Effect of row spacing and sowing date on yield and yield components of common bean 
(*Phaseolus vulgaris* L.)

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Seed legumes are extremely important crop plants, which are widely cultivated in the Middle East. The study was conducted to determine the effect of different seeding times and seed rates on the growth, yield and quality of common bean (*Phaseolus vulgaris* L.). The experiment was laid out using RCBD under split plot arrangement with three replications. Three Row space as main plot R1 (50), R2 (40) and R3 (30) and tow sowing dates D1 (2 June) and D2 (14 June) as sub plot. Obtained result from this research showed that grain yield, 100 seed weight, number of pods and seeds per plant, stem height and harvest index of bean were affected significantly by row space and sowing date treatments. Highest amount of all of these characters was measured in 50 cm row space between bean crops and lowest amount of them was recorded in 30 cm distance between beans. Among two sowing date maximum amount of grain yield, 100 seed weight, number of pods and seeds per plant was obtained in D1 (sowing in 2 June).

**Key words:** Bean, row spacing, sowing date, yield components.

**INTRODUCTION**

Due to rapid population growth, it is, essential to explore the economic feasibility of less known pulse crops. Pulses are an excellent source of plant protein and good substitute of animal protein so known as poor man's meat in the developing world. Grain legumes have twice and sometimes even three times the protein content of cereals. Common bean is the most important legume worldwide for direct human consumption. Planting date is one of the important cultural practices that result in the greatest differences in growth and yield of grain legumes. The optimum planting date varies according to cultivar planted. The time of sowing a crop is a critical factor in determining the environmental conditions at planting, anthesis, pod-filling and drying. Therefore, sowing date can be important in determining the success of the crop and in maximizing seed yield (Dapaah et al., 2000). Early sowing can result in high grain yields if it enables the crop to escape hot summer weather that can hinder reproductive development (Hall, 1992). Early sowing invites a large number of insect pests and diseases, while late sowing fetches lesser grain yield due to short growing season and ultimately lesser accumulation of photosynthesis (Quresh and Rahim, 1987). Earlier studies have shown that seeding rate or planting density is an important factor affecting yield of grain legumes. Steele and Grabau (1997) observed low initial stands of plants in early sowing. These results are quite similar to the findings of Gebologlu et al. (1996), who reported higher number of pods per plant in late sowing as compared to early sowing. Increase in yield can be ensured simply, by maintaining appropriate plant population through different planting patterns. Planting pattern influences radiation interception and utilization of moisture from soil (Rehman, 2002). Therefore, yield response of seed legumes to seeding rates were discussed by several workers, and different relative
values between hay and seed yield with seeding rate were found (Martin et al., 1994; Noffsinger, Santen, 1995; Tawaha, Turk, 2001). Rajput et al. (1984) reported that number of pods per plant was significantly affected by planting geometry. Khan et al. (2001) in reported that different planting and row spacing significantly affected the number of grains pod$^{-1}$. Hussain (2003) reported that sowing methods affected the harvest index and maximum harvest index was recorded with bed sowing. Seijoon et al. (2000) found that the increased harvest index with late sowing could be related to high assimilate use efficiency due to increased sink capacity. Several studies have reported yield advantage in legume crops when planted in narrow rows. Blackshaw et al. (1999) demonstrated that reduction in row spacing from 69 to 23 cm increased yield. Park (1993) and Sandoval-Avila et al. (1994) also reported similar effects in common bean (Phaseolus vulgaris L.).

The aim of this experiment was to investigation of sowing date and row spacing on common bean yield and yield components in Kermanshah region of Iran.

MATERIALS AND METHODS

This experiment was conducted on 17 June 2007 cropping at Agriculture Research Center Mahidasht of Iran. The site lies at longitude 48, and latitude 34°16 and the altitude of the area is 1365 m above sea level. The experiment was laid out using RCBD under split plot arrangement with three replications. Row space as main plot R$_1$ (50 cm), R$_2$ (40 cm) and R$_3$ (30 cm) and sowing dates as sub plot D$_1$ (2 June) and D$_2$ (14 June) in three replication. The net plot size was 3m×5m. Phosphorus was supplied in the form of Triple superphosphate (21% P$_2$O$_5$). The phosphate fertilizer was used before cultivation. Nitrogen fertilizer was applied uniformly by hand across all treatments [30 kg N ha$^{-1}$ at sowing in form of Urea (46% N) and 30 kg N ha$^{-1}$ top-dressed at start flowering]. Weeds were controlled by hand as needed. Data collected (Obtained by combining the four center rows at each experiment unit) included: were Plant height, number of pods plant$^{-1}$, Number of seeds per plant, 100-seed weight and seed yield. The following measurements were taken from each sub plot: seed yield (ton ha$^{-1}$) was obtained by threshing the plants from the harvested (3 m$^2$) area; clean seeds were weighed, and the average seed yield ha$^{-1}$ was calculated. Seed weight plant$^{-1}$ (g) was obtained from ten random plants 100 seed weight (g) was determined by mixing the whole sample; thereafter 100 seeds were randomly counted and weighted. Pods plant$^{-1}$ and seeds plant$^{-1}$ were determined from ten random plants. Plant height (cm) was measured at 100% flowering from the soil surface to the top of plant using a standard ruler. Data were analyzed considering a randomized complete block design (RCBD) with split-plot MCTATC software. Comparisons between means were made using least significant differences (LSD) at 0.05 probability level.

