# Effects of Growth-Promoting Substances on Sugar Beets

J. T. ALEXANDER AND C. E. CORMANY[1]

The application of dilute solutions of trace elements directly to the leaves of deficient plants, particularly plants deficient in iron, has often resulted in the elimination of the deficiency symptoms. The remarkable results obtained by using 2,4 D and related growth-promoting substances also shows how readily these compounds may enter the plants through the above ground structure. It was felt that perhaps in the case of the sugar beet plant spraying the leaves would offer a means of furnishing certain materials necessary for optimum growth and sugar formation not readily supplied otherwise. With this in mind, sprays containing various nutrients, trace elements, growth-promoting substances and organic mixtures were applied to sugar beet foliage in the field during the summer of 1949 at Swink, Colorado.

## Procedure

Eighteen treatments, as listed in Table 1, are included in this exploratory test. Small plots of .004 acre were sprayed four times at two-week intervals. The first application was applied August 22, 1949. The plots were sprayed late in the growing season in an effort to exert a ripening or maturing influence on the beets. It was hoped an increase in sucrose percentage would result. Both sucrose and yield data were secured, however.

All substances were mixed with water and applied at the rate of 31.25 gallons per acre.

A randomized block design was used with nine replications of each treatment. The eighteen treatments were split into two tests of nine treatments plus a check.

The treatments, concentration of the sprays expressed in parts per thousand and pounds per gallon, sugar per acre, yield, and sucrose percentage are shown in Table 1.

Stands on all plots were comparable and not a factor in the test.

## Results

None of the treatments affected yield significantly. Several of the treatments did influence the percent sucrose, however. A mixture of iron, magnesium and potassium sulfate applied at the rate of 13 1/3 pounds each, per acre, lowered the percent sucrose a significant amount. Copper sulfate applied at the rate of 20 pounds per acre and pregnant cow urine applied at the rate of 125 gallons per acre also lowered the sugar percent significantly. Magnesium sulfate sprayed on the leaves at the rate of 20 pounds per acre raised the percent sucrose significantly at the 5 percent level. In addition, potassium chloride at the 40-lb. rate closely approached significance and should be considered in further testing.

Distinct burning of the foliage was noted where iron, copper and zinc compounds were applied in concentrations of 19 parts per thousand. In fact,

[1] Associate Agronomist and Chief Agronomist respectively, Holly Sugar Corp.

burning was noted in every case where iron (ferrous) sulfate was applied. The leaves sprayed with the ion-exchange regenerate solution exhibited slight burning.

The plots which were sprayed with NuGreen, cow urine and the ion-exchange regenerate solution showed a dark green color normally attributed to beets having an abundant nitrogen supply. As all three of these sprays contained nitrogen in varying amounts, it may be assumed that the plants in these plots were able to assimilate an appreciable amount of this element.

**Table 1.—Concentration and Acre Production of Various Spray Treatments Applied to Sugar Beets at Swink, Colorado—1949.**

