Performance of Kidney bean (Phaseolus vulgaris L.) under different sowing dates in sub-mountainous area of Punjab

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ABSTRACT
A field experiment was conducted at Regional Research Station (Punjab Agricultural University) Gurdaspur and Krishi Vigyan Kendra, Pathankot during the spring season of 2016, to determine the performance of kidney bean genotypes at different sowing dates under sub-mountainous conditions of Punjab. The two kidney bean genotypes i.e. red and speckled were evaluated for yield potential at two locations by adopting different sowing dates viz., 20th January, 1st February, 10th February and 20th February, 2016. The treatments were laid out in split plot design with four replications by keeping sowing dates in main plots and genotypes in sub plots. Among different dates of sowing, crop sown on 10th February showed superiority than other dates through higher emergence count per meter row length, plant height, branches per plant, pods per plant, seeds per pod, length of pod, length of pod, biological yield and seed yield. The seed yield in February 10 sown crop was 66.4, 33.3 and 21.7 per cent higher than February 20, January 10 and February 1 sown crop, respectively at Gurdaspur. Similarly, at Pathankot, the percent increase in seed yield in February 10 sown crop was 36.0 and 7.2 per cent as compared to February 20 and February 1 sown crop, respectively. The kidney bean genotype speckled produced significantly higher yield attributes (seeds per pod, length of pod and 100 seed weight) and seed yield at both Gurdaspur and Pathankot (935.1 and 823.1 kg per ha, respectively) as compared to red genotype. Therefore, it can be concluded that to attain higher productivity of kidney beans, the speckled genotype could be used for cultivation by adopting February 10 as the optimum time of sowing in the sub-mountainous area of Punjab.

Key words: Dates of sowing, Kidney beans, Red, Seed Yield, Speckled, Varieties.

INTRODUCTION
Kidney bean (Phaseolus vulgaris L.) is one of the important seed crops and belongs to the family Fabaceae. It is also known as rajmash, rajma, kidney bean, french bean, haricot bean, field bean, snap bean, navy bean, dry bean and pole bean etc. and widely used for its fresh pods and dry seeds. It provides calories, proteins, vitamin A and C (Mayhew and Penny,1988) and minerals like calcium, phosphorus, and iron (Lema, 2003) and has high nutritive value in human nutrition in the world (El-Noemani et al. 2010). Since 6000 years ago, it was domesticated in Central and South America (Chatterjee and Bhattachryya, 1986). In India, it is mainly grown as a winter crop in Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh and some parts of Andhra Pradesh, Maharashtra, Western and Eastern Ghats and North-East plains where winters are mild and frost free. Kidney bean crop is greatly affected by weather and among physical factors of weather, temperature is one which influences the rate of growth and development in a particular agro-climatic condition. Kay (1979) reported that the optimum temperature required for the growth and development of kidney bean is 16-24°C. In kidney bean cultivation, time of sowing is the most critical factor for attaining higher yields. Farmers can achieve much higher yields by doing simple alterations in the sowing dates along with the selection of varieties. Amanullah et al. (2002) also reported that among different agronomic practices, optimum sowing time and a suitable variety are very much important for exploring potential yield. Vange and Obi (2006) also observed marked reduction in growth and yield of kidney beans with delay in sowing beyond the optimum time in different parts of the world. Sowing time is also a critical parameter in determining the environmental conditions that are required for its good growth and development without involving additional costs and varies according to cultivars (Dapaah et al. 2000). The positive effect of environmental factors on growth and yield could only be harnessed if proper information about optimum time of sowing is made available along with a suitable variety (Moniruzzaman et al. 2007). In Punjab, kidney bean is a new crop and no systematic

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research has been done to evaluate the effect of sowing dates and genotypes on yield and yield attributes. Therefore, this experiment was conducted to observe the influence of date of sowing and genotypes on yield and yield attributes of kidney beans in the sub-mountainous area of Punjab state of India.

