SUGAR BEET

PLANT DISTRIBUTION AND MACHINE HARVESTING NAS 507 ML 76

In this experiment four separate seed spacings drilled to a stand were compared with equivalent plant populations obtained by hand singling. The efficiency of machine harvesting was compared over this range of plant populations and from the regular and irregular plant distributions obtained from hand singling and drilling to a stand respectively.

The treatments were:-

Irregular Distribution

1. Drilled to a stand at 15.2 cm spacing
2. " " " " " 19.0 cm "
3. " " " " " 22.8 cm "
4. " " " " " 30.4 cm "

Regular Distribution

5.) Drilled at 3.7 cm spacing and hand singled to give
6.) a regular plant distribution at population levels
7.) equivalent to those obtained from treatments 1-4.
8.)

The experiment was drilled on 9 April and seedling establishment was complete by 27 May when the regular plant distribution was obtained by hand singling. The experiment was harvested on 24 November by which time the heavy autumn rainfall had re-wetted the soil to field capacity, consequently soil conditions for harvesting were difficult. From the last few days of August to the date of harvest of the trial 239.8 mm of rain were recorded. A two stage harvesting system was used, a six row Moreau topper with chopper blower attachment and a three row Peter Standen lifter. The topping was by conventional feeler wheel and knife but with no cleaning flails whilst the lifting was by Opel wheels and elevator web. Forward speed was approximately 5 km/h.

Root losses from machine harvesting was divided into:-

1. Topper losses. The number and weight of roots dislodged from the row and top tare.

2. Lifter losses.
   (a) Surface The number and yield of small roots (<5.7 cm). The number and yield of larger roots.
   (b) Underground All root material.

RESULTS

PLANT POPULATION (thousands/ha)

Plant Distribution	Seed spacing (cm) 15.2	19.0	22.8	30.4	Mean
		(±5.13)			(±2.56)
Regular	94.2	78.3	63.7	53.3	72.4
Irregular	97.2	72.1	58.8	53.5	70.4
		(±3.63)			
Mean	95.7	75.2	61.3	53.4	

The range of seed spacings drilled to a stand presented the harvester with plant populations ranging from 53 to 97 thousand/ha irregularly distributed within the row. A similar range of plant population regularly spaced was produced by hand singling.

As there were no treatment differences in sugar percentage yields can most conveniently be presented as root yield.

TOTAL HARVESTED ROOT YIELD (tonne/ha)

Plant Distribution	Seed spacing (cm) 15.2	19.0	22.8	30.4	Mean
		($\pm$4.24)			($\pm$2.12)
Regular	49.6	42.4	46.7	36.7	43.9
Irregular	43.3	39.8	47.1	42.3	43.1
		($\pm$3.00)			
Mean	46.4	41.1	46.9	39.5	

The level of accuracy obtained by machine harvesting under wet plastic soil conditions was rather low, the SE per plot being $\pm$7.34 tonne/ha giving a coefficient of variation of 16.9 per cent. There was no difference in total root yield obtained by machine harvesting over the range of plant density encountered or due to regular or irregular distribution within the row.

SMALL SIZE ROOTS (<5.7 cm) (tonne/ha)

Plant Distribution	Seed spacing (cm) 15.2	19.0	22.8	30.4	Mean
		($\pm$0.23)			($\pm$0.11)
Regular	1.7	0.8	1.3	0.9	1.2
Irregular	2.0	0.9	0.9	0.7	1.1
		($\pm$0.16)			
Mean	1.8	0.8	1.1	0.8	

The yield of small roots collected by the harvester was 1.8 tonne/ha at the highest plant population decreasing to 0.8 tonne/ha at the lowest. There was no difference in the yield of small roots harvested due to regularity of distribution along the row. Of the total harvested yield 4.0, 2.1, 2.3 and 2.0 per cent were small size roots from the populations of 96, 75, 61 and 53 thousand plants/ha respectively.

Topper Losses

Top tare showed no relationship with plant density or regularity of plant distribution within the row.

