EFFECT OF PLANT DENSITY ON PLANT GROWTH
SIZE AND YIELD OF ONION

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ABSTRACT: Seeds of onion cv. 'Desi Red' were sown in the nursery and later on transplanted in the field with arrangement of 20, 30 and 40 plants/m². Increased planting density resulted in reduction of mean bulb weight with leaves (1.80-1.70 kg/10 bulbs) and without leaves (1.61 - 1.50 kg/10 bulbs). Bulb diameter and neck diameter also reduced from 6.82 to 6.67 cm and 1.91 to 1.61 cm, respectively. Yield/unit area increased with the increase in planting density. Maximum yield of 3.56 kg/m² was obtained by the highest planting density.

Key Words: Allium cepa; Varieties; Plant Density; Bulbs; Weight; Diameter; Crop Yield; Pakistan.

INTRODUCTION

Onion is by far the most important of the bulb crops and also have great significance among vegetable crops because of its year round consumption. General consensus is that, higher yield and better control over bulb size could be obtained if plants were grown at the optimum density. The control of plant spacing is a valuable way of controlling bulb size, shape and yield.

Relationship between plant density and yield of onion bulbs was studied by Vigai et al. (1976) by planting intact and longitudinally cut, half bulbs at 20, 30 and 40 cm intra-row and 30 cm inter-row distance. Maximum yield was obtained from the plots with intact bulbs planted at 20cm x 30 cm. Rashid and Rashid (1976) observed that maximum yield was obtained (13108.84 lbs/ha) from the 4" x 4" spacing. Wotaszek and Kmeicik (1977) found that doubling the seed rate of onions, from 17.5 to 35.0 kg/ha, resulted in higher percentage of onion bulbs in the total yield. Dumitrescu and Radoi (1984) planted onion sets of different sizes (7-14 and 14-21 mm) at plant densities of 360000 and 560000 sets/ha. The highest yield of 42.6 t/ha was obtained for 14-21 mm sets with 460000 plants/ha.

Miccilis et al. (1984) concluded that onion seedlings planted at 14.28 plants/m² resulted in maximum yield of 15.7 quintals/ha. McGeary (1985) experimented on an onion cv. 'White Spanish' in a square arrangement at a density of 178, 400, 625, 816, 1111 and 1600 plants/m². He found that increased plant density resulted in reduction in plant size, mean bulb weight, and time to maturity but had no effect on soluble solids and percentage dry weight. Density of 400 and 625 plants/m² proved better.

Onion cv. 'Hydor' was sown by Muller and Hartmann (1985) at spacing of 15, 20 and 30 cm between rows and 1-4 cm within rows. They found that 20cm x 20cm spacing gave the highest yield of 687 t/ha. Nagre et al. (1985) showed that plantings of onion at 15cm x 10cm gave the best yield and quality as compared with 15cm x 15cm and 15cm x 25cm plantings.

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Considering the importance of spacing, an experiment was designed to study the effect of plant density on the yield of onion bulbs and other aspects of quality such as, shape, size and uniformity.

MATERIALS AND METHODS

Onion seeds of local cv. 'Desi Red' were sown on October 20, 1987 at National Agricultural Research Centre, Islamabad. Later on, seedlings of equal size were transplanted on December 22, 1987 in three arrangements of 40, 30 and 20 plants/m². Line to line distance in all the treatments remained constant i.e., 30 cm. A complete fertilizer (1:1:1) was incorporated into the soil before sowing. Remaining dose of nitrogenous fertilizer (ammonium sulphate) was applied about one month after transplanting and then at bulb formation. Irrigation was done in the form of flooding. Hoeing and other field operations were done manually.

Randomized complete block design with three replications was used. Harvesting was done on May 20, 1988. Ten randomly selected plants were taken washed, placed in plastic bags and stored at 4°C for 2 weeks and were then examined for bulb and neck diameter, number of leaves, bulb weight and bulb and leaves weight. Fresh yield was measured after harvesting the crop from the plot. All the data were subjected to analysis of variance.

