The Extent of Sugar Beet Emergence Studies at Colorado A & M College

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Since March, 1946, a total of 334 planter treatments, to study the effect of various equipment on beet seedling emergence, has been made by the Mechanical Engineering Section of the Colorado Agricultural Experiment Station in cooperation with the Beet Sugar Development Foundation and the U. S. Department of Agriculture. With few exceptions each treatment was replicated six times to reduce experimental error as far as possible. Every advantage was taken of variation in soil, moisture, climate and time of year to gain as much knowledge as possible from the different equipment. Plantings have been made from southern Colorado to the northern boundary of Wyoming and in other parts of Colorado, Nebraska and Wyoming. Planting dates in this area have extended from March 20 to July 26, the latter date being much later than any commercial planting could be made, but it did give some very interesting results on emergence during hot weather when it was necessary to supply moisture by irrigation.

During this time more than 75 mechanical devices and combinations have been used, not to mention more than 50 chemical, hormone and fertilizer treatments applied to the seed, designed to improve viability and stimulate early plant growth. As the experiment has progressed, only those devices and techniques which have fallen in a bracket equal to or better than the check were used for further testing. It has been felt that if a device showed an increase in seedling germination under some conditions but was never poorer than the check under other conditions that definite progress had been made. This system has eliminated a high percentage of the devices tested but has given some assurance that those continued in the test definitely have some merit. Some equipment has been continued in the tests for two or three years because, under the first set of conditions, good results were obtained as compared to the standard check planter. In all these tests the standard check was a commercial horizontal plate planter of the precision type with double disc furrow opener and cast iron, deep concave press wheels set 3/4 of an inch apart.

As already stated the work was done in the semi-arid area of the Rocky Mountain states where sugar beets are grown under irrigation. The findings here may not be applicable to conditions of heavier rainfall or in West Coast fields where heavy freezing does not occur to improve the quality of the seedbed. In the mountain area it is seldom if ever necessary to plant when the surface of the field is wet enough to stick to the furrow opener or press wheels. Normal precipitation is heaviest in the spring months which is an aid to germination. However, rain or snow even at this season is not dependable as proven by one of the tests which was planted in five inches of dry soil and received no rain for five weeks after planting. In the heavier rainfall areas it might be necessary to provide scrapers for some devices. This has been kept in mind, however, in the design of all equipment and in some cases such as the pneumatic rubber press wheel there would be less danger from sticking soil than in the conventional iron wheel. Some cloddy fields similar to seedbed condition in parts of California have been encountered and in 1949 a device which produced top results in good seed-

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bed conditions failed to show substantial improvement in the cloddy field.

Apparently the ideal condition, as indicated by this series of tests, is first of all good cultural practices in crops preceding the beet crop which will enable the farmer to prepare a uniform, firm seedbed smooth and free of trash and weed seed, with sufficient moisture to produce germination. The planting equipment should place the seed uniformly in the bottom of

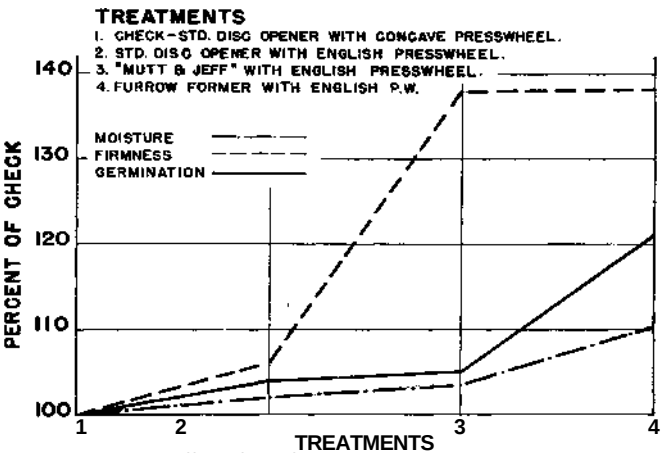

Figure 1. The effect of soil firmness and moisture on germination.

the furrow which has been packed below the seed by the furrow opener or in some other manner and the furrow closed over the seed by press-wheels which will pack soil tightly in the seed zone, leaving the surface mulched to prevent crusting. Tests have shown that when these conditions are met good germination results, but it has been very difficult to meet these requirements in the wide variety of field conditions encountered.

