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Considerable effect of sowing dates and cultivars on the nutritional and functional properties of Mung Bean (*Vigna Radiata*)

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Abstract

Different sowing dates affect the growth and development of crop plants due to change in climatic conditions. The main objective of this study is to characterize mung bean cultivars for protein concentration and to determine high yielding mung bean genotypes with its ability of maximum protein synthesis under different sowing dates. A field experiment was conducted at the two locations in Pakistan one experimental area being the NARC (Islamabad) whereas the second experimental area was the Koont farm (Chakwal). The experiment was laid out in RCBD factorial design with three replications. Sowing dates on the main plot and cultivars on the sub plots, three sowing dates *viz*., 28 June, 8 July and 16 July and three cultivars *viz*. AZRI-06, NM-06 and NM-11 were used in the experiment. Late sowing in July was produced maximum yields (851.56 kg ha^{-1}) and protein contents. AZRI-06 was produced maximum potential yield (911 kg ha^{-1}) in the prevailing arid conditions of both locations. It appears to be well adapted to the agro-ecologiical conditions of both Islamabad and Chakwal. Moreover, the use of AZRI-06 is suggested in arid conditions where soils are loam and sandy loam with arid environmental conditions.

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Introduction

Pakistan is the 6th most populous country in the world with projected population of 188 million with an annual increase of 1.95 % (GOP, 2013-14). Due to fast population growth, it is, consequently, important to discover the economic possibility of less recognized pulse crops. Legumes are significant and inexpensive proteins source.

They are recognized as poor man's meet in the developing countries (Chandel *et al.*, 1978). Legumes seeds used for food are known as pulses. It is one of hoariest food crops got invented in the fertile semicircular of the near east (Webb and Hawtin, 1981). Pulses are the main protein sources in the vegetarian diet. In addition being a rich source of protein, they sustain fertility of soil through nitrogen fixation in soil and thus play a energetic role in sustainable agriculture (Kannaiyan, 1999). It delivers a poise diet for the people when eaten in combination with rice, wheat and other cereals. They can also be used for animals in the form of straw (Maqsood *et al.*, 2001).

Mung bean (*Vigna radiata* L.) is an important pulse crop for developed and developing countries. It has the ability to produce higher yield of about 1295 kg ha^{-1} (Bilal, 1994). Mung bean production was 92.9 thousand tons from 130.9 thousand ha, during the year 2013-14 (GOP, 2013-14). It has high nutritive value (protein contents about 22-24%), digestibility especially for babies and convalescents make it important crop at world level (Hozayn *et al.,* 2007).

Planting time is one of the important agronomic factors that determines the growth and development of mung bean ultimately affecting its final yield (Asghar *et al.,* 2006). In the southern states where there is not much difference in climate change occur, it is cultivated both during rainy and summer season. In spite of the small variation in optimal sowing date during different seasons reliant on agro-climatic zone, soil and variety situations sowing between mid-June to mid-July is originate to be optimal time for kharif season (Aslam *et al.*, 200).

Protein contents of seeds vary from 14 to 24% and high amount of methionine, tryptophane and amino acids (Chandel *et al.*, 1978). Being leguminous, mung bean preserves fertility of soil by atmospheric nitrogen fixation through symbiosis with rhizobial strains. Among different reasons of small production of pulses in Pakistan, seeding times and plant population are of main importance (Khan *et al.*, 2000). Agro ecological conditions play a vital role for determination of planting time, similalrly optimum sowing in mung bean may vary from variety to variety (Sarkar *et al.,* 2004).

Sowing times has significant effects on crop growth as interruption in sowing away from the optimal time generally causes reduction in yield (Vange and Obi, 2006). Selection of the cultivar and decisive appropriate sowing date are very essential to attain yield (Jan *et al.*, 2002). Late sowing results in decrease in the crop yield (Green *et al.*, 1985). It has the utmost impacts on the yield of mung bean. Crop sowing at July 5 gave the maximum vendible yield while the minimum vendible yield was attained when sown on May 22 (Yan-sheng *et al.*, 2010). Higher yield but lesser dry matter, pod diameter and pod length was produced at the time of early sowing as compared to the late sowing (Yoldas and Esiyok, 2007).

There is an inordinate potential for increasing area of mungbean and invention in Pakistan by developing high yielding genotypes appropriate for major growing areas. “Ramzan” (mungbean variety) has been developed through hybridization among local and outlandish germplasm. It would be the good option for the farmers to grow this cultivar for harvesting high yields compared to growing old varieties (Khattak *et al.*, 2006).

