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Effect of different sowing dates on yield contributing traits of Mash bean (*Vigna mungo* L.)

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Abstract

Optimum sowing time and a promising variety are of prime importance to catch potential yield of any crop. Sowing time affects plant physiological and morphological specifications like effect on vegetative and reproductive periods, harvest time, yield and its quality. To achieve good yield, crop must be sown at appropriate time. In this regard, yield response of two mash bean genotypes namely mash-97 and ES-1 sown at different sowing dates was studied under field conditions during Kharif 2009 and 2010. Results of study showed that number of fruit bearing branches, 1000-grain weight, pods per plant, seeds per plant and grain yield were significantly affected by sowing dates and higher seed yield was recorded when crop was sown at June 28. The genotype ES-1 gave significantly the highest seed yield compared to mash-97.

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Introduction

Grains of legumes are an important and cheap source of proteins. Pulses are known as poor man's meet in the developing world. When eaten in combination with wheat, rice and other cereals, provide a balance diet for the people. They can be used for animals in the form of hay and straw (Maqsood *et al*., 2001). In addition to their value as food stuff, they are also important in cropping systems because of their ability to produce nitrogen through nitrogen fixing rhizobacteria resulting into an increase in the fertility of the soil and hence economical as these can partially replace the expensive nitrogenous fertilizers (Kannaiyan, 1999). Mash bean is one of the commonly grown pulse crops in many countries of the world. In Pakistan, it is grown as a minor crop and used as food. Its seed contains about 24% protein, 60% carbohydrates and 1.3% fats (Ali *et al*., 2002). It is palatable, highly nutritional, easily digestible and one of the premium food legumes of the country. Moreover, mung bean and mash bean also contain high amount of vitamins A, B, C and minerals such as potassium, phosphorus and calcium, which are necessary for human body (Rattanawongsa, 1993; Sarwar *et al.,* 2004).

In Pakistan, it occupies an area of over 32.5 thousand hectars with 17.3 thousand tones production (GOP, 2008-09). The crop is grown under a wide range of agro-ecological zones (Pakistan Economic Survey, 2013). Although yield potential is high but the average yield in Pakistan is very low as compared to its potential yield obtained in many other countries. There are many constrains including weed infestation, disease and insect pest attack and unawareness of farmers about optimum sowing time. Among these factors, sowing time is the single most important factor to obtain optimum yield from mash bean (Ihsanullah *et al*., 2002).

Sowing times has makeable effects on growth and yield of most crops in different parts of the world as delay in sowing beyond the optimum time usually results in yield reduction (Vange and Obi, 2006). Early sowing of crop calls disease and insect pest while late sowing cause yield penalty due to short growing period. Selection of the most suitable variety and determining suitable sowing date are very important to obtain potential yield (Amanullah *et al*., 2002). Delay in sowing beyond optimum date results in a progressive reduction in the potential yield of the crop (Green *et al*., 1985). Sowing date has the greatest effects on the grain yield of mash bean. Sowing of crop at July 5 gave the highest marketable yield whereas the lowest marketable grain yield was obtained when sown on May 22 (Yan-sheng *et al*., 2010). Early sowing of crop produced higher yield, plant height but lower pod diameter, dry matter and pod length than the late sowing (Yoldas and Esiyok, 2007). According Marlene *et al.* (2008) mean pod width was greater in the late planting season than in the early planting seasons. Ismail and Khalifa (1987) reported reduced number of seeds per pod in late sown crop. Higher number of pods was obtained in the earlier sowing than the late sowing (Escalante *et al*., 1989). Hence, the positive effect of environmental factors on growth and yield could be harnessed if the information on optimum time of sowing is made available (Moniruzzaman *et al*., 2007) along with a suitable variety. Keeping this in view the present study was undertaken to compare the performance and productivity of mash bean genotypes sown at different sowing dates and to evaluate the possible sowing date for mash bean.

Materials and methods

Seed source, experimental site, soil and design

Seeds of mash bean varieties mash-97 and ES-1 used in this study were taken from Pulses Research Institue, Ayub Agriculture, Research Institute, Faisalabad, Pakistan. Crop was sown at different eight sowing dates viz. June 14, 21, 28, July 5, 12, 19, 26 and August 2 during 2010. While in 2011, crop was sown at June 12, 19, 26, July 3, 10, 17, 24 and 31 under field condition. For seed bed preparation and better germination of mash bean seed, soil was cultivated twice with tractor mounted cultivator followed by planking each time. A pre-sowing irrigation was applied and when soil reached at field capacity, again soil was cultivated 2 times followed by planking. The experimental soil

texture was sandy loam with pH 8.2, total exchangeable salts 0.31 dS m^{-1}, 0.87% of organic matter, total nitrogen 0.047%, available phosphorus 9 mg kg^{-1}, exchangeable potassium 112 mg kg^{-1} and exchangeable sodium 0.5 me 100 g-1. Complete block design with split plot arrangement having three replications was used. Net plot size was kept 6.25 m × 1.50 m. Row spacing was 30 cm and plant to plant distance was 10 cm. Recommended dose of fertilizers were applied, whole phosphorus and one third of the nitrogen were applied as basal while rest of nitrogen was at 2nd irrigation.

