Effect of Seed Type, Planter Type and Depth of Planting on Sugarbeet Emergence[1]

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ABSTRACT

Field studies were used to evaluate the effects of three seed types (bare, coated and pelleted), two planter types (Stanhay-Webb Rallye 590 and John Deere 71 Flexi-planter) and four planting depths (1.25, 2.5, 3.75 and 5.0 cm) on the emergence of sugarbeet. Field plots were planted at four different times during April and May of 1989, 1990 and 1991 to simulate seed germination and emergence conditions. When all sites were combined, no significant difference in emergence was found among the three types of seed tested. The John Deere 71 Flexi-planter provided better emergence than the Rallye 590 planter except at the 1.25 cm depth where emergence was the same. Sugarbeet seed planted at 1.25 and 2.5 cm planting depths had greater final emergence for both planter types tested as compared to the 3.75 and 5.0 cm planting depths.

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Obtaining adequate sugarbeet (*Beta vulgaris L.*) plant populations under field conditions can vary widely due to climatic limitations. Plant emergence is influenced most by soil temperature, moisture and aeration plus physical impedance from the soil (Bowen, 1966). Yonts et al., 1983 determined that soil temperature influenced the rate of sugarbeet emergence but not the final number of plants emerged. Soil moisture and aeration, unlike soil temperature, can be managed with proper planting techniques and irrigation. Physical impedance relates to the distance seedlings move through the soil to emerge and the structure of the soil that the seedling has to move through.

Maintaining plant population of sugarbeet between 40,000 and 100,000 plants/ha can provide maximum sugar yield (Yonts and Smith, 1997). In a similar study on population, Fornstrom (1980) determined when initial plant population was in the range of 62,500 to 100,000 plants/ha, the yield of sugarbeet planted to stand was comparable with the yield of sugarbeet thinned to stand. Sugarbeet emergence was found to be higher for sugarbeet planted at a 1.9 cm depth compared to those planted at a 3.2 cm depth (Fornstrom and Miller, 1989)

Though soil environmental factors play a key role in seedling emergence, other factors can significantly impact emergence. When soil crusting was a concern, vermiculite and coke placed over the sugarbeet seed enhanced sugarbeet emergence compared to covering the seed with soil (Ririe and Hills, 1970). In another study, planter type influenced sugarbeet emergence by as much as 10%, however the difference in emergence did not result in increased yield (Fornstrom and Miller, 1989). When sugarbeet seed was planted into moist soil compared to a post-plant irrigation treatment, emergence increased (Wang et al., 1995). In the same study, sugarbeet emergence was improved with the use of a fungicide seed treatment. Planting depth may also affect the possibility of herbicide injury on sugarbeet (Wilson et al., 1990).

Planting sugarbeet to stand is an acceptable practice, but due to changes in soil conditions during emergence, the desired planting depth may vary from season to season. In dry years, producers may try to plant seed deeper to place the seed in or near moist soil to ensure emergence. In wet years or when crusting may be a problem, the desire is to plant shallow to reduce the distance the seedling must move through the soil. This allows the sugarbeet seedling to emerge as quickly as possible.

The objective of this study was to determine the influence of seed type and planting depth on the emergence of sugarbeet. A secondary objective was to determine sugarbeet emergence after use of a shoe type planter or a disc opener type planter over a range of planting depths.

MATERIAL AND METHODS

The study was conducted at the University of Nebraska, Panhandle Research and Extension Center near Scottsbluff, NE on a Tripp very fine sandy loam soil (Typic Haplustolls). Field plots were planted over a three year period beginning in 1989, using the variety Monohikari. A three-factor factorial design with six replicates within each site was used with, planter type, seed type and planting depth as factors. Each site consisted of the combination of two planter types, three seed types, and four planting depths.

It was felt that different soil conditions would allow the drive wheels on the planters to turn at a different speed even though ground speed was constant. Therefore, the drive wheels on the planters were equipped with counters to determine the number of revolutions of the drive wheels during planting. The number of seeds dropped per revolution of the drive wheels were determined in the lab. The number of revolutions were counted in each plot planted to determine the seeding population. The planter units were set to achieve a 5 cm in row seed spacing.

Plots were 4.6 m in length and two 56 cm rows wide. Planters were calibrated to determine the number of seeds planted within a 3 m distance of each plot for each planter and seed type. Percent emergence was calculated on the basis of seeds planted and plants emerged within 3 m. Emergence counts were taken when plants started to emerge and continued at two to four day intervals until plant numbers no longer increased. The study was concluded when final emergence was reached and was not taken to final yield.

The two planters used were the Stanhay Webb Rallye 590 planter and the John Deere 71 Flexi-planter. The Rallye 590 planter uses a ceramic shoe type opener followed by a pair of flat covering disks. The seed press wheel is 15 cm in diameter and 1.5 cm wide. The John Deere 71 planter used a disk type opening system. Seed is covered by soil falling back into the disk opening after the seed is dropped. The seed press wheel on the John Deere 71 unit was 10 cm wide and 30 cm in diameter. To gauge seeding depth, depth bands were used on the John Deere 71 planter. The Rallye 590 provided a more accurate seeding depth and was adjusted by raising or lowering the entire planter shoe in relation to the soil surface.

