# Controlling Soil Crusting in Sugar Beet Fields By Applying Concentrated Sulfuric Acid

RONALD C. JOHNSON AND JAY B. LAW[1]

*Received for publication May 18, 1966*

The control of soil crusting has been one of the most serious problems encountered in securing adequate, uniform stands of sugar beets on heavy calcareous soils. Immediately after a rain storm or an irrigation these soils form thick, tough crusts that prevent beet seedlings from emerging. Various mechanical devices can be used to break the crusts, but their effect has been directly proportional to the efficiency of the device and the timeliness of the operation. This can be costly and frequently ineffective.

In 1964 and again in 1965 the Utah-Idaho Sugar Company conducted tests in Utah to evaluate the effectiveness of applying concentrated sulfuric acid over the beet row to prevent the formation of crusts.

## Methods and Materials

In these tests concentrated sulfuric acid was placed in 1½-inch to 2-inch bands immediately over the planted row. Eight tests were conducted by using a gallon plastic bottle filled with sulfuric acid and allowing the acid to cover a 2" band over the planted row immediately after the beets were planted. The acid flowed entirely by gravity and only the orifice at the end of the plastic tube from the bottle and the ground speed of the applicator controlled the rate of application. In four other tests, low rates of pressure—not exceeding 20 pounds—were applied to the acid to secure a more uniform distribution.

The rates of application in all of the tests varied from 250 to 600 pounds, and from 17 to 40 gallons of the acid per acre.

In five of the tests the application was made several days after the beets had been planted and in three of these tests a crust had already started to develop.

## Results and Discussion

The results of these tests were most encouraging. In all of the tests, the acid combined with the soil to form a fine film of gypsum and once this was formed, rainfall and continued irrigation did not make the soil crust in the treated bands. In all but

---

[1] Agricultural Research Manager and Research Agronomist, respectively, Utah-Idaho Sugar Company, Salt Lake City, Utah.

two of the tests, adjacent rows where no acid was applied had crusts that prevented or at least retarded the emergence of the seedling, whereas the treated rows were absolutely free of crusts except for one test where the crust had developed before the application of the acid. Instead of a crust in the treated area, there was a thin friable film that prevented crusting. This film was extremely thin and could be broken with the slightest pressure, nevertheless it persisted through several rain storms and overhead or furrow irrigations. The only exception to the preservation of this crust preventing film was in one field where enough errosion occurred to wash away some of the treated area. Otherwise, no difficulties were encountered with crusts in the treated areas.

Stand counts were taken on three fields that had been treated. These fields were not heavily crusted in the untreated areas although it would appear there was sufficient crust to retard field emergence. The results show an increase of 11 to 14 beets per 100 inches of row, or 42 to 54% increase in emergence from the acid application (Table 1).

**Table 1.—Results of trials with sulfuric acid showing average number of beets in 100 inches of row.**

| Grower | Check | 300# Sulfuric acid | 600# Sulfuric acid |
|---|---|---|---|
| T. Tateoka | 28.5 | 39.6 | 36.6 |
| Richard Bogess | 16.0 | 23.3 | 18.4 |
| S. O. Newbold | 33.4 | 47.8 | 64.9 |
| Average | 26.0 | 36.9 | 40.0 |

The rate of the acid had little or no effect on crust prevention. The lowest rate was as good as the highest rate if the band 1½ to 2 inches in width was maintained over the planted area. Narrower bands frequently failed to give an adequate area where there was acid; therefore, crusts did become a problem. It was more difficult to maintain a 1½ to 2-inch band with the lighter rates than with the heavier rates. but if the band was maintained, additional acid did not seem to be beneficial. Having some pressure on the liquid instead of relying entirely on gravity flow helped maintain the desired band width with the lower rates of material.

The best results were obtained when the acid was applied to soil that was fairly dry. Wet soil, or even damp soil. seemed to prevent the formation of the thin film that prevented the crust from developing. On dry soils, and particularly at the heavier rates, there was frequently a noticeable effervescence when the acid came in contact with a high calcareous soil. At the lighter rates this effervescence was not observed, but the film that formed was not visually different.

There were some beneficial side effects from the application of the acid. The flea beetle became a problem in two of the fields that had only small sections treated with the acid. The surrounding areas had varying populations of the flea beetles and the visual damage became quite extensive; however, there was no damage to the beets and no beetles could be found in the areas treated with the acid. If this would have remained true had larger areas been treated so that the beetles would not have had their preference in such a limited area was not determined. However, it was obvious the beetles did at least prefer the beets where the acid had not been applied.

The cost of the materials used in these experiments varied from a low of about $3.00 to a high of about $7.50 per acre. These costs could vary some for the same rate, depending upon the amount of acid purchased and availability of supply. Acid for these tests cost $25.00 per ton; however, the cost may have been lower if larger amounts had been purchased.

Two difficulties were encountered in these tests. First, was that even though the applicators wore rubber clothing over most of their body, jackets, pants, and shirts were damaged and skin burns were quite frequent. Just the fumes from the acid is sufficient to cause deterioration of most clothing and frequent skin burns. Before the use of concentrated sulfuric acid could become a general practice, rigid recommendations of application must be made. Second, was that when the application was made several days after planting, the seedling beets were frequently close enough to emergence that some damage was done to the beets. Beets or weeds that had emerged in the treated areas were killed. This can be avoided by making the application immediately following planting.

There seems to be sufficient benefits to warrant the application of the acid on soils where most difficulties from crusts are encountered. Many growers are interested in applying the acid, but are waiting for recommendation as to rates and method of application.

It is hoped that similar results can be obtained from applying ferric sulfate instead of concentrated sulfuric acid. This would eliminate the dangers and hazards of the acid and would be easier to apply.

**Summary**

1. Concentrated sulfuric acid was applied in 1½″ to 2″ bands over the planted row on heavy calcareous soils in Utah.

2. A fine film formed in the treated areas which completely prevented the formation of any crusts.

3. This film was easily broken and presented no problem to the emerging beets.

4. Adjacent areas generally had heavy crusts that either prevented or retarded seedling emergence.

5. Wet or damp soil made the application less effective because the soil film did not develop as well.

6. Flea beetles did not feed on the beets where the soil was treated.

7. The beets were damaged or killed if they had emerged or were approaching emergence when the acid was applied.

8. The dangers and hazards of applying concentrated sulfuric acid are many.

9. Rigid and precise application procedures need to be adapted before this program could be recommended.

10. Tests will be conducted using ferric sulfate in hopes of maintaining effectiveness, but reducing dangers.