Agronomic and yield related traits

Data regarding yield and yield related attributes were recorded at maturity following the standard procedures. For plant height, ten plants were selected at randomly in each plot and plant height was taken from base to the shoot tip and 1000-grain weight was recorded in grams. To record grain yield, crop was harvested and threshed manually from each pot and then clean and air dried grains were weighed and expressed in t ha^{-1}. Harvest index (%) was calculated as the ratio of grain yield to total above ground biomass and multiplied with 100. The data collected were analysed statistically by employing Fisher analysis of variance technique (Steel *et al.*, 1996) using computer software M-STATC (Freed and Eisensmith, 1989) and treatment means were compared by applying least significance difference (LSD) test at 5% probability level.

Results

The number of fruit bearing branches was significantly affected by sowing dates (Fig. 1). Mash bean sown on June 28 and 26 produced maximum number of fruit bearing branches during 2010 and 2011 respectively. Both varieties differed significantly in number of fruit bearing branches during 2010 while in 2011; there was no difference of fruit bearing branches (Fig. 1). Interactive effect of sowing dates and varieties was also significant during 2010 however, during 2011; interactive effect of sowing dates and varieties was non-significant. During 2010, variety ES-1 sown at June 28 produced maximum number of fruit bearing branches. Minimum number of fruit bearing branches was recorded in both varieties when both varieties sown at August 02 (Fig. 1).

Table 1. Analysis of variance for the effect of sowing dates and varieties on fruit bearing branches, pods per plant and grain per pods of mash bean.

SOV	DF	Mean Sum of Square					
		Fruit bearing branches		Pods per plant		Grain per pod	
		2010	2011	2010	2011	2010	2011
Sowing dates	7	0.773 **	1.085 **	76.51 **	258.95 **	45.24 **	30.29 **
Error-I	14	0.043	0.1625	3.39	15.68	1.15	1.91
Varieties	1	1.053 **	0.0892 ns	5.08 ns	3.68 ns	16.87 **	5.88 ns
Sowing dates × Varieties	7	0.123 **	0.1274 ns	12.16 **	3.46 ns	2.35 ns	0.62 ns
Error-II	16	0.021	0.3075	2.05	9.24	1.20	1.58

* = Significant at 0.05 probability level, ** Significant at 0.01 probability level, ns = Non-significant at 5% probability level.

Table 2. Analysis of variance for the effect of sowing dates and varieties on 1000-grain weight and grain yield of mash bean.

SOV	DF	Mean Sum of Square			
		1000-grain weight		Grain yield	
		2010	2011	2010	2011
Sowing dates	7	51.26 **	93.14 **	383613 **	205988 **
Error-I	14	3.85	5.64	15198	25393
Varieties	1	27.16 **	18.09 ns	129688 **	352 ns
Sowing dates × Varieties	7	3.61 ns	7.87 ns	10145 ns	19681 ns
Error-II	16	2.71	6.08	9685	16215

* = Significant at 0.05 probability level, ** Significant at 0.01 probability level, ns = Non-significant at 5% probability level.

Alike, number of pods per plant and number grain per pod was also affected by various sowing dates during both years of study (Fig. 2, 3). Mash bean sown at June 21 and 26 produced higher number of pods and number of grain per pod during 2010 and 2011 respectively. Varietal effect and interactive effect of sowing dates and varieties on number of pods per plant and number of grain per pod was non-significant (Fig. 2, 3).

