PLANT POPULATION EFFECTS ON THE GROWTH AND YIELD OF SUNFLOWER

BY

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ABSTRACT
The field experiment on plant population effects on the growth and yield of HO-1 sunflower variety was conducted at Student Farm, Department of Agronomy, Sindh Agriculture University, Tandojam, Pakistan during spring season-2006 in randomized complete block design, replicated four times. The treatments were different plant populations viz. 90000, 70000, 50000, 30000 and 10000 plants ha\(^{-1}\). The results showed that optimum plant population (50000-70000 plants ha\(^{-1}\)) exhibited taller plants (267.25 cm), maximum stem girth (9.31 cm), better head diameter (21.62 cm), seeds head\(^{-1}\) (1481.25 cm), seed weight head\(^{-1}\) (66.75 g) and seed index (53.25 g) were noted in thinly population plots having 10000 plants ha\(^{-1}\). However, maximum seed yield (1551.25 kg ha\(^{-1}\)) was recorded in the plots where 70000 plants ha\(^{-1}\) was practiced. The extent of relationship showed that stem girth, head diameter and seed index had non-significant and negative relationship with seed yield of sunflower, however, plant height, seeds head, seed weight head\(^{-1}\) recorded positive association with seed yield.

KEYWORDS: Sunflower, population, girth, heads, head diameter, index, seed, yield

INTRODUCTION
Sunflower is one of the most important oilseed crop grown for edible oil purpose in the world next to soybean and palm oil. The productivity of sunflower can be increased with judicious use of inputs under higher plant population levels. In general, higher sunflower yield at higher plant population and N levels has been widely reported by Vijayakumar et al. (2001). Reddy and Babu (2004) also recommended that plant population significantly affect on seed and oil yields. The crop sown at 57000 and 114000 plant ha\(^{-1}\) with high nitrogen rates showed better interaction by recording increased dry matter, seed number m\(^{-2}\) and seed yield of sunflower crop (Vega et al., 2001) whereas, Huagur and Prabhakar (1998) found 83000 plants ha\(^{-1}\) for achieving satisfactory seed yield of sunflower. As plant population increased from 3000 to 95000 plants ha\(^{-1}\) the head diameter, 1000 seed weight and seed weight per head decreased, but height of plants increased. Thus, it was found that highest seed yield and oil content were obtained at 95000 plants ha\(^{-1}\) (Goksoy et al., 1998). Olade et al. (2000) also were of the view that number of green leaves per m\(^{2}\) and leaf area index increased with increasing N levels and plant density. The higher net income was obtained with N 10g m\(^{-2}\) and plant density of 10 plants m\(^{-2}\). However, Salehi and Naderi (2000) observed that 75 and 20 cm row and plant spacing was a better practice for sunflower crop which recorded 2500 kg ha\(^{-1}\) seed yield. Bahrani (2000) reported 6.66 plant m\(^{-2}\) and 69 kg N ha\(^{-1}\) as optimum plant population and nitrogen respectively for better head diameter, seed number, seed weight and oil content. Further, Singh et al. (2003) found that plant population has a linear functional relationship with seed yield. It is important that all the available resources should be utilized for increasing the oil seed production in the country. However, yield per acre can be much improved by adopting varieties inputs including improved varieties, plant protection coverage, cultural and agronomic practices. Looking the economic importance of sunflower as oilseed crop and role of plant populations for growth and seed yield production, the field research was conducted to explore suitable plant population for obtaining higher production.
MATERIALS AND METHODS
The research trial was laid out to determine the plant population effects on the growth and yield of sunflower. The experimental area was selected at Students Farm, Department of Agronomy, Faculty of Crop Production, Sindh Agriculture University, Tando Jam, during spring season of 2006. For the purpose, land was prepared by giving dry ploughing, followed by clod crushing and leveling to eradicate the weeds and uniform distribution of irrigation water. A four acre inches of soaking dose was applied, when soil came in condition one cultivator followed by rotavator and leveling respectively was practiced. The variety HO-1 was treated with different plant populations (90000, 70000, 50000, 30000 and 10000 plants ha\(^{-1}\) in RCBD having four replications.

Cultural practices: Land was given two cross wise dry plowings each followed by clod crushing and leveling. The seeds of sunflower variety HO-1 were drilled with single coulter hand drill at row spacing of 75cm. Earthing was performed before first irrigation. The plant populations were maintained before first irrigation. All the cultural practices for crop maintenance were adopted to maintain the experiment area.

Fertilizers: The recommended rates of N (120 kg ha\(^{-1}\)) and P (60 kg ha\(^{-1}\)) were applied. The whole P from DAP was incorporated during final land preparation, while 1/3 N from urea were split applied during land preparation and reaming were applied in equal splits, during 2\(^{nd}\) and 3\(^{rd}\) irrigations. The data collected were analyzed statistically, using analysis of variance method. Comparison of treatment means was tested by LSD test (Least Significant Differences) following procedures of Gomez and Gomez (1984).