The present study was conduct in order to appraise the effects of various mung bean cultivars when sown under varying sowing dates at two different locations in Pakistan. The main aim of the study is to characterize three different cultivars of mung bean for their ability for storing protein in seeds.

Material and methods

Experimental Sites

The present study was conducted during 2013-14 at National Agricultural Research Centre, Islamabad (33° 43' N, 73° 3' E) and Koont Farm, Chakwal (32.93° N, 72.87° E), Pakistan. The elevation is 499 meters above the sea level and both the experimental fields are located in an arid climate that receive hot dry summers while winters are dry and cool.

Experimental design and treatments

The experiment was laid out in RCBD factorial design with 3 replications that place sowing dates on the main plot and cultivars on the sub plots, three sowing dates *viz.*, 28 June, 8 July and 16 July and three cultivars *viz.* AZRI-06, NM-06 and NM-11 were used in the experiment. The soil of Islamabad is loam soil whereas the soil of chakwal is sandy clay soils. Row to row (R×R) distance was 30 cm and plant to plant (P×P) distance was 10 cm and seed was used at the rate of 8 kg ha^{-1}. The recommended dose of fertilizer was applied at 25-50-50 NPK kg ha^{-1}. The crops were grown under rainfed condition; therefore, no irrigation was applied.

Parameters Studied

At physiological maturity 10 plants per plot were selected, separated from plants, counted and threshed for seeds, before being weighted seeds were cleaned and protein contents in seed were calculated by micro-kjeldhal method and protein contents was calculated by formula as given below (AOAC, 1920):

$$\text{Crude Protein} = \text{Nitrogen} \times 6.25$$

Data analysis

Collected data was analyzed statistically using Statistics 8.1 program and means were associated with Duncan's multiple range test at 5% probability level (steel and torrie, 1997).

Results and discussion

Effect of sowing dates

Sowing at different dates affected the yield parameters of mung bean up to a significant level, as phonological phases of mung bean are temperature dependent such as flowering, bud and pod formation. After 25 DAE crop has maximum number of flowers and it was gradually decreased after that. Bud formation was initiated after 28 DAE and remained till 34 DAE in different treatments.

Table 1. Mean comparison of yield and yield components of mung bean as affected by sowing dates, cultivars and location.

Treatments	Buds	Pods per plant	Seeds per pod	Seed yield Kg ha^{-1}	Protein content %
Sowing dates					
28 June	34.44 c	11.16 c	5.81 c	486.77 c	24.95 c
8 July	36.89 b	16.91 b	6.33 b	648.53 b	25.51 b
16 July	40.5 a	25.61 a	7.64 a	851.56 a	26.98 a
Cultivars					
AZRI-06	36.67 c	20.59 a	6.94 a	726.05 a	26.30 a
NM-06	37.22 b	15.94 c	6.18 b	600.4 c	25.49 b
NM-11	37.94 a	17.15 b	6.66 a	660.41 b	25.64 b
Location					
NARC	37.63 a	21.14 a	6.93 a	716.8 a	26.02 a
K. Chakwal	39.93 b	14.67 b	6.25 b	607.78 b	25.6 b

Means with the same letter in each column and treatment are not significantly different at probability level of 5% using DMRT.

Minimum number of buds (34.4) were observed in sowing date 1 (28 June) where average mean temperature was 29.8 °C while maximum number of buds (40.5) were calculated in 16 July where mean average temperature was 28.5 which favors the bud formation as higher temperature causes flower shedding. High temperature, precipitation and wind speed during the reproductive phase cause enormous

bud and flower shedding (Rainey and Griffiths, 2005). Tzudir *et al.,* (2014) found that number of mung bean buds increased significantly with in temperature ranged 27-29 °C and below this temperature number buds per plant would be decreased. They found that flower production in mung bean cultivars enhanced if mean air temperature lies between 27-30.5 °C and temperature ranged 27-32 °C is crucial for reproductive stage in mung bean. Pod formation was started after 34 DAE and gradually increased up to 48 DAE.

Table 2. Interactive effect of sowing date and cultivars on seed yield and yield components of mung bean during 2014.

