CORN FERTILIZER CORRELATION STUDIES IN MASSACHUSETTS

Stephen J. Herbert & John H. Baker
Department of Plant & Soil Sciences
University of Massachusetts

One objective of this project was to examine fertilizer recommendations for corn silage in relation to the new soil testing procedures in operation with the plasma emission spectrophotometer now being used at the Suburban Experiment Station of the University of Massachusetts. This equipment, once adequately standardized, is well suited for full integration with a computerized system of soil test result reporting and fertilizer recommendations.

Two years of experimentation have been conducted at the Agricultural Experiment Station Farm in South Deerfield, beginning in 1980. Fertilizer levels of broadcast nitrogen, phosphorus, potassium and sidedressed nitrogen were factorially combined in a 2^4 factorial with two replications. Fertilizer levels in 1980 were

broadcast nitrogen	100 and 180 lbs per acre
broadcast P_2O_5	50 and 150 lbs per acre
broadcast K_2O	100 and 200 lbs per acre
sidedressed nitrogen	0 and 60 lbs per acre

In 1981 the same experimental plots and treatments were used, except that no phosphorus or potassium fertilizers were applied and plots that received the 100 lbs per acre broadcast nitrogen in 1980 were reduced to 60 lbs per acre in 1981. Sidedressed nitrogen rates and the higher broadcast nitrogen rate were the same in 1981 as in 1980 for their respective plots.

Results from these two years are shown in Table 1. Initially the experimental area before the 1980 experiment tested in the very high range for both phosphorus and potassium. This would account for the lack of response to both these nutrients in 1980 when rainfall was about 7 inches below the norm for May through September. This site has not received manure for at least 10 or more years and hence a response to nitrogen might have been expected.

In 1981, as in 1980, there were no responses or interactions to any of the nutrients. In this second year the Agway 584S corn hybrid produced excellent yields from soil reserves of phosphorus and potassium. Again in this season there were no significant responses to nitrogen above 60 lbs per acre. Apparently sufficient nitrogen was released from organic sources. Nitrogen conservation through cover cropping and return of crop residues has probably occurred, since manure is not the source of residual nitrogen.

A response surface, central composite design experiment with incomplete blocks adjacent to the above factorial experiment confirms these results. In this experiment we examined in 1980 three factors at five levels as follows:

broadcast nitrogen	20, 60, 120, 180, 200 lbs per acre
broadcast K_2O	50, 90, 150, 210, 250 lbs per acre
sidedressed nitrogen	0, 20, 50, 80, 100 lbs per acre

In 1981, the experimental design was similar except the broadcast nitrogen levels ranged from 20 to 260 lbs per acre and since no potassium fertilizer was applied the levels were the residual from 1980.

Table 1. Corn fertilizer studies at the University of Massachusetts Experiment Station Farm (South Deerfield). Individual plots were treated with the same nitrogen rates in both years, except as noted. Phosphorus and potassium were only applied in 1980. No significant differences were determined at the 5% level of confidence for main effects or interactions.

Fertilizer Rate lb/acre		Silage* ton/acre	Earcorn† ton/acre	Percent Ears	Non-lodged Plants %	Silage ton/acre
		1980				1981
Nitrogen						
Broadcast	Sidedress					
100 (60)¶	0	25.3	5.0	49	98	28.6
100 (60)¶	60	25.5	5.2	51	98	28.6
180	0	26.5	5.3	52	94	30.0
180	60	25.6	5.1	51	95	30.2
Phosphorus (P_2O_5)						
50		26.1	5.3	51	98	29.1
150		25.1	5.1	51	95	29.6
Potassium (K_2O)						
100		25.3	5.2	52	96	29.1
200		25.9	5.2	50	97	29.6
Overall mean		25.6	5.2	51	96	29.4

* 70% moisture

† 25% moisture

¶ The lower broadcast rate of nitrogen was reduced to 60 lb/acre in 1981.

In both years there were no significant interactions or main effect responses to nutrients applied. It should be noted in this design main effects are calculated for a given treatment when the other treatments are at their central level. That is the response to broadcast nitrogen is calculated when broadcast K_2O and sidedressed nitrogen are 150 and 50 lbs per acre respectively. The mean silage yields of all 20 plots in this design in these years were 25.5 tons per acre in 1980 and 31.1 tons per acre in 1981.

