L. Barron

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Fertilizing Sweet Corn For Seed Production

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About 8,000 acres of sweet corn seed are grown annually in southwestern Idaho. This production supplies 90 to 95 percent of the seed used in the sweet corn industry of the United States. Idaho seed corn growers must maintain a product of high yield and quality if this position is to be maintained.

Many factors such as moisture, tillage, variety, disease, insects and soil fertility affect the yield and quality of sweet corn seed.

In recent years, stalk rot has become an increasing problem in the area. Continuous cropping with susceptible corn varieties and tillage practices used by sweet corn seed growers have encouraged and aggravated the stalk rot problem.

Losses from this disease in 1962 and 1963 were of economic proportions. Losses the past four years were even more devastating.

Simpson (1, 2) showed that late side-dressing of anhydrous ammonia (near lay-by time) increased the amount of stalk rot, that side-dressing applications near the plant resulted in more stalk rot damage than an application made in the center between rows, and that side-dressing anhydrous ammonia after the plants were 6 inches high resulted in more stalk rot than ammonium sulphate applied broadcast and plowed under prior to seeding.

Since very little research was available on fertilization for growing sweet corn seed, investigations were conducted from 1961 through 1967 to study effects of fertilization on yield and quality of sweet corn seed produced.

This publication summarizes this research.

Nitrogen Source and Rate of Application

Since some evidence supports the theory that forms of nitrogen and rate of application may influence the degree of stalk rot shown in corn, an experiment was conducted in 1965 to measure this effect. Two nitrogen treatments were used, one of ammonium sulfate alone and one of ammonium sulfate with a nitrifying inhibitor applied at a rate of 5 percent of the nitrogen rate, to delay the conversion of the ammonium nitrogen to nitrate nitrogen. The

Nitrogen fertilizer can increase stalk rot

High rates of nitrogen and use of ammonium sources of nitrogen increase stalk rot losses in corn. These photos, taken in fertilizer research plots, illustrate the early firing (above) and severe lodging (below) typical of stalk rot infection. Disease symptoms (right) are darkened stalk internodes, stunted roots and weak, pithy stalks.

Table 1. The effect of nitrogen rates on sweet corn seed yields and incidence of stalk rot, 1965.

Nitrogen lb/acre	Shelled corn lb/acre	Number per 90 ft of row		Total nitrogen in leaves %
		Ear drop	Stalk breakage	
0	3860	24	2	2.03
120	3776	42	9	2.20
160	3697	47	10	2.22
200	3700	51	13	2.24
L.S.D. 5% level	N.S.	5	3	

fertilizer was side-dressed at early emergence of corn at rates of 0, 120, 160 and 200 pounds of nitrogen per acre. Symptoms of stalk rot that were recorded included the number of ears dropped and number of stalks broken or lodged in 90 feet of row at harvest. The effect of nitrogen rates on sweet corn seed production is shown in table 1.

Results indicate that nitrogen fertilizer did not increase corn yields but did increase symptoms of stalk rot in this location where corn followed alfalfa. Analysis of corn leaves for total nitrogen at early silking of ears ranged from 2.03 percent in no-nitrogen treatment to 2.24 percent on the 200-pounds-per-acre treatment. This would suggest that corn having about 2 percent total nitrogen in leaves opposite and below the ear has sufficient nitrogen to produce yields of sweet corn seed shown.

The ammonium form of nitrogen increased degree of stalk rot symptoms shown in the corn plants (table 2). Where nitrification of the fertilizer was delayed by addition of the nitrifying inhibitor, stalk rot symptoms were greater.

Research was continued in 1966 at two locations to determine the effect of other nitrogen sources and rates on sweet corn seed yield and stalk rot incidence. One location was on the same field used

Table 2. The effect of nitrifying inhibitor on stalk rot incidence, 1965.

Nitrogen lb/acre	Number per 90 ft of row			
	Ear drop		Stalk breakage	
	NH_4	NH_4+N.I.	NH_4	NH_4+N.I.
0	20	26	3	3
120	41	43	7	11
160	33	61	6	14
200	38	63	8	18
L.S.D. — 5% level,	ear drop 7		stalk breakage 4	

Table 3. Effect of nitrogen sources on sweet corn seed yields and incidence of stalk rot, 1966.

Nitrogen source	Shelled corn lb/acre	Shelled corn on ground lb/acre	Number per 80 ft of row		
			Ear drop	Stalk breakage	Green plants
Ca $(NO_3)_2$	3271	68	70	1	15
Urea	3235	114	83	1	15
NH_4NO_3	3380	135	85	0	13
$(NH_4)_2SO_4$	3260	287	103	18	3
L.S.D. 5% level	N.S.	97	9	3	4

Table 4. Effect of nitrogen rates on sweet corn seed yields and incidence of stalk rot, 1966.