RESULTS AND DISCUSSION

The data recorded on the number of leaves per bulb, bulb diameter, bulb weight, bulb + leaves weight and yield per plot indicated non-significant effect of planting densities on the number of leaves per bulb, while its effect on the bulb diameter, neck diameter, bulb weight, bulb + leaves weight and yield per plot were highly significant (Table 1). The fact that planting densities did not affect the number of leaves per bulb marks that this genetic character is not altered by closer or wider spacing.

Results on the bulb diameter were also highly significant. It revealed that increasing the planting density from 20 to 30 and 40 bulbs/m² resulted in reduced bulb diameter of 6.82, 6.72 and 6.67 cm, respectively. This reduction was significant at 1% probability level for 10 cm plantings, only, which had lesser diameter than 15 and 20 cm. However, 15 and 20 cm planting density did not differ significantly with each other.

The reason for reduction in bulb diameter with an increase in planting density may be due to space and nutrition availability which was more in lesser populated plots as compared to greater populated plots. This in return may have affected the bulb size, i.e. more nutrition and space availability to lower planting density resulted in greater bulb size.

Data on neck diameter offered highly significant results (Table 1). Neck diameter reduced significantly at 1% probability level with the increasing density of the onion seedlings. Plants spaced at 20 cm had the thickest neck (1.91 cm) followed by 15 and 10 cm density. Same explanation, may be furnished for this character as discussed earlier.

Planting densities significantly affected the weight of bulb at 1% probability level (Table 1). Lowest populated plot (20 plants/m²) had significantly heavier bulbs (161 g) than the greater
Table 1. Effect of planting density on the growth and yield of onion bulbs grown at the National Agricultural Research Centre, Islamabad during 1987-88

<table>
<thead>
<tr>
<th>Planting density (Bulbs/m²)</th>
<th>No. of leaves per bulb</th>
<th>Bulb diameter (cm)</th>
<th>Neck diameter (cm)</th>
<th>Wt. of 10 bulbs With leaves (kg)</th>
<th>Wt. of 10 bulbs Without leaves (kg)</th>
<th>Yield (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>12.67 a</td>
<td>6.82 a</td>
<td>1.91 a</td>
<td>1.80 a</td>
<td>1.61 a</td>
<td>2.16c</td>
</tr>
<tr>
<td>30</td>
<td>12.67 a</td>
<td>6.72 a</td>
<td>1.66 b</td>
<td>1.75 b</td>
<td>1.50 b</td>
<td>2.75 b</td>
</tr>
<tr>
<td>40</td>
<td>11.67 a</td>
<td>6.67 a</td>
<td>1.61 c</td>
<td>1.70 b</td>
<td>1.50 b</td>
<td>3.56 a</td>
</tr>
</tbody>
</table>

populated treatments. While the 30 and 40 bulbs/m² treatments did not differ significantly with each other.

Data on weight of bulb + leaves also revealed highly significant results. The 20 cm treatment had the heaviest bulbs + leaves weight (180 g) followed by 15 and 10 cm treatments. These results agree to the idea that greater spaced plantings utilized more nutrition and greater space for growth as compared with lesser planting treatments.

Perusal of the data would indicate highly significant results for yield per plot. Planting density of 10 cm gave the highest yield (3.56 kg/m²) followed by 15 and 20 cm plantings, yielding 2.75 and 2.16 kg/m² respectively. All the treatments differed at 1% probability level with each other. Higher yields with greater planting treatment may be attributed to greater number of bulbs per unit area.

Results of this experiment support the findings of Vagai et al. (1976), Rashid and Rashid (1976), Wotaszek and Kmiecik (1977), Miccolis et al. (1985), but do not coincide with that of Mc Geary (1985) may be due to, very high planting density.

The findings are important, keeping the consumers and grower point of view. Consumers prefer medium sized onions with thin necks, while growers like practices that result in higher yields. Highest planting density (10 cm) in this experiment seems to fulfill the requirements of both the consumers and the growers.

LITERATURE CITED

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