To broaden the data base of information on soils analyzed by the plasma a survey of the corn crop growing across the state was conducted. Twenty different fields were selected from farmer cooperators. Each field chosen was growing the Agway 584S corn hybrid. Three experiments growing 584S, located at South Deerfield were also incorporated into this survey. These included the 2^4 factorial fertilizer study previously discussed, and a soil acidity study comparing different limestones. On each grower's field four separate sampling sites were selected at random. At these sites and in the three experiments soil samples and ear-leaf samples were taken from twenty plants within a row at silking for soil and tissue nutrient determination. Analysis of samples has now been completed and a preliminary summary of the results is shown in Table 2.

Results of plotting soil and tissue against each other for phosphorus and potassium are shown in Figures 1 and 2. It is apparent from the analysis of these tissue levels that the corn crops are not deficient in either of these nutrients. Only ten samples out of the 133 taken show a tendency to be low for tissue potassium. The correlation between tissue and soil samples were phosphorus $r = 0.33$ and potassium $r = 0.50$.

The results from this survey and the fertilizer and the soil acidity-limestone studies have been used to check the fertilizer recommendations that are calculated in our soil analysis report program. You will note in the sample copies of these reports with recommendations that we are now recommending limestone grades on the basis of the soil magnesium level. Also we have a limestone requirement and maximum economic rate of 4 ton in one application recommended. Rather than set a yield goal for nitrogen we have provided a range of 140-180 lbs per acre. Phosphorus and potassium recommendations are based upon soil test results and some cultural advice is provided. Adjustments are suggested for nutrients from manure and previous crop.

We believe these recommendations to be the best we can achieve before we do more extensive field calibration. We feel the plasma is able to determine soil levels of the major nutrients with the necessary repeatability and have made independent checks on its accuracy compared to alternative equipment at the Amherst campus. We are less confident about the present standardization of micronutrients and heavy metals. While in our soil reports we will for highly fertile soils recommend as little as 50-60 lbs per acre of potassium and 0-10 lbs per acre of phosphorus, we feel we can justify these levels, and that our program is responsive to varying levels of nutrients in the soil. Considering the reports for your fields, if the soil test for potassium was 100 ppm then the reserve of potash K_2O is 240 lbs per acre in the surface 6 inches of soil. In Figure 2 for the soil which had the highest soil test result, while showing tissue potassium in the low range

Table 2. Summary of the 1982 corn fertility survey - 133 samples taken from research experiments and Massachusetts farms.

Element	SAMPLES FROM CORN SURVEY						Reference Tissue Standards†		
	Soil Level			Tissue Level					
	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Deficient	Adequate	High
	ppm			%			%		
Nitrogen				3.1	2.4	3.7	2.0	2.5-3.5	3.5
Phosphorus	25.8	4.4	86.4	0.4	0.3	0.5	0.1	0.2-0.5	0.3
Potassium	114.2	15.7	346.5	2.4	1.6	3.1	1.0	1.5-3.0	3.0-5.5
Calcium	880.1	227.7	2724.0	0.5	0.3	0.7	0.1	0.2-1.0	1.0
Magnesium	138.5	10.1	426.3	0.4	0.2	0.6	0.1	0.2-1.0	1.0
				ppm			ppp		
Boron	0.3	0.1	0.8	5.4	2.0	29.3	2.0	6-40	40-55
Molybdenum	0.1	0.1	0.1	1.0	0	3.0			
Zinc	0.1	0.1	2.4	30.3	5.1	112.4	15.0	20-70	70-150
Copper	1.1	0.1	4.3	9.4	0	19.7	2.0	6-50	50-70
Iron	2.0	0.6	8.2	107.2	66.6	329.5	10.0	10-300	300-550
Manganese	8.3	1.2	56.8	52.5	4.0	246.3	10.0	20-200	200-350
Aluminum	26.5	8.0	64.9	18.0	0	140.1			
Arsenic	0.1	0.1	0.2	0.5	0	3.0			
Lead	0.1	0.1	6.3	1.0	0	14.7			
Cadmium	0.1	0.1	0.1	3.0	0	126.5			
pH	6.07	4.10	6.90						
Buffer pH	6.65	5.40	7.30						

† Tissue standards from Christensen et al. In Mengel, K. & E.A. Kirby (1978), Principles of Plant Nutrition, International Potash Institute, Berne, Switzerland.