| Treatment | Spray Concentration: Quantity per acre | Spray Concentration: Parts per thousand | Spray Concentration: Lbs. per gallon | Lbs. sugar per acre | Tons per acre | Percent sucrose |
|---|---|---|---|---|---|---|
| **Test A** | | | | | | |
| **1** Potassium chloride | 40 lbs. | 38.00 | 0.32 | 5,378 | 16.668 | 16.14 |
| 2 Magnesium sulfate | 40 lbs. | 38.00 | 0.32 | 5,016 | 15.814 | 15.87 |
| 3 Potassium chloride | 20 lbs. | 19.00 | 0.16 | 4,945 | 15.712 | 15.83 |
| 4 Magnesium sulfate | 20 lbs. | 19.00 | 0.16 | 4,919 | 15.252 | 16.17[2] |
| 5 Manganese sulfate | 20 lbs. | 19.00 | 0.16 | 4,900 | 15.345 | 15.91 |
| 6 Zinc sulfate | 20 lbs. | 19.00 | 0.16 | 4,869 | 15.935 | 15.30 |
| 7 NuGreen (Dupont) Soluble Nitrogen (43%) | 20 lbs. | 19.00 | 0.16 | 4,778 | 15.156 | 15.75 |
| 8 Check | | | ..... | 4,715 | 15.032 | 15.69 |
| 9 Iron sulfate | 20 lbs. | 19.00 | 0.16 | 4,471 | 14.621 | 15.26 |
| 10 Copper sulfate | 20 lbs. | 19.00 | 0.16 | 4,203 | 14.011 | 15.00[1] |
| | | General Mean | | 4,819 | 15.357 | 15.69 |
| | | Diff. for Sig. | | ns | ns | .48 |
| **Test B** | | | | | | |
| 11 Check | | | ..... | 4,771 | 14.720 | 16.14 |
| 12 Sugar Beet Molasses Sp. Gr. 1.414 approx. | 328 lbs. (27.8 gal.) | | 2-65 | 4,741 | 14.737 | 16.07 |
| 13 Liquid $P_2O_5$, (52%) | 20 lbs. | 19.00 | 0.16 | 4,577 | 14.298 | 16.02 |
| 14 Ion Exch. Reg. (3.8%) N.Sp.Gr. 1.110 | 1158 lbs. (125 gal.) | | 9-30 | 4,476 | 13.945 | 15.97 |
| 15 P-chlorophenox of acetic acid (Sure-Set) | 2.3 gal. | 00.03 | ..... | 4,447 | 14.005 | 15.82 |
| 16 Sodium salt of a-napthyl acetic acid (App-1-Set) | 10 lbs. | 9.60 | 0.08 | 4,395 | 13.774 | 15.96 |
| 17 Whole raw milk | 27.8 gal. | | ..... | 4,386 | 13.991 | 15.60 |
| 18 Mixture of $CuSO_4$, $FeSO_4$, $MnSO_4$, $ZnSO_4$—5 lb./ each | 20 lbs. | 19.00 | 0.16 | 4,292 | 13.721 | 15.59 |
| 19 Pregnant cow urine | 125 gal. | | ..... | 3,960 | 13.466 | 14.69[1] |
| 20 Mixture of $MgSO_4$, $K_2SO_4$, $FeS0_4$—13.33 lb/ each | 40 lbs. | 38.00 | 0.32 | 3,592 | 12.103 | 14.81' |
| | | General Mean | | 4,363 | 13.876 | 15.67 |
| | | Diff. for Sig. | | ns | ns | .75 |

[1] Significantly lower than the check at 5% level.
[2] Significantly higher than the check at 5% level.

## Discussion

This exploratory test was designed primarily to discover what, if any, influence these sprays might have on the percent sugar in the beets when applied late in the season. Had they been applied in the growing season a yield response might have been shown. This is particularly so of the nitrogen-bearing sprays and growth-promoting substances and, in all probability, liquid phosphoric acid.

With but one exception, the plots having the lowest sucrose percent were those which exhibited the most burning. These plots which were sprayed with the iron, copper, and zinc compounds had started to grow new tissue to replace the burned leaves and thus reduced the carbohydrate reserve. The plot which was the exception was the one treated with pregnant cow urine. These plots showed no burning of the leaves. They did exhibit what appeared to be nitrogen stimulation, however. It may be possible that this spray stimulated the vegetative growth of the beets on these plots to such an extent that maturity was delayed.

The only plots which showed an increase in sugar percent were those sprayed with potassium, magnesium and manganese compounds. This may indicate that such compounds may be used as a spray late in the growing season to hasten maturity and increase the storage of sugar.

## Summary

Eighteen substances were sprayed on sugar beet foliage in the field at the rate of 31 gallons per acre. Four successive applications were made during late summer. None of the treatments was found to increase yields.

Two spray treatments, a mixture of iron, magnesium, and potassium sulfate, applied 3 1/3 pounds each per acre for each spray application, and pregnant cow urine applied at the rate of 31 gallons per acre per each spraying, significantly depressed the sugar percent. Copper sulfate was also found to have a significantly depressing effect when applied at the rate of 5 pounds per acre in each of four sprayings. In fact, in all treatments containing iron, zinc and copper compounds, a depression of sucrose percent was shown.

Sucrose content was raised significantly by an application of 5 pounds of niagnnesium sulfate per acre for each spraying. Potassium chloride at the rate of 10 pounds per acre per each spraying approached significance.

Results from this exploratory test encourage further investigation as to times and rates of application as well as new compounds.