

PLANT DISTRIBUTION AND MACHINE HARVESTING (NAS 507 ML 77)

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 a regular
6. } plant distribution at population levels equivalent to those
7. } obtained from treatments 1-4.
8. }

The experiment was drilled on 7 April with Vytomo. Harvesting took place on 24 November when soil conditions were moist and friable and appeared good for machine operation. 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 Oppel wheels and elevator web. Forward speed was approximately 5 km/hr.

Losses from machine harvesting was divided into:-

1. Topper losses. The number and weight of small roots (<5.7 cm) dislodged from the row.
The number and weight of larger roots dislodged from the row.
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)				MEAN
	15.2	19.0	22.8	30.4	
		(± 2.43)			(± 1.22)
Regular	88.7	77.8	69.1	59.4	73.8
Irregular	89.1	82.6	67.5	58.5	74.4
MEAN	88.9	80.2	68.3	59.0	
		(± 1.72)			

The range of seed spacings drilled to a stand presented the harvester with plant populations ranging from 58 to 89 thousands/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 content, yields can be presented most conveniently as root yield.

Total harvested root yield (t/ha)

Plant distribution	Seed spacing (cm)				MEAN
	15.2	19.0	22.8	30.4	
		(± 2.17)			(± 1.08)
Regular	42.1	39.5	40.3	38.6	40.1
Irregular	39.3	41.3	40.2	43.1	41.0
MEAN	40.7	40.4	40.3	40.9	
		(± 1.53)			

The level of accuracy obtained by machine harvesting under the good soil conditions was reasonable, the SE per plot being ± 3.75 t/ha, giving a coefficient of variation of 9.3%. 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) harvested (t/ha)

Plant distribution	Seed spacing (cm)				MEAN
	15.2	19.0	22.8	30.4	
		(± 0.16)			(± 0.08)
Regular	2.7	1.5	0.8	0.9	1.5
Irregular	3.0	2.2	1.1	0.7	1.8
MEAN	2.9	1.9	1.0	0.8	

The yield of small roots collected by the harvester was 2.9 t/ha at the highest plant population, decreasing to 0.8 t/ha at the lowest. There was also an increase of 0.3 t/ha of small roots harvested from the irregular distribution compared with the regularly distributed plant population. Of the total harvested yield, 7.1, 4.6, 2.4 and 1.9% were small size roots from the populations of 90, 80, 68 and 59 thousand plants/ha respectively.

Topper Losses

Top tare as % total yield harvested + top tare

Plant distribution	Seed spacing (cm)				MEAN
	15.2	19.0	22.8	30.4	
		(± 0.46)			(± 0.23)
Regular	6.3	6.0	2.8	1.9	4.3
Irregular	4.6	3.3	3.7	3.1	3.6
MEAN	5.4	4.6	3.2	2.5	
		(± 0.32)			

Top tare decreased with decreasing plant population, this being particularly apparent on the regular plant distribution.

Total root losses by topper (t/ha)

Plant distribution	Seed spacing (cm)				MEAN
	15.2	19.0	22.8	30.4	
		(± 0.185)			(± 0.092)
Regular	0.38	0.14	0.16	0.28	0.24
Irregular	0.00	0.00	1.04	0.44	0.37
MEAN	0.19	0.07	0.60	0.36	
		(± 0.131)			

The number of small roots lost by the topper was negligible. Weight of losses due to the topper were variable and generally low.

Lifter Losses

The number of small and larger roots lost by the lifter and the weight of these were variable and unaffected by population and regularity. When these losses were combined they were still unaffected by the treatment as is shown in the following table.

Total root losses on surface by lifter (t/ha)

Plant distribution	Seed spacing (cm)				MEAN
	15.2	19.0	22.8	30.4	
		(± 1.070)			(± 0.535)
Regular	2.58	1.38	1.99	2.53	2.12
Irregular	1.69	1.19	2.52	0.70	1.53
MEAN	2.14	1.28	2.25	1.62	
		(± 0.757)			

Underground lifter losses were similarly unaffected by treatment. These consisted of whole small roots, sliced roots and broken roots and averaged 2.42 t/ha.

Total losses (t/ha)

Plant distribution	Seed spacing (cm)				MEAN
	15.2	19.0	22.8	30.4	
		(± 2.325)			(± 1.162)
Regular	4.90	4.52	3.75	8.21	5.34
Irregular	3.09	1.92	7.16	2.81	3.75
MEAN	3.99	3.22	5.45	5.51	
		(± 1.644)			

When all the losses were combined no effect of treatment was discernable, with very variable results and a coefficient of variation of 88.6%.

The sum of the total losses and the harvested yield represents 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 absolute yield

Plant distribution	Seed spacing (cm)				MEAN
	15.2	19.0	22.8	30.4	
		(± 4.8)			(± 2.4)
Regular	14	10	8	18	13
Irregular	7	4	14	6	8
MEAN	11	7	11	12	
		(± 3.4)			

There was no clear relationship between treatments and harvesting losses. On average, 10% of the absolute or biological yield was lost during machine harvesting.

Whilst this experiment has not clearly distinguished any relative importance between root losses at the differing plant densities and distributions, it has shown how large the yield losses can be under difficult harvesting conditions. In the wet autumn of 1976 losses averaged 21%, whereas under better conditions in 1977 they averaged