How Serious Is Phosphorus Fixation on Indiana Soils?

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When soluble phosphorus fertilizers are applied to the soil they react with the soil to form rather insoluble iron, aluminum and calcium phosphates. This reaction is called fixation. Because of this fixation, phosphorus fertilizers have been applied so that a minimum of soil contact occurs. Consideration of phosphorus fixation was probably important when low amounts of fertilizer were applied. Comparisons of 10 to 15 lbs. of phosphorus (P_2O_5) applied as a row application with a similar amount applied broadcast for corn has frequently shown the row application to be more effective in increasing corn growth. This relationship may not necessarily be true at higher rates of application.

Two phosphorus fertilizer experiments conducted in recent years allow a comparison of method and time of application of the phosphorus on the residual availability of the phosphorus to corn. The residual effects of phosphorus applications were determined on the basis of the phosphorus content of the corn leaf at the tasseling stage. In an experiment at the Purdue Agronomy farm, at Lafayette, on Raub silt loam, the total phosphorus applied in the period 1952 to 1958 was correlated with the phosphorus composition of the corn leaf in 1958, Figure 1. The phosphorus was applied both as broadcast and row applications to a corn, soybean, wheat, and hay rotation. The amounts, method of application and time of application of the phosphorus on these plots is shown in table 1. The significant relationship here, is that the availability of phosphorus was apparently not affected by the time or method of application but only by the amount applied.

Since results on one location may be influenced by the soil and by the particular manner of fertilization, a second experiment was investigated. This experiment was conducted on a Bedford silt loam near Salem, Indiana.

The correlation of the total phosphorus applied from 1953 to 1958 with the phosphorus content of the sixth corn leaf is shown in figure 2. In this case all broadcast applications were made when the experiment started in 1953 and no phosphate has been broadcast since. Row applications were made for corn and wheat. The amounts applied and times of application for each treatment are shown in table 2.

The results of these two experiments indicate that where large phosphorus applications (more than 25 lbs. P_2O_5 per acre per year) are used, the time and method of application are not of great importance in determining the residual benefits of phosphorus fertilizers. The soils in both cases had a pH of 6.5 to 7.0.

This is an important consideration in phosphorus fertilization since, if fixation is not a problem, a farmer can apply most of his phosphate once every three or more years and use very small amounts as row fertilizers. The possibility of doing this enables a farmer to use bulk fertilizers rather

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than bagged fertilizer. He can also have it custom applied if he wishes so that he eliminates or reduces the labor and time involved in applying the fertilizer when he is planting the crop.

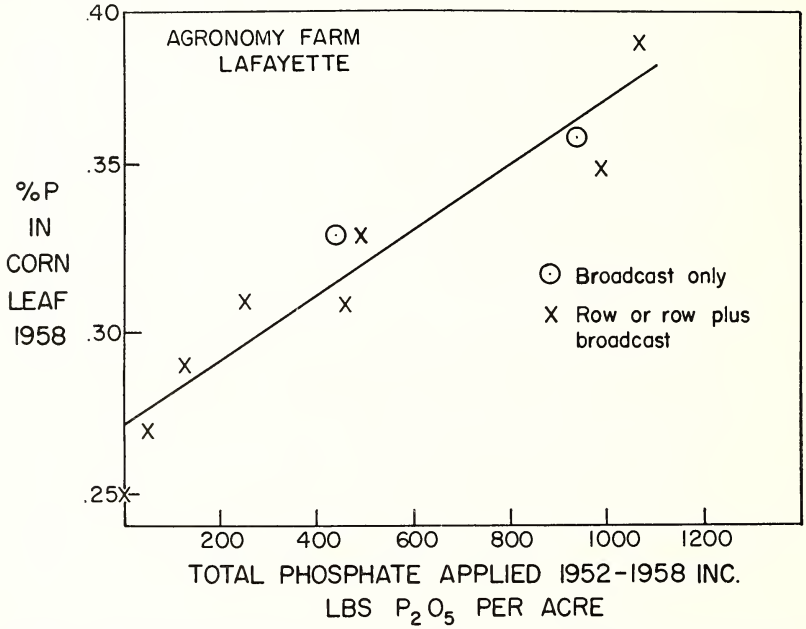

Figure 1. The relation between phosphate applied from 1952-1958 inc. and percent phosphorus in the corn leaf in 1958. Raub silt loam, Purdue Agronomy Farm, Lafayette, Indiana.

