SUGAR BEET

PLANT DISTRIBUTION AND MACHINE HARVESTING NAS 507 ML 75

In this experiment four separate seed spacings drilled to a stand were compared with equivalent plant populations obtained by hand singling. The efficienby of machine harvesting was compared over this range of plant population 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
6.) to give a regular plant distribution at
7.) population levels equivalent to those
8.) obtained from treatments 1-4.

The experiment was drilled on 22 April and seedling establishment was completed by 10 June when the regular plant distribution was obtained by hand singling. The experiment was harvested on 7 December by which time rainfall was sufficient to have rewetted the soil to plough depth after the dry summer. 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 5km/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 ($<$ 5.7cm).
   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
			($\pm$1.32)		($\pm$0.66)
Regular	86.1	70.9	64.0	49.1	67.5
Irregular	-	70.9	64.0	49.1	67.5
			($\pm$0.93)		
Mean	-	70.9	64.0	49.1	

The 15.2 cm spacing drilled to a stand was omitted due to a faulty drill mechanism. However, these treatments presented the harvester with plant populations ranging from 49 to 86 thousand/ha either regularly or irregularly distributed within the row.

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

TOTAL HARVESTED ROOT YIELD (t/ha)

Plant Distribution	Seed Spacing (cm) 15.2	19.0	22.8	30.4	Mean
		(±2.46)			(±1.23)
Regular	36.3	40.1	41.1	37.5	38.7
Irregular	-	40.1	38.1	37.3	37.7
		(±1.74)			
Mean	-	40.1	39.6	37.4	

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) (t/ha)

Plant Distribution	Seed Spacing (cm) 15.2	19.0	22.8	30.4	Mean
		(±0.28)			(±0.14)
Regular	2.7	2.2	2.2	1.6	2.2
Irregular	-	2.2	2.3	1.5	2.2
		(±0.20)			
Mean	-	2.2	2.3	1.6	

The yield of small roots collected by the harvester was 2.7t/ha at the highest plant population decreasing to 1.6 t/ha at the lowest. Of the total harvested yield 7.4, 5.6, 6.0 and 4.2% were small size roots from the populations of 86, 71, 64 and 49 thousand plants/ha respectively.

Topper Losses

Top tare tended to increase with increasing plant density. At 86 and 49 thousand plants/ha top tare was 1.9 and 1.3% (SE±0.23) respectively. There was no difference in the incidence of top tare due to the regularity of plant distribution within the row.

TOPPER LOSSES (t/ha)

Plant Distribution	Seed Spacing (cm) 15.2	19.0	22.8	30.4	Mean
		(±0.27)			(±0.13)
Regular	0.5	0.4	0.2	0.5	0.4
Irregular	-	0.5	0.4	0.9	0.6
		(±0.19)			
Mean	-	0.4	0.3	0.7	

Losses due to the topper were variable and no differences due to treatment were detected either in the number or yield of roots lost.

Lifter Losses

SURFACE LIFTER LOSSES (t/ha)

Plant Distribution	Seed Spacing (cm) 15.2	19.0	22.8	30.4	Mean
		(±0.38)			(±0.19)
Regular	2.2	1.9	0.6	1.3	1.5
Irregular	-	1.5	1.5	1.1	1.6
		(±0.27)			
Mean	-	1.7	1.1	1.2	

The numbers of small and large roots lost by the harvester were also very variable and could not be related to plant density or regularity of distribution. The general magnitude of these losses were 3.7 thousand/ha as small roots yielding 0.5 t/ha which were lost from the elevator web. The Opel wheels failed to successfully pass to the elevator web 2.3 thousand large roots/ha which amounted to 1.0 t/ha.

Combining the small and large root losses by the lifting mechanism (see above table) gave significantly greater losses at the higher plant densities but no effect due to regularity of distribution along the row.

UNDERGROUND LIFTER LOSSES (t/ha)

Plant Distribution	Seed Spacing (cm) 15.2	19.0	22.8	30.4	Mean
		(±0.92)			(±0.46)
Regular	5.4	5.0	5.7	3.9	5.0
Irregular	-	3.8	4.7	1.7	3.6
		(±0.65)			
Mean	-	4.4	5.2	2.8	

These underground losses consisted of whole small roots unlifted and of broken roots. Losses of roots below the soil surface were greater at higher plant densities and oddly were greater from the regular plant distribution.

TOTAL LOSSES (t/ha)

Plant Distribution	Seed Spacing (cm) 15.2	19.0	22.8	30.4	Mean
		(±0.99)			(±0.49)
Regular	8.1	7.3	6.5	5.6	6.9
Irregular	-	5.7	6.6	3.7	5.7
		(±0.70)			
Mean	-	6.5	6.5	4.7	

When all the losses were combined the same trend was apparent, losses were greater at higher plant densities. The sum of these 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 % OF BIOLOGICAL YIELD

Plant Distribution	Seed Spacing (cm) 15.2	19.0	22.8	30.4	Mean
		($\pm$1.86)			($\pm$1.32)
Regular	18.2	15.4	13.7	13.1	15.1
Irregular		12.4	14.8	8.8	13.0
		($\pm$0.93)			
Mean		13.9	14.2	10.9	

A clear relationship was shown - as plant density increased total harvesting losses were greater. Harvesting losses may therefore be a simple function of the number of roots per unit area to be harvested. The distribution of plants within the row did not influence harvesting efficiency.

R.W. Clare,
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