MATERIALS AND METHODS

A field experiment was conducted at Regional Research Station, Gurdaspur and at Krishi Vigyan Kendra, Pathankot during the spring season of year 2016. At Gurdaspur, the site was situated at latitude of 32°02’ and longitude of 75°25’ and an elevation of 219 m above mean sea level. The site comes under sub mountainous undulating zone having annual average rainfall of 1075 mm. The soil of experimental site was loam in texture, normal in reaction, medium in fertility with respect to available nitrogen and phosphorus and low in potassium. The second location i.e. Pathankot, also comes under sub mountainous undulating zone having annual average rainfall of 1100 mm. Pathankot is situated at latitude of 32°26’ and longitude of 75°64’ and an elevation of 331 m above mean sea level. The soil of experimental site was loam sand in texture having normal in reaction, medium in organic carbon, available nitrogen and phosphorus and low in potassium.

The treatments comprised of dates of sowing and genotypes. The experiment was laid out in split plot design with four replications at both the locations. In this experiment, dates of sowing were kept in main plots while sub-plot treatments consisted of genotype namely red and speckled. The four dates of sowing at 10 days interval i.e. January 20, February 1, February 10 and February 20 were executed in Gurdaspur and in Pathankot the sowing of kidney beans was done on three dates at similar intervals i.e. February 1, February 10 and February 20. The sowing of both the varieties was done by dibbling seeds on the top of ridges at a depth of 3-4 cm and keeping row to row and plant to plant spacing of 60 cm and 10 cm, respectively. The fertilizers were applied at the rate of 80 kg urea and 100 kg single super phosphate per acre. Half dose of urea and full dose of single super phosphate was applied at sowing time and half dose of urea was applied at about one month after sowing. Weeds were controlled by doing manual weedings at 30 and 60 days after sowing.

The data for emergence count was taken at 30 days after sowing. From each plot two rows were randomly selected and number of plants emerged were counted from one meter row length and mean was calculated. The vegetative growth was evaluated as plant height and number of branches per plant. At harvest, five plants were randomly selected from each plot to collect data on vegetative growth and yield attributing characters like pods per plant, seeds per pod and 100 seed weight. Plant height (cm) was measured up to base of last branch on the main shoot and then mean was calculated. For recording data on number of branches per plant, total branches bearing pods were counted from five plants and then average worked out. To calculate seeds per pod, ten pods were randomly picked from five randomly selected plants and seeds per pod were counted for ten pods and then mean number was taken. To calculate 100 seed weight, sample was taken from produce of each plot and 100 seeds were counted and weighed in grams. The biological yield and seed yield were recorded on plot basis and were converted to kg per hectare.

The data for all the parameters were statistically analyzed by CPCS-1 software by Cheema and Singh (1991) as per the standard procedure for the analysis of variance (ANOVA) for split plot design for both the locations. All possible pairs of treatment means were compared at 5 % probability level.

RESULTS AND DISCUSSION

The effect of date of sowing on yield and yield components: The experimental results revealed that the crop sown on 10 February recorded maximum plant height (36.0 cm) and it was statistically at par with the crop sown on 20 February at Gurdaspur (Table 1). Similarly, at Pathankot the maximum plant height of 36.4 cm was observed in the crop sown on 10 February. Maximum plant height during the month of February could be due to extended prevalence of

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Date of Sowing</th>
<th>Emergence count per 2 m row length</th>
<th>Plant Height (cm)</th>
<th>Branches plant⁻¹</th>
<th>Biological yield (kg ha⁻¹)</th>
<th>Days to maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Gsp</td>
<td>Ptk</td>
<td>Gsp</td>
<td>Ptk</td>
<td>Gsp</td>
</tr>
<tr>
<td>D1 (January 10)</td>
<td>83.6</td>
<td>-</td>
<td>32.1</td>
<td>-</td>
<td>5.6</td>
<td>-</td>
</tr>
<tr>
<td>D2 (February 1)</td>
<td>117.4</td>
<td>116.6</td>
<td>30.1</td>
<td>31.5</td>
<td>5.3</td>
<td>5.3</td>
</tr>
<tr>
<td>D3 (February 10)</td>
<td>143.0</td>
<td>137.0</td>
<td>36.0</td>
<td>36.4</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>D4 (February 20)</td>
<td>113.6</td>
<td>109.3</td>
<td>35.8</td>
<td>32.4</td>
<td>5.3</td>
<td>5.3</td>
</tr>
<tr>
<td>LSD = 0.05%</td>
<td>14.5</td>
<td>3.4</td>
<td>2.7</td>
<td>2.5</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Genotype

