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Evaluating the Effect of Irrigation Interval on the yield and Yield components of mungbean (*Vigna radiate* L)

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ABSTRACT: In order to study the effect of irrigation interval and density on mungbean, an experiment was conducted in a split-plot design in a complete block design with 3 replications in a research station in Neyshabour Branch of Islamic Azad University in 2013. The treatments including irrigation intervals in three levels of 8, 10, and 12-days were considered as the primary factor and the density on three levels of 15, 20, and 25 cm row spacing as the secondary factor. The studied traits in this design were: plant height, number of pods per plant, number of seeds per pod, pod length, the weight for 100 seeds, and biological yield. The effect of irrigation interval was significant on traits such as plant height, number of pods per plant, the weight for 100 seeds, and pod length. Most of these traits were resulted in an 8-day-irrigation interval. The effect of density was significant on traits such as plant height, number of pods per plant, numberof seeds per pod, the weight for 100 seeds, and pod length, and biological yield. The maximum height and biological yield was gained in 15 cm row spacing. The maximum number of pods per plant, the number of seeds per pod, pod length was gained in 25 cm row spacing. The interaction of irrigation interval and density in plant height and the weight for 100 seeds was meaningful. Based on the results, it was shown that 8-day irrigation interval and 25cm row spacing could result in better yield in area unit (g/m^2).

Keyword: Mungbean, Irrigation Interval, Density, Row Spacing, Yield

INTRODUCTION

One of the main goals of today's crop yield increase is to match the growing population of the world. The world population is growing at a 1.6-to-1.7% rate; in other words, 95 million people are annually added to the number of consumers of agricultural crops while over 90 % of this increase is happening in developing countries, the areas that have already suffered food shortages. This means that food production should raise permanently in order to compensate for food shortages in many areas in the world (Majnoon Hoseini, 2004). In most areas in the country, the efficiency of grains yield in area unit (ha) is low, therefore, an appropriate plan is needed for utilizing the soil and water for developing goals. If we could use plants and their related indices for planning irrigation, a step is taken for the optimal use of soil and water in the country (Nourmand *et.al.*, 2001). Mungbean (*Vigna radiate*) is a one-year-plant from legume family. In Vavilov's idea, mungbean originates in India, but some know its originality in central Asia (Vavilov, 1987). The average yield of mungbean has been reported as 580-770 kg/ha. In Iran, about 25thousand hectares is under cultivation and its average yield is750kg/ha. India has 75% mungbean production in the world; Burma(Myanmar), Thailand, and Indonesia are among the major Asian producers of mungbean. Mungbean is cultivated dispersedly in Azarbaijan, Khorasan, Esfahan, Fars, Khoozestan, and Northern provinces in typical way, but rain-fed cultivated in Gorgan foothills (Majnoon Hoseini, 2008). In water scarcity conditions, changing agricultural patterns to cultivating plants adaptive to dryness is a better solution (Dow et.al., 1984). Appropriate irrigation interval is an important parameter in managing irrigation which shows the time of irrigation in the program. With suitable irrigation interval, the product is not influenced by stress resulted from water and the waste of water and energy is minimized as well (Ne'mati, 2001). The program was implemented regarding the above mentioned options for improving efficiency in using water and the needed environment for the plant growth, determining the most appropriate density and irrigation interval on yield and yield components of mungbean.

MATERIALS AND METHODS

This experiment was carried out in research station in Neyshabour Branch of Islamic Azad University in split-plot and a complete block design with 3 replications in summer, 2013. The treatments including irrigation intervals in three levels of 8, 10, and 12-days were considered as the primary factor and the density on three levels of 15, 20, and 25 cm row spacing as the secondary factor. Soil test was done before tillage operation with sampling from 30 to zero cm depth; blocks and plots were firstprepared and varieties were determined. Bed preparation processwas done using plow, disk, leveler, and furrower. Soil test was conducted as following: 8 parts of the land with 20 cm height (equals the depth of a shovel) were sampled, they were mixed and then a one-kilogram-sample was send to the laboratory for soil test. The tested soil for loamand its acidity was about 7.36% and its saturation was about 45%.

The tillage process was first done by plowing with plough, two perpendicular discs, and a trowel. Next, plotting and blocking was fully done. Fertilization operation (nitrogen and potash) was conducted after the test soil and tillage operations. In processing stage, irrigation was done according to the treatments every 8, 10, and 12 days.

