

THE PERFORMANCE OF FOUR OPEN-POLLINATED SUNFLOWER
CULTIVARS UNDER VARYING POPULATIONS AND ROW WIDTHS

By

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Crops the world over have an optimum seeding rate for a given area depending on rainfall, temperature variation, latitude, elevation, length of growing season, and soil types. Three years ago, when I began working with sunflowers, one of the first questions that entered my mind concerned the optimum seeding rate for sunflowers. A review of the literature on the subject indicated a lack of precise recommendations for seeding rate. Some literature stated rates in pounds per acre. This seemed an impractical recommendation since achene size and weight varied from cultivar to cultivar. Some unpublished data indicated that 20 or 30 inches (50 or 75 cm) between rows gave higher yields of sunflowers. Discrepancies were noted from year to year and cultivar to cultivar as to which distance between rows gave the highest yield of sunflowers.

A preliminary experiment in 1967 included populations of sunflowers from 15,000 to 120,000 plants per acre (37,500 to 300,000 plants per hectare). This experiment gave some indication that 40,000 plants per acre (100,000 plants per hectare) was the maximum number of plants to crowd into an area.

Methods and Materials

An experiment was seeded using 20, 30 and 40 inches (50, 75 and 100 cm) between rows and populations of 15,000, 20,000, 25,000, 30,000, 35,000 and 40,000 plants per acre (37,500, 50,000, 62,500, 75,000, 87,500 and 100,000 plants per hectare) for the 1968 growing season. The desired populations were attained by overseeding the rows and thinning at the 4 to 6 true-leaf stage of growth. The plot size was three rows 20 feet (6 meters) long and plots were separated by 20 inches (50 cm). The experiment was conducted in a split-split plot design with cultivars being whole plots, populations as sub plots and width between rows as sub-sub plots with four replications. Data was collected for bloom date, plant height, head diameter, achene yield, 100 achene weight, oil content for cultivars Arrowhead, Peredovik, Krasnodarets, and Mingren and seed size for Mingren only. The experiment was repeated in 1969; however, VNIIMK 89.31 replaced the cultivar Krasnodarets. Also, Arrowhead and Mingren were grown at 10,000 plants per acre (25,000 plants per hectare) rather than 40,000 plants per acre (100,000 plants per hectare) in an attempt to get a higher percentage of large seeds.

Results

The analysis of variance for the entire experiment in 1968 resulted in the non-significant (ns), significant (*) (5% level) and highly significant (**) (1% level) mean squares as shown in Table 1 for the characteristics achene yield, 100 achene weight, plant height and head size. The means

squares for cultivars indicated significant differences for all four characteristics. Populations were highly significantly different for all characteristics except yield, where the mean square indicated a significant difference. For width between rows, highly significant differences were found except for plant height. Highly significant differences were also attained for the interaction between cultivars and populations and the three-way interaction cultivars x populations x width between rows for 100 achene weight.

The combined analysis of variance for 1969 was performed on the populations in common for the four cultivars, *i.e.*, 15,000 through 35,000; and the significance of the mean squares are shown in Table 2. The characteristic plant height was not included in the analysis but oil content was included.

The mean squares for cultivars showed highly significant differences except for yield. The mean square for 100 achene weight for populations indicated a highly significant difference. For width between rows, all mean squares gave highly significant differences except head size, which gave a non-significant difference. The two-way interaction cultivars x populations were highly significantly different for head size. The interaction populations x width between rows was highly significantly different for 100 achene weight.

When cultivars were analyzed individually, 100 achene weight and head diameter were highly significantly different for populations for Mingren, Arrowhead, and Peredovik, except head diameter of Peredovik in 1969 was significantly different. The mean squares for width between rows was significant or highly significant in some cases but not to the same degree in the two years. The interaction of populations and width between rows showed highly significant and significant differences for 100 achene weight and plant height for Peredovik in 1968.