Seed coating types used in this study were bare, coated, and pelleted. Each type used base seed from the same seed lot. This base seed was classified as medium size, described within the industry as 0.32 to 0.36 cm. The fungicide Maneb, which is commercially used to prepare sugarbeet seed, was used at the same rate to treat each seed type. Bare seed used the base seed with only a slurry applied fungicide. Coated seed used the base

seed with 17%, by weight, buildup of organic material commercially used for this seed coating type, plus the fungicide material applied with the organic material. The pelleted seed used the base seed plus the commercial pelleting formulation used for sugarbeet. The pellet size was 0.38 to 0.46 cm diameter and considered a regular pellet size. The pelleting material included the fungicide treatment used with bare and coated seed types. All three seed coating types were prepared by Seed Systems, using the current commercial coating process.

Planters were set to place the sugarbeet seed at depths of 1.25, 2.5, 3.75 and 5.0 cm. Planter depth settings were determined in the field in a test area adjacent to the plots. Planter settings were determined just prior to planting each depth treatment to account for any changes due to soil condition. Planting depth was determined by uncovering the seed and measuring the distance from the soil surface to the seed at several locations. The soil was prepared the same in the test area as in the plot area.

To obtain different climatic and soil conditions for germination and emergence, planting was conducted at different times during the spring. A total of twelve sites were planted during 1989 to1991. Irrigation was used on some sites as a method to supplement soil water when rainfall was lacking and create different emergence conditions. Two sites were irrigated in 1989, one site in 1990 and all sites in 1991. Two April planting sites were destroyed in 1990 due to a spring freeze, thus reducing total sites reported in this study to ten. Table 1 gives the planting date for each of the sites tested.

RESULTS

An analysis of variance was conducted using a three-factor randomized complete block design combined over site-years. The results of the study are given in Table 1. No significant difference was found among the three seed types tested when combined over factors of planting depth and planter type. A significant difference was found between planter type and among planting depths, however a significant interaction was found between planter type and planting depth.

Planting Depth

Sugarbeet emergence for the two planters and four planting depths are given in Table 2. For the Rallye 590, as planting depth increased sugarbeet emergence decreased for each increment in planting depth.

Table 1. Effect of depth of planting, planter type and seed type on sugarbeet emergence at Scottsbluff, NE for all sites and years.

Factor	Sugarbeet Final Emergence %
Depth of Planting	
1.25 cm	53.5
2.5 cm	51.4
3.75 cm	44.7
5.0 cm	32.8
LSD at 5%	1.7
Planter Type	
Stanhay Webb Rallye 590	43.1
John Deere 71 Flexi-planter	48.1
LSD at 5%	1.2
Seed Type	
Bare	44.9
Coated	46.6
Pelleted	45.3
LSD at 5%	N.S.
Site	
Planted 4/22/89 - Irrigated	57.4
Planted 4/24/89 - Not Irrigated	34.2
Planted 5/9/89 - Irrigated	21.8
Planted 5/11/89 - Not Irrigated	32.3
Planted 5/1/90 - Not Irrigated	54.3
Planted 5/15/90 - Irrigated	55.7
Planted 4/3/91 - Irrigated	46.4
Planted 4/17/91 - Irrigated	53.5
Planted 4/29/91 - Irrigated	58.1
Planted 5/10/91 - Irrigated	42.4
LSD at 5%	2.7
Mean	45.6

Table 2. Sugarbeet emergence for John Deere 71 Flexi-planter and Stanhay Webb Rallye 590 planters at 1.25, 2.5, 3.75 and 5.0 cm depths averaged over ten sites.

	Stanhay Webb Rallye 590	John Deere 71 Flexi-planter
Depth of Planting (cm)	Sugarbeet Emergence (%)	
1.25	53.4 a	53.7 a
2.5	49.0 b	53.8 a
3.75	41.7 c	47.7 b
5.0	28.5 d	37.1 c
LSD	2.3	2.5

Greatest emergence occurred at the 1.25 cm planting depth, 53.4% to a low of 28.5% at the 5.0 cm planting depth. For the John Deere 71 planter, sugarbeet emergence was greatest and similar at the 1.25 and 2.5 cm planting depths. As planting depth increased to 3.75 and 5.0 cm, sugarbeet emergence decreased by 6.1 and 16.7%, respectively.