Nitrogen lb/acre	Shelled corn lb/acre	Shelled corn on ground lb/acre	Number per 80 ft of row		
			Ear drop	Stalk breakage	Green plants
60	3245	107	77	1	14
120	3184	169	84	4	11
180	3350	165	91	8	11
240	3366	160	90	8	10
L.S.D. 5% level	N.S.	N.S.	9	3	N.S.

Table 5. Effect of nitrogen rates applied as ammonium sulfate on sweet corn yields and incidence of stalk rot, 1966.

Nitrogen lb/acre	Shelled corn lb/acre	Shelled corn on ground lb/acre	Number per 80 ft of row		
			Ear drop	Stalk breakage	Green plants
0	3480	96	60	0	25
60	3291	174	91	3	8
120	3225	281	108	19	3
180	3169	400	115	29	3
240	3178	415	107	31	2
L.S.D. 5% level	N.S.	193	12	6	4

in 1965 where corn followed corn; the second location was on the same farm with corn following alfalfa in the rotation.

Rates of 0, 60, 120, 180 and 240 pounds nitrogen per acre were applied by methods similar to those used in 1965. Nitrogen sources included ammonium sulfate, ammonium nitrate, urea and calcium nitrate. Ammonium sulfate treatments were applied with and without the nitrifying inhibitor. Results at both locations were similar to those found earlier.

As in 1965, the ammonium source of nitrogen showed the highest incidence of stalk rot symptoms (table 3). Although the total yield was not affected by treatment, the amount of corn picked off the ground is a significant factor. Mechanical corn pickers would leave most of this corn in the field. This could mean as much as $25 per acre difference in gross income.

The effects of different nitrogen rates were also similar both years (tables 1 and 4). The greatest effects were noted with the ammonium sulfate applications (table 5).

High rates of nitrogen applied as ammonium sulfate increased stalk rot and increased the amount of shelled corn picked off the ground. Since stalk breakage and loss of total yield due to corn laying on ground appear to be the best criteria for evaluating nitrogen rates and sources of sweet corn seed production, the interactions between rates of nitrogen and sources as affecting stalk breakage are shown in table 6.

It is quite apparent that stalk breakage is increased by nitrogen applied as ammonium sulfate, especially at high nitrogen rates.

Application of a nitrifying inhibitor to the ammonium sulfate source increased stalk breakage but not as great as shown in 1965 results.

Total nitrogen in corn leaves ranged from 2.28 to 2.40 percent with no difference shown between sources or rates of nitrogen applied.

In 1967, a nitrogen source and rate experiment was conducted at a different location in the Boise Valley area. Sweet corn followed three years of beans and one year of potatoes in the crop rotation. Early symptoms of stalk rot were not observed in the field. No difference in stalk rot symptoms was

Table 6. Effect of nitrogen source and rates on stalk breakage in sweet corn seed production, 1966.

Nitrogen lb/acre	Plants lodged per 80 ft of row			
	Nitrogen sources			
	$(Ca)_2NO_3$	Urea	NH_4NO_3	$(NH_4)_2SO_4$
60	0	0	0	4
120	2	2	0	13
180	3	2	1	26
240	0	1	1	29
L.S.D. 5% level	9			

shown between nitrogen sources. However, higher nitrogen rates increased stalk breakage and the amount of corn picked off the ground (table 7). This agrees with previous results.

These investigations show that nitrogen source will affect the amount of stalk rot in sweet corn seed production. This is most evident where susceptible varieties are grown on soils having a severe infestation of the stalk rot organisms. The ammonium source of nitrogen will increase stalk rot compared with the nitrate source of nitrogen. Analyses of leaves at early silking time show similar concentrations of nitrate nitrogen and total nitrogen between sources. Consequently it would appear that the effect of nitrogen source is obtained at an early stage of plant growth before all the nitrogen is changed to the nitrate form.

Nitrogen rates of 60 to 120 pounds per acre are adequate for yield of corn obtained at locations studied. Higher rates increased stalk rot and amount of corn on the ground.

Table 7. Effect of nitrogen rates on sweet corn seed yields, stalk breakage and total percent nitrogen in corn leaves, 1967.

Nitrogen lb/acre	Shelled corn on ground lb/acre	Stalk[1] breakage	Total nitrogen %
60	501	15	2.34
120	727	20	2.53
180	786	22	2.57
240	922	26	2.53
L.S.D. 5% level	178	5	—

[1]Plants per 70 feet of row.

Plant analyses of corn leaves at early silking indicate that about 2 percent total nitrogen in leaves is sufficient to produce sweet corn seed. High nitrogen rates increased total nitrogen in leaves to about 2.5 percent.

Root injury by late side-dressing of nitrogen fertilizer increases stalk rot and should be discontinued.

Phosphorus Fertilizer

At the four locations used for nitrogen studies, soils were high in available phosphorus and the experimental areas had a general application of 80 to 120 pounds P_2O_5 and 10 pounds of zinc per acre. Neither source nor rates of nitrogen affected total phosphorus content of corn leaves analyzed at early silking. There was a difference in phosphorus content of leaves between locations. This varied from about 0.32 to 0.42 percent total phosphorus.