Thinning and weeding was similarly and optimally done in all studied treatments. The studied traits in this design were: plant height, number of pods per plant, numberof seeds per pod, pod length, the weight for 100 seeds, and biological yield. From each plot, which was representative of the status of plant inside each plot, some were taken randomly and their mean was measured. Using a meter, the plant height was measured in cm, the length of pod was measured by using a caliper. Biologic yield or the dry weight of plant in which samples were transferred to oven in paper bags for 48 hours and were dried in 70-75 degree and they were then weighted. Statistical analysis and tables were done using SAS and Excel software. Duncan test was used for comparing the means.

RESULTS AND DISCUSSION

The effect of irrigation interval on plant height was meaningful at 1% level. The maximum height was seen in 8-day irrigation interval in a way that irrigation in 8-days interval was 0.70% and 12.60% more respectively from that of 10 and 12 days. Comparing the mean irrigation interval, it was shown that irrigation in 8days and 10 days were placed in the same statistical group. If there were limited sources of water, the water absorption rate of soil would be less than its evaporation and transpiration rate by plants and if the humidity of soil gets lower than the critical level, the plant would be exposed to different kinds of stress (Sreevalli *et al,* 2001). Drought stress reduces cell division and accordingly plants growth, as a result, the plant height is reduced as well. In the experiment (Karimi *et.al.* 2013), complete irrigation increased chlorophyll growth and therefore the height of mungbean compared to non-irrigated treatments. In an experiment on soy plant, it was reported that plant height decreased due to an increase in irrigation interval (Desclaux *et.al.* 1996). It seems that the excessive struggle between plants for getting water in draught stress treatments, reduces the allocation of photosynthesis materials to the stalk which results in stunting of plant. Also by supplying enough water in irrigation interval of 8 days, the nutrition is better provided for the plant and it increased plant height. The effect of density on plant height was meaningful at 5% level in a way that the height of plant on the 15-cm-row spacing was 4.56, 7.32% more than that of on 20-25-cm row spacing. The increase of plant height is usually one of the most prominent traits of changes of growth in plants and it can have some privileges in struggle with weeds and other unwanted plants, otherwise it might not matter. Another result of increase in height is the formation of new leaves in upper parts of plant; younger leaves with more efficiency are placed over older ones and receive more light.

Table 1: Square mean of traits.

		Square Mean					
Sources of change	**Degree of freedom**	**Plant height**	**Pod length**	**Number of pods per plant**	**Biologic yield**	**weight for 100 seeds**	**Number of seeds per pod**
Block	2	25.18n.s	0659.0n.s	66.21n.s	3.2894n.s	1378.0n.s	4539.0n.s
Irrigation interval a	2	0.225**	4031.0*	26.611*	7.989n.s	857.6**	2807.0n.s
Error a	4	724.2	238	35.41	9.916	1087	487
Density b	2	007.61*	347.2**	7.1652**	0.33106**	258.1n.s	613.7**
Irrigation interval*density	4	7.102*	0015.0n.s	40.85n.s	9.256n.s	613.1*	0771.0n.s
Error b	12	814.12	178	52.31	7.1075	4698	2362
Coefficient of variation		30.5	35.1	37.1	71.11	68.11	26.4

This feature puts the most efficient leaves in the most appropriate position regarding photosynthesis (Mokhtarpour, 1376). The main reason of plant height increase in high densities can be the light struggle of plants for getting more light. Also lack of light in plants causes less solution of hormone auxinin plants and accordingly increases the plant's elongation growth which is in line with the findings in the study conducted by Ghanbari (Ghanbari, 2004).