Treatments	Flowering	Pods per plant	Seeds per pod	Seed yield	Protein content
June 28-AZRI-06	35d e	13.01g	6.03de	526.7 g	25.72 cd
June 28-NM-06	33.83 f	9.59 i	5.53 e	433.48 h	24.04 f
June 28-NM-11	34.5 ef	10.87 h	5.88 de	500.13 g	25.07 e
July 8-AZRI-06	37.33 c	18.58 d	6.07 d	740.45 d	25.25 e
July 8-NM-06	37.5 c	15.29 f	6.77 c	573.7 f	26.27 bc
July 8-NM-11	35.83 d	16.84 e	6.18 d	631.6 e	25.00 e
July 16-AZRI-06	41.5 a	30.17 a	8.73 a	911 a	27.93 a
July 16-NM-06	40.33 b	22.93 c	6.25 cd	794.17 c	26.16 c
July 16-NM-11	39.67 b	23.74 b	7.93 b	849.5 b	26.85 b

Means with the same letter in each column and treatment are not significantly different at probability level of 5% using DMRT.

Among all sowing dates highest number of buds and pods were recorded in 16th July. Number of pods per plant was affected by varying sowing dates, highest number of pods per plant were produced on 16 July sown crop (25.61) as shown in Table 1. Our results are in accordance with findings of previous research which showed that higher number of pods per plant were higher in late sowing as compared to the early sowing (Gebologlu *et al.,*1997), number of seed per pod was also affected significantly with the maximum reading obtained in mungeabn in 16 July sowing while early sowing of 8 June gave the minimum results (5.81). Sarkar *et al.,* (2004) found that number of seeds per pod were significantly affected by sowing date with the maximum result was obtained in late sowing. Crops that were sown on 16 July gave the maximum readings in yield parameters of mung bean seed yield was maximum in mung bean sown at 16 July (Table 1) maximum seed yield is also attributed to higher number of pods per plant as well as grain yield. Same results have also been reported by Asghar *et al.,* (2006) who argued that sowing time affect the final seed yield, morover they said that 3rd week of july produced maximum final protein as compared to other sowing dates. Maximum grain yield (851.56 kg ha^{-1}) and protein contents (26.98 %**)** were observed in crop sown on 16th july and minimum yield (486.77 kg ha^{-1}) was given by 1st sowing date (26 June) (Table 1).

Effect of cultivars

Three different cultivars used in experiment had significant results on mung yield artributes. Number of buds and pods per plant varied significanly in case of three cultivars. Maximum numbers of buds (37.94) were calculated in NM-11 while minimum (36.67) were observed in AZRI-06 and NM-06 shwed result between them. But maximum number of pods per plant was observed in AZRI-06 (20.59) whereas the minimum reading was obtained in NM-06 (15.94) whereas NM-11 produced number of pods per plant in transition between the other two cultivars as shown in Table1. This was due to the genetic make up of these cultivars that though NM-11 had highest number of buds but more shedding were observed in this variety and AZRI-06 beared maximum pods. Similarly the maximum number of seeds per pod (6.94) was

observed in AZRI-06 while minimum was recorded in case of NM-06 (6.18). The results are justified as change in cultivar yield components reading might be due to the change genetic make up of each variety. Our results are in accordance with those of Khan and Malik (2001) and Ayub *et al.,* (1999) who presented that number of seeds per pods differ significantly among different cultivars.the maximum number of seed per pod was recorded (6.94) in AZRI-06 that differ statically with those of other cultivars. Khan and Malik (2001) and Sarkar *et al.,* (2004) also reported that seeds per pod differe accordingy to cultivars.

