

Planting Equipment for Monogerm Seed¹

R. D. BARMINGTON²

Received for publication February 6, 1958

The possibility of having true monogerm sugar beet seed in the near future makes it very important for us to see where we stand on the problem of machinery for planting this seed. Designing a machine to accurately plant a seed before the seed is fully developed is a problem that plagues the implement manufacturer. The sugar beet industry has come to the point now where plant breeders can tell it what to expect from the new seed with respect to size, shape, and density. Any real changes in this pattern will take more years of diligent work by the plant breeders and, in the meantime, it will be necessary for farmers to plant the seed in its present state of development or developments made in the very near future.

The writer's sympathies are with the implement manufacturers and plant breeders in seeking a satisfactory solution to the problem, however, it is not felt that the situation is hopeless. Of chief concern is that both plant breeders and implement manufacturers may relax their efforts before a completely satisfactory solution is reached. In the beginning of the development of monogerm seed one plant breeder made the statement that monogerm seed could be made any size and shape wanted. While this is believed to be true, if taken over a long enough period of time, it is going to be necessary to work out some satisfactory compromises before the ultimate is reached.

To clarify some points it may be well to re-examine some of the requirements of planting equipment, whether it be for sugar beets or some other crop. First, the seed must be handled in such a way that it is not damaged to the extent that germination is affected. Second, the seed must be metered and conveyed to the bottom of the furrow in a uniformly distributed pattern. Third, the seed must be placed in the soil in such a way that all the factors affecting germination will be as favorable as possible. In this age of chemical agriculture more demands are made upon the beet planter from the standpoint of fitting into the over-all system. It is becoming increasingly important to plan for the application of chemical weed killers, fungicides, and fertilizers at the time of planting. These materials may be either in the dry or liquid form and may be applied either to the sur-

¹ Scientific Journal Series No. 544, Colorado Agricultural Experiment Station.

² Associate Research Engineer, Agricultural Engineering Section, Colorado Agricultural Experiment Station, Colorado State University, Fort Collins, Colorado.

³ Numbers in parentheses refer to literature cited.

face or below the surface of the soil. As the requirements placed upon the planting equipment increase so do the problems of the design engineer increase and the final machine becomes a series of compromises so that each part and requirement will fit in with all other parts and requirements.

Some of the requirements need to be examined more carefully. Real concern for the effect of mechanical seed damage upon germination of sugar beet seed has been expressed by plant breeders³. Limited laboratory germination tests conducted by the writer have shown that by running sugar beet seed through one sugar beet planter the germination was reduced 8 percent as determined by a blotter test and no measure was made of the seeds which germinated but did not develop normally. In 1944 Tolman and Stout (1)⁴ reported before this Society that 12 to 15 percent of the segmented seed tested developed abnormally due to mechanical injury in the segmenting process. Field observations of planter tests made during the last four years have shown plants following some machines to be more vigorous in early stages of growth. There are several design differences between the several machines, but it is also true that the healthier appearing plants followed machines which handle the seed with a very minimum of damage in the metering device. It may well be that abnormal germination due to mechanical seed damage is a factor in early plant development.

Probably the most important single requirement of a planter with respect to monogerm seed is the ability of the machine to accurately space the seed in the soil without multiple seed units or skips between the units occurring in the row. Nothing is gained from the use of monogerm seed from the standpoint of mechanical thinning if uniform distribution is not a reality. A search of domestic and foreign planters has failed to reveal any truly satisfactory machine for distributing monogerm sugar beet seed. However, some of the foreign built machines handle the seed with much less cracking and damage to the seed.

A rather extensive field testing program is being planned jointly by the Colorado Agricultural Experiment Station and The Great Western Sugar Company for domestic and foreign built planters and experimental machines using a monogerm seed exclusively. The tests will be made in farmers' fields in all types of soil in an effort to get an indication of what may be expected from monogerm seed compared with processed seed and the type of planters best suited for planting at this time.

³ Communication with Dr. H. E. Brewbaker, plant breeder, The Great Western Sugar Company.

Distribution usually begins with some kind of seed cells in either metal plates or rubber belts, and it would seem that at this point seed spacing should be accurate except for empty cells or multiple seeds in a single cell. After the seed leaves the seed cells, everything seems to go wrong from a distribution standpoint. Based on a system of evaluation (2) which gives a planter a score of 100 if all the seeds are placed in the bottom of the furrow in the theoretically calculated place, a score of zero if only half of the seeds are properly spaced and negative values if less than half are properly spaced, it appears that planters which discharge the seed from the hopper near the bottom of the furrow fill and distribution on a limited number of planters comparing polished monogerm seed with segmented multigerm seed. Small smooth tubes from the seed hopper to a point near the bottom of the furrow seem to be about the only improvement that has been made in several years to planters carrying the seed hopper 14 inches or more above the furrow. International and John Deere use the smooth tube design while low hopper discharge is used by Milton, Ventura, Taxigraine, and Stanhay.

