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Response of Mungbean *(Vigna radiata)* To Different levels of density and weed management in Lorestan Province

Abdolreza Ahmadi

Assistant Professor of Weeds Control, Department of Agronomy, Faculty of Agriculture, Lurestan University of Khorramabad.
Email: ahmadi1024@gmail.com; ahmadi.a@lu.ac.ir; Tel: 09168688556

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Optimum crop density plays an important role to enhance crop productivity. Crop density in mung bean (*Vigna radiata*) planting as one of the most important cultural factors have effective role in the distribution of weed plants and also intraspecific competition. This research was aimed to evaluate the effect of mung bean density on competitiveness of mung bean weeds during 2014 in Khorramabad. The experimental design was a randomized complete block with 3 replications. Treatments were crop density at 4 levels (25, 50, 75 and 100 kg ha^{-1}) and weed treatments at 2 levels (weeding and no weeding). The maximum yield (2011 kg ha^{-1}) was achieved for weed control treatment with crop density of 25 kg ha^{-1}, while, the lowest yield (672.7 kg ha^{-1}) was related to weedy plots with crop density of 100 kg ha^{-1}. The study revealed that crop density of 25 kg ha^{-1} is optimum to obtain maximum mungbean yield. Results also indicated mung bean yield increased by 82.68 by weed control, highlighting the importance of weed interference in reducing mung bean yield and necessity of weed control to achieve higher yields.

Keywords: Mung bean, yield, Weed, Plant density, Khoramabad.

INTRODUCTION

Mung bean (*Vigna radiata*) is the most important source of protein in south and southeast Asia (Prakit *et al*., 2014). This plant, have the most important sources of protein in arid and semiarid regions and played a major role in the economy of the regions (Tesfaye *et al*., 2006). Seed mung bean has 51% carbohydrate, 26% protein, 10% moisture, 4% mineral and 3% vitamin (Sehrawat *et al.,* 2013). Legumes, have mainly poor competition against weeds (Young *et al*., 2000). Mainly the reduction of the *mung bean* yield depends on the species and weed density, also, some of the researchers reported that decreased of mung bean yield in different levels between 20 to 85 percent (Singe *et al.,* 1991). Raman & Krishnamoorthy (2005) reported that mung bean yield decreased in infested treatment to weeds to 35 percent. One way to increasing product and weed suppression is follow the appropriate density of plants and planting pattern, and can the type of plant, number and plants traits, plant intervals so chosen that absorption of light does not exist problem to crop (Habibzadeh *et al*., 2006), in research of Shukla *et al* (2000) on the mung bean, reducing the interval between shrubs increased crop growth rate during the vegetative, reproductive period, absorption of light in the growing season and grain yield. Plant density change can affected on growth and development of weeds. So that increasing density, increases crop competitiveness and as a tool introduced in integrated weed management (Harries & White, 2007). Research findings of Singe *et al* (1991) showed that grain yield in row spacing of 30 cm was more than in compared to 20 and 25 cm. In cultivation with a distance of 30 cm pod number per plant, seed number per pod and 1000-seed weight was significantly higher and seed yield (ha^{-1}) increased steadily with increasing seeding rate. Also, George and Barnes (1997) in the two varieties of mung bean concluded that 1000-seed weight and seed number per pod not affected by density. Yield decrease in crops due to the presence of weed, depending on the area and specific weed species its area (Ahmadi *et al*., 2013). According to the reported research, seed number and harvest index was not affected by density and seed yield increased with increasing plant density (De Costa *et al*, 1999). Determining of the optimum plant density is special importance in planning to obtain max quantitative and qualitative yield (Board & Harville, 1996). In very high densities due to from very reduction of shrubs spacing, due to shading and competition for light and limitations of environmental factors, defoliation rate increases (Board and Harville, 1996), and in the event of severe restrictions on environmental factors caused decrease of seed yield (Erman *et al*., 2008). Reports show that the suitable density range of mung bean depends on the distance between plants (Habibzadeh *et al*., 2008). The results of Shukla *et al* (2000) showed that the effect of plant density on the growth and development period varied on yield components, especially the pod number/area and seed yield in varieties and in different environmental conditions. Increase the competitiveness of crops is one of the key tools weed management, that can be used in sustainable agriculture through plant breeding, food management and using planting density (Habibzadeh *et al*., 2008). One of the most important needs in arable planning in order to obtain high yield and optimum quality determine the best density and the best time for planting (Mimbar, 1993). This study was conducted to investigation the effect of density on the morpho-physiologic traits and seed yield of the mung bean (Gohare variety) and so to determine the optimum planting density on weed management in the Khorramabad.

