SPACING OF TOMATOES FOR MACHINE HARVESTING

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ABSTRACT

Yield of process grade, fully coloured, sound fruit, from cvs. VF145-B7879 and VF145-21-4P grown in single rows or in double rows 20 or 30 cm apart on 1.5 m centres increased significantly when populations increased from 11000 plants/ha to 33000 plants/ha, but did not change significantly when populations increased from 33000 plants/ha (plants 20 cm apart in a single row) to 267000 plants/ha (plants 5 cm apart in each row of double rows). Yield of process grade fruit was significantly higher from plants grown in a five row 1.5 m bed with rows 20 cm apart and plants 30 cm apart in the row (population 167000 plants/ha) than from plants in single or double rows at populations ranging from 33000 plants/ha to 267000 plants/ha.

INTRODUCTION

In other studies examining the effect of plant populations and arrangements on yield of single harvested dwarf tomatoes, the crop has been grown either in beds approximately 1.5 m wide, with up to five rows per bed, and with a rectangular plant arrangement (e.g. Crowder 1970, Wilcox 1970, Zahara 1970), or in a continuous area with plants equidistant between and within rows (e.g. Fery and Janick 1970, Nichols **et al.** 1973, Zahara and Timm 1973).

Experiments were, therefore, done at research stations in Levin and Hastings with different populations and arrangements of plants grown under a wide range of seasonal conditions. In contrast to many of the other studies, a cultivar suitable for machine harvesting was used and plants were treated with chlorethephon to enhance ripening for single harvest. The results of nine experiments are reported in this paper.

MATERIALS AND METHODS

The experiments at Levin, using cv. VF145-21-4P, were started in mid-September of the 1973-74 and 1974-75 seasons, and at Hastings using cv. VF145-B7879, from late September to late October of the 1972-73 and 1973-74 seasons Table 1).

Randomised block designs were used in all experiments, with five or six replications of treatments. These were one or two rows with rectangular plant arrangement; or five rows with equidistant plant arrangement in flat beds 1.5 m wide. Plant populations ranged from 11000 to 267000 plants/ha. Details of treatments are given in table 1.

The population of 11000 plants/ha, which is close to that grown in multiple hand harvested dwarf tomato crops in New Zealand, was established from nursery raised transplants, and plants were transplanted when they had the same number of leaves as other plants direct drilled in the same experiment. All other populations were direct drilled, using natural seed sown at a high rate with a Stanhay drill, and thinned at the three leaf stage to the required stand.

Fertiliser was broadcast before sowing or transplanting. At Levin, on a silt loam soil which had previously been cropped for many years, 900 kg/ha 10:18:8 compound was used. At Hastings, on a clay loam soil immediately out of pasture, 1000 kg/ha 0:5:15 was used. Irrigation was applied to the Levin experiments as required, but the Hastings experiments were not irrigated.

TABLE 1. Details of plant poopulations, row arrangements and spacings; and years experiments were done at Levin and Hastings.

Plant Population [000's/ha]		Row Arrangement	Plant Dist. in row [cm]	Levin Expt No	Hastings Expt No
11					
	11	Single	60	1,2	1,2,3
	27	"	25	-	4
	33	"	20	1,2,3	1,4,5,6
	44	"	15	-	2,3,4
	67	"	10	1,2,3	2,3,4,5,6
	67	Double *	20	1,2	1,5,6
	133	"	10	1,2	1,5,6
	267	"	5	1,2,3	5,6
	167	5 Row	20	3	5,6

Years Experiments done — 1972-73 Hastings 1
1973-74 Levin 1,3 Hastings 2,3,4,5,6
1974-75 Levin 2

* Double rows 20 cm apart at Hastings, 30 cm apart at Levin

A 2500 ppm solution of cholrethephon (2-chloroethane phosphonic acid; I.W.D. Ethrel 48 formulation) containing a wetting agent was sprayed onto plants when approximately 15% of the fruit was coloured, and either 3 m or 6 m plot lengths were harvested, by shaking fruit from the plants by hand or by using a small mechanical harvester, 15 to 21 days later. Total yields and weights of process grade fruit (fully coloured sound fruit) were recorded.

RESULTS

The yields of process grade fruit from the three experiments at Levin and the six experiments at Hastings are given in Table 2.