RESULTS
Mean values of various parameters and statistical analysis is given in Table-1, whereas values regarding relationship of various parameters with yield are depicted in Table-2. The results under separate headings are given here under:

Plant height (cm)
The results showed the equal superiority of three plant populations i.e 10000, 30000 and 50000 plant populations ha\(^{-1}\) which recorded non-significant differences in the plant values of height (267.25, 270.00 and 255 cm respectively) followed by treatment i.e 70000 plant population which showed the plant height of 226.25 cm. The minimum plant height (186.75 cm) was exhibited in the plots where dense plant population of 90000 plants ha\(^{-1}\) was recorded.

Stem girth (cm)
The results for stem girth showed that plant population of 10000 ha\(^{-1}\) recorded significantly higher stem girth (9.3 cm), followed by 30,000 plant population ha\(^{-1}\) which showed the stem girth 8.8 cm. The minimum stem girth (6.50 cm) was exhibited in the plots where dense plant population of 90,000 plants ha\(^{-1}\) was practiced.

Head diameter (cm)
The results of the experiment revealed that maximum head diameter (21.62 cm) was recorded under 10,000 population ha\(^{-1}\) followed by 30,000 plant population ha\(^{-1}\), which recorded the head diameter of 21.43 cm whereas the minimum head diameter (13.81cm) was observed in the dense plant population having 90,000 plants ha\(^{-1}\).

Seeds head\(^{-1}\)
The experiment for seeds head\(^{-1}\) showed that four plant populations i.e 10,000, 30,000, 50,000 and 70,000 plants ha\(^{-1}\) were equally superior and recorded non-significant differences for the seeds head\(^{-1}\) (1481.25, 1475.75, 1448.75) and 1355.00 followed by treatment where 90,000 plant population was maintained.

Seed weight head\(^{-1}\) (g)
The results for seed weight head\(^{-1}\) showed the superiority of 10000 plant population ha\(^{-1}\) which recorded 66.75 g seed weight head\(^{-1}\) followed by 30,000 plant population ha\(^{-1}\) (61.75 g). The minimum seed weight head\(^{-1}\) (34.50 g) was observed in the plots where dense plant populations of 90,000 plants ha\(^{-1}\) were kept.
Seed index (g)
The seed index under different plant population exhibited different results for seed index. The experimental results showed that three plant populations i.e 10000, 30000 and 50000 plants ha⁻¹ maximized the seed index values (53.25, 52.25 and 51.00 g respectively) followed by the treatment where 70,000 plants population of ha⁻¹ was used which showed the seed index of 45.500 g. The minimum seed index value (36.00g) was noted in the plots where dense plant population of 90,000 plants ha⁻¹ was tested.

Seed yield (kg ha⁻¹)
The results for seed yield (kg ha⁻¹) showed the superiority of 70000 plant population ha⁻¹ by recording significantly higher seed yield (1551.25 kg ha⁻¹), followed by treatment where 50,000 and 30,000 ha⁻¹ plant populations were tested. Low seed yield (1215.00 kg ha⁻¹) was observed in very high plant population (90000 plants ha⁻¹) or under very low plant population (10000 plants ha⁻¹). The reason may be that dense plants competed for moisture, sunlight and nutrients. The yield was also low in the plots having low plant population which gave lower number of heads which in turn recorded reduced seed yield.

Relationship of sunflower crop parameters with seed yield

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Relationship of sunflower crop parameters with seed yield

The extent of relationship of crop parameters showed that stem girth (r= -0.02), head diameter (r= -0.01) and seed index (r= -0.06) had negative and non significant association with sunflower seed yield. However, plant height (r= 0.01), seeds head⁻¹ (r= 0.33) and seed weight head⁻¹ (r=0.13) exhibited positive but non significant relationship with seed yield of sunflower crop under different plant population (Table-2). The negative and non significant association of crop parameters might be due to response of these parameters to very low plant population (10000 plants ha⁻¹), whereas, seed yield response was maximum to moderate plant population (70000 plants ha⁻¹).

