Section E. Sugar beet machinery - Chairman: H. B. Walker

DEVELOPMENT AND PERFORMANCE OF SINGLE SEED SUGAR BEET PLANTERS

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Two years ago at the Salt Lake meeting a preliminary report was given on single seed planting of sugar beets. Data were presented which showed the advantage of single seed planting in securing more uniform germination stands and stands which contained increased numbers of single seedlings. The desirability of such plantings for mechanized blocking and thinning as well as for hand thinning was pointed out. A single row planter unit which had been developed for single seed planting was described and data were given showing the effectiveness of its work. The construction of a multiple row planter using similar single seed units was reported.

Since that time there has been considerable experimental work done on this type of beet planting. Several different single seed planters have been developed. Two years' experimental results in the field have been obtained with part of these machines. Significant improvement in uniformity of germination stands and increased numbers of single seedlings has been obtained. It has been learned that new type planters with more or less elaborate mechanisms for dropping single seeds are not necessary, but that regular planters with proper special equipment will do satisfactory work. A laboratory method for testing planters has been developed which considerably speeds up comparisons of uniformity of seed distribution of the machines. The development has progressed to the stage where commercial equipment for single seed planting can be obtained for this year's planting season.

Several requirements or desirable features of a single seed planting machine were considered when the development was begun. The first was the selection or pick-up of single seed balls at regular intervals and, if possible, from sack-run or ungraded seed. Second, the uniformity of seed spacing should be maintained as nearly as possible until the seed balls were deposited in the bottom of the opened furrow. Third, the mechanism should be adapted to a disk type furrow opener because previous tests had shown this type of opener to be superior to the runner type in obtaining increased seedling germination. Furthermore, it was felt that a mechanism which could be used with the disk opener could probably also be used with the runner type while the reverse condition would not always be true. It was also desired that planting be done at normal speeds of at least two miles per hour. It has been learned since that all of these qualifications are not necessary.

The multiple row, chain feed planter, which was being built at the time of the meeting two years ago, was designed to fulfill the above requirements as nearly as possible. It uses an endless chain of seed cups which pick up single seeds in the cups as they pass upward through the hopper. The cups emerge from the surface of the seed, thus allowing extra seed balls to fall back into the hopper, and enter a tube which holds the balls between the cups. The chain passes over a sprocket and down through the tube to the bottom of the opened furrow where the seed balls are deposited equally spaced.

The planter with its feed chains of seed cups, the special chain housings with their four sprockets and rollers each, and the separate drives for each unit is a rather elaborate machine which would be expensive to build commercially, but which has been particularly satisfactory as an experimental machine because seed spacings could be obtained with it which were comparable with hand spacing. It was built as a four or a six-row machine so that it could be used with commercial plantings of either kind. It has been used for experimental field plantings the past two years.

Mervine's single seed planter uses a vertical disk with a series of cups around its periphery to pick up single seed balls. The disk of cups is attached to the inner face of one of the furrow opener disks which is positively driven. The cups pick up seeds from a small, secondary hopper in the disk opener casting, carry them around through a channel in the casting and drop them into the bottom of the opened furrow. Either graded or sack-run seed can be used. A four-row planter using these units was built and used for experimental planting in 1938. Two additional planters using these units were built for further experimental plantings this past year.

The John Deere Plow Company became interested in this type of planting and built several four-row units of an experimental single seed planter in time for field test in 1938, both in California and in the later-planting districts. This planter is of the horizontal plate type using special, single seed plates with special seed cut-offs and notched seed knocker wheels. The seed cells are notched into the edge of the plate and are sized to take smaller sized, graded seed. The seed hoppers are mounted directly on runner openers so that the distance of seed drop is decreased to seven inches.

The seed hoppers from this low-hoppered, experimental planter could be used on an old style, regular, runner opener planter which gave a 24-inch seed drop. As the plate could be run at the same speed relative to the forward travel of the planter, this gave a very satisfactory comparison of two heights of seed drop with exactly the same plate equipment.

Tests in 1938 showed no significant differences between germination stands obtained with the single seed plate hoppers when used on the two planters with the 7-inch and the 24-inch seed drop. It was therefore suggested to the manufacturer that the special, single seed plates with their seed cut-offs and knockers be made available for the current, commercial plate planters.

These special single seed plates for small sized, graded seed were supplied for this past season's test work. In addition plates were machined from blanks which would accommodate the larger sized, graded seed or could also be used with sack-run seed. These single seed plates with the necessary false plates, seed knockers, etc., will be available for this season's planting.

Another type of single seed planter was developed by C. J. Cobbley of the Utah-Idaho Sugar Company in 1938. Several four-row units have been built and tested both in 1938 and 1939. This planter utilizes a vertical seed wheel with a double row of seed cells around the edges of the rim. This seed wheel is mounted in the bottom of a seed hopper and on a runner type furrow opener to minimize the distance of seed drop. Seed balls are accumulated in the cells as the wheel turns through the bottom of the seed hopper. The seed are held in the cells by guides until they reach their lowest point when the cells are uncovered and the balls drop into the bottom of the opened furrow.