Figure 1 graphically shows the achene yield of Mingren in pounds per acre for the various populations and widths between rows. The analysis of variance resulted in a non-significant mean square for populations but a highly significant mean square for width between rows. Achene yield was somewhat erratic as populations increased. For width between rows, the 20 inch (50 cm) spacing resulted in the highest achene yield when averaged over all populations.

The weight of 100 achene for Mingren populations had a highly significant difference for both years. As the populations increased, the weight of 100 achene decreased. For width between rows, a significant difference was noted in 1968 only for 100 achene weight.

Non-significant differences for achene yield were obtained for Arrowhead. Some trend for higher yields under higher populations was noted (Figure 3). Highly significant differences in 1968 and non-significant differences in 1969 for widths between rows were found for achene yield of Arrowhead.

Differences in yield of Peredovik were non-significant in both years for populations but highly significant for width between rows in 1968. For Peredovik, the head diameter (Figure 5) differed with high significance in 1968 and significantly in 1969 for populations. A significant difference for width between rows was found in 1968 for head diameter. The oil contents

of Peredovik differed with high significance for width between rows in 1969, the only year this characteristic was measured, as shown in Figure 6.

Figure 7 shows the achene yield of VNIIMK 89.31. Populations differed significantly but widths between rows were not significantly different.

Conclusion

The cultivar Mingren gave higher yields as width between rows was reduced with one exception, in 1969 for the 30,000 plant populations. When quality of achene is considered for Mingren, the combination of 15,000 plants per acre and 20 or 30 inch spacing between rows would seem most desirable. Arrowhead sunflowers seemed to have higher yields as populations were increased and width between rows was reduced. The economics of increased seeding rate could fail to prove advantageous.

Higher yields for Peredovik and VNIIMK 89.31 can be attained using 20,000 or 25,000 plants per acre and 20 or 30 inch width between rows without affecting the oil content of the cultivar to any great extent.

* * *

Table 1. The significance of mean squares for achene yield, 100 achene weight, plant height and head size for the 1968 experiment.

	<u>YIELD</u>	<u>100 Achene</u>	<u>PLANT HT.</u>	<u>HEAD SIZE</u>
CULTIVARS	**	**	**	**
REPS	ns	*	ns	*
POPS	*	**	**	**
CULT X POPS	*	**	ns	*
WIDTH	**	**	ns	**
CW	*	ns	ns	ns
PW	ns	ns	ns	ns
CPW	ns	**	ns	ns

Table 2. The significances of mean squares for achene yield, 100 achene weight, head size and oil content for the 1969 experiment.

	<u>YIELD</u>	<u>100 ACHENE</u>	<u>HEAD SIZE</u>	<u>OIL CONTENT</u>
CULTIVARS	ns	**	**	**
REPS	ns	ns	*	ns
POPS	ns	**	ns	ns
Cult X POPS	ns	ns	**	ns
WIDTH	**	**	ns	**
CW	ns	ns	ns	ns
P.W	ns	**	ns	ns
CPW	ns	ns	ns	ns

Figure 1. The average achene yield in pounds per acre of Mingren sunflowers for 1968 and 1969 for the various populations and widths between rows.

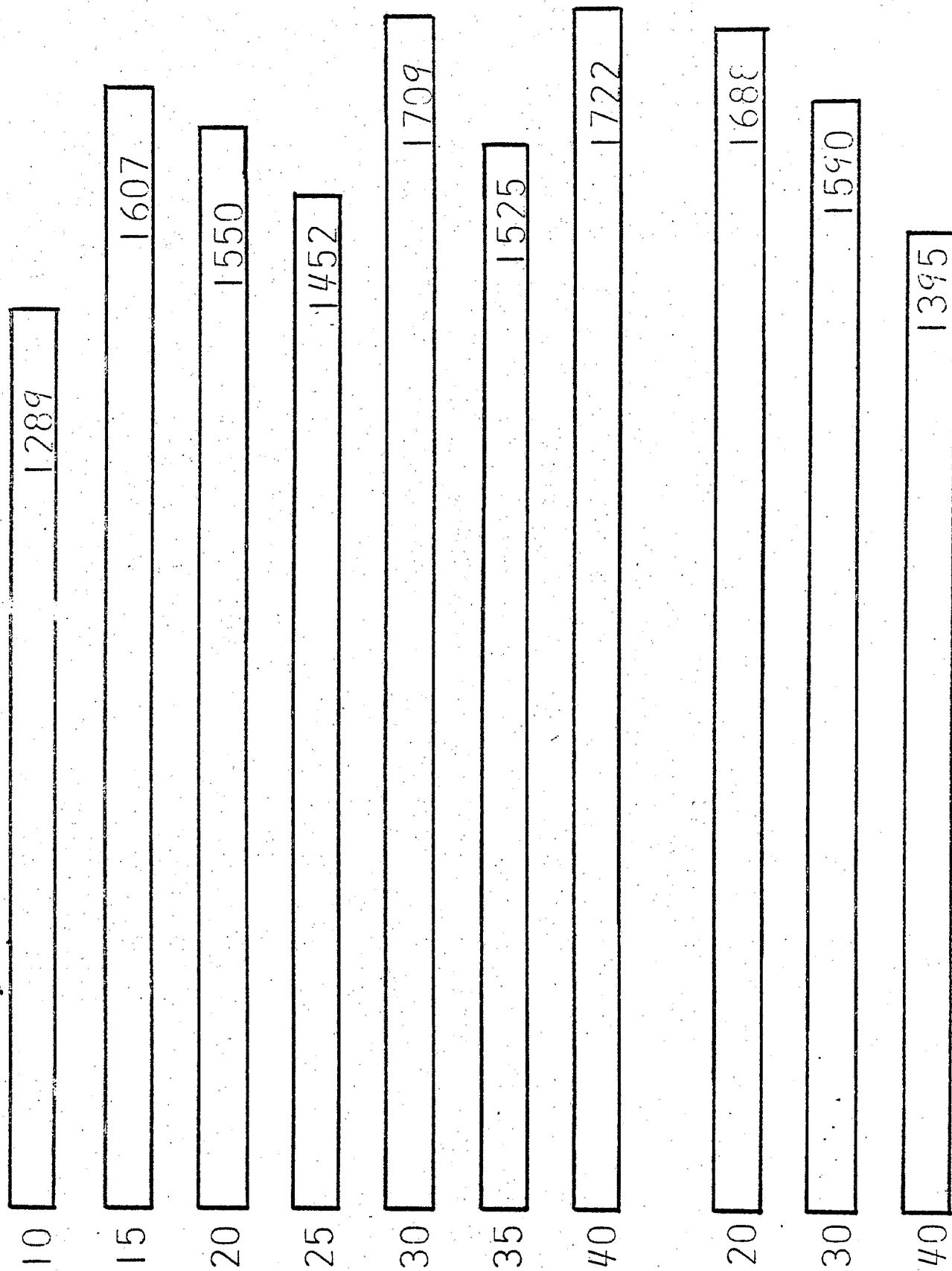


Figure 2. The average 100 achene weight in grams of Mingren sunflowers for 1968 and 1969 for the various populations and widths between rows.