MATERIALS AND METHODS

Field experiments were conducted at Lorestan Agricultural and Natural Resources Research Center, Khorramabad, Iran (48.36°E, 33.48°N, altitude), 1,125 m above the sea level with a yearly average precipitation and temperature of 471.5 mm and 17.7 C, respectively. The fields were in fallow in the preceding year of the experiments. The soil at the test sites was a clay- silt with a pH of 7.7 and organic matter of 1.0% in 2014. The experiment was designed as factorial on the basis of randomized complete block design (RCBD) with 8 treatments in 3 replications. Weed factor with two levels (controlled and uncontrolled) and seed density per unit area (25, 50, 75 and 100 kg ha^{-1}) equivalent (240,180,120,60 plant m^2) was calculated for each plot. In this experiment, after sowing mapping, evaluated treatments were randomly assigned to experimental plots and any density considered on the 6 lines with 6 meters length, rows spacing of 30 cm and depth 4 cm sowing. and seeds planting was conducted with hand in date on June 12, 2014. Irrigation was done immediately after planting (Tofighian *et al*., 2012). Due to climatic conditions, farm irrigation until the end of the growing season was carried out flooding (every 7 days). In the plots of interference treatment no operations up against the weed control. Assessing the density and weeds biomass were randomly three times in flowering time of crop with samples of the two frame 0.5* 0.5m per plot. density and dry matter of weeds were counted and measured. At the end of the growing season after physiological maturity with marginal effects deletion (half a meter from the beginning and end of eachrow) area of 6 m^2 from 4 central rows of each plot was measured to estimate biomass and yield and seed yield by 14% seed moisture. Determining of morphological traits and yield components was selected 10 plants from each plot at final harvest. The traits measured, was include biological yield, seed yield, shrub density, pods number/shrub, seed number/s and seed weight/s. data of each traits was analyzed by MSTAT-C software. Means comparison was done by Duncan's test at 5% level.

RESULT AND DISCUSSION

The effects of experimental treatments on Mung bean

The results of the analysis of variance showed that seed rate, no effect on biological yield, seed yield and harvest index of vetch (Table 1). However, according to the increase in seed, three attributes mentioned above showed a trend decreasing, as by increasing the seed rate from 25 to 100 kg ha^{-1}, biological yield, seed yield and harvest index were 28.55%, 31.25% and 4.06%, respectively (Table 2). This represents showed that 25 kg ha^{-1} for seed yield potential of mung bean and no need to using much more than is seed. the need to make greater use of seed values, in other words. Tofighian et al., (2013) found similar results by increasing the density of the mung bean (parto variety) from 14.3 to 33.3 p m^2, seed yield decreased. Cause of the yield reduction, was reducing the sub-branches number in dense canopy, reduce of 1000-seed weight and reduce the number of pods p. Also by reducing of density, increased the number of pods/plant. So, the can

Table 1: Analysis of Variance of Mungbean studied traits

S.O.V	Biologic Yield	Grain Yield	Harvest index	1000-Grain weight	Seed weight per m^2	N. of pod per plant	N.Seed per Pod
Seed rate	$606899.78^{n.s}$	328220.17^{ns}	$23.532^{n.s}$	6.252*	$35841.375^{n.s}$	21.137**	7.202**
Weed Control	7020016.67**	3445868.17**	$10.270^{n.s}$	$5.607^{n.s}$	5541192.042**	109.227**	10.270*
Seed rate* Weed Control	$44397.56^{n.s}$	$14717.50^{n.s}$	$8.558^{n.s}$	$5.094^{n.s}$	$8597.153^{n.s}$	10.819*	2.548n.s
Error	246501.17	115073.81	13.932	1.784	17074.054	2.925	1.197
C.V(%)	26.19	26.19	5.49	5.49	21.86	27.22	12.27