Small knocker rollers running in grooves on the inside of the rim dislodge the seed balls from the cells.

The Case Company has also developed single seed plates for its regular, tractor-mounted beet planter. This planter uses an inclined plate with pick-up cup seed plates. These plates will also be available for this year's planting season.

The Ventura Manufacturing and Implement Company and the Strong Hamilton Implement Works, both of Ventura, California, are also developing or have developed machines for single seed planting. Both are of the type using vertical seed wheels with pick-up seed cups. Tests have not been run with these units. Other manufacturers of beet planters are also giving attention to single seed planters.

Field germination stand counts have been used for comparing single seed and conventional planters. The method used is based on the assumption that with a given number of seedlings per hundred inches, the planter which spreads those seedlings into the greatest number of inches of row, or in other words, has the smallest number of seedlings in each beet-containing inch, is the one doing the most satisfactory planting. In other words, the planter doing the best work is the one which secures the highest per cent stand for a particular seedling stand. The number of single seedlings obtained is also used as a means of comparison. Direct comparisons between planters can only be made with the same seedling stands or seeding rates and for practical comparisons of planters curves with per cent stands and numbers of singles plotted against seedling stands must be used.

The method of comparing planters just described takes three to four weeks after planting, often longer, depending on germination and growing conditions following planting. In addition it introduces the variable of germination which is important and necessitates a number of separate counts to get a reasonably good average.

A year ago a laboratory means of testing beet planters and making comparisons of the uniformity of their seed drop was developed. It consists of pulling the planter being tested along a slightly raised runway at planting speed and with the openers down in position and catching the seed dropped on boards covered with a thin coating of light weight cup grease. The boards are set so that they are just cleared by the furrow openers, and the distance of seed drop is therefore only slightly more than it would be in field planting. The seed balls are caught and held at the exact point where they strike. Such a surface is not comparable with the narrow bottom of the opened furrow into which the seeds are dropped in the field, but it overcomes all bounce or roll of the seed and provides a means of comparison of uniformity of seed drop.

A flexible steel tape is laid down on the board alongside the row of seed dropped in each test and the longitudinal position of each seed is recorded. A run and a check run, each 200 inches, were made for each test set-up. From an original set of data sheets the frequencies of seed spacing were tabulated and a curve made up showing the percentage frequency of each seed interval observed in the tests. Such curves, with the mean seed spacing also shown, gave a graphic comparison of the seed drop of the planter. The percentage of the frequencies within a plus and minus band about the mean was used as a numerical value of comparison of the work of the planters. For our work we used the interval of plus and minus one-fourth inch from the mean. Direct compari-

sons can only be made between tests with practically the same mean seed spacing as the percentage of frequencies within the band about the mean increases for a planter as the seeding rate increases.

The averages of the data taken in a series of laboratory tests such as described above gave the following results.

The seed drop of the chain-feed single seed planter was significantly more uniform than that of the other single seed or conventional planters as a group or than any of the planters as individuals. The single seed planters as a group were significantly better than the conventional planters. There were no significant differences between the single seed planters other than the chain-feed planter nor between the conventional planters though larger numbers of test runs might show differences which were significant. On plate planters there was a tendency toward more uniform seed distribution with the single seed plates as the distance of drop decreased, but not enough for significance or near significance.

Field tests with the single seed and conventional planters show substantially the same results though the differences between the chain feed and the other single seed planters are not so marked. Seed balls undoubtedly bounce or roll around somewhat as they drop into the bottom of the opened furrow so that very uniformly spaced seed dropping into the bottom of a furrow would probably lose some of the uniformity of spacing. Furthermore, seedlings do not grow vertically from the seed balls, but rather follow paths of least resistance so that seedlings from very carefully spaced seed balls do not have the uniformity of spacing of the balls. Probably for these reasons the significant differences between the chain-feed and other single seed planters as shown by the greased board laboratory tests are less consistent and become less significant in field comparisons. We are, therefore, probably not justified in developing elaborate planting mechanisms for obtaining single seed planting.

The single seed planters as a group show significant improvement over conventional planters in uniformity of field stands and increased numbers of single seedlings. They produce the same percentage stands with slightly over 90 per cent of the amount of seed required for conventional planters, or they produce from four to five per cent greater percentage stands at the same seeding rates over the usual range of seeding rates. They also produce 20 per cent to 30 per cent more singles than conventional planters. Seeding rates of from 5 to 15 pounds per acre have been used for the tests.

The differences between most of the single seed planters are not great. The chain feed pick-up cup planter, though doing somewhat better work is more complicated, and the additional cost of its manufacture perhaps is not justified. The work of the experimental single seed planters with pick-up cup disks or wheels, as compared with horizontal plates or with vertical wheels showed no significant differences. Furthermore, a standard plate planter equipped with special single-seed plates, seed cut-off and knocker and with its normal 34-inch seed drop did practically as well as the same type of equipment in the single seed planter with its low hoppers. This means that new type planters are probably not needed for satisfactory single seed planting and that conventional plate planters equipped with the proper special equipment will be satisfactory for commercial single seed planting.