Comparison of Sugarbeet Planters and Planting Depth with Two Sugarbeet Varieties

K. James Fornstrom and Stephen D. Miller[1]
University Station, Box 3295, Laramie, WY 82071

ABSTRACT

The objective of this study was to compare emergence of two varieties of sugarbeets planted with four planters operated at two planting depths. The study was conducted in 1987 and 1988 at Torrington, WY. Sugarbeets planted with a John Deere Maxemerge planter or with a Milton planter with depth bands had 10 percent higher emergence than those planted with a John Deere 71 planter or a Milton planter with depth wheels. Plant spacing uniformity was poorest with the John Deere Maxemerge. Sugarbeets planted at the shallower depth (¾ inch) had 8 percent higher emergence when compared to those planted at the greater depth (1¼ inch) in 1988, but depth had no influence on emergence in 1987. Variety 'Monohikari' had 9 percent better emergence than 'Holly Hybrid 30' for the two years of the study. However, no sugarbeet yield differences were found according to planter type or seeding depth.

Additional Key Words: Plant spacing, emergence, *Beta vulgaris*

Yields of sugarbeets (*Beta vulgaris L.*) planted to stand are comparable with yields of sugarbeets planted in excess and then thinned, if the initial plant populations are in the range of 25-40,000 plants/A (Fornstrom, 1980). Planting sugarbeets to stand has been successful in 30-inch rows as well as 22-inch rows

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if plant populations are maintained (Cattanach and Schroeder, 1980; Fornstrom and Jackson, 1983; Winter and Wiese, 1977). Thus, a uniform, predictable and preferably high emergence (ratio of emerged plants to seeds planted) is required. Emergence often varies considerably within a field, from field to field, and from year to year. The objective of this study was to compare emergence of two varieties of sugarbeets planted with four planters operated at two planting depths.

Average plant spacing ($\overline{X}$) is related to the seed spacing (S) and emergence (E) by (Becker, 1969):

$$\overline{X} = S/E.$$

Thus, a lower emergence can be overcome by changing the seed spacing. However, variation in plant spacing due to low emergence cannot be overcome by changing the seed spacing. Large plant spacing variations result in excessive plant competition when the plants are too close and open areas when plant spacings are too large. If seed spacings are uniform then plant spacings have a standard deviation (σ) given by (Fornstrom et al., 1972):

$$\sigma = \overline{X}\,(1 - E)^{1/2},$$

which indicates that variation in plant spacing increases as emergence rate decreases.

Emergence is influenced by many factors including environmental conditions, seed characteristics, and pesticide applications. Temperature, moisture, physical impedance, and aeration are recognized as the basic soil environmental factors influencing germination and seedling emergence (Bowen, 1966). Models have been developed to predict final emergence and emergence rate of sugarbeets based on moisture and temperature conditions (Cattanach et al., 1979; Yonts et al., 1983). Moisture can be managed through irrigation and physical impedance can be changed by planting depth. Planting depths greater than about one inch appear to reduce the emergence of sugarbeets (Cattanach et al., 1979; Fornstrom and Miller, 1987). One of the largest causes of variation in emergence of sugarbeets appears to be the variety, or even seed lots of the same variety, where ranges of 20-30 percent have been noted (Steen, 1987). Some reduction in emergence also can be expected when herbicides are applied (Schweizer, 1979).

The functions of a planter include metering the seed, opening a seed furrow, delivery of the seed to the furrow, and covering the seed with soil and firming the soil around the seed. Planter performance has been studied for many years (Bainer, 1947) and new planters have been developed. Accurate seed metering is obtained using cell-type planters if the seed is properly sized to the cell (Bainer, 1947; Giles and Cattanach, 1988). Non-uniformity of seed spacing generally is related to the method of seed delivery to the furrow (Fornstrom and Miller, 1987) and to planting speed. Greater emergence has been noted with improved furrow opening and covering designs (Barmington, 1968; Jafari and Fornstrom, 1972). In addition to the variation in plant spacing due to emergence, there are variations in seed spacing introduced by the planter. For many planters, the drop error follows a Gaussian probability function (Rohrbach, 1971). The drop error can be observed by comparing the distributions of plant spacings. If there is no drop error, all plant spacings are at a multiple of the seed spacing. As drop error increases, the plant spacings tend to form a more continuous distribution. Thus a secondary objective of this study was to compare plant spacing distribution of the planters.