NS, ✳ and ✳✳ Significant at %5 and %1 level, respectively

Table 2: Means Comparison of Mungbean studied traits

Treatments	Biologic Yield ($Kg.ha^{-1}$)	Grain Yield ($Kg.ha^{-1}$)	Harvest index	1000-Grain weight (g)	Seed weight per m^2($g.m^{-2}$)	N. of pod per plant	N.Seed per Pod
$25kg.ha^{-1}$	2273^{a}	1600^{a}	70.65^{a}	22.05^{ab}	674.7^{a}	8.817^{a}	10.43^{a}
$50kg.ha^{-1}$	2045^{ab}	1395^{ab}	67.62^{ab}	23.57^{a}	653.7^{a}	6.517^{b}	8.567^{b}
$75kg.ha^{-1}$	1641^{b}	1087^{b}	65.87^{b}	23.02^{a}	527.2^{a}	4.533^{b}	7.833^{b}
$100kg.ha^{-1}$	1624^{b}	1100^{b}	67.78^{ab}	21.27^{b}	535.3^{a}	5.267^{b}	8.850^{b}
Weedy	1355^{b}	916.5^{b}	63.3^{a}	22^{a}	445.8^{b}	4.2^{b}	8.3^{b}
weed free	2436^{a}	1674.3^{a}	68.6^{a}	23^{a}	749.7^{a}	8.4^{a}	9.6^{a}

Means with the same letter are not significantly different based on LSD test (p≤0.05).

be concluded that the reaction of different varieties of mung bean is different to Planting density. The results of the effect of plant density on the growth and development stages (Rezai & Hasanzadeh, 1995), yield components, especially the pods/a^{-1} number (Kumar and sharma, 1989) and seed yield varied in varieties and in different environmental conditions. Generally, density increase led to reduced stem No/p and or reduce in sub-branches No, that this case led to comparison in more density, that with reduce in space of plants, reduced stem number or sub-branches of plant.

According to results of analysis of variance, weeds control was affected to biological yield, seed yield at the level of 1%, but was not significant onto the harvest index (Table1). Weed control treatment led to increased 79.83%, 82.68% and 8.37% in biological yield, seed yield and harvest index of mung bean, respectively (Table 2). This case indicates the importance of weed interference in yield reduce and weed control necessary to obtaine high produce. The results obtained in accordance with the results of Mousavi *et al* (2010), which stated that weed-infested affects on seed yield of chickpea per unit area. The interaction of the seed rate and the weed control case for traits such as biological yield, seed yield and harvest index of mung bean was not significant (Table 1). A similar response to changes in the seed rate under weed control conditions and no control of weed is one of the reasons for this case. The max and min of biological yield was obtained for weed control treatment to 25 kg ha^{-1} (2862 kg ha^{-1}) and for weed infested with seed rate of 100 kg ha^{-1} (988.7 kg ha^{-1}), respectively. The highest of seed yield (2011 kg/ha) for weed control treatment was belonged to 25 kg $ha^{-1}$and the lowest of yield mean (672.7 kg ha^{-1}) to weed infested treatment with seed rate of 100 kg ha^{-1},

Table 3: Means Comparison Interactions studied traits in weed and seeds of Mungbean