Red

|           | 111.7 | 117.3 | 37.4 | 36.7 | 5.7 | 5.5 | 2249.3 | 2028.8 | 89.1 | 90.0 |

Speckled

|           | 117.1 | 124.6 | 29.6 | 30.2 | 5.2 | 5.1 | 2773.4 | 2485.4 | 89.4 | 89.7 |

LSD = 0.05%

|           | NS | NS | 2.7 | 3.4 | 0.4 | 0.3 | 193.6 | 282.5 | NS | NS |

Note: Gsp- Gurdaspur; Ptk- Pathankot
sunlight during the growth period which might have stimulated more growth compared to the sowing done in the month of January. Singer et al. (1996) reported maximum plant height at the warmest than the coolest environmental condition. A decrease in plant height was observed in both early and delayed sowing of crop. The decrease in plant height in early sowing of crop might be due to the lower temperatures during early phase of the crop (Fig 1). However, the smaller plants in late sown crop might be due to shorter growing period. Vieira et al. (1990) also reported that the depression of plant height could result from reduction of photosynthetic efficiency of a plant and it was also clearly indicated in Table 1, that the late sown crop took less days to mature at Gurdaspur and Pathankot locations. The crop sown on 20 January took maximum number of days to mature at both the locations. The number of fruit bearing branches did not significantly affected by sowing dates. But, the biological yield of kidney beans was significantly affected by sowing dates at both the locations. At Gurdaspur, the crop sown on February 10 recorded significantly higher biological yield with the per cent increase of 51.3, 32.1 and 196.0 per cent over January 10, February 1 and February 20 respectively. Similarly, at Pathankot the per cent increase was 38.3 and 193.2 per cent over February 1 and February 20, respectively. The maximum biological yield in February 10 sown crop at both the locations might be due to the maximum number of plants per metre row length. The data in Table 1, clearly revealed that the emergence count of February 10 sown crop was significantly higher as compared to the other dates of sowing.

Seed yield of kidney beans (Table 2) was significantly influenced by dates of sowing. The highest seed yield of 1123.0 kg per ha was recorded at Gurdaspur in February 10 sown crop and which was higher to the extent of 33.3, 21.7 and 66.3 per cent over January 20, February 1 and February 20 sown crop, respectively. Similarly, at Pathankot the crop sown on February 10 yielded higher seed yield as compared to all other treatments with per cent increase of 7.2 and 36.0 per cent over February 1 and February 20 sown crop, respectively. The lower yield from late sowing was probably because of limited vegetative growth due to the increased temperature (Fig 1) at later stages which cause limited photosynthetic availability to the plants. Seyum (2014) reported reduced yield in late sown crop due to shortening of vegetative growth of plants. Marlene et al.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Seed yield (kg ha⁻¹)</th>
<th>Pods plant⁻¹</th>
<th>Seeds pod⁻¹</th>
<th>Length of pod (cm)</th>
<th>100 seed weight (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gsp</td>
<td>Ptk</td>
<td>Gsp</td>
<td>Ptk</td>
<td>Gsp</td>
</tr>
<tr>
<td>D1 (January 10)</td>
<td>842.3</td>
<td>-</td>
<td>10.2</td>
<td>-</td>
<td>4.2</td>
</tr>
<tr>
<td>D2 (February 1)</td>
<td>922.5</td>
<td>818.7</td>
<td>9.4</td>
<td>9.3</td>
<td>4.2</td>
</tr>
<tr>
<td>D3 (February 10)</td>
<td>1123.0</td>
<td>877.9</td>
<td>10.4</td>
<td>10.3</td>
<td>4.4</td>
</tr>
<tr>
<td>D4 (February 20)</td>
<td>668.6</td>
<td>645.5</td>
<td>9.8</td>
<td>8.3</td>
<td>4.0</td>
</tr>
<tr>
<td>LSD = 0.05%</td>
<td>101.9</td>
<td>78.1</td>
<td>0.7</td>
<td>0.8</td>
<td>NS</td>
</tr>
</tbody>
</table>

**Table 2:** Yield and yield attributes of kidney beans as influenced by sowing dates and genotypes.

**Note:** Gsp- Gurdaspur, Ptk- Pathankot
Yield variations could be attributed to various yield contributing characters (Table 1). Number of pods per plant were significantly higher with February 10 sowing date in both the locations and it decreased with both advancement and delay in sowing. The decrease was as high as 9.6 per cent in February 1 at Gurdaspur (9.4 pods per plant) and by 19.4 per cent in February 20 at Pathankot (8.3 pods per plant) when compared to February 10 sown crop. The number of seeds per pod, length of pod and 100 seed weight remained statistically at par with each other at both the locations, however the more number of seeds per pod with maximum length of pod were recorded when crop was sown on February 10. Saini and Negi (1998) also reported better performance of yield components in early sown crop of rajmash. The late sowing dates had short growing periods and might be produced less leaf area. The amount of photosynthesis is a function of the total leaf area and the solar radiation intercepted (Poehlman, 1991). This might be the reason for decreased pods per plant and grain yield in late sown crop. This result is in agreement with the works of Yoldas and Esiyok (2007), who obtained the lowest yield during the time of late sowing due to a short vegetation period of the crop. The pod number, length of pod and 100-seed weight decreased thereafter with delayed sowing.

**Growth and yield as affected by genotypes:** The results depicted in Table 1 revealed that both the genotypes differed significantly for plant height, branches per plant and biological yield. But, emergence count and days to maturity did not differed significantly at both the locations. The significantly taller plants (37.4 and 36.7 cm) with more number of fruit bearing branches per plant were recorded in kidney bean genotype *red* as compared to *speckled* at Gurdaspur and Pathankot, respectively. However, the biological yield was significantly higher in *speckled* genotype and it was 23.5 and 22.2 per cent higher than *red* genotype at Gurdaspur and Pathankot, respectively. Differential response of genotypes to plant height, branches per plant and biological yield was might be due to their genetic character and adaptability to growing environment. Interactive effect of sowing dates and varieties were found to be non significant at both the locations.

The seed yield of *speckled* genotype was recorded significantly higher with 10.9 and 11.4 per cent increase over *red* genotype in Gurdaspur and Pathankot, respectively. However, the number of pods per plant were significantly higher in kidney bean genotype *red* but the number of seeds per pod and pod length were significantly more in *speckled* genotype at both the locations. 100-seed weight is another important character in kidney beans. The *speckled* genotype recorded significantly higher 100-seed weight at both Gurdaspur and Pathankot (36.3 and 36.2 g, respectively) than the genotype *red* (26.1 and 25.2 g, respectively). It was mainly due to boldness of seed in *speckled* as compared to *red* genotype. Pandey *et al.* (1978) stated that the pod yield of French bean increased mainly due to higher pod number per plant and pod weight per plant. Thus, owing to integration of all the favorable yield components, such as more number of seeds per pod, pod length and higher seed weight per plant *speckled* genotype produced significantly higher grain yield as compared to *red* genotype. None of the interaction effects involving dates of sowing and genotypes were significant for growth components, yield components and yield of kidney beans. Thus, the results revealed that *speckled* genotype could be used for cultivation and 10 February is the optimum time for sowing the crop in the sub-mountainous area of Punjab.

**REFERENCES**