Planter type

In Table 2, sugarbeet emergence averaged 53.6% among the 1.25 cm planting depth of the Rallye 590 and the 1.25 and 2.5 cm planting depths of the John Deere Flexi-planter. Sugarbeet emergence was similar for the Rallye 590 at the 2.5 cm planting depth and the John Deere 71 planter at the 3.75 cm planting depth. This same trend continued with sugarbeet emergence similar for the 3.75 planting depth of the Rallye 590 and the 5.0 cm planting depth of the John Deere 71 planter. For the two planters, the Rallye 590 at the 5.0 cm planting depth resulted in the least sugarbeet emergence for both planters and for all planting depths.

Seed Type

In Table 1, percent emergence varied less than 2.0% among the bare, coated and pelleted sugarbeet seed types and the differences were not significant when combined over the other factors tested. The overall mean sugarbeet emergence for all three seed types combined over planting depth and planter type was 45.6%.

Site

In the analysis, two-way interactions were found between seed type and site and between planting depth and site. Variation among the ten sites was by design and therefore expected in order to determine the effects of planting depth, seed type and planter type on sugarbeet plant emergence under different field and climatic conditions. Statistical difference was found for the ten different sites over the three-year period. Sugarbeet plant emergence ranged from 21.8% for the May 9, 1989 site to 58.1% for the April 29, 1991 site. The overall mean sugarbeet plant emergence for all sites was 45.6%.

In Table 3, average sugarbeet emergence is given for sugarbeet planted before April 30, sugarbeet planted after April 30, sugarbeet irrigated after planting and sugarbeet not irrigated after planting. The irrigated sites and those sites planted before April 30 tended to have higher sugarbeet emergence in comparison to the sites that were not irrigated or sites planted after April 30. No statistical analysis was completed due to incomplete data sets, but the trend in all cases were similar to the overall sugarbeet emergence given in Table 1 for the four planting depths tested.

Table 3. Sugarbeet emergence for early planted, before April 30, late planted, after April 30, irrigated after planting and not irrigated after planting treatments at the 1.25, 2.5, 3.75 and 5.0 cm planting depths at Scottsbluff, NE for all sites and years.

	Sugarbeet Final Emergence %			
Depth of Planting (cm)	Early Planted	Late Planted	Irrigated	Not Irrigated
1.25	56.9	50.2	55.9	48.0
2.5	56.6	46.1	53.9	45.5
3.75	48.9	40.5	47.2	38.8
5.0	37.3	28.3	34.5	28.8

DISCUSSION

When planting at the 1.25 cm depth, the John Deere 71 planter did not maintain as uniform depth as did the Rallye 590 planter. The John Deere 71 planter uses a double disk opener mechanism whereas the Rallye

590 planter uses a shoe opener. Through observation, the difference in opener types had an influence on "effective" planting depth. Sugarbeet seed was observed on or near the soil surface when the John Deere 71 planter was used. To plant the 1.25 cm depth treatment, it was necessary that some seed be very near or on the soil surface to maintain the average planting depth desired.

As can be seen in Table 2, the percent emergence is nearly the same with the 1.25 and 2.5cm planting depths for the John Deere 71planter. At 3.75 and 5.0 cm, emergence continued to decrease for the John Deere 71 planter. For the Rallye 590 planter sugarbeet emergence continued to decrease as expected as the planting depth increased. Since sugarbeet seed was observed on or near the soil surface at the time of planting the 1.25 cm depth treatment with the John Deere 71planter, and not observed with the Rallye 590 planter, it is likely that planting depth accuracy was less for this study when using the John Deere 71 planter. This resulted in a shallower planting depth for the John Deere 71 planter. Based on this analysis, a greater number of seeds would be placed at less than each of the desired planting depth treatments. Planting seed between the soil surface and a 1.25 cm depth would result in some seed desiccation before germination could occur and thus would reduce final emergence. At the 2.5 to 5.0 cm planting depths, placing some seed at less than the desired planting depth could result in higher overall emergence for the John Deere 71 planter because seed would have less distance to emerge through the soil.

Due to the observed variability in planting depth accuracy between the two planters, the depth of planting treatments in this study should be viewed as targeted planting depths. Comparison of final emergence between the two planters is difficult since planting accuracy and effective planting depth varied. However, other than the 1.25 cm planting depth, the two planters exhibit the same emergence trend.

These data suggests that planting depth is important to achieving good sugarbeet plant emergence. The 1.25 and 2.5 cm planting depths provided greater emergence for both the John Deere 71 planter and Rallye 590 planter, than did the 3.75 and 5.0 cm planting depths for the same planters. These results compare favorably with the results found by Fornstrom and Miller(1989).

In this study, overall sugarbeet plant emergence(45.6%) was lower than what would be desired under normal field conditions(60 to 70%). However, this study attempted to simulate a variety of sugarbeet seed germination and emergence conditions, similar to the range of sugarbeet emergence conditions that would be expected for sugarbeet production over a period of years. The overall results of this study indicate that the selection of sugarbeet seed should not be based on whether seed has been coated or

pelleted, but rather on the ability of a given planter to correctly space and plant sugarbeet seed at a depth of between 1.25 and 2.5 cm.

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