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Optimum Planting Density of Mung Bean for Lordegan Region

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ABSTRACT

Mung bean is one of the important beans in human nutrition. The aim of this study was to determine the most appropriate planting density for the highest yield of mung bean (*Vigna radiata* L.) cultivars in Lordegan region. The study was carried out as a factorial experiment in a randomized complete block design with three replications. Factors included four mung bean cultivars namely Parto, VC6173A, VC637194 and Lordegan Local mung bean plus three different planting densities of 30, 40 and 50 plants per square meter. Flowering date, physiological maturity date, plant height, number of pods per plant, number of seeds per pod, 100-seed weight and seed yield were measured. Results of combined analysis of variance over two years showed that genotypes were significantly different in studied traits (except for number of seeds per pod). The effect of planting density was significant on all traits (except for 100-seed weight and the number of days to maturity). The interaction between genotype and density was not significant for any of the traits. The highest grain yield (1357.8 kg/ha) was obtained from VC6173A line a density of 40 plants per square meter.

***Keywords**:* Planting density, Variety, Yield, Mung bean

INTRODUCTION

As one of the most important protein-rich sources, legumes are the second largest human food source after cereals. These plants improve soil fertility via nitrogen bio-stabilization and prevent soil erosion in the form of cover crops or in rotation with other crops (Koochekhi and Sarmadnia, 1990). Mung bean (*Vigna radiata* L.) is a tropical plant that grows above 16°C and will be damaged in temperatures below 1°C. Total required temperature for the growth of mung bean is 2000 degree days. The appropriate germination temperature for mung bean is 8 °C and the appropriate temperature for growth of this plant is 30 °C.

Mung bean is a major source of vegetable protein for humans with 25% protein and 340 calories of energy per 100 grams of dry grain (Ghavami and Rezaei, 2000). The cultivated area of mung bean is small in Chaharmahal and Bakhtiari province and is often located in Lordegan. Unfortunately, mung bean farming in the province is one of the forgotten ones, however, it is consumed as one of the important legumes in the region. It is worth mentioning here that since in the crop rotation program, land is usually unused in summer, using a suitable plant such as mung bean can optimize inputs to increase productivity of land and time.

Beans and mung beans have the highest cultivation area among the legumes globally. Production of these crops has grown 180 percent over the past two decades in Iran. Much of this growth is due to improved yields (from 975 to 1688 kg /ha) through improved cultivars (Parsa and Bagheri, 2008). Researches of Haqqani and Pandy (1994) and Panwar and Sirohi (1987), showed 33 and 30 plants per square meter, as the best planting densities for the highest yield, respectively. In Shukla and Dixit Research (2000), lessening the distance between plants increased crop growth rate during vegetative growth and early reproductive period, caused more light absorption throughout the growing season and finally increased seed yield. Little Jonhs (1988) reported that when the row spacing of the mung bean was constant, a balanced increase in plant density accelerated canopy closure, increased leaf area index; developed the use of environmental factors, increased yield components per unit area and finally enhanced grain yield.

In studies of Singh *et al.* (1990), higher yield of the selected cultivar was attributed to the higher number of pods per plant, number of seeds per pod and 100-seed weight. The researchers reported that reduced row spacing at high densities, intensified competition between plants and all three components were decreased. As a result, single plant yields were lower at higher densities. In addition, plants grew more longitudinally and had fewer branches.

Fathi (2010) investigated the effect of four row spacing (10, 15, 20 and 25 cm) on three mung bean cultivars (Gohar, VC1973A and NM92) in Khuzestan climatic conditions. Results showed that the highest grain yield (3471 kg /ha) was obtained from NM92 at a density of 13.3 plants per square meter with 15cm row spacing. In this study, the lowest seed yield (2115 kg /ha) was obtained from Gohar cultivar at a density of 20 plants per square meter with of 10 cm row spacing.

MATERIALS AND METHODS

This study was carried out in Lordegan (Chaharmahal and Bakhtiari Province) as a factorial experiment in randomized complete block design with three replications during 2014 and 2015.

Factors included four mung bean cultivars namely Parto, VC6173A, VC637194 and Lordegan Local mung bean plus three different planting densities of D1, D2 and D3 includes 30, 40 and 50 plants per square meter, respectively. The distance between rows was 50 cm and plant spacing on the rows were 7, 5 and 4 cm, respectively. Treflan herbicide at two liters per hectare was used before planting. Genotypes were sown in the first week of July (after harvesting barley) as summer cultivation and irrigated the next day. Seeds were disinfected with Rural TS fungicide prior to planting. Hand weeding was performed twice. During the growing season, flowering date and physiological maturity were recorded. To determine the grain yield components, five plants were randomly harvested from the middle part of each

plot, and the mean number of pods per plant, number of seeds per pod and plant height were determined. 100-seed weight was calculated from four random samples each plot. Obtained data were analyzed using SAS program and means were compared using Tukey test.

RESULTS AND DISCUSSION

Combined analysis of variance showed significant differences between years of experiment for different traits. Genotypes were significantly different in terms of studied traits except for number of seeds per pod. The effects of planting density on all traits were significant except for 100-seed weight and the number of days to maturity (Table 1).