RESULTS AND DISCUSSIONS

Grain yield

Data clearly were shown that (Table 1) grain yield was influenced significantly (P < 0.01) by row space and sowing date. Higher and lower grain yield of bean (Phaseolus vulgaris L.) in different row spacing were obtained from R$_1$ (50 cm) and R$_3$ (30 cm) with mean of 4.10 and 2.34 ton ha$^{-1}$ respectively as shown in Table 2. This result showed that increase in row space from 50 to 30 cm increased grain yield of bean about 42.92%. These results confirm the findings of Khan et al. (1988) who reported that moderate seed rate (17.5 to 25 kg ha$^{-1}$) were better than low (10 to 15.5 kg ha$^{-1}$) and higher (27.5 to 37.5 kg ha$^{-1}$) seed rate. Steele and Grabau (1997) Planting density is an important factor affecting yield of grain legumes. Results in Table 2 showed maximum and minimum amount of grain yield among sowing dates measured in D$_1$ (2 Jun) and D$_2$ (14 Jun) with mean of 3.38 and 3.07 ton ha$^{-1}$ respectively. These results showed that sowing beans in 2 June increased grain yield of bean by 9.17% in compare to sowing in 14 June. These results are in line with the findings of Bilal (1994) who reported that late sowing (13 April) decreased seed yield of mungbean. Dapaah et al. 2000 stated that sowing date can be important in determining the success of the crop and in maximizing seed yield. In another study Hall (1992) reported early sowing can result in high grain yields if it enables the crop to escape hot summer weather that can hinder reproductive development.

100 grain weight

Obtained results in this research (Table 1) showed that row space and sowing date had significant (P < 0.01) effect on 100-grain weight of bean but interaction of them was not significant. Main compression showed that among row spaces maximum amount of 100-grain weight (49.70) resulted from R$_1$ (50 cm) and lower 100-grain weight (40) was measured from R$_3$ (30 cm) treatment. Results in this part showed that 50 cm distance between bean crops could increased 100-grain weight about 19.51% as compare to 30 cm distance. These results are in conformity with the findings of Tahir (1998) who reported that different influenced significantly 1000-seed weight. Among two sowing dates, highest mean of 100-grain weight was obtained from sowing in 2 June (D$_1$) (43.65 gr) and lowest amount of 100-grain weight was measured from sowing in 14 June (D$_2$) (43.12 gr). This result corroborated the earlier findings of (Quresh and Rahim, 1987) how reported late sowing fetches lesser grain yield due to short growing season and ultimately lesser accumulation of photosynthesis.

Number of pods and seeds per plant

The effect of row space and sowing date on number of pods per plant and number of seeds per plant an increase in number of pods per plant and number of seeds per plant was observed by increasing row space. The highest amount of pods and seeds per plant was
Table 1. Analysis of variance for yield and yield components of bean.