Treatments	Biologic Yield (Kg.ha^{-1})	Grain Yield (Kg.ha^{-1})	Harvest index	1000-Grain weight (g)	Seed weight per m^2 (g.m^{-2})	N. of pod per plant	N.Seed per Pod
25kg.ha^{-1} plus Weedy	1684^{bcd}	1188^{bcd}	70.5^{a}	20.47^{d}	534^{bcd}	4.80^{bcd}	10.50^{a}
25kg.ha^{-1} plus Weed free	2862 ^{a}	2011^{a}	70.8^{a}	23.63^{ab}	815.3^{a}	12.83^{a}	10.37^{a}
50kg.ha^{-1} plus Weedy	1555^{cb}	1039^{cd}	65.8^{a}	22.77^{abcd}	502.7^{cb}	5.66^{bcd}	8.10^{bc}
50kg.ha^{-1} plus Weed free	2536 ^{b}	1751^{ab}	69.43^{a}	24.37^{a}	804.7^{a}	7.36^{b}	9.03^{ab}
75kg.ha^{-1} plus Weedy	1193 ^{b}	766.7^{d}	64.43^{a}	22.90^{abc}	414.3^{cd}	2.83^{d}	6.33^{c}
75kg.ha^{-1} plus Weed free	2090^{abc}	1407^{bc}	67.30^{a}	23.13^{ab}	64ab^{c}	6.23^{bc}	9.33^{ab}
100kg.ha^{-1} plus Weedy	988.7^{d}	672.7^{d}	68.57^{a}	21.83^{bcd}	332^{d}	3.30^{cd}	8.13^{bc}
100kg.ha^{-1} plus Weed free	2259^{abc}	1527^{abc}	67^{a}	20.70^{cd}	738.7^{ab}	7.23^{b}	9.56^{ab}

Means with the same letter are not significantly different based on LSD test ($p \leq 0.05$).

respectively. Mean comparisons test showed a 9.88% increase in harvest index of mung bean in the treatment seed rate of 25 kg ha^{-1}with seed rate of 75 kg ha^{-1} in the weed interference condition (Table 3). The effects of datura weed on soybean growth and yield showed that there are a significant relationship between weed competition and growth indices (Hall *et al*., 2000). Graham *et al*., (1988) reported that mainly weeds by reducing the leaf area and leaf area duration, led to are reduced crop yield. In the study of soybean competition with natural mixed of weeds, reduced dry matter and crop growth rate (Van Acker *et al*., 1993).

The number of pods per plant

The effect of seed rate on the number of pods per plant /m^2 of mung bean was not statistically significant (Table 1). The highest number of pods/ plant (674.7 No/m^2) was belonged to 25 kg ha^{-1} and the lowest its seed rate (527 No/m^2) to 100 kg ha, respectively (Table 3). In weed control condition, increased density leads to a significant reduction ($P \leq 0.01$) number of pods/plant (Table 1). Woolley *et al* (1993), was introduced the number of pods per plant as the most sensitive of component to control of the weed. In the investigation of Malekmaleki *et al* (2013) reported that the

Table 4: Different weed species and average density, distribution uniformity, frequency and Degree of noxiousness

Weed species	Vegetative cycle	Uniformity Distribution	Frequency	Degree of noxiousness
Portulaca oleracea	Annual	65.8	91.7	-
Solanum nigrum	Annual	54.3	91.7	-
Glycyrrhiza glabra	Perennial	39.9	66.7	-
Hibiscus trionum	Annual	30.5	58.3	-
Amaranthus retroflexus	Annual	9.9	50	-
Chenopodium album	Annual	3.7	41.7	Noxious
Xanthium strumarium	Annual	13.6	33.3	-
Cynodon dactylon	Perennial	0	25	Noxious
Chrozophora tinctoria	Annual	14.8	16.7	-
Heliotropium sp.	Perennial	0	8.3	-
Cyperus spp	Perennial	0	8.3	-

Table 5: Analysis of variance dry weight data and weed density in mung bean farm

S.O.V	Weed dry weight	weed density
	Mean square	
Repeat	0.033	2.92
Seed rate	$0.024^{n.s}$	$8.99^{n.s}$
Error	0.366	6.069
C.V(%)	11.47	31.93

NS, ✳ and ✳✳ Significant at %5 and %1 level, respectively

number of pods per plant of lentil lens were significantly influenced by the density, so that the highest pods number was obtained from density of 80 plant (82.73) and the lowest its to density of 320 plants (29.83), respectively. Also, Lopez Bellido *et al* (2005) reported that the number of pods/ plant of bean with increasing plant density decreases due to the decrease in the number of sub-branches of plant. Wanchi *et al* (1993) the resulted that with the effect of planting density in three varieties of mung bean, the number of pods/ plant is the most sensitive of yield component, and in higher density reduced yield, due to the reduced number of branches, number of flowers and pods.

