

Sugar Beet Yields Increased By Phosphorus Fertilization

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Phosphorus fertilization increased beet yields an average of 2.6 tons per acre in five Glenn-Butte County experiments.

A STUDY TO correlate soil analyses with the response of sugar beets to phosphorus fertilization has been under way in Glenn and Butte counties since 1964. Soil samples were obtained from each field in the study by compositing several 8-inch cores from a 3/4-inch-diameter soil tube. After sieving and thoroughly mixing, five grams from each sample were extracted with 100 ml of 0.5 molar sodium bicarbonate solution. The extract was then analyzed colorimetrically by the ammonium-molybdate-stannous-chloride method and the phosphorus present expressed as ppm of P in the dry soil.

To date, six experiments have been located on fields where the soil P content ranged from an average of 4.5 to 22.0 ppm. Each trial involved one or two rates of phosphorus, as single superphosphate, and a no-phosphorus control. The fertilizer was applied prior to planting by broadcasting—followed by listing the soil into ridges and shaping into planting beds. The treatments were replicated three or four times, with individual plots being strips through a field at least 12 beet rows wide. For each experiment, nitrogen fertilizer was uniformly applied to all plots at the same rate the grower used for the entire field.

Leaf samples were collected periodically throughout the growing period of each trial and analyzed to determine the adequacy of the fertilization practice in supplying the phosphorus needs of the crop—and to determine how well the plants were supplied with other essential nutrients.

Early response

In five fields, with soil phosphorus levels from 4.5 to 8.4 ppm, there was a striking visible response in top growth early in the season. By mid-May, however, leaf analysis showed that nonfertilized plants were taking up sufficient phosphorus for maximum growth, indicating that the period of phosphorus deficiency occurred very early in the growth period of the crops. By midseason, visible top growth differences had largely disappeared. In one trial where the soil P level was 22 ppm there was no visual response to phosphorus, even early in the season.

Increased root yield

Yield records were taken by machine harvest of the center four rows of each plot, or by hand harvesting 50 ft of four rows from each plot. Considering the five trials as typical of the soils of this area (low in soil phosphorus) and combining all data, the average increase of 2.6 tons of beets per acre is statistically significant (well beyond the 1% level)—indicating that the responses to phosphorus are real. Sucrose concentrations in beet roots were not consistently affected by phosphorus fertilization.

The vigorous early growth, associated with phosphorus fertilization in such soils,

is important in improving emergence and seedling survival and facilitates planting to a stand and the use of mechanical thinners. The increased root yield of 2.6 tons per acre represents an increased return of over \$20 per acre after all costs associated with fertilization and the handling of the extra tonnage are deducted.

It now appears that when soils of the Wyo and Tehama series test below 10 ppm P (by the sodium bicarbonate test), phosphorus fertilization should be considered for sugar beets planted in early spring when soils are cold. Twenty to 30 lbs of P per acre (46 to 69 lbs. P₂O₅) appears to be an adequate rate.

Additional work is planned to further correlate soil analysis with response to phosphorus fertilization and to improve the use of plant analysis as a diagnostic procedure for determining the phosphorus status of sugar beet seedlings.

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SUMMARY OF PHOSPHORUS TRIALS, WITH YIELD INCREASES IN SUGAR BEET ROOTS HARVESTED

| Trial | Soil series* | Soil analysis (dry basis) | Planted | Harvested | Roots | | |
|-------|--------------|---------------------------|-----------|-----------|-------|------|----------|
| | | | | | No P | P† | Increase |
| | | ppm P | tons/acre | | | | |
| 1 | Wyo | 4.5 | 4/24/64 | 3/4/65 | 24.2 | 26.7 | 2.5 |
| 2 | Tehama | 6.0 | 3/17/66 | 9/3/66 | 19.3 | 22.7 | 3.4 |
| 3 | Tehama | 8.4 | 3/18/66 | 10/22/66 | 17.3 | 19.9 | 2.6 |
| 4 | Wyo | 7.4 | 3/25/66 | 9/2/66 | 17.0 | 19.0 | 2.0 |
| 5 | Tehama | 6.3 | 3/7/67 | 9/12/67 | 20.6 | 22.9 | 2.3 |

* All soils are silt loams.

† Rate of fertilization in pounds of P per acre. #1-40, #2-26, #3-26, #4-31, #5-13. To convert to pounds of P₂O₅/acre, multiply by 2.3.

Sugar beet response in phosphorus fertilization tests is seen in photos below. The field was planted in March and photos were taken in May. Rows and plants to left were fertilized with 26 lbs of P per acre, as compared with unfertilized check plants and rows to right. Test plot soil was low in phosphorus.