The effect of irrigation interval on the number of pods in plant was significant at 5% level in a way that the number of pods in plant in 8 days of irrigation interval was respectively 11.22% and 26.51% more than that of 10 and 12 days irrigation intervals. Irrigation intervals of 8 and 10 days are also statistically in a same group and there was no significant difference between them. Drought stress, having a negative effect on growth of reproductive organelles, caused reduction in yield components including the number of pods in mungbean plant. This is true for all plants. (Moradi *et al.,* 2008); In a study on the effect of drought stress on yield and yield components of corn it was shown that drought stress with a negative effect on growth of reproductive organelles causes reduction in yield components including number of maize in unit area (Rafi'ie *et al.,* 2002) (Tamini *et al.,* 2012). The effect of density on the number of pods in plant at 1% level was meaningful in which the number of pods in plant on 25cm row spacing was respectively 32.74% and 34.47% more than that of on 20cm and 15 cm. Row spaces of 15 and 20cm were statistically in the same group and were not significantly different from one another. The effect of irrigation interval on the number of seeds in pod was not meaningful (Table 1). The effect of density on number of seeds in pod at 1% level was significant in a way that number of seeds in pod in 25cm row spacing was respectively 7.07% and 14.95% more than that of 20cm and 15 cm. In a thinner planting density, the number of pods was increased as a result of better consumption of soil and sun nutrients (Hasanzadeh, 1991)

In general, yield components of seed are dependent on one another in a way that increase in one of the components of one causes decrease in components of the other (Moa'dab *et al.,* 1990). The effect of irrigation interval on number of pods in plant at 5%level was meaningful (Table 1) in a way that the number of pods in plant in 8 days irrigation interval was respectively 11.22% and 26.51% more than that ofin10 days and 12 days irrigation intervals. Irrigation intervals of 8 and 10 days were also statistically in the same group and there was no significant difference between them (Fig. 1).

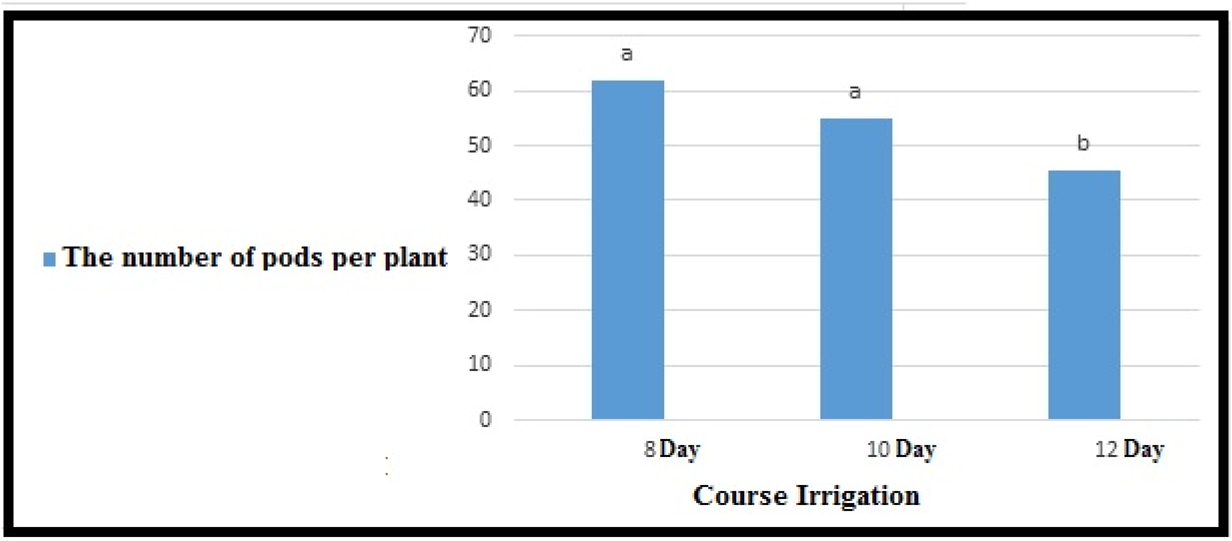

Fig. 1. Effect of irrigation interval on number of pods in plant.

Drought stress caused reduction in yield components including number of pods in mungbean plant by having a negative effect on growth of reproductive organelles. This is true about all plants (Moradi *et al.,* 2008).

In a study on the effect of drought stress on yield and yield components of maize, it was shown that drought stress with a negative effect on growth of reproductive organelles causes reduction in yield components including number of maize in unit area (Tamini *et al.,* 2012) (Rafi'ie *et al.,* 2002).

The effect of density on the number of pods in plant at 1% level was meaningful (table 1) in which number of pods in plant on 25cm row spacing was respectively 32.74 and 34.47% more than that of on 20 cm and 15 cm row spacing. 15 and 20cm row spaces were statistically in the same group and were not significantly different from one another (Fig. 2).