Table 8. Effect of phosphorus fertilizer on yield of sweet corn seed and amount of phosphorus shown in leaves at early silking, 1967.

P_2O_5 lb/acre	Shelled corn lb/acre	Phosphorus in leaves %
60	2001	0.34
120	1967	0.34
240	2035	0.36

In 1967, three rates of P_2O_5 were applied with three similar rates of nitrogen and potassium. Rates used were 60, 120 and 240 pounds P_2O_5 per acre. Phosphorus fertilizer showed no effect on yield of sweet corn seed or stalk rot (table

8). Soil analysis indicated a high level of available phosphorus at the location studied.

These data indicate that soils high in available phosphorus as shown by a soil test should not need phosphorus fertilizer to produce sweet corn seed. The total phosphorus in plant leaves analyzed at early silking is high at all rates of phosphorus used.

Potassium Fertilizer

The use of potassium fertilizer to decrease stalk rot and lodging of corn is a common practice in areas where soils are low in available potassium. To evaluate the need for potassium fertilizer for producing sweet corn seed in Idaho, two experiments have been conducted over the past three years. In 1965, four rates of potassium were applied with and without four rates of nitrogen applied as ammonium sulfate. All fertilizer was side-dressed at early emergence of corn. Soil tests indicated a high level of available potassium in the soil.

Results show no significant effect from potassium on yield, stalk rot or potassium content in leaves (table 9). High levels of available potassium, as shown from soil test, apparently are sufficient to grow sweet corn seed without adding potassium fertilizer. Plant analyses indicate that 2 percent total potassium in leaves taken opposite and below ears at early silking is sufficient to produce sweet corn seed.

In 1967, three rates of potassium were applied with three similar rates of nitrogen and phosphorus on a sandy soil showing a medium level of available potassium. All fertilizer was banded at early emergence of corn. As in 1965, no significant effect was shown on yield, stalk rot or potassium content in leaves (table 10).

At both locations studied, the soil and plant analyses indicated a sufficient level of available potassium without potassium fertilizers.

Table 9. Effect of potassium fertilizer on sweet corn seed yields, incidence of stalk rot and concentration of potassium in leaves, 1965.

K_2O lb/acre	Shelled corn lb/acre	Number per 90 ft of row		Total potassium %
		Ear drop	Stalk breakage	
0	3814	41	9	1.99
120	3852	40	8	2.01
240	3756	41	9	2.00
480	3612	40	8	1.98

Table 10. Effect of potassium fertilizer on sweet corn seed yields, incidence of stalk rot, and concentration of total potassium in leaves, 1967.

K_2O lb/acre	Shelled corn lb/acre	Number per 70 ft of row			Total potassium %
		Stalk breakage	Ear drop	Early firing	
60	2069	1	56	10	2.76
120	1969	1	63	8	2.77
240	1965	1	60	12	2.82

Zinc Fertilizer

Some of the first corn fertilization research conducted in Boise Valley evaluated zinc fertilizer for sweet corn seed production. Twelve pounds of zinc per acre were side-dressed at early corn emergence at 9 locations in 1961. Yield increases were obtained at 3 of the 9 locations studied. The average increase in yield is shown in table 11.

Table 11. Effect of zinc fertilizer on yield of sweet corn seed, 1961.

Treatment	Average yield sweet corn seed (lb/acre)	
	Total	Increase from zinc
No zinc	1143	—
12 lb zinc/A	1604	461

In 1962, 12 pounds zinc per acre were side-dressed at early corn emergence at 3 locations. Zinc fertilizer increased seed corn yield at only 1 location. This increase was 200 pounds seed per acre.

Literature Cited

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KEY RESULTS OF THESE STUDIES

In areas producing sweet corn seed:

- Source of nitrogen will affect stalk rot. The ammonium source of nitrogen increases stalk rot when compared with the nitrate source.

- Rates of 60 to 120 pounds of nitrogen per acre are sufficient to produce sweet corn seed. Higher rates increase stalk rot and lodging, resulting in more corn left on ground after harvest.

- Analyses of leaves taken opposite and below ear at early silking show that 2 to 2.5 percent total nitrogen appears to be sufficient to produce sweet corn seed.

- Phosphorus and potassium fertilizers are not needed on soils high in available phosphorus and potassium as indicated by soil tests.

- Plant analyses showed high levels of total phosphorus and potassium in corn leaves without the addition of phosphorus and potassium fertilizers. Leaf totals were above the 0.30 and 1.6 percent levels considered to be sufficient for phosphorus and potassium, respectively, in corn production.

- Late side-dressing will increase stalk rot. Fertilizer materials should be side-dressed only at early emergence of corn plants.

- Zinc fertilizer increased yields of sweet corn seed at 4 of the 12 locations studied.