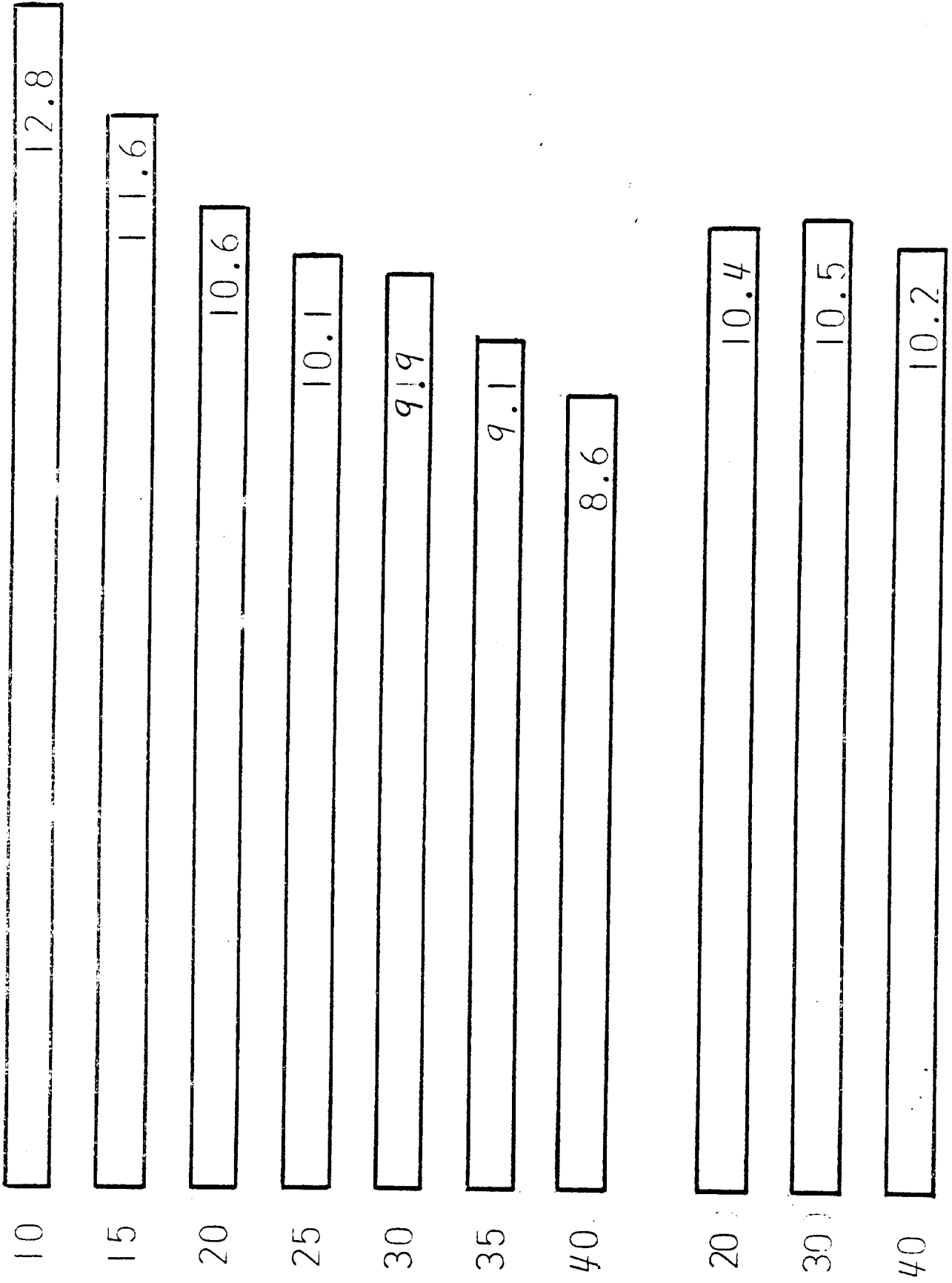


Figure 3. The average achene yield in pounds per acre of Arrowhead sunflowers for 1968 and 1969 for the various populations and widths between rows.

