. Row applications have been superior in a few cases where the soil test was very low and where potassium was broadcast and disked in rather than plowed under.

Micronutrients

Higher corn yields have created more interest in micronutrient fertilization. While most of these elements are actually present in the soil in an adequate quantity for high crop yields, they are not always present in a form that is available to the plant.

Since available soil tests for micronutrients are not as reliable as those used for phosphorus (P) and potassium (K), a plant analysis should be made to determine the nutrient status of the corn plant. If a deficiency is suspected, two different plant samples should be taken and submitted for diagnosis. One sample should be taken from the leaves of several different plants that exhibit deficiency symptoms. The second sample should be taken from healthy appearing plants in the same field for comparison. Also, soil samples should be taken from both areas and submitted with the plant samples.

Zinc is one of the micronutrients most frequently observed to be deficient in corn. Only 0.002 lb. of zinc is required per bushel but even this small amount occasionally is not available. Conditions which favor zinc deficiency are: 1) high soil pH, 2) high P levels in the soil combined with heavy row applications of phosphorus, 3) cool, wet soil conditions and 4) high corn yields.

Inorganic materials such as zinc sulfate or zinc oxide can be used to correct this deficiency. Zinc can be broadcast and plowed down with phosphorus and potassium fertilizers at the rate of ten pounds of zinc per acre. Three pounds of zinc can be used in row fertilizer. This can be obtained by using special fertilizers containing varying quantities of zinc. It can also be added to bulk blends or liquid fertilizers at the desired concentration. If a zinc chelate is used, the recommended rate should be reduced by one-fifth.

If the deficiency appears to be rather severe, a foliar spray can be used. One and one-half pounds of zinc sulfate in 30 gallons of water should give marked improvement. The following year zinc could then be added to the soil as a preventative.