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Investigation of row orientation and planting date on yield and yield components of mung bean

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ABSTRACT

For estimation of mung bean row orientation and planting date, a field study was conducted in Research Field of Islamic Azad University, Shahr-e-Rey Branch, Tehran, Iran in 2007. The experiment was planted as a randomized complete block design with split-plot arrangement and four replications in which treatments consisted of two seeding methods: seeding with east–west and north–south row orientations. Planting date of main plots is 5th and 20th of May and 6th of June for subplots. The results of analysis of variance for row orientation showed significant effects on grain yield, biomass, leaf wet weight, harvest index and fruit wet weight. Grain yield in east- west row orientation was 455 g/m^2 while this factor in another orientation method was 379 g/m^2 and it represented more than 16% yield loss on this condition. Effect of planting date on many of traits had significant effects which include grain yield, biomass, harvest index, and the number of seed per pod. The first planting date (5th May) with 479 g/m^2 had the highest grain yield.

Keywords: mung bean, row orientation, planting date, yield and yield competition**.**

INTRODUCTION

Mung bean (*Vigna radiata* L.) belongs to fabaceae family that currently is grown in different parts of world and it have large role in nutrition at developing countries [5]. Its seed contains 24.7% protein, 0.6% fat, 0.9% fiber and 3.7% ash [1]. Mung bean is a leguminous pulse crop for it's use as a vegetable protein source, animal fodder and green manure. An important feature of the mung-bean crop is its ability to establish a symbiotic partnership with specific bacteria, setting up the biological N2-fixation in root nodules that supply the plant's needs for N2 [8,9]. Sowing time, is the single most important factor to obtain optimum yield from mung-bean [14]. Nanda and Saini (1987) reported that there was a linear relationship between appearance of leaves and accumulation of heat in comparison between two mung-bean variety in different planting dates and Zhang et al. (2008) reported that in field crops, there is often a linear relationship between cumulative intercepted photosynthetic active radiation (PAR) and accumulated biomass [17]. Relative humidity and different length of day in this condition were effective too [11]. Board et al. (1990) reported delay in planting date caused decrease in length of main stems, sub stems and the number of nod and as a result, decrease in grain yield [3]. Phuong et al (2005) showed that among the seeding methods drill seeding with east–west row orientation had the lowest rice grain yield loss caused by weeds (38% in

the wet and 20% in the dry season) [12]. Kasperbauer (1987) reported that soybeans that grown in north-south rows had slightly longer internodes and had initiated fewer branches [7].
The present study was undertaken to estimate the effect of row orientation and planting date selected in optimum way on the growth and yield of mung-bean in share-e-Ray region.

MATERIALS AND METHODS

This study was conducted in Research Field of Islamic Azad University Shahr-e-Rey Branch, Tehran, Iran (35°42'N, 51°25'E, 1060 m) in 2007. 20 samples from 0-30 cm depth were collected and analyzed by soil testing laboratory for basic soil physical and chemical properties (Table 1) to determine soil characteristics. The experiment was planted as a randomized complete block design with split-plot arrangement and four replications which treatments consisted of two seeding methods: east–west and north–south row orientations as main plots and three planting dates: 5th and 20th of May and 6th of June as subplots. Each plot planted at 5 lines with length of 8 meters and width of 50 (cm) and there was a distance equal to 1 meter between plots and 2 meters between replications. The variety used in this experiment was Parto and was treated by Thiram fungicide. P and N fertilizer were applied according to the recommendation of soil testing laboratory in form of ammonium phosphate urea respectively. Weeding method was used for control of weeds during the culture. For measurement of yield components, 5 normal plants randomly from the two middle rows of each plot were selected. In order to evaluate grain yield, biomass (g) and harvest index (%), 3 middle rows of each plot (3 meters) were harvested.
Data analysis was done using SAS (9.1) software and means were compared using Duncan's multiple range test at 0.05 probability level. Before statistical analysis, all data were passed normality test and were transformed when needed.

RESULTS

Method of seeding
The effect of row orientation on grain yield and yield components is summarized in Table 2. According to the results, row orientation showed significant effects on grain yield, biomass, leaf wet weight (in $P \leq 0.05$), and harvest index and fruit wet weight (in $P \leq 0.01$). East-west row orientation cased more than amounts compared with north-south orientation in all traits, based on results of means comparison for grain yield and yield competitions (Table 3). Grain yield in east- west row orientation was 455 g/m^2 but this factor in other orientation method was 379 g/m^2 which represent more than 16% yield loss on this condition. There are some reductions in other traits in north-south orientation illustrating 38% reduction in harvest index, 28% in stem dry weight and 25% in biomass (Table 3).

Date of planting
Results of variance analysis showed that the effect of planting date on most of the traits was significant in a way that grain yield, biomass, harvest index were meaningful in probability level of 1% and respectively the number of seed per pod in probability level of 5% (Table 2). According to results of means comparison (Table 3) in some of traits (grain yield, harvest index and number of seed per pod), the first planting date (5th May) had the highest amounts compared with other planting dates as grain yield in this treatment was 479 g/m^2. But delay in planting caused 32% yield loss (at 6th June). On the other hand, about traits that have high relationship with biomass (stem, leaf and fruit wet weight) the highest amounts were in second panting date (20th May). Miah et al. (2009) and Sadeghipour (2008) showed that delay in sowing date of Summer mung-bean varieties decreased the seed yield producing the lowest value [10, 13]. Azizi et al. (2005) reported that planting date was effective on seed yield and delayed planting caused the weakness of performance so that the highest on the first planting and the third seeding date had lowest performance [2]. Sadeghipour (2008) and Sarkar et al (2004) reported that number of seed per pod affected by sowing date [13, 15].