Statistical comparisons were made between the following —

A. The population of 11000 plants/ha and the next highest population, either 33000 or 44000 plants/ha, in experiments where 11000 plants/ha was grown.
B. Populations of 27000, 33000 or 44000 plants/ha and all higher populations grown in single or double rows in any one experiment.
C. The five row bed treatment and all populations under B.

With an increase in population from 11000 plants/ha to 33000 plants/ha (Levin expts 1, 2: Hastings expt 1) or 44000 plants/ha (Hastings expts 2, 3) yield increased, significantly so in three of the five experiments. With an increase in population from between 27000 plants/ha and 44000 plants/ha to 267000 plants/ha and with plants grown in single or double rows, there were, with the exception of one experiment at Hastings, no significant differences in yield in all nine experiments carried out. The yield from five row beds (population 167000 plants/ha) was significantly and considerably higher than the yield from single or double rows at populations higher than 33000 plants/ha in two experiments (Levin expt 3, Hastings expt 6) but was not significantly different in one other experiment (Hastings expt 5).

The percentages of process grade fruit were similar, with no significant differences between plant populations and plant arrangements, in each experiment. However, the mean percentage process grade fruit (Table 2) ranged from 39% (Levin, expt 1) to 81% (Hastings, expt 5).

DISCUSSION

It has been demonstrated (Fery and Janick 1970) that higher populations are required to achieve the same yield when the dwarf tomato crop is single harvested than when it is multiple picked. Workers growing plants in single or double rows on approximately 1.5 m centres (Wilcox 1970, Zahara 1970) have found that yield from a single harvest increased steadily with increasing plant populations from approximately 5000 plants/ha to approximately 40000 plants/ha and then attained a nearly constant level with further increases in plant populations. The results from experiments reported in this paper support the above findings in that the low population of 11000 plants/ha gave a low single harvest yield and yields reached a nearly constant level at a population of approximately 30000 plants/ha. The experiments reported here, and those of Wilcox (1970) and Zahara (1970), used large vined cultivars. With smaller vined cultivars, the population at which yields reached a plateau could be expected to be higher (Fery and Janick 1970).

The need to grow the tomato crop at high populations to achieve uniform ripening for single harvest has been emphasised by many workers (Crowder 1970, Fery and Janick 1970, Nichols **et al.** 1973, Sims and Rubatsky 1974). However, in the experiments reported here, where plants were treated with chlorethephon before harvest, the percentage of process grade fruit in any one experiment from all populations was not significantly different. The use of chlorethephon to aid ripening therefore reduces the need to grow very high populations for uniform ripening, and allows any population above approximately 30000 plants/ha to give the highest single harvest yield that can be attained from a crop grown in a single or double row system.

The results from the five row bed treatment suggest that much higher yields are attainable than from similar populations grown in single or double rows. However, further work growing many rows with an equidistant or near equidistant plant arrangement and single or double rows with a rectangular plant arrangement in beds, or growing plants with an equidistant arrangement in a continuous area is required. Further studies in spacing of tomatoes for machine harvesting should also involve the use of improved cultural practices such as those used in the machine harvested dwarf tomato crop in California

TABLE 2: Yield (tonnes/ha) and mean percentage of process grade fruit.

Plant Populations and Arrangements	EXPERIMENT								
	Levin			Hastings					
	1	2	3	1	2	3	4	5	6
11 s	27	45	-	45	57	52	-	-	-
27 S	-	-	-	-	-	-	72	-	-
33 S	42	71	58	108	-	-	81	91	49
44 S	-	-	-	-	60	63	81	-	-
67 S	45	74	59	-	72	82	87	74	61
67 D	36	79	-	96	-	-	-	87	68
133 D	45	81	-	107	-	-	-	87	51
267 D	47	85	44	-	-	-	-	72	50
167 5R	-	-	73	-	-	-	-	87	104
% Process Grade	39	71	53	77	69	66	71	81	67
Significance of tests (see text)									
A	5%	1%	-	1%	n.s.	n.s.	-	-	-
B	n.s.	n.s.	n.s.	n.s.	n.s.	5%	n.s.	n.s.	n.s.
C	-	-	5%	-	-	-	-	n.s.	1%

(Sims and Rubatzky 1974), the investigation of increased fertiliser levels at high populations (Nicklow and Downes 1971, Nichols **et al.** 1973), and possibly the use of extra irrigation at very high populations.

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