MATERIALS AND METHODS

The study was conducted at the Torrington, WY Research and Extension Center in 1987 and 1988. Plots were planted in a 30-inch row spacing and tilled conventionally. Four replications were arranged in a split, split block design to compare: John Deere Maxemerge, John Deere 71, Milton with depth bands, and Milton with depth wheel planters; seeding depths of approximately ¾ inches and 1¼ inches; and 'Monohikari' and 'Holly Hybrid 30' sugarbeet varieties. "Bare," large size seed was used for each variety.

The John Deere Maxemerge planter was equipped with a horizontal, plate type metering system with auxiliary aluminum drop tube inserts. In the 1987 study there was excessive lateral variation in seed placement with the Maxemerge planter. Acraplant runners between the opening disks were attached to the planter for the 1988 studies; this corrected the lateral variation problem. The John Deere Model 71 flex planters were equipped with beet runners, depth bands which leave 1 or 1½ inches of the opening disk exposed and 7-inch wide zero pressure press wheels. The Milton planters with depth bands also were equipped with 1-inch and 1½-inch depth bands and 7-inch wide zero pressure press wheels. The Milton planters with depth control wheels had a depth control frame with a 4-inch wide zero pressure wheel in front of the furrow opening disks and two narrow Milton press wheels following the furrow opening disks. Depths of the Maxemerge and Milton-wheel planters were set to approximate the depths obtained with the depth-band planters. The 1-inch depth bands produced a seed depth of about ¾ inches and the 1½ inch depth bands produced a seed depth of about 1¼ inches.

Seed spacings were obtained through a combination of field and laboratory calibration for both varieties. Counters were mounted on the plate drive wheels to obtain the distance per revolution of the drive wheel while planting the plots. Laboratory calibrations to obtain the seeds per wheel revolution with each planter also were conducted. The seed spacings could then be obtained. There were slight variations between planters (±4,000 seeds/A) with an average seeding rate of 64,000 seeds/A. Emergence was calculated using the seed spacing obtained for each specific planter.

An early preplant application of metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide] (3 lb ai/A) was broadcast applied ten days before the 1988 plots were planted. After the sugarbeets were planted, ethofumesate [(±)-2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate] (1.5 lb ai/A) plus diethatyl [N-(chloro-acetyl-N-(2,6-diethylphenyl) glycine] (2 lb ai/A) was broadcast applied. The herbicide was not machine incorporated. The plots were sprinkler irrigated immediately after planting.

In 1988, initial stands were very poor, probably due to freezing temperatures during emergence. After stand counts were obtained, the plots were tilled with a Lely vertical tine tiller and reseeded on May 24. No additional herbicides were applied.

Evaluation included initial stand counts (17.4 ft of row) and harvest sampling (10 ft of row). Plant spacings of 100 plants for one treatment for each planter (shallow, Monohikari) were measured (to the closest 0.4 inch) at the time of initial stand counts. Sugarbeets less than approximately two inches in diameter were considered non-machine harvestable.

RESULTS AND DISCUSSION

Emergence rates, plant populations, and yields of two varieties of sugarbeets planted with four planters at two planting depths are shown in Table 1. The 1988 stands and yields are for the reseeded beets. There were significant differences in emergence, plant populations, and percent sugar between years but trends for each year were similar and so the yearly data were combined for planter, depth, and variety comparisons. Emergence and initial plant populations were highest for the John Deere Maxemerge and Milton-depth band planters. However, the initial population differences did not translate into differences in harvest population or sugarbeet yield. Harvest populations are lower than initial populations due to losses incurred when hoeing for weed control and due to small, nonharvestable beets. These two influences smooth out differences obtained for initial populations. Average emergence and initial plant populations were higher for the ¾-inch planting depth than for the 1¼-inch planting depth. However, there was a significant interaction between year and planting depth because there was no significant difference in emergence as a function of planting depth in 1987. A study at Powell, WY in 1986 (Fornstrom and Miller, 1987) indicated about a four percent emergence difference between the ¾ and 1¼ inch seeding depth. Perhaps the planting depths chosen were not extreme enough to show large differences. Other studies (Cattanach et al., 1979; Fornstrom and Miller, 1987) have shown larger emergence differences when planting depths to 2¼ inches were employed.

Table 1. Emergence, plant populations, and yields of two varieties of sugarbeets planted with four planters at two planting depths, Torrington, WY Research and Extension Center 1987-88.