Table 1. Mean squares of studied traits

Source of variation	Degrees Of Freedom	Seed Yield	Number Of Pods Per Plant	Number Of Seeds per Pod	100-Seed Weight
Year	1	127672.5 **	467.7 *	29.3 **	7.6 **
Error (Block Per Year)	4	5239.5	33.8	1	0.3
Genotype	3	182964.7 **	538.7 *	3 ^{ns}	34.4 *
Density	2	31700.9 **	191.6 **	1.9 *	0.8 ^{ns}
Genotype*Density	6	1446.5 ^{ns}	5.8 ^{ns}	0.06 ^{ns}	0.05 ^{ns}
Year*Genotype	3	4239.3 **	26.9 **	1.2 **	2.5 **
Year * Density	2	375.1 ^{ns}	0.3 ^{ns}	0.04 ^{ns}	0.1 **
Year*Genotype* Density	6	649.3 **	3.8 *	0.02 ^{ns}	0.07 **
Error	44	212.3	1.4	0.04	0.01

Table 1. continued

Source of variation	Degrees Of Freedom	Plant Height	Day To Flowering	Day To Maturity
Year	1	1580.2 **	26.9 *	45.1 *
Error (Block Per Year)	4	76.7	2.1	2.99
Genotype	3	702.6 **	93.7 **	84.1 *
Density	2	308.6 **	34.1 *	40.9 ^{ns}
Genotype*Density	6	10.1 ^{ns}	0.5 ^{ns}	1.2 ^{ns}
Year*Genotype	3	17.3 **	1.4 ^{ns}	6.6 **
Year * Density	2	4.6 ^{ns}	1.3 ^{ns}	2.8 *
Year*Genotype* Density	6	4.9 ^{ns}	0.6 ^{ns}	0.51 ^{ns}
Error	44	4.2	0.6	0.85

Mean comparison results of two years showed that VC6173A line with the yield of 1307.8 kg /ha was superior to other genotypes. This line was placed in group “a” for other traits as well. The number of seeds per pod was higher in the above-mentioned line with no significant difference. Parto variety was flowered somewhat later than other genotypes and was late mature (Table 2).

Table 2. Mean Comparison results of genotypes by Tukey test

Genotype	Seed Yield ($kgha^{-1}$)	Number Of Pods Per Plant	Number Of Seeds per Pod	100-Seed Weight (g)	Plant Height (cm)	Day To Flowering	Day To Maturity
Parto	1164.7 b	22.3 ab	7.8 a	5.2 ab	57.6 ab	47.6 a	86.9 a
VC6173A	1307.8 a	26.4 a	8.1 a	7.4 a	60.4 a	46.3 a	86.4 a
VC637194	1080.2 b	14.5 b	7.1 a	6.7 ab	46.1 b	44.4 ab	84.9 ab
local mung bean	1111 b	16.3 b	7.4 a	4.3 b	52.8 ab	42.3 b	82.1 b
least significant difference	186.8	8.3	1.76	2.5	11.9	3.4	4.1

There is no significant difference between the means of each column ($p<0.01$) with at least one common letter.

Mean comparison results of different planting densities over two years showed that the best planting density was 40 plants per square meter. At this planting density, the amount of 100-seed weight was insignificantly different, but the values of other major components of yield were significantly different.

Table 3. Mean Comparison results of different densities by Tukey test

Planting densities	Seed Yield ($kgha^{-1}$)	Number Of Pods Per Plant	Number Of Seeds per Pod	100-Seed Weight (g)	Plant Height (cm)	Day To Flowering	Day To Maturity
D1	1165.9 b	19.8 b	7.6 ab	5.9 a	50.6 b	44 b	83.9 a
D2	1202.3 a	22.7 a	7.8 a	6.1 a	54.3 ab	45 ab	84.9 a
D3	1129.6 c	17.1 c	7.3 b	5.7 a	57.8 a	46.4 a	86.5 a
least significant difference	32.9	2.2	0.4	1.2	3.7	1.9	2.8

There is no significant difference between the means of each column ($p<0.01$) with at least one common letter.

Interactions between genotypes and densities were not significant for the studied traits over two years; therefore, the trends of genotypes were the same at different levels of planting densities and the most desirable line and density could be determined. Accordingly, line VC6173A at 40 seed/m^2 was superior to other genotypes and densities in both two years. Growth types of Parto variety and local mung bean were indeterminate, whereas VC6173A and VC637194 lines had determinate growth. A prominent feature of the VC6173A line is the large seed and its standing growth type. large seeds are marketable, and the standing type of plants facilitates mechanical harvesting. The average growth period of VC6173A line was 86.4 days which is good for double cropping in Lordegan area. The land is virtually useless during this time, but cultivation of mung bean yields about 1358 kg /ha, which is a significant yield. According to the 100-seed weight of this line, the amount of required seed for planting is about 30 kg/ha. This amount of seeds provides good canopy and achieves optimum yield.

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