DISCUSSION

In the present experiment, it was found that plant population had significantly different trends for plant height. The lower plant population ha⁻¹ recorded the taller plants, whereas, higher plant population recorded smaller plants. Similar trend was observed in stem girth, head diameter, seeds ha⁻¹ and seed index. All these parameters were significantly higher under 10,000-50,000 plant population ha⁻¹. However, seed yield (kg ha⁻¹) was superior in 70000 plant population ha⁻¹. The seed yield was recorded low in the plots where high plant population (90000 plants ha⁻¹) and very low plant population (10000 plants population ha⁻¹) were listed. This might be due to competition of plants for moisture, nutrients and light in very high plant population plots or minimum yield in low populated (10000 plants ha⁻¹) plots were associated with low number of harvested heads in turn reduced the seed yield of the crop. These findings are in close agreement with the findings of Goksoy et al. (1998) they reported that plant population significantly affected seed and oil yields and other plant characteristics. As plant population increased, head diameter, 1000-seed weight and seed weight per head decreased linearly and highest seed yield was obtained at 95000 plants ha⁻¹. Salehi and Naderi (2000) reported that increasing plant population decreased head diameter, seed number and weight per plant and seed protein percentages. Seed and oil yields increased with increasing plant population and reached maximum at a population of 6.66 plants m² (25 cm between plants in row). Singh et al. (2003) also observed that plant population had a linear functional relationship with seed yield (Y= 3.73+ 4.52).

Table-1: Sunflower plant parameters as affected by different plant population.

<table>
<thead>
<tr>
<th>Plant Population (plant ha⁻¹)</th>
<th>Plant Height (cm)</th>
<th>Stem Girth (cm)</th>
<th>Head Diameter (cm)</th>
<th>Seeds Head⁻¹</th>
<th>Seed Weight Head⁻¹ (g)</th>
<th>Seed Index Value (g)</th>
<th>Seed Yield (kg ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90000</td>
<td>186.75</td>
<td>6.50</td>
<td>13.81</td>
<td>759.50b</td>
<td>34.50d</td>
<td>36.00c</td>
<td>1241.25c</td>
</tr>
<tr>
<td>70000</td>
<td>226.25</td>
<td>7.67</td>
<td>16.50</td>
<td>1355.00a</td>
<td>45.75c</td>
<td>45.500b</td>
<td>1551.25a</td>
</tr>
<tr>
<td>50000</td>
<td>255.00</td>
<td>8.56</td>
<td>20.68</td>
<td>1448.75a</td>
<td>58.00b</td>
<td>51.00a</td>
<td>1411.25b</td>
</tr>
<tr>
<td>30000</td>
<td>270.00</td>
<td>8.81ab</td>
<td>21.43ab</td>
<td>1475.75a</td>
<td>61.75ab</td>
<td>52.25a</td>
<td>1408.75b</td>
</tr>
<tr>
<td>10000</td>
<td>267.25a</td>
<td>9.31a</td>
<td>21.62a</td>
<td>1481.25a</td>
<td>66.75a</td>
<td>53.25a</td>
<td>1215.00c</td>
</tr>
</tbody>
</table>

Statistical analysis results

<table>
<thead>
<tr>
<th>CV (%)</th>
<th>SE</th>
<th>LSD (5%)</th>
<th>LSD (1%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.87</td>
<td>3.457</td>
<td>10.65</td>
<td>14.93</td>
</tr>
<tr>
<td>3.95</td>
<td>0.146</td>
<td>0.450</td>
<td>0.630</td>
</tr>
<tr>
<td>2.06</td>
<td>0.193</td>
<td>0.59</td>
<td>0.83</td>
</tr>
<tr>
<td>10.42</td>
<td>67.95</td>
<td>209.40</td>
<td>286.75</td>
</tr>
<tr>
<td>5.18</td>
<td>1.38</td>
<td>4.25</td>
<td>4.21</td>
</tr>
<tr>
<td>4.10</td>
<td>0.975</td>
<td>3.00</td>
<td>4.17</td>
</tr>
<tr>
<td>1.42</td>
<td>9.67</td>
<td>29.80</td>
<td>41.78</td>
</tr>
</tbody>
</table>

Means followed by common letter are not significantly different at 1% probability level.
Table-2: Correlation coefficient (r) values of various sunflower crop parameters as affected by different plant population.

<table>
<thead>
<tr>
<th>Crop parameters</th>
<th>Plant height</th>
<th>Stem girth</th>
<th>Head diameter</th>
<th>Seeds head(^1)</th>
<th>Seed weight head(^1)</th>
<th>Seed index</th>
<th>Seed yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant height</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stem girth</td>
<td>0.92</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head diameter</td>
<td>0.96</td>
<td>0.92</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seeds head(^1)</td>
<td>0.83</td>
<td>0.81</td>
<td>0.811</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed weight head(^1)</td>
<td>0.95</td>
<td>0.89</td>
<td>0.93</td>
<td>0.860</td>
<td>1.00</td>
<td></td>
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<tr>
<td>Seed index</td>
<td>0.94</td>
<td>0.95</td>
<td>0.95</td>
<td>0.765</td>
<td>0.92</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Seed yield</td>
<td>0.10</td>
<td>-0.02</td>
<td>-0.01</td>
<td>0.33</td>
<td>0.13</td>
<td>-0.06</td>
<td>1.00</td>
</tr>
</tbody>
</table>

REFERENCES