Item of Comparison	Emerg.	Population		Yield	
		Initial	Harvest	Root	Sugar
	%	1000 pl/A		Tons/A	%
Year					
1987	65.0	42.3	32.7	25.1	15.4
1988	72.6	46.5	27.4	24.1	16.5
LSD (0.05)	2.9	1.9	2.4	NS	0.4
Planter					
John Deere Maxemerge	72.7	45.0	30.4	24.2	15.7
John Deere 71	63.4	41.5	30.3	25.4	15.8
Milton-depth band	74.8	49.3	31.3	24.5	16.1
Milton-wheels	64.4	41.8	28.3	24.3	16.1
LSD (0.05)	4.2	2.7	NS	NS	NS
Depth					
¾-inch	71.0	45.4	30.2	24.2	15.9
1¼-inch	66.6	43.4	29.9	25.0	16.0
LSD (0.05)	2.9	1.9	NS	NS	NS
Variety					
Monohikari	73.5	47.5	31.9	24.2	16.7
Holly Hybrid 30	64.1	41.3	28.2	25.0	15.1
LSD (0.05)	2.9	1.9	2.4	NS	0.4
Average	68.8	44.4	30.1	24.6	15.9

There were consistent differences in emergence and plant populations as a function of sugarbeet variety. 'Monohikari' had higher emergence and populations than did 'Holly Hybrid 30.' However, there were no interactions with planter or depth parameters indicating no variety trends as a function of method of seed placement.

Frequencies of plant spacings in 2-inch intervals for each planter and year are shown in Figure 1. Sugarbeets spaced in the 0-2 inch and greater than 12-inch ranges were higher for the John Deere planters than for the Milton planter. This indicates a higher seed drop error for the John Deere planters. This result probably was expected because the John Deere planters use seed tubes and thus have a longer length of drop, whereas the Milton planters drop the seed directly from the plate to the furrow. However it does not appear that this variation in spacing is extremely important since there were no significant yield differences as a function of planter used. This observation tends to agree with other results. Field observations indicate that there is usually a dominant beet with two closely spaced beets. Although there may be a large number of the non-harvestable small beets, they weigh very little. Yield curves (Becker, 1969; Cattanach and Schroeder, 1980; Fornstrom, 1980; Fornstrom and Jackson, 1983; Henry and Van Doren, 1976; Winter and Wiese, 1977) indicate that low populations are much more damaging to sugarbeet yield than high populations. Further, studies designed to show the effect of uniformity of stand (Henry and Van Doren, 1976) or the effect of doubles (Smith, 1980) indicate that the effect of plant population overshadows the effect of nonuniformity of stand.

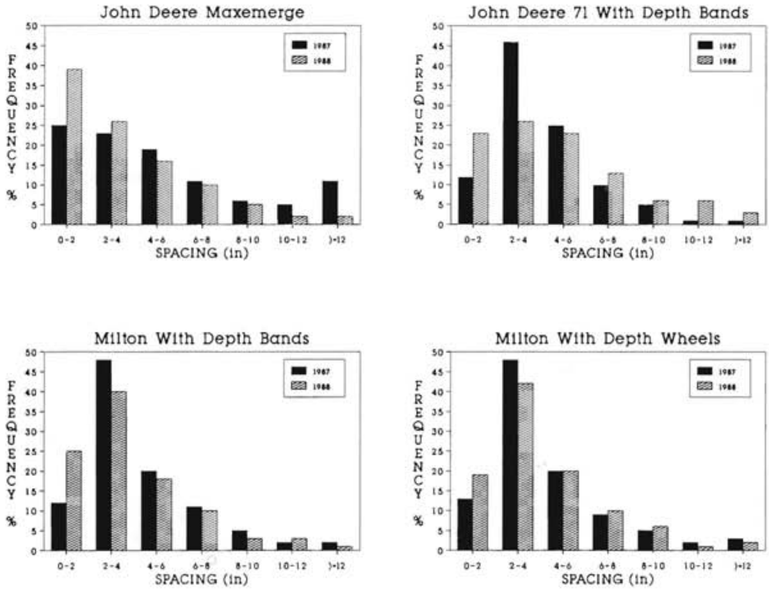

Figure 1. Frequencies of plant spacings produced by four planters in two years.

In conclusion, the results of this study indicated that there were differences in emergence and plant spacing distributions as a function of planter used, but these differences did not influence the yields obtained. This study and others indicated about 4-6 percent higher emergence when using a ¾-inch seeding depth as compared to a 1¼-inch seeding depth under these conditions, but the results were not always consistent. There were differences in emergence according to variety, but no variety interactions with planters or depth.

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