Number of pods/m^2, under the influence of weed control was significant at the 1% level (Table 1). As control treatment in compared to the weed interference treatments, the highest of pods no/m^2 (749.7) and due to increase 68.16% in the number of pods/m^2 (Table 2). In the study of Maron (1997) showed that, weeds in the high density, as well as environmental stresses such as drought and nutrient loss are effect in the number of pods. The effect of seed rate on mung bean pods was statistically in terms of statically (Table 1). Mean comparisons test showed an increase 94.4% and 94.48% in the number of pods/p of mung bean in the amount of 25 kg of seed/ha (8.81 No.) in compared to 75 kg of seeds/ha (4.53 No.) and 100 kg ha^{-1} (5.26 No) (Table 2) The number of pod/p of mung bean in compared to weed control showed a significant effect (Table 1). As the highest number of pods per plant was belonged to weeding factor (8.4 No.) and the lowest to weed interference (4.2 No.), respectively (Table 2). The interaction of the seed rate and weed management on number of pods/p of mung bean was significant (Table 1). Seed rate of 25 kg in weed control (12.83 No.) and rates of 75 and 100 kg ha^{-1} had the highest and the lowest number of pod/p in mung bean, respectively (3.83, 3.20 No.) (Table 3), and this difference in the compared to other means was significant.

Interaction of seed rate factors and weeds management in the number of pod/ plant, was not significant (Table1). But, mean comparisons showed that in weed management

Table 6: Effect of mung bean seed rate on dry weight and weeds density

Treatment	Dry weight-weeds g/m^2	Density-weeds $Plant/m^2$
$25kg.ha^{-1}$	154.8^{a}	59.33^{ab}
$50kg.ha^{-1}$	174.5^{a}	64^{b}
$75kg.ha^{-1}$	90.53^{a}	38.67^{ab}
$100kg.ha^{-1}$	75.60^{a}	24.67^{a}

Means with the same letter are not significantly different based on LSD test (p≤0.05).

rather than weed competition conditions in the seed rate of 100 kg ha^{-1}, the number of pods/m^2 increased to 145.5% in the seed treatment of 25 kg (Table 3). Thus, less seed (25 kg ha^{-1}) and weed control is provided the best conditions for increasing the number of pods/m^2.

Number of grain per pod

Treatments were significantly in the No of seed in pod (Table 1). The highest and the lowest number of seed in pod of mung bean (10.43 seeds in pod) were belonged to seed rate of 25 kg ha^{-1} and 75 kg/ha (7.83 seeds in pod), respectively (Table 2). Also, the number of seeds in pod can be affected by water stress and is reduced number of pods in high plant density (Haqqani *et al*., 1994). The effect of weed management on the number of seeds in pod of mung bean was significant at 5% level (Table 1). Hoeing, due to increase the number of seeds in pod of mung bean. So that , weeds interference and their competition with mung bean, decreased 13.54% of seed No/pods in compared to weed control (Table 2).Interaction of seed rate factor and weed control on the number of seeds in pod of mung bean was not significant (Table 1). Mean comparison test showed that the seed rate of 25 kg ha^{-1} in interference and weed control conditions due to increased 66.66% and 63.82% in compared to the seed rate of 75 kg ha^{-1}in weed interference respectively (Table 3).

1000- grain weight

Table 1 shows the effect of seed rate on 1000-seed weight was significant at the 5% (P≤0.05). and 1000-seed weight is a genetic trait that 20 to 30% is influenced by environmental conditions, thyus, different densities of planting on 1000-seed weight can affect up to 3%. The average weight of 1000-seed weight in seed rate of 25 kg ha^{-1}, 10.81% was higher than the average of 1000-seed weight of 100 kg ha^{-1}. However, seed rate of 50 kg ha^{-1} (23.02gr of 1000-seed weight) and 75 kg ha^{-1} (22.05 gr of 1000-seed weight), there was no significant difference (Table 2). 1000-seed weight did not affected by weed control and management (Table 1). Such as, was 1000-seed weight average in weeding treatments (23g) and in weed infested treatment with green gram plants (22g) (Table 3). Based on the analysis of variance, interaction of the seed rate and weeds control on the 1000-seed weight was not significant (Table 1). The maximum of 1000-seed weight was belonged to 50 kg ha^{-1} in weeding condition (24.37g) and the lowest to 25 kg/ha in weed interference (Table 3).

The effect of experimental treatments on weed

In this study, 11 species of weed, purslane, pigweed, nutsedge, chenopodium album, nightshade, licorice, cocklebur, bemuda grass, musk mallow, euphorbia and heliotrope in the agricultural field observation and evaluated. frequency of Purslane and nightshade weeds was equal to 7.91% that had the highest frequency. frequency of licorice was equal to 66.7%, requency of lantern flower 58.3% and pigweed species with a frequency of 50% was mentioned account. Abundance of heliotrope and nutsedge species with 8.3% were bearing min of frequency (Table 4). The abundance of uniformity frequency to some species showed that are fitting with of the climate and soil, while high levels of the density average of farm for some species showed high levels of competitiveness and reproduction of species more than other (Minbashi *et al*., 2008). The effect of Seed rate on weed dry weight was not significant (Table 5). The average dry weight of weed for 100 kg $ha^{-1}$of seed rate of green gram (75.6 g m^2) and the highest average was belonged to seed rate of 50 kg ha^{-1} (175.4 g m^2), respectively (Table 6). Harries & White (2007) reported that change of plant density can affected to growth and development of weeds. With increasing density, increases crop competitiveness and is introduced as a tool in integrated weed management.

Weeds density was not affected by the seed rate and between of difference seed rates of mung bean in terms of weed density was not significant (Table 5), but, mean comparisons test showed a reduction of 61.5% in the weed density in 100 kg $ha^{-1}$of seed rate, that in compared to the 25 kg ha^{-1} was 58.4% (Table 6).

It seems that at low densities of mung bean, aboundant of environmental sources shch as light, food and moisture have led the growth of weeds, but in the high density, plant population led to is low growth opportunities for weed. In other words, this result probably reflects self-thinning of weeds from competing with the crops (Ezueh, 1982). Researches results showed that the growth of weeds suppressed with using narrow row (Legere & Schreiber, 1989). And numerous studies have found no effect or its low effect. Teasdal and Frank (1983) examined the effect of row spacing on weeds competition in snap bean and reported that the reduction of row spacing from 91 to 46cm, was reduced light hitting the surface, and this leads reducing the growth of weeds.

CONCLUSION

Results showed that the densities of the test, the seed rate of 25 kg ha^{-1} (equivalent to 60 plant/m^2) to obtain seed yield potential for oral consumption and also its biological yield as a forage crop is preferable to other densities .it seems that in 25 kg ha^{-1} (seed rate of mung bean) reduced mung bean density in area unit and pay attention to weeds competition in this condition, will increased weed growth probably due to abundance of resources, so moisture and nutrition. However, density of 100 kg ha^{-1} of seeds, the highest yield reduce from than other treatments and this represents less competitive against the weed. Generally, the results of this research showed that selecting of mung bean varieties with runner type and optimum density performance used against weeds can be increased competitive pressure and resulting prevented from their damage at the significant. weeds management by weeding out, not only makes more seed yield but also prevented environmental damage and will help environmental sustainability.

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