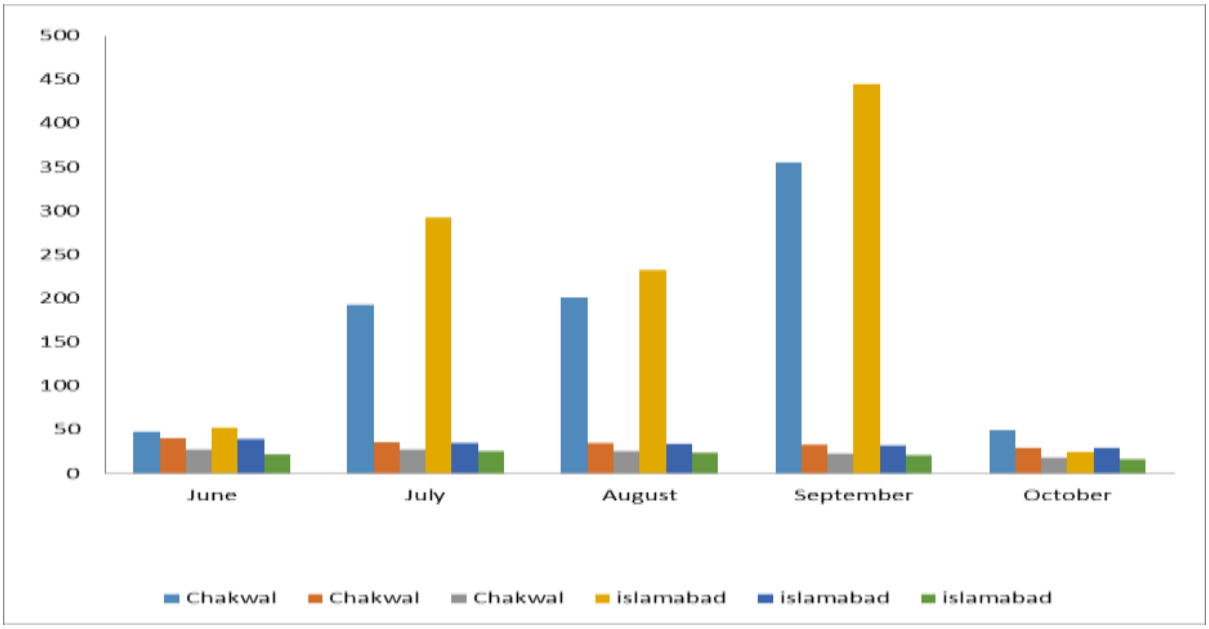

Fig. 1. Temperature and precipitation data.

Statistically significant result was obtain in case of seed yield with maximum in AZRI-06 (726.05 kg ha^{-1}) and minimum in NM-06 (600 kg ha^{-1}) favoured by findings of Singh *et al.,* (2006). Seed yield also increased in AZRI-06 as it is related to number of pods per plant and seed per pod (Table 1) supported by Rehman *et al.,* (2009) that grain yield and yield components were significant with the cultivars potential as well as with the changing sowing dates.

Effect of location

Location effect the yield attributes and final protein differ significantly. Mung bean growth is effected by temperature and precepitation. At NARC islamabad conditions prevailed during the experimental period were more favourable for mung bean growth as compared to conditions in chakwal. Maximum number of pods (21.14) was at NARC and minimum (14.67) were observed in Chakwal. Yield has higher values in NARC then Chakwal. Higher yield (716.8 kg ha $^{-1}$) was obtained from NARC and lower (607.78 kg ha^{-1}) was from Chakwal. Our main concern is of seed protein and it had higher protein (26.02) accumulation in NARC then crop obtained from Chakwal. Crop harvested from Chakwal has lower value of protein (25.6).

That was due to more appropriate conditions for growth that was at NARC during growing season of mung bean (Fig. 1). Adequate and appropriate rainfall received by NARC sown crop increase the productivity of crop that was also the reason of low production in first and second sowing date because it had intense showers at inappropriate timing and high temperature causing the flower shedding and had also received rainfall at later growth stages declining the yield as reported by Khan and Khalil (2010) that Intense showers at later growth stages had drastic effect especially after pod initiation cause decline in yield.

Interaction between sowing dates and cultivars

Seed yield, final protein and various components of yield were affected significantly when analysed in terms of interaction between sowing date and variety, AZRI-06 gave the maximum results of seed yield when it was sown on 16 july (911 kg ha^{-1}) that was mainly due to increased number of pods per plant whereas vaiety NM-06 give the minimum result (433.48 kg ha^{-1}) when it was sown on 28 june that might be attributed to the decreased number of pods per plant and 1000 grain weight (Table 2), number of pods per plant was highest when sown at 16 july in AZRI-06 as well as highest number of seeds per pod was also found to be maximum in AZRI-06 wheras NM-06 performed poor when sown on June 28. Protein and final seed yield was recorded to be maximum in AZRI-06 while significantly poor results were obtained in the other two varities as shown in Table 2. Thus recommended variety selection is suggested because with little fluctuation in environmental condition might cause variation in final yield. Similar results have been reported by Dhuppe *et al*. (2005) and Pun and Villarreal (1989).

Conclusion

From the present study it is concluded that sowing dates and cultivers both affect seed yield and seed components of mung bean. Late sowing in july can produced higest yields and protein contents and AZRI-06 is capable of producing maximum potential yield in the prevailing arid conditions of both locations. It appears to be well adapted to the agro-ecologiical conditions of both Islamabad and Chakwal moreover use of AZRI-06 is suggested in arid condition where soils are loam and sandy loam with arid environmental conditions.

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