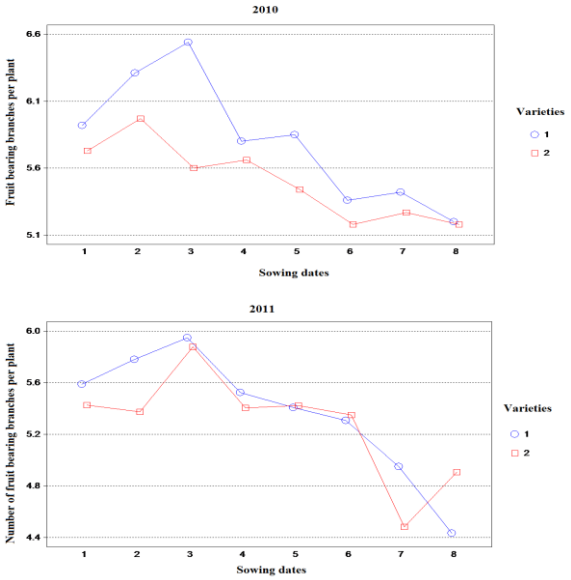

Fig. 1. Effect of sowing dates on number of fruit bearing branches per plant of mash bean during 2010 and 2011.

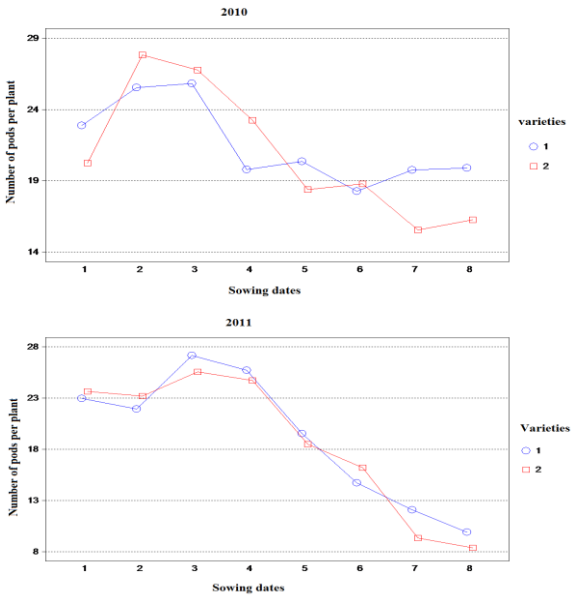

Fig. 2. Effect of sowing dates on number of number of pods per plant of mash bean during 2010 and 2011.

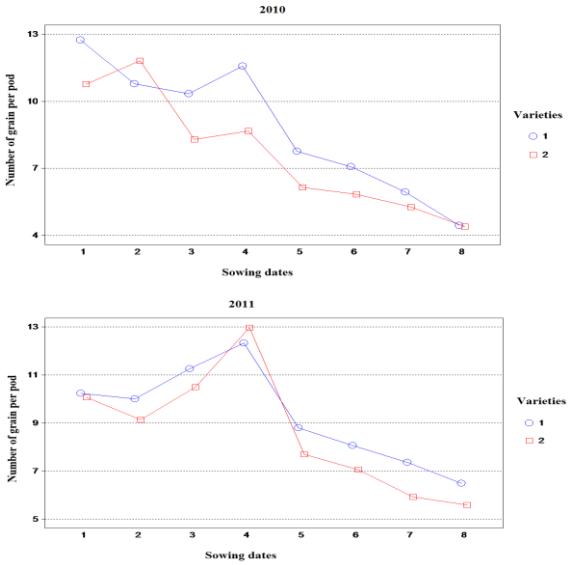

Fig. 3. Effect of sowing dates on number of grain per pod of mash bean during 2010 and 2011.

Similarly, different sowing dates significantly affected 1000-grain weight of crop during both years of study. Maximum 1000-grain weight was recoded when crop was sown at June 14 during both experimental years. Variety ES-1 gave higher 1000-grain weight compared to mash-97 cultivar during both experimental years (Fig. 4). However, interactive effect of sowing dates and varieties on 1000-grain weight was non-significant during both experimental years (Fig. 4).

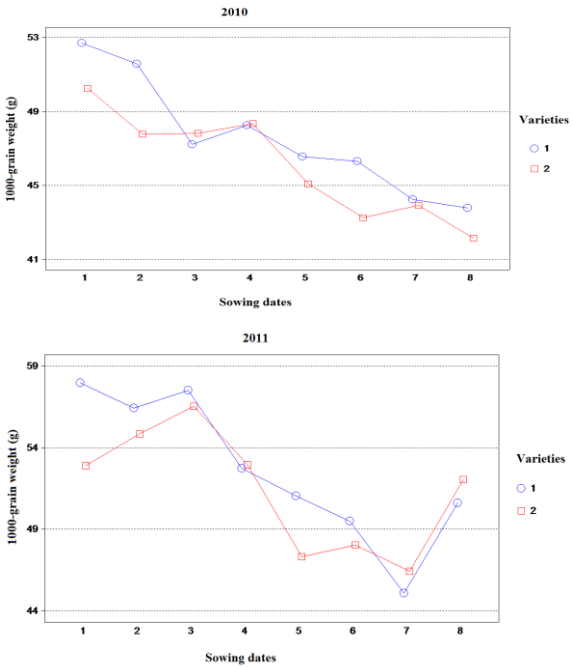

Fig. 4. Effect of sowing dates on 1000-grain weight of mash bean during 2010 and 2011.