Regardless of the equipment used to accomplish the desired results, certain standards must be met. The device must not disturb the seed pattern or interfere in any way with the process of placing seed in the ground, as was the case when a stream of water was introduced through a special tube on top of the seed. The presswheel must not leave a smooth glazed surface which will bake and crust. Any projection on the packing device must not extend so far into the ground that the soil is loosened as the wheel moves on down the row. The presswheels must not leave the row so the plants come up in a small ditch since such a condition does not lend itself to mechanical thinning or weed control practices. A small ridge in the row is not desirable because the extra depth of soil over the seed may cause the plants to be weakened before they come up.

The outstanding device in this series of tests was the Furrow-Forming wheel which presses a "V"-shaped furrow into the ground 11/4 inches deep with a small shoe following immediately behind the wheel to hold the furrow

open while the seed is being deposited. When this unit was used with any good presswheel design, it gave good results.

Although several devices have shown from 5% to 15% increased germination over the standard check, this is not good enough to take full advantage of the potential sprouts available. The Furrow Former has given 50% increase in many instances and has, in some cases, produced as much as 100% more plants per 100 inches than the check. Even in late summer plantings where it was necessary to irrigate for germination the Furrow Former produced 56% more plants from the same seeding rate. *Seeds planted with this unit have always germinated faster,* making it possible to see the row plainly before plants from other units could be seen at all.

Pneumatic rubber presswheels have given variable results but the experience of 1949 indicates that perhaps most of the rubber wheels used have been of too large a cross section, which gave a low unit pressure on the ground. In general a single rubber presswheel which ran directly over the row gave better results than two wheels set to run on either side of the row, running either in a vertical plane or at an angle. A single wheel 14 inches in diameter having a solid rubber tire of an approximate "V" cross section running directly on the row gave a surprising increase in germination in the 1949 tests. The chief disadvantage was that the beets came up in a small furrow which made mechanical thinning or even close cultivation impossible when the plants were small. This difficulty might be overcome by dragging something to fill this furrow but no tests have been made to check the theory.

The English-type presswheel has given consistent improvement of 10% to 15% over the check. The English-type presswheel consists of two 3/16-inch steel plates 12 inches in diameter spaced 5 inches apart. Running between the plates on the periphery, i/£-inch steel rods are placed at li/o inch intervals, forming a cage like structure. Inside the cage is a piece of steel shafting 4 inches in diameter and 414 inches long which rolls freely by gravity to the bottom of the cage. This device packs the soil around the seed and leaves the surface in a very nice mulched condition.

Some type of toothed projection placed between the two halves of the standard concave presswheel running directly on the row has also given consistent improvement in germination. The projections should be made so they are self cleaning and should not extend more than .% of an inch beyond the rim of the wheel.

It is recognized that not all the possibilities for mechanical changes to improve germination have been investigated but, of those which have, some have shown consistent improvement. These and new ideas will be continued in future tests as time and facilities permit.

Table 1.—Combined results of part of the presswheel equipment tested at Colorado A & M College during the four years 1946 through 1949.

No. Tests	No. Replications	Description	% Emergence
52	147	Deep concave presswheels (check)	100
43	260	Furrow Forming wheels	128
9	54	"V" cross section rubber (single wheel)	128
15	90	Old flat rim presswheels	120
9	54	Pneumatic rubber (two wheels beside row)	117
12	72	Toothed projections between presswheels	115
10	52	Multiple wedge shaped presswheels	113
20	120	Pneumatic rubber (single wheel over row)	113
8	38	Deep concave set together	112
19	74	English presswheel	110
10	48	Sishc Presswheels	95