Influence of "Pop-up" Fertilizers on Soybean Stands and Yield

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ABSTRACT

Both liquid and granular fertilizers containing nitrogen, phosphorus, and potassium were applied directly in the seed zone of soybeans (Glycine max (L.) Merrill) at planting. An application of 35.5 liters/ha (3.8 gallons/acre) of a liquid 5.0-8.8-4.2 (N-P-K) "pop-up" fertilizer reduced stands by 57.8% and yields by 20.3%. Plant stands were reduced when only 11.2 kg/ha (10 lb/acre) of a granular 10-15-5 (N-P-K) "pop-up" fertilizer was applied in the seed zone at planting.

Additional index words: Pop-up fertilizers, Glycine max (L.) Merrill.

The placement of fertilizers in relation to the seed of agronomic crops has been studied for many years. Recently, interest has developed in placing a small amount of fertilizer in the seed zone at planting as a possible means of stimulating rapid seed germination and early seedling growth. Fertilizers which are generally higher in phosphorus than nitrogen or potassium and applied with the seed have become known as "pop-up" materials.

Previous work has generally been confined to corn (Zea mays L.) with rates of less than 168 kg of material being applied per hectare (150 lb/acre). Both success and failure with "pop-up" materials on corn have been obtained by previous research work and farmer experience (1, 2, 5, 8). Many workers agree that 11.2 kg/ha (10 lb/acre) of nitrogen + potassium (as potassium oxide) is enough for use as a "pop-up" material for corn (7). Limited information is available concerning the use of small amounts of fertilizer applied directly in the seed zone for soybeans (Glycine max (L.) Merrill).

The study reported in this paper was designed to evaluate the use of small amounts of liquid and granular fertilizers applied directly in the soybean seed zone at planting.

MATERIALS AND METHODS

Field experiments were conducted during 1967 and 1968 at several locations in eastern North Carolina. Table 1 shows the location and soil type for each of the experiments. At each location phosphorus and potassium were applied broadcast according to soil test suggestions, and disked into the top 15 cm of soil prior to planting.

A liquid material (Supplied by N.A-Churs Plant Food Company, Marion, Ohio) containing N, P, and K (5.0-8.8-4.2) was applied at a uniform rate of 35.5 liters/ha (3.8 gallons/acre) at three locations in 1967 and at two locations in 1968. A two-row tractor-mounted planter was adapted to apply the liquid material through a number 29 Delavan metering orifice at a constant pressure of 20 psi on top of the seed after they had fallen to the seed furrow but before covering.

A second experiment using a granular material (Supplied by International Minerals and Chemical Corp. Skokie, Ill.) containing N-P-K (10-15-5) was conducted at one location in 1967 and at another location in 1968. This material was applied by use of a granular insecticide applicator that was mounted on a two-row planter. The material was applied directly in the furrow with the seed at rates of 11.2, 28.0, 56.9, and 84.0 kg/ha (10, 25, 50, and 75 lb/acre).

A randomized block design with four replications was used at each location. Individual plots consisted of four rows spaced 90.5 cm (36 inches) apart and 12.2 m (40 feet) long. Plant stand counts were determined in 1.5 m (5 feet) of row selected at random from each of the two center rows. Seed yields were obtained by harvesting 11.6 m (38 feet) of the two center rows of each plot with a self-propelled combine. Yield data are based on 14% moisture.

RESULTS AND DISCUSSION

The use of 35.5 liters/ha of a liquid 5.0-8.8-4.2 (N-P-K) fertilizer applied in the seed zone at planting reduced soybean stands by 57.8% as compared to the check treatment during 1967 (Table 2). A similar reduction in plant stand also occurred during the 1968 season when only visual observations were made at the two test locations. The 57.8% reduction in plant stand which occurred in 1967 resulted in reducing the average yield at the three locations by 63.2 kg/ha. The use of the liquid "pop-up" fertilizer resulted in reducing yields by 20.3% when averaged for the five locations during 1967 and 1968.

These results indicate that germinating soybean seeds are severely affected by very low rates of liquid fertilizers when placed in the seed zone at planting. The 35.5 liters/ha fertilizer rate used in this experiment contained 5.0, 8.8, and 4.2% of N, P, and K, respectively. Using a weight of 1.32 kg/liter for the liquid fertilizer, the amounts of N, P, and K applied per hectare were 2.34, 5.00, and 1.97 kg, respectively. The combined nitrogen and potassium rate of 4.31 kg/ha used in this experiment is considerably less than the rate found to be beneficial for corn production (7).

The data in Table 3 show the influence of a granular "pop-up" fertilizer on soybean stands and yields when applied at rates of 11.2, 28.0, 56.9, and 84.0 kg/ha. A reduction in plant stand was obtained when...
Table 3. Influence of a granular pop-up fertilizer on soybean stand and yield. 1967-68.

<table>
<thead>
<tr>
<th>Treatment* (kg/ha)</th>
<th>Stand, plants/1.5 meters</th>
<th>Yield, kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>25.8</td>
<td>2,339</td>
</tr>
<tr>
<td>11.2</td>
<td>20.8</td>
<td>2,157</td>
</tr>
<tr>
<td>26.0</td>
<td>14.8</td>
<td>2,103</td>
</tr>
<tr>
<td>56.0</td>
<td>12.3</td>
<td>2,009</td>
</tr>
<tr>
<td>84.0</td>
<td>9.2</td>
<td>1,734</td>
</tr>
<tr>
<td>LSD .05</td>
<td>4.5</td>
<td>186</td>
</tr>
<tr>
<td>.01</td>
<td>6.2</td>
<td>259</td>
</tr>
</tbody>
</table>

* Treatment consisted of using a 10-15-5 (N-P-K) material at planting.

only 11.2 kg of a 10-15-5 (N-P-K) were applied per hectare to the seed zone at planting. Additional stand reductions were obtained with increasing amounts of fertilizer applied in this manner. The highest rate of application (84.0 kg/ha) reduced the stand by 64.3% when compared with the check treatment.

The increasing loss in plant stands with increased amounts of fertilizer applied in the seed zone at planting had a detrimental effect on soybean yields. As noted in Table 3, yield reductions were obtained with the use of only 28.0 kg/ha of the 10-15-5 (N-P-K) fertilizer as compared to the check treatment. A close examination of the data shows that the least amount of fertilizer (11.2 kg/ha) applied almost resulted in a significant yield decrease. The highest rate of application (84.0 kg/ha) reduced yields by 25.9% as compared to the check treatment. This reduction in yield is not as great as the reduction in plant stand (64.3%), indicating that the plants growing at the lower population levels were producing a greater quantity of soybeans per plant.

The results obtained from this study indicate that liquid or granular fertilizers containing N, P, and K should not be placed in contact with soybean seed at planting. When used in this manner substantial reductions in plant stands can occur resulting in a loss in soybean yields.

Results from these fertilizer tests also emphasize the importance of proper placement when regular fertilizers are being applied by the band method. Generally, suggestions from Agricultural Experiment Stations stress the need for placement of fertilizer bands from 5 to 10 cm below and 8 to 13 cm to the side of the soybean seed in order to avoid seedling injury (3, 4, 6). Many soybean producers are currently broadcasting their regular fertilizer materials in order to avoid the type of yield losses incurred in this study.

LITERATURE CITED

2. Jacob, K. D. 1967. Pop-up fertilizers are sweeping the corn belt. Farm Chem. 130:46.