Similarly, seed yield was also affected by sowing dates during both years of study. ES-1 produced more grain yield as compared to M-1 (Fig. 5). Maximum grain yield was recorded when crop was sown at June 28 and 26 during 2010 and 2011 respectively, while minimum seed yield was recorded when crop was sown at August 02. Interactive effect of sowing dates and varieties on grain yield was non-significant during both years of study during both experimental years (Fig. 5).

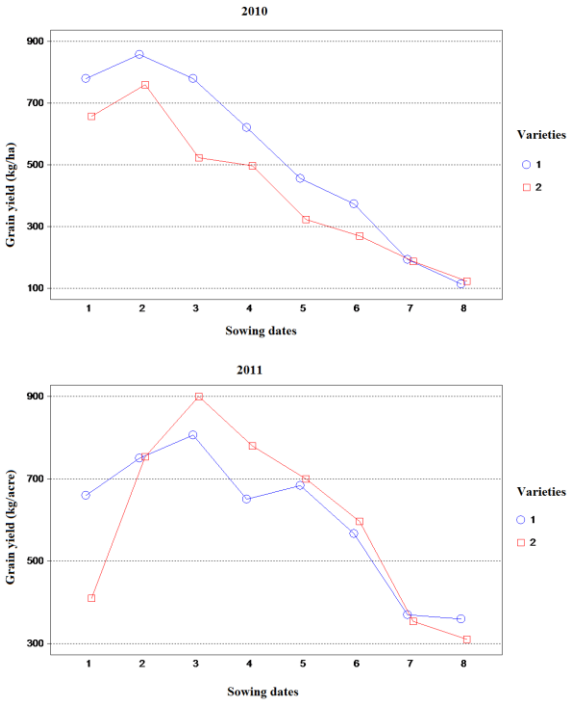

Fig. 5. Effect of sowing dates on grain yield of mash bean during 2010 and 2011.

Discussion

Highest marketable pod yield, 1000-grain weight, number of pods per plant was obtained from the earlier sowing and yield and yield components reduced as time of sowing is extended. This might be due to one or a combination of reasons: plants sown at early sowing dates had long growing periods and might be produced higher number of green trifoliates and leaf area. The amount of photosynthesis is a function of the total leaf area and the solar radiation intercepted (Poehlman, 1991). Therefore, higher number of branches and leaf area is directly proportional to photosynthates production. This might be reason for increased pods per plant, 1000-grain weight and grain yield. Increased 1000-grain weight and grain yield may be due to better translocation of photosynthates to sink (seed). This result is in agreement with the works of Yoldas and Esiyok (2007), Radulovich (1990), Escalante *et al.* (1989) and Ismail and Khalifa (1987) who obtained the lowest yield during the time of late sowing due to a short vegetation period of the crop.

Variation in fruit bearing branches, pods per plant, seed per pod and 1000-grain weight between the varieties of mash bean might be due to their different genetic characteristics. Similar trend of performance in 1000-seed weight was also observed in mung bean by Samanta *et al.* (1999). Higher grain yield in MN-92 mung bean was due to improvement in yield contributing traits. Sowing date is related to temperature that is imperative factor for good production of crop. Increase in crop growth and yield by both cultivars sown at early sowing dates (June 14, 21, 28 and July 05) might be due to one or a combination of reasons: plants sown at early sowing dates had long growing periods and might be produced higher number of green trifoliates and leaf area. The amount of photosynthesis is a function of the total leaf area and the solar radiation intercepted (Poehlman, 1991). Therefore, higher number of branches and leaf area is directly proportional to photosynthates production. This might be reason for increased pods per plant, 1000-grain weight and grain yield. Increased 1000-grain weight and grain yield may be due to better translocation of photosynthates to sink (seed). More branches clearly implies that it act as big source that can support larger sink that is, number of pod per plant, thereby resulted in higher grain yield. Short vegetation period causes a reduction in plant fresh weight, pods number, number of seeds, seeds weight and yield. Decreased in yield and yield components depending on sowing time have been reported by Sugui and Sugui (2002).

Conclusion

In conclusion, ES-1 is the most suitable variety of mash bean and Last week of June is appropriate time

of sowing in agroclimatic conditions of Faisalabad, Pakistan.

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