Figure 1. Relationship between tissue phosphorus in the ear leaf of Agway 584S soil phosphorus of 133 samples taken across Massachusetts. Sufficiency range from Mack Drake (Dept. Plant & Soil Sciences, Univ. Massachusetts) and Jones & Eck in Soil Testing and Plant Analysis (Walsh & Beaton, Editors) SSSA.

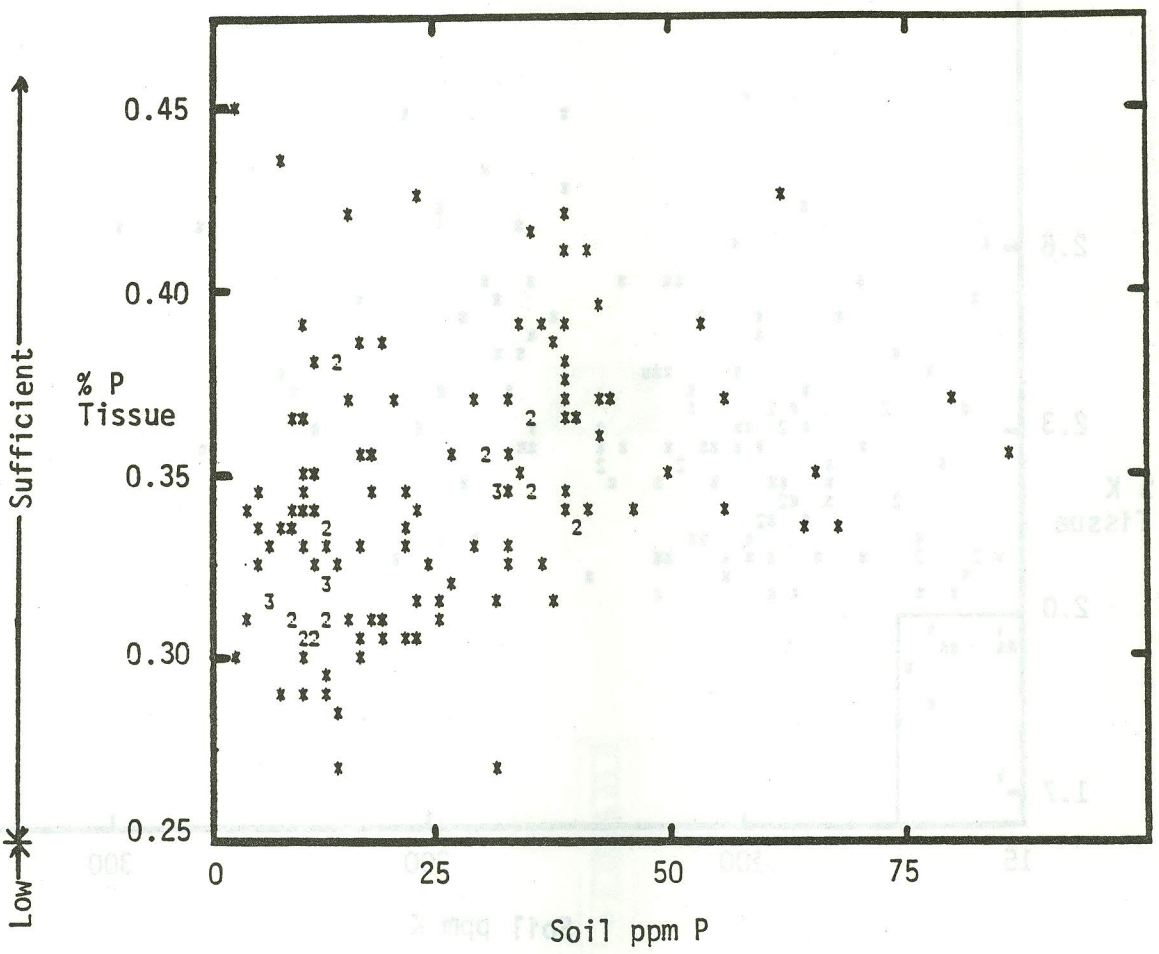
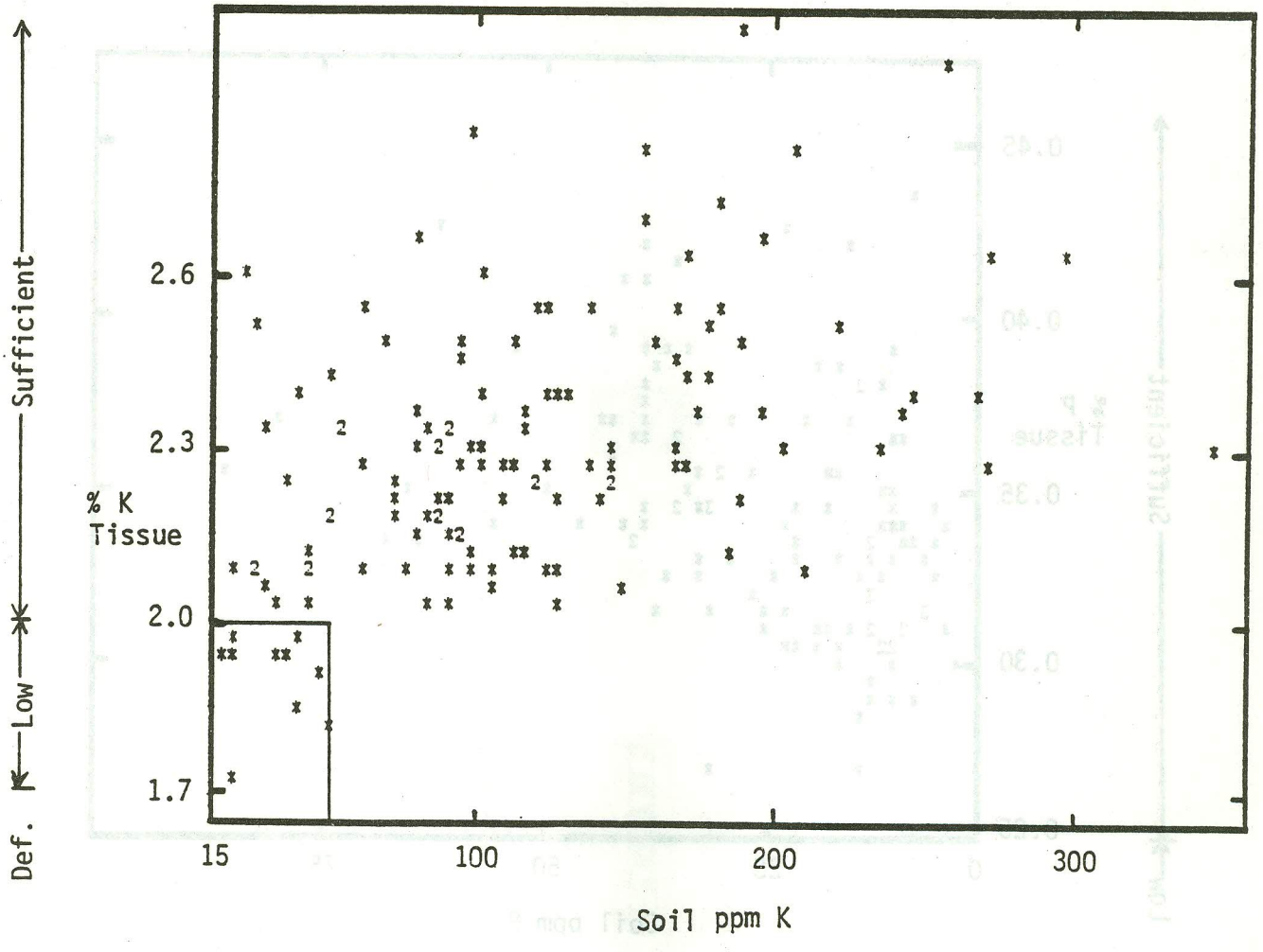


Figure 2. Relationship between tissue potassium in the ear leaf of Agway 584S corn and soil potassium for 133 samples taken across Massachusetts. Sufficiency ranges from Mack Drake (Dept. Plant & Soil Sciences, Univ. of Massachusetts). Note Jones & Eck in Soil Testing and Plant Analysis (Walsh & Beaton, Editors) SSSA give a sufficiency range of 1.70 to 2.5 or 3.0.



(i.e. a soil K level of 50 ppm or 120 lbs per acre K_2O equivalent) we would be recommending for this soil 240-250 lbs K_2O per acre. It is not until the soil potassium result exceeds 100 to 160 ppm depending upon cation exchange capacity that we recommend the minimum of 50-60 lbs of K_2O per acre. Similarly with phosphorus, the minimum amount recommended only occurs when the soil test is greater than 20 ppm P in the very high testing range for soil phosphorus.

The recommendations for corn silage, alfalfa hay, grass-legume hay and pasture on the soil analysis reports have now been released to growers for the spring of 1982. We will continue the analysis of our corn survey, including other nutrients as determined by the plasma. While we believe our recommendations to be correct it will be useful in 1982 to continue the fertility experiments at the Agricultural Experiment Station Farm in South Deerfield since now after one year of no potassium addition the soil analysis results suggest that in 1982 the corn crop will need substantial additions.

EVALUATION OF HERBICIDES FOR ANNUAL WEED CONTROL IN CORN

Prasanta C. Bhowmik
Department of Plant & Soil Sciences
University of Massachusetts

Several herbicides were tested (i) to determine the response of annual weeds and corn, and (ii) to demonstrate this response to growers, extension agents, students, and others interested in weed control. The experiment was conducted at the Agricultural Experiment Station, South Deerfield.

All herbicides were applied with a backpack CO_2 sprayer at 22 psi in 40 gal/ac. Preplant incorporated treatments were applied May 18 and incorporated immediately in one direction with a disc. Corn (Agway 584S) was planted May 19. Preemergence treatments were applied May 21 and post-emergence treatments were applied June 9 when grasses were at the 2-leaf stage, corn was at the 3-4 leaf stage and broadleaf weeds were at the 2nd pair true leaf stage. Treatments were laid out in a randomized block design and replicated three times. Plot size was 10 by 20 feet and each plot contained 3 rows of corn.

The area was heavily infested with fall panicum and crabgrass (large and hairy). There was also a uniform but light infestation of barnyard grass, common lambsquarters, redroot pigweed, common ragweed, and carpet weed. Rainfall was 3.12 inchs in May and 10.26 inches in June. Plots were rated on July 12. The results on weed control and crop injury are presented in Table 1. Grain and silage yields will be determined later.

Table 1. Annual weed control in corn.

Treatment	Rate (lb/ac)	Method of Application	% Control Compared to Check		Crop Injury %
			Grass	Broadleaf	
1) Sutan+ + Atrazine	4.0 + 1.0	PPI	100	95	0
2) Sutan+ + Bladex	4.0 + 1.5	PPI	100	95	0
3) Eradicane + Atrazine	4.0 + 1.0	PPI	100	100	0
4) Eradicane + Bladex	4.0 + 1.0	PPI	95	85	0
5) Untreated Check	-	-	0	0	0
6) Lasso + Atrazine	1.5 + 1.0	Pre	95	100	0
7) Dual + Atrazine	1.5 + 1.0	Pre	100	100	0
8) Lasso + Bladex	1.5 + 1.5	Pre	100	100	0
9) Dual + Bladex	1.5 + 1.5	Pre	100	95	0
10) Lasso + Banvel	1.5 + 0.5	Pre + EP	100	100	32
11) Dual + Banvel	1.5 + 0.5	Pre + EP	95	95	25
12) Bladex + Atrazine	2.0 + 1.0	Pre	95	100	0
13) Bladex	2.5	EP	100	100	0
14) Atrazine	2.5*	EP	100	100	0
15) Prowl + Atrazine	1.5 + 1.25	Pre	100	100	0
16) Lasso + Basagran	1.5 + 1.0*	Pre + EP	85	95	0
17) Dual + Basagran	1.5 + 1.0*	Pre + EP	80	80	0
18) Untreated Check	-	-	0	0	0
19) Lasso + Banvel II	1.5 + 0.5	Pre + EP	95	100	22
20) Dual + Banvel II	1.5 + 0.5	Pre + EP	80	100	17

* Crop oil concentrate was applied at the rate of 1 qt/ac.

A similar experiment was also conducted in Westport, Bristol County. The results of this trial will be discussed during the Field Day.