TABLE 1. The time and amount of phosphate application prior to the corn crop grown in 1958 on Raub silt loam, Purdue Agronomy Farm.

Treatment Number	1952[2]	1953	1954	1955	1956	1957[2]	1958	Total Applied	Soil test 1957[1]
	Year and Crop								
	Oats	Hay	Corn	Soybeans	Wheat	Hay	Corn		
	lbs. P_2O_5 per acre								
1	0	0	0	0	0	0	0	0	38
2	0	0	10	0	30	0	10	50	66
3	0	0	25	0	75	0	25	125	72
4	0	0	50	0	150	0	50	250	82
5	200	0	0	0	0	220F[3]	0	420	85
6	200	0	10	0	30	180F	10	430	85
7	200	0	25	0	75	120F	25	445	100
8	600	0	0	0	0	340F	0	940	170
9	600	0	10	0	30	340F	10	990	180
10	600	0	25	0	75	340F	25	1065	200

[1] Test before 1957 fertilizer applied.

[2] Fertilizer applied broadcast, in these years all other applications applied in the row.

[3] F means fall application.

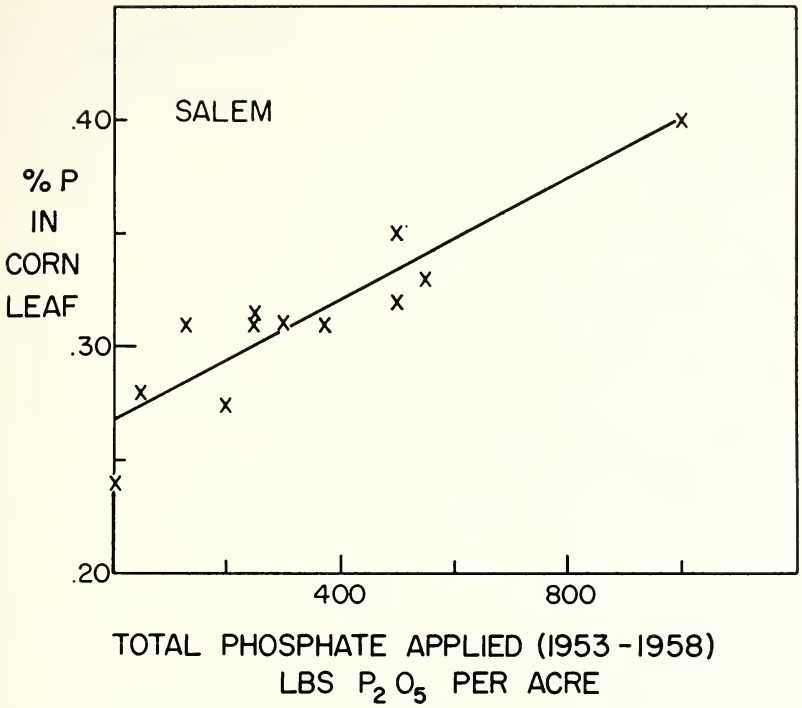

Figure 2. The relation between phosphate applied from 1953-1958 inc. and the percent phosphorus in the corn leaf in 1958. Bedford silt loam, Salem, Indiana.

TABLE 2. The time and amount of phosphate application prior to the corn crop grown in 1958 on Bedford silt loam. Salem, Indiana.

Treatment Number	Year and Crop 1953	1954	1955	1956	1957	1958	Total Applied	Soil test 1958
	Wheat	Hay	Corn	Wheat	Hay	Corn		
	lbs. P_2O_5 per acre							
1	0	0	0	0	0	0	0	26
2	0	0	10	30	0	10	50	15
3	0	0	25	75	0	25	125	27
4	0	0	50	150	0	50	250	55
5	250B[1]	0	0	0	0	0	250	72
6	250B	0	10	30	0	10	300	51
7	250B	0	25	75	0	25	375	75
8	250B	0	50	150	0	50	500	66
9	500B	0	0	0	0	0	500	200
10	500B	0	10	30	0	10	550	117
11	1000B	0	0	0	0	0	1000	420

[1] B refers to broadcast application, all other applications applied in the row.