In an attempt to improve seed distribution in a conventional plate type planter, a John Deere No. 70 unit was revised so the seed knocker was replaced by an air ejection device and a $\frac{1}{4}$ -inch copper seed tube was used to give the system an "air rifle" effect. Air pressure from 5 to 30 pounds per square inch were used but distribution, as shown in Table 1, was poorer than when the standard star wheel knocker and seed tube were used.

The seed used in the laboratory test was screened to sizes 8 to 10/64 for both segmented and monogerm. The monogerm seed was polished in a special machine, but the polishing process did not remove much of the outside corky material. Both lots of seed were obtained from The Great Western Sugar Company where it had been processed. The segmented seed was screened in the Colorado State University laboratory to the 8 to 10/64 inch size from seed which was originally sized 7 to 10/64 inch. The monogerm seed was screened to the 8 to 10/64 inch size before it was delivered to the University. Other monogerm seed has been obtained for experimental planter work from the American Crystal Sugar Company, but it all has a very strong tendency toward flatness and present equipment for polishing seems to preserve the flat characteristic.

Even though the two types of seed were screened to the same size range, there is a great deal of difference in physical characteristics. This lot of segmented seed contains 39,900 seed pieces per pound while the monogerm seed has 49,400 pieces per pound. The flatness of monogerm seed is the thing that is most notice-

Table 1.—Laboratory Planter Performance Test.

Planter	Seed	Average Percent Cell Fill	Average Percent Seed Damage	Average Distribution Score ³
John Deere No. 70 Plate Cells 11/64"	Segmented ¹	84.5	1.53	-11.
	Monogerm ²	113.3	4.59	-3.3
John Deere No. 70 Plate Cells 11/64" Air Ejection	Segmented	78.7	2.98	-17.6
	Monogerm	100.2	5.17	24.3
Milton Plate Cells 11-9½-9½	Segmented	85.8	3.83	10.
	Monogerm	113.5	5.27	-1.3
Stanhay Belt Cells 11/64"	Segmented	91.5	Nil	+22.3
	Monogerm	117.2	0.5	+19.3

¹ Commercial segmented seed screened 8-10/64". 39,900 seeds per pound.

² Polished monogerm seed screened 8-10/64". 49,400 seeds per pound.

³ With this system a planter may have a score of +100 for perfect distribution or -100 if none of the seeds were deposited in the proper position. Half the seeds properly spaced gives a score of zero.

able. The average thickness of the 8 to 10/64 inch monogerm seed as determined by a large number of measurements made with a micrometer was .082 inches. Measurements made on the same lot of polished monogerm seed in the 10 to 12/64 inch size range showed the thickness to be .087 inches, a difference of only .005 of an inch. The major diameter of the seed in these two size ranges increased an average of .031 of an inch for the larger seed. It appears from this that even the larger diameter monogerm seeds are only slightly thicker than the smaller seeds.

The corky material around the edge of the flat monogerm seed is relatively easy to break off to make the seed more nearly spherical, but present decorticating machines and polishing equipment seem to make the flat seed even flatter rather than orienting it so the softer material is broken off. Development of new processing machines to do this would be a material aid in more accurate metering of the seed. It is known that pelleted seed, which is round and dense, can be planted with a high degree of accuracy. If dependable field emergence could be obtained from using pelleted seed, this would probably be a satisfactory answer. Since the use of pelleted seed has not proven universally satisfactory in the field, the next best thing seems to be to make the seed as near spherical as possible and as large and dense as it can be made through developments in plant breeding.

The problems of getting field emergence are essentially the same for monogerm seed as they are for any other sugar beet seed. Some increase in the size of the seed kernel itself has been accomplished by plant breeders so more plant food is available to the young seedling in the early stages of growth. Accurate control of planting depth and proper presswheel action is essential for good emergence. Proper presswheel and soil manipulation seem to be different in different beet growing areas. In the Rocky Mountain region it is practically impossible to pack the soil around the seed too much. Reports from Michigan indicate that a minimum of seedbed preparation (3) and packing with presswheels is superior to the many operations and firm seedbeds desirable in the mountain states. Even though these differences need attention, they are no different for monogerm seed than they are for other beet seed in common use.

In general it can be concluded that the problems of planting monogerm seed are much the same as for any other type of sugar beet seed now in general use, but the flat nature of the seed makes it more difficult to handle. Present planting equipment and the present stage of seed development has not reached a point where we can realize the ultimate benefits from the use of this seed. Monogerm seed is new to us from the standpoint of planting for commercial use and like all new things presents many problems. There seems to be great hope for a bright future in mechanization through the use of monogerm seed and other new developments which are still in the dream stage.

References Cited

- (1) TOLMAN, BION and STOUT, MYRON. 1944. Segmented sugar beet seed with special reference to normal and abnormal germination. Proc. Am. Soc. of Sugar Beet Tech. III:25-33.
 - (2) BARMINGTON, R. D. 1956. Metering devices and test results of some foreign and domestic sugar beet planters. Jour. Am. Soc. Sugar Beet Tech. IX (1):41-50.
 - (3) FRAKES, M. G. 1954. Minimum seed bed preparation. Proc. Am. Soc. Sugar Beet Tech. VIII (1):281-284.
-