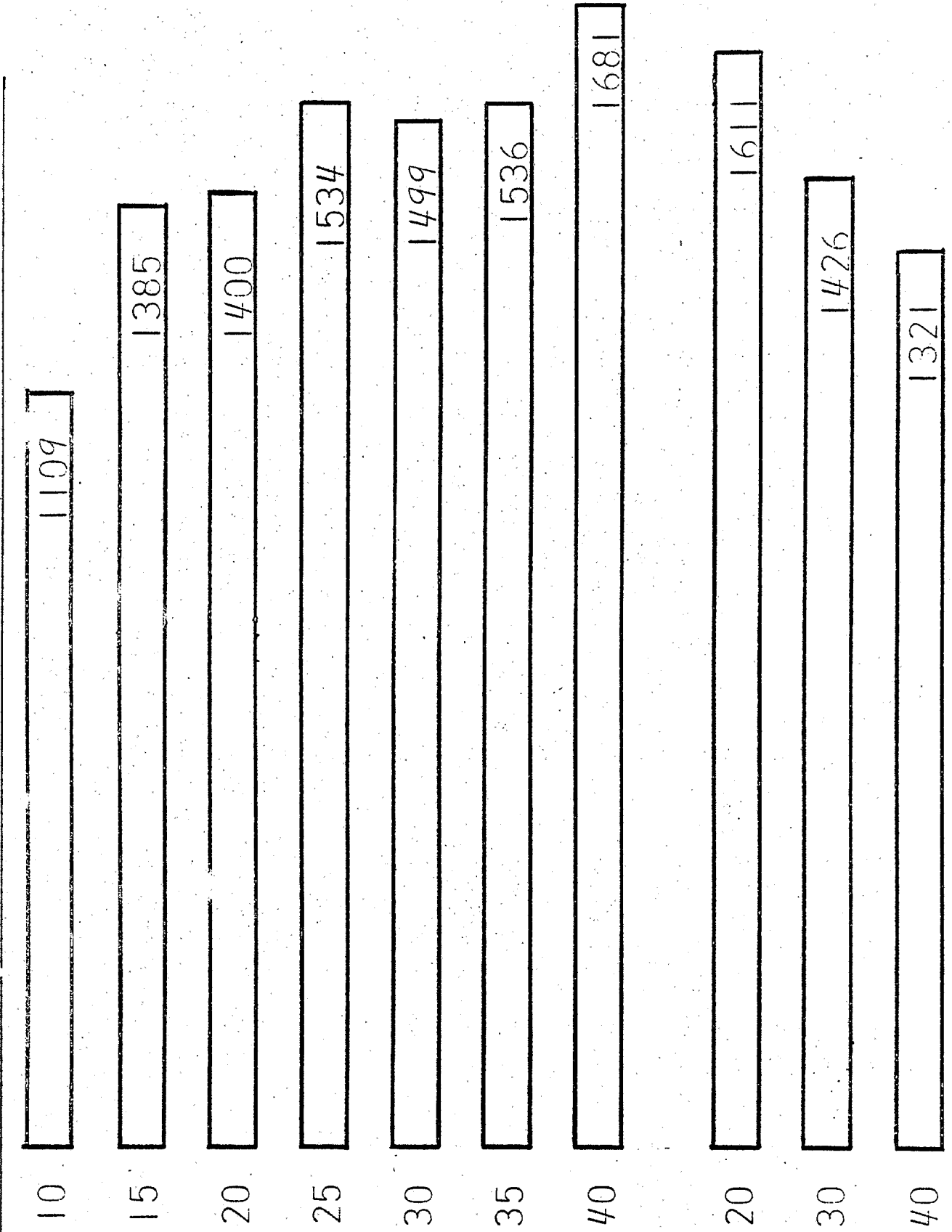


Figure 4. The average achene yield in pounds per acre of Peredovik sunflowers for 1968 and 1969 for the various populations and widths between rows.