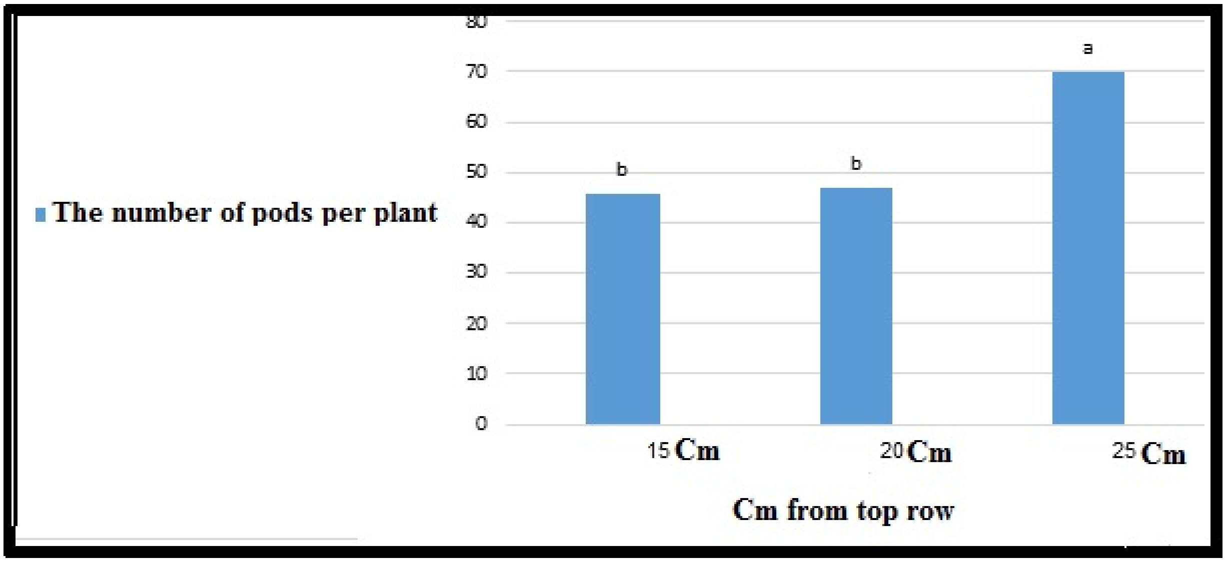

Fig. 2. Effect of density (row spacing) on number of pods in plant.

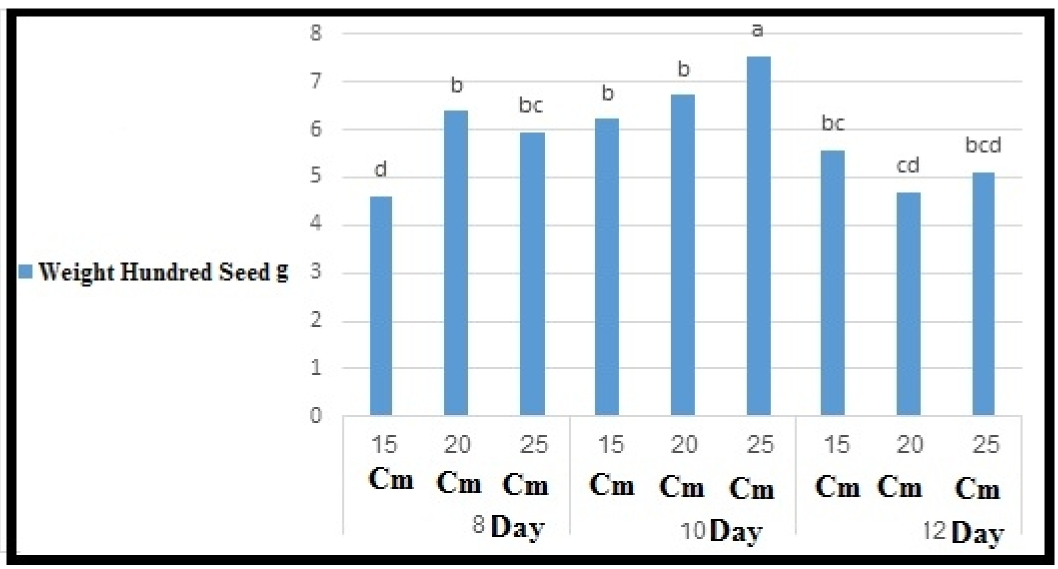

Fig. 3. Interaction between irrigation intervals and density (row spacing) on weight of 100 seeds.