<table>
<thead>
<tr>
<th>S.O.V</th>
<th>df</th>
<th>Grain yield</th>
<th>100-grain weight</th>
<th>Number of seeds per plant</th>
<th>Number of pods per plant</th>
<th>Stem height</th>
<th>Harvest Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row spacing</td>
<td>2</td>
<td>5233043**</td>
<td>781/29**</td>
<td>11939/23**</td>
<td>1219/65**</td>
<td>486/88**</td>
<td>612/725**</td>
</tr>
<tr>
<td>Error a</td>
<td>4</td>
<td>52672</td>
<td>0/55</td>
<td>1/49</td>
<td>0/84</td>
<td>5/16</td>
<td>0/79</td>
</tr>
<tr>
<td>Sowing date</td>
<td>1</td>
<td>1654592/22**</td>
<td>5/12*</td>
<td>61/97**</td>
<td>22/89**</td>
<td>43/38**</td>
<td>10/59**</td>
</tr>
<tr>
<td>Interaction</td>
<td>2</td>
<td>111888/85ns</td>
<td>1/07ns</td>
<td>0/61ns</td>
<td>1/25ns</td>
<td>2/72ns</td>
<td>9/73ns</td>
</tr>
<tr>
<td>Error b</td>
<td>6</td>
<td>8792/87</td>
<td>5/76</td>
<td>1/56</td>
<td>6/65</td>
<td>33/70</td>
<td>5/57</td>
</tr>
<tr>
<td>CV</td>
<td></td>
<td>15/53</td>
<td>2/87</td>
<td>14/47</td>
<td>16/35</td>
<td>6/43</td>
<td>8/65</td>
</tr>
</tbody>
</table>

*, ** significantly at the 5 and 1% levels of probability respectively and ns (non significant).

Table 2. Mean comparison of interaction effects yield and yield components of bean.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain yield</th>
<th>100-grain weight</th>
<th>Number of seeds per plant</th>
<th>Number of pods per plant</th>
<th>Stem height</th>
<th>Harvest Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row spacing</td>
<td>ton/ha</td>
<td>gr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R₁ (50 cm)</td>
<td>4/10 a</td>
<td>49/70 a</td>
<td>67/75 a</td>
<td>23/23 a</td>
<td>49 a</td>
<td>50/30 a</td>
</tr>
<tr>
<td>R₂ (40 cm)</td>
<td>3/50 b</td>
<td>44/83 b</td>
<td>39/67 b</td>
<td>15/19 b</td>
<td>44/83 b</td>
<td>30/72 b</td>
</tr>
<tr>
<td>R₃ (30 cm)</td>
<td>2/54 c</td>
<td>40 c</td>
<td>23/69 c</td>
<td>9/01 c</td>
<td>40 c</td>
<td>20/89 c</td>
</tr>
<tr>
<td>Sowing date</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D₁ (2 June)</td>
<td>3/38 a</td>
<td>43/65 a</td>
<td>44/63 a</td>
<td>16/37 a</td>
<td>44/97 a</td>
<td>25/28 a</td>
</tr>
<tr>
<td>D₂ (14 June)</td>
<td>3/07 b</td>
<td>43/12 b</td>
<td>15/25 b</td>
<td>15/25 b</td>
<td>44/25 a</td>
<td>24/98 a</td>
</tr>
</tbody>
</table>

Mean followed by similar letters in each column, are not significantly at the 5% level of probability.

measured in R₁ (50 cm) treatment with mean of 23.23 and 67.75 respectively and lowest mean of pods and seeds per plant was recorded in R₃ (30 cm) treatment with mean of 9.01 and 23.69 respectively. These results are in line with the findings of Rajput et al. (1984), how stated that number of pods per plant was significantly affected by planting geometry. In another study Khan et al. (2001) using mungbean, reported that different planting and row spacing significantly affected the number of grains pod⁻¹. But Gebologlu et al. (1996), reported higher number of pods per plant in late sowing as compared to early sowing. Among the two sowing date maximum amount of pods and seeds per plant was recorded in D₁ (2 June) with mean of 16.37 and 44.69 and minimum number of pods and seeds in bean was measured in D₂ (14 June) with mean of 15.25 and 15.25 respectively. These results showed that changing in sowing date from 2 June to 14 June decreased number of pods per plant with about 6.8% and decreased number of seeds per plant with about 65.83% (Table 2).

Stem height and harvest index

Observed result showed that row spacing treatment had significant effect on stem height and harvest index of bean as shown in Table 1 and the mean comparison data in Table 2 using 50 cm row space in R₁ (49 cm) between bean crop increased stem height by 18.36% in compare to using 30 cm row space (40 cm) and the harvest index was increased by 58.46% with increasing row space from 30 cm (harvest index = 20.89) to 50 cm (harvest index = 50.30) between bean crops. Our results in Table 2 showed that sowing date didn’t have any significant effect on stem height and harvest index. These results are in line with the findings of Hussain (2003), how reported that sowing methods affected the harvest index and maximum harvest index was recorded with bed sowing. Seijoon et al. (2000) found that the increased harvest index with late sowing could be related to high assimilate use efficiency due to increased sink capacity.

REFERENCES


Dapaah HK, Mckenzie BA, Hill GD (2000). Influence of sowing date and irrigation on the growth and yield of pinto beans (Phaseolus vulgaris)