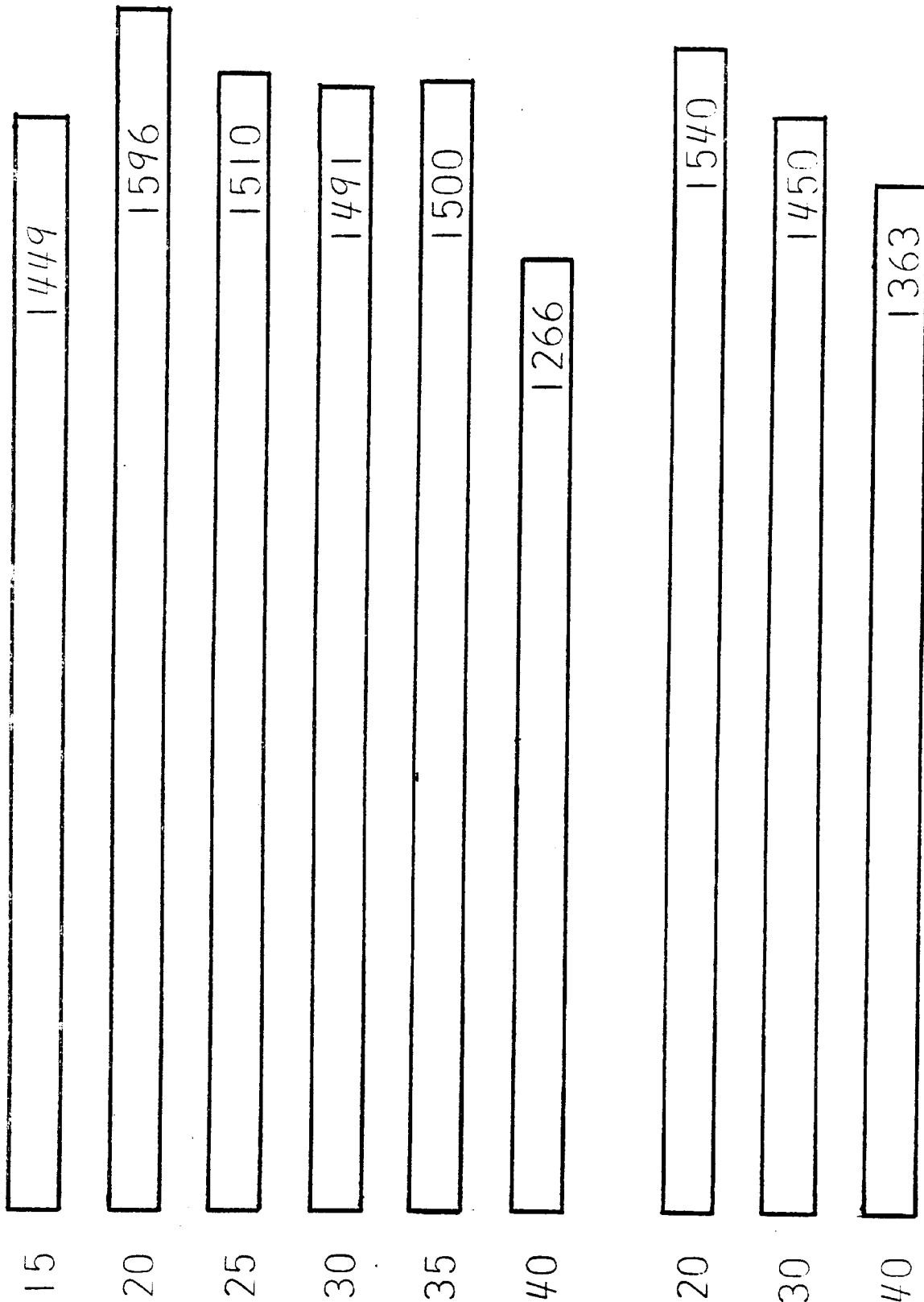


Figure 5. The average head diameter in centimeters of Peredovik sunflowers for 1968 and 1969 for the various populations and widths between rows.