TOPPER LOSSES (tonne/ha)

Plant Distribution	Seed spacing (cm) 15.2	19.0	22.8	30.4	Mean
		(±0.307)			(±0.153)
Regular	0.47	1.17	0.65	1.64	0.98
Irregular	0.57	1.01	0.46	0.72	0.69
		(±0.217)			
Mean	0.52	1.09	0.55	1.18	

Losses due to the topper were variable; plant density did not affect the number of roots lost but the weight of those roots lost tended to be greater at the lower plant densities. Surprisingly more roots were lost from the hand singled stand but in terms of root yield lost there was no difference.

Lifter Losses

The number of large roots lost by the harvester were also very variable and could not be related to plant density or regularity of distribution. These losses represent those roots which fail to pass successfully from the Opel wheels to the elevator web. This yield loss amounted to 1.73, 1.39, 1.61 and 4.18 tonne/ha from the populations of 96, 75, 61 and 53 thousand plants/ha respectively. The number of small roots (<5.7 cm) which were lost tended to be greater at higher plant densities but were not any worse from the drilled to a stand treatments. The general magnitude of those losses were 2.1 thousand small roots/ha which represented a yield loss of 0.41 tonne/ha. This result confirms other experiments in demonstrating the relative unimportance of small root loss.

SURFACE LIFTER LOSSES (tonne/ha)

Plant Distribution	Seed spacing (cm) 15.2	19.0	22.8	30.4	Mean
		(±1.157)			(±0.579)
Regular	1.59	3.10	2.10	6.21	3.25
Irregular	2.93	1.57	1.76	2.87	2.28
		(±0.818)			
Mean	2.26	2.34	1.93	4.54	

Combining the large and small root losses by the lifting mechanism (see above table) gives the total surface lifter losses. There was

little effect of plant density or distribution on the level of root loss. The anonolous result obtained at the lowest plant density when hand singled was caused by a large root loss from the sides of the Opel wheels due to soil blockage on one plot only.

UNDERGROUND LIFTER LOSSES (tonne/ha)

Plant Distribution	Seed spacing (cm) 15.2	19.0	22.8	30.4	Mean
		(±5.024)			(±2.512)
Regular	2.72	13.08	4.92	9.91	7.66
Irregular	7.79	16.71	5.21	9.91	9.90
		(±3.552)			
Mean	2.25	14.89	5.07	9.91	

These underground losses consisted of whole small roots, sliced roots and broken roots. No differences due to treatment were detected against a background of high variation due to off row lifting as a consequence of wet soil conditions.

TOTAL LOSSES (tonne/ha)

Plant Distribution	Seed spacing (cm) 15.2	19.0	22.8	30.4	Mean
		(±5.631)			(±2.815)
Regular	4.78	17.35	7.66	17.75	11.89
Irregular	11.28	19.29	7.43	13.50	12.88
		(±3.981)			
Mean	8.03	18.32	7.55	15.62	

When all the losses were combined no effect of treatment was discernable with very variable results and a coefficient of variation of 79 per cent. Acceptable results from machine harvesting have been obtained under friable soil conditions but previous experiments at the Station have shown poor efficiency and a high level of variability when soil conditions are wet. This is mainly as a result of wheel-slip and rutting which squeeze beet from the row centre and also cause the subsequent off centre operation of the topper and lifter. Whilst this experiment has not clearly distinguished the relative importance of root losses at the differing plant densities and distributions it has shown how large the yield losses can be under difficult harvesting conditions.

The sum of the total losses and the harvested yield represent the biological or absolute yield. There was no significant difference in biological yield over the range of plant densities and regularity of distribution encountered in this experiment.

HARVESTING LOSSES AS PER CENT OF ABSOLUTE YIELD

Plant Distribution	Seed spacing (cm) 15.2	19.0	22.8	30.4	Mean
		($\pm$8.3)			($\pm$4.1)
Regular	9	27	14	32	20
Irregular	21	31	14	24	22
		($\pm$5.9)			
Mean	15	29	14	28	

There was no clear relationship between treatments and harvesting losses. On average 21 per cent of the absolute or biological yield was lost during machine harvesting.

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