DISCUSSION

In general, selection of east-west row orientation was better for grain yield (Table 3). Main cause of this result might be high amounts of biomass and harvest index in this planting condition, regarding row orientation treatment not being significant effect on traits of seed number per pod, number of pod per plant and 100 grain weight. Generally when water and nutrients are not limiting, production of plant dry matter is determined by the amount of solar radiation in field canopy. Namely the production of dry matter by plants depends on the amount of photosynthetic active radiation (PAR) absorbed by the leaves and its efficiency of conversion into chemical energy. Otherwise, the amount of absorbed radiation depends on the efficiency of interception of solar radiation by leaves [3]. One of the most important factors estimating this potential of plants is row orientation. Therefore, these plants (with east-west row orientation) possibly received higher solar ratios, and contributed to more photosynthate partitioned to shoot and develop seed.

Table 1: soil properties of the experimental plots

Soil texture	K(solvable) (ppm)	P(solvable) (ppm)	N total (ppm)	PH	EC (ds/m)	Organic carbon percentage (% O.C)
Loam-clay	440	22.43	0.1	7.59	3.43	1.09

Table 2: Analysis of variance for grain yield and yield competitions

S.O.V	df	Grain yield	biomass	Harvest index	100 grain weight	number of pod per plant	number of seed per pod	Stem wet weight	leaf wet weight	Fruit wet weight
replication	3	1976.6^{ns}	72.1^{ns}	7.3^{ns}	0.184^{ns}	709.7^{*}	70.2166^{*}	7.82^{ns}	2.83^{ns}	0.46^{ns}
Method of seeding (A)	1	34646.8^{*}	3688.7^{*}	545.3^{**}	0.224^{ns}	109.2^{ns}	6.1440^{ns}	43.74^{ns}	35.79^{*}	46.39^{**}
Error (A)	3	2612.4	113.5	13.1	1.432	40.0	2.4336	8.19	2.24	0.10
Date of Planting (B)	2	54616.9^{**}	12595.3^{**}	283.4^{**}	0.543^{ns}	26.3^{ns}	11.6433^{*}	135.91^{**}	342.37^{**}	184.47^{**}
A*B	2	9828.4^{*}	263.3^{ns}	98.2^{**}	0.717^{ns}	26.4^{ns}	0.0276^{ns}	0.09^{ns}	1.03^{ns}	18.48^{**}
Error	12	2413.2	131.8	3.5	0.288	41.0	1.9594	3.68	1.94	0.24
C.V (%)	-	11.75	13.28	9.36	11.40	21.31	16.87	23.38	13.41	7.75

*ns, *and **means non-significant, significant at 5 and 1% levels of probability, respectively*

Table 3: means comparison for grain yield and yield competitions

S.O.V	Grain yield	biomass	Harvest index	100 grain weight	number of pod per plant	number of seed per pod	Stem wet weight	leaf wet weight	Fruit wet weight
Method of seeding									
North –south orientation	379.94b	74.07b	15.27b	4.61a	27.91a	8.82a	6.86a	9.17b	5.02b
east –west orientation	455.93a	98.87 a	24.80a	4.81a	32.18a	8.64a	9.56a	11.61a	7.80a
Date of Planting									
5^{th} May	479.87a	76.63b	25.52a	4.97a	28.30a	10.26a	6.11b	7.20b	5.82b
20^{th} May	449.82a	130.14a	13.70b	4.70a	31.92a	9.69b	12.96a	17.91a	11.48a
6^{th} June	324.11b	52.64c	20.88a	4.45a	29.92a	6.31b	5.56b	6.05b	1.93c

For a given means within each column of each section followed by the same letter are not significantly different ($p<0.05$)

Clark et al. (2000) reported that interplot interference caused a 12% yield reduction in Oslo in the north–south rows, which was significantly greater than the 7% yield reduction in the east–west row orientation [4]. The highest grain yield as mentioned was in first planting date (5th May), and there was yield loss order in other planting dates (20th may and 6th June respectively); however, biomass shows difference procedure so that second planting date (20th may) showed the highest amount. It is probably the reason why there was higher temperature in second planting date and therefore seeds had faster emergence and higher vegetative growth, but reproductive grow of plants and sensitive stages (for example pollination stage) confronts the heat stress. Decreasing in the number of seed per pod is an example of these damages (Table 3). Therefore with decrease in reproductive growth duration, most of energy of plants remains in vegetative parts and grain yield is big loser. Egli et al. (2000) reported that delayed planting generally shifts reproductive growth into less favorable conditions with shorter days and lower radiation and temperature [7]. Rashid et al. (2004) also reported that yield of non-primed mung bean declined linearly with date of sowing [13]. In conclusion, we suggested that early sowing is clearly important to produce a successful mung bean Crop. Namely delaying in planting date due to the loss of plant potential for the growth, and so this leads to yield decrease. On the other hands, selection of east-west row orientation by better use of solar radiation and avoidance of shade was better grain yield can produce higher grain yield.

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