The interaction between irrigation interval and density (row spacing) on weight of 100 seeds at 5% level was meaningful (table 1) in a way that the maximum weight of 100 seeds was achieved in 10 days irrigation interval and 25cm row spacing (Fig. 3).

The effect of irrigation interval on biological yield was not significant (Table 1). The effect of density (row spacing) on biological yield at 1% level was significant in which biological yield in 15 cm row spacing was respectively 24.68 and 33.70% more than that of on 20 and 25 cm (Fig. 4). The light use efficiency shows the ability of plant in transforming received energy from sun to dry matter, and it is different depending on environment and plant type. The light use efficiency depends on the amount of received photosynthetically active radiation, these radiations are also effected by density (Mohammadi Khanghah, 2008). Radiation absorption in thin densities is low and efficiency coefficient of photosynthesis in such densities is very low, on the other hand, in high densities, in which the leaf area index is high, sun radiation is not absorbed sufficiently, as a result of the shadow of cross leaves the efficiency of photosynthesis is very low; thus, it is prominent to have maximum light energy absorption in vegetation in longer times than growth season (Koochaki & Sarmadnia, 1990).

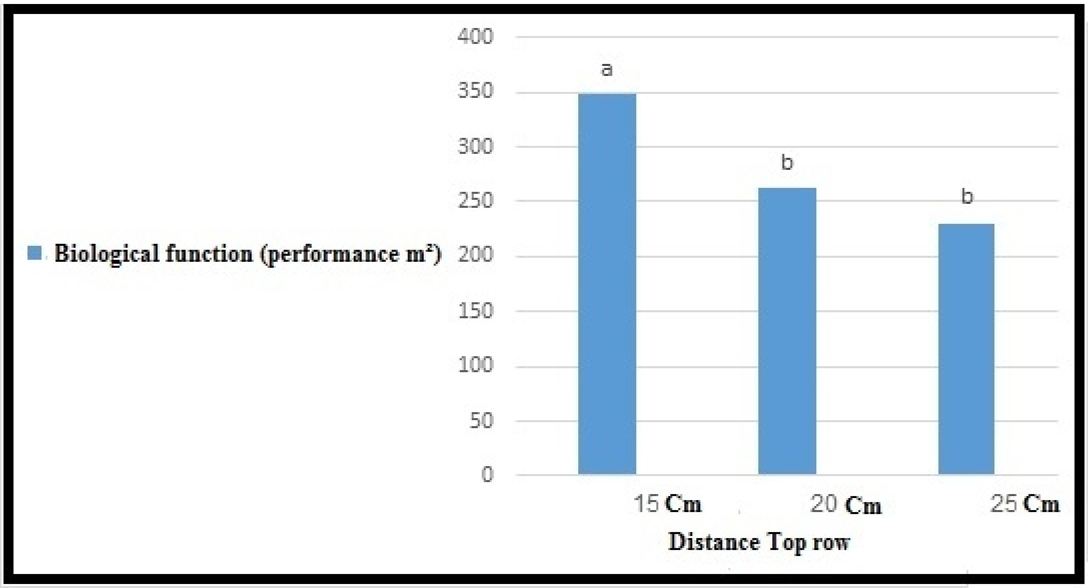

Fig. 4. Effect of density (distance in row) on biological yield.

CONCLUSION

The effect of irrigation intervals on plant height, number of pods, weight of 100 seeds, pod width, and pod length was meaningful, and the maximum of these traits were seen in 8-days irrigation intervals. The effect of density on plant height, number of pods, number of seeds in pod, weight of 100 seeds, pod length, and biological yield was significant, and the maximum height and biologic yield was observed in a treatment with 15 cm rows. The number of pods in plant, number of seeds in pod, and pod length were achieved in 25cm rows. In fewer densities, because of plant growth, germination of lateral branches and more fertile nodes, the average yield of each plant increased; however, fewer number of plants in unit area caused reduction of yield in unit area. Although there were more plants in higher density, because of less access of plant to materials produced by photosynthesis the yield of each plant and yield per unit of area will be reduced. The interaction between irrigation interval and density was meaningful for plant height and weight of 100 seeds. It seems that regarding the obtained results of this study, irrigation interval of 8 days and 25 cm row spacing could have a better yield in unit area (g/m^2).

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