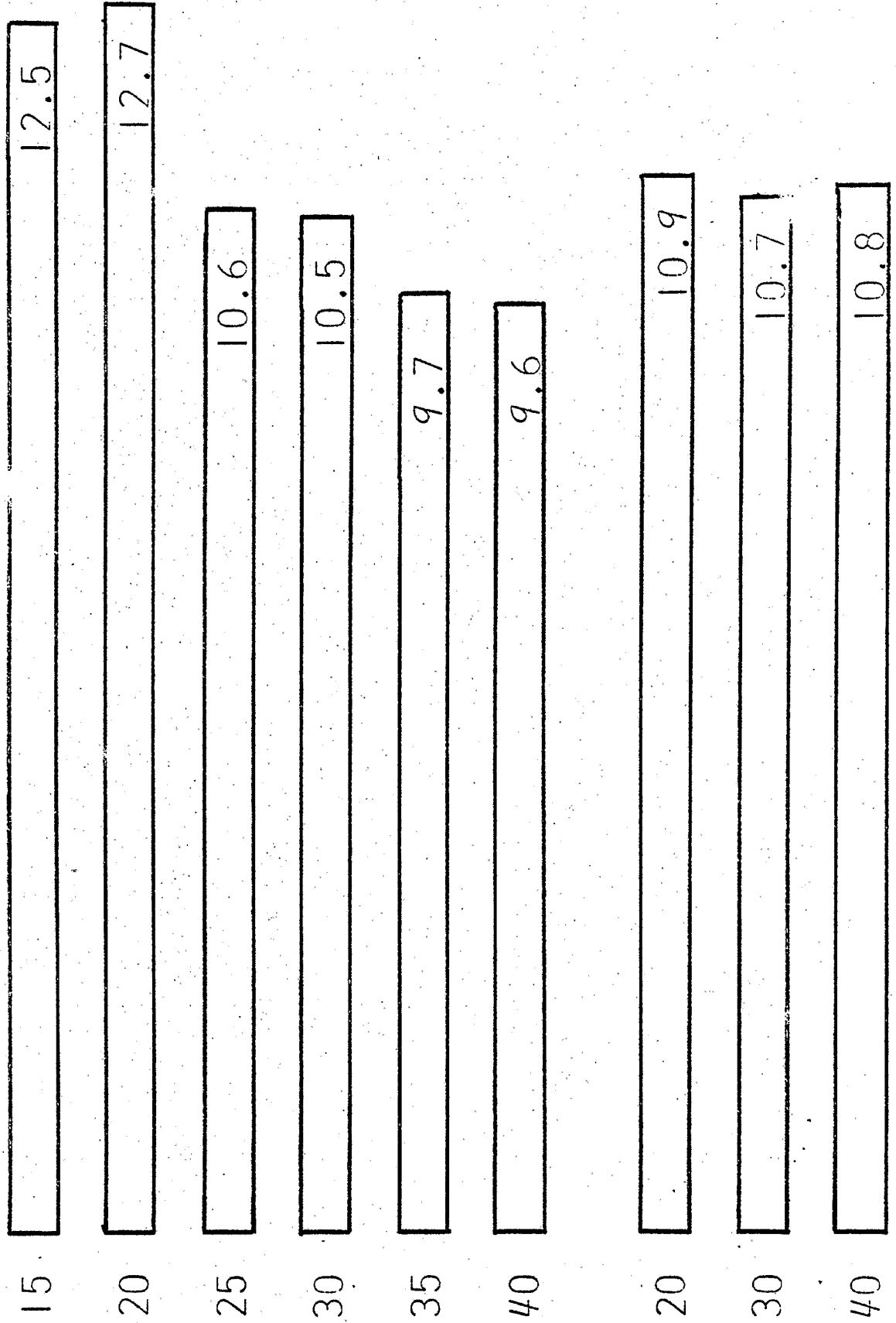
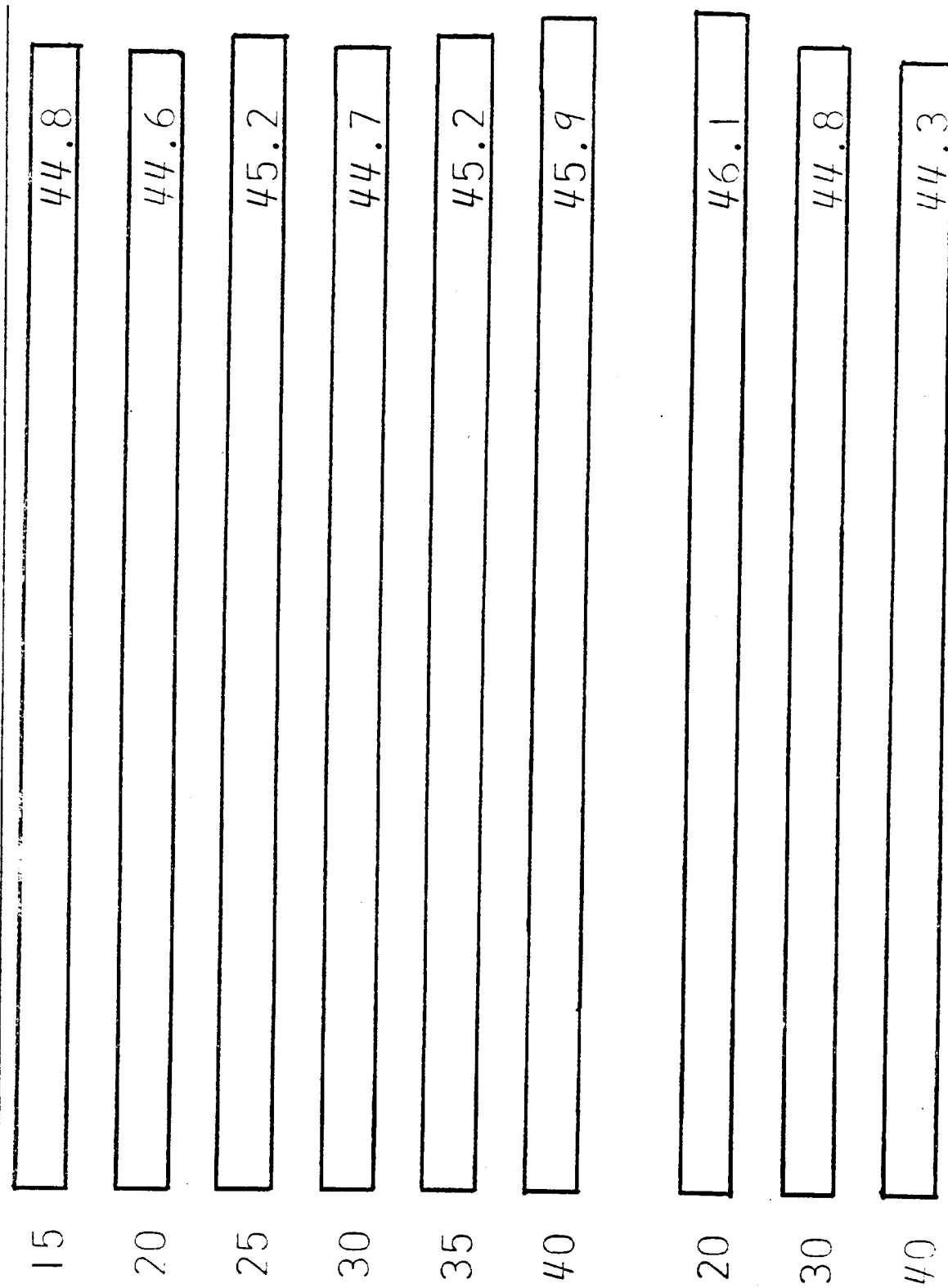


Figure 6. The average percent of oil content of whole achenes of Peredovik sunflowers for 1968 and 1969 for the various populations and widths between rows.



20 | 324

25 | 349

30 | 1182

35 | 1126

40 | 924

20 | 1154

30 | 1245

40 | 144