INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 5, No. 4, p. 238-244, 2014

RESEARCH PAPER OPEN ACCESS

Effect of different levels of superabsorbent and foliar application of auxin hormone on yield and morphological traits of mungbean (*Vignaradiata* L.)

Seyede Vania Moosavi Nasab[1], Seyyed Gholamreza Moosavi[2*], Tayeb Saki Nejad[3]

[1,2]*Departement of Agricultural, Birjand Branch, Islamic Azad University, Birjand, Iran*

[3]*Departement of Agricultural,Ahvaz Branch, Islamic Azad University, Ahvaz, Iran*

Key words: Superabsorbent, auxin, mung bean, yield, morphological traits.

http://dx.doi.org/10.12692/ijb/5.4.238-244 Article published on August 30, 2014

Abstract

In order to investigate the effect of different levels of superabsorbent and auxin hormone on yield and yield components of mung bean, a split plot experiment in the form of randomized complete block design with four replications was carried out in the research field of Islamic Azad University, Ahvaz Branch in the summer of 2011. The main plots included three levels of superabsorbent (0, 60, 120 kg/ha) and sub plots were three levels of auxin hormone (0, 10, 15 ppm). The results showed that simple and interaction effects of superabsorbent and auxin on plant height, pod length, grain and biological yield were significant. But the harvest index was only influenced by the simple effect of superabsorbent. Mean comparisons showed that the increase of superabsorbent application up to 120 kg/ha led to the significant increase of above traits by 14.91, 13.26, 11.17 and 18.46 %, respectively in comparison to without application of superabsorbent treatment and application of 15 ppm auxin caused the significant increase of those traits by 14.88, 13.26, 18.67 and 17.71 %, respectively in comparison to without application of auxin treatment. In general, the results of this research showed that the best treatment for optimal yield within the research condition was the one with application of 120 kg/ha superabsorbent and 15 ppm auxin.

* **Corresponding Author:** Seyyed Gholamreza Moosavi ✉ s_reza1350@yahoo.com

Introduction

Mung bean is one of the most important indigenous legumes of India whose grains are full of phosphorous and protein. It is a heat-loving and short day plant and requires high temperature. Its physiological zero is 8 ℃and can easily tolerate temperature increase of environment up to 45 ℃. With regard to the mentioned features, there are suitable ecological conditions for sowing this crop in many provinces of Iran including Khuzestan (Habib Zade *et al.*, 2006). Limited water resources in Iran clarify the necessity of saving water. One of the strategies for optimal use of water resources and their preservation is application of superabsorbent polymers. Super absorbent polymer is a soil additive which absorbs and retains water and nutrients and contributes to optimal plant growth, reduction of irrigation costs and waste of water. Such polymers are made up of potassium polyacrylamide and copolymers of polyacrylamide and their unique feature is their high capacity of water absorption and maintenance. These materials do not make any changes in cultivation soil after constant use (Chatzopoulos *et al.*, 2000). Abedini *et al.* (2011) reported that through the use of superabsorbent because maintaining moisture, number of inoculated reproductive units and consequently the number of grains in wheat cluster and finally seed yield increased in comparison to without application superabsorbent treatment.

Researches conducted by Alahdadi *et al.* (2005) in soybean indicated the increase of number of flowers per plant and ultimately seed and biological yield in treatments with application of superabsorbent. The increase of seed yield in treatments with polymer in comparison to treatment without polymer was reported in soybean by Yazdani *et al* (2007). Moreover, Alahyari *et al.* (2013) reported that the effect of different levels of polymer on grain yield of pea was significant at 1% probability level.

Harvey (2002) stated that consumption of superabsorbent increased dry matter and red bean's resistance to drought. According to the studies of Laosheng (2002) superabsorbent in addition to preventing moisture fluctuations stress and gradual releasing of available nutrients in soil by preventing their leaching, would increase the number of pods per plant and seed yield in peas. Auxin causes a wide range of growth responses. Plants responses to auxin varies from the effect on cell metabolism to coordination of plant morphology including the loss of leaves and plant aging and such responses depend on auxin concentration. High concentration of auxin due to competition at receptors' binding inhibits growth. Moreover, plant response to auxin varies and largely depends on the sensitivity of plant. Stems respond to a large range of auxin concentration (Sarmadnia and Kouchaki, 2007).

Roots growth is influenced by auxin hormone and elongation of main axis and emergence of lateral roots are primarily stimulated by auxin originated from plant shoots (Marschner, 1995). Therefore, auxin develops the root system and thus the plant will be able to uptake materials optimally which faced lack of mobility under moisture stress conditions. On the other hand, plant will have access to more soil moisture reserves and will prevent the yield reduction. Gadallah (2000) stated that auxins are generally known as stimulating root growth in plants and can improve the grain yield by keeping the moisture balance. The role of foliar application of auxin in increasing plant cells and increasing the reservoir need and dry matter was investigated by Tomar *et al.* (1990) and Tripathy *et al.* (1999).

The purpose of this experiment was to investigate the effect of different levels of superabsorbent and auxin on yield and morphological traits of mung bean and to determine the most appropriate rate of superabsorbent and auxin application for cultivation mung bean within the research conditions.

Materials and methods

Study side

This experiment was carried out in Shahid Salemi Research Field in Ahvaz at longitude 48°40' E, latitude 31°20' N and 22.5 m above the sea level in the summer of 2011.

Experimental design and treatments

It was a split plot experiment as randomized complete block design with four replications. Experimental treatments included three levels of superabsorbent (0, 60, 120 kg/ha) as the main factor and three levels of auxin hormone (0, 10, 15 ppm) as the sub factor.

Cultivation

Superabsorbent was placed at depth of 10 cm below the seeds while planting the seeds and foliar application of auxin hormone was done at 6-leaf stage. Each plot included 5 planting line as long as 5 meters. The space between

sowing lines was 75 cm and the distance between two main plots and two sub plots was 3 and 1 non-planting line, respectively.

To determine of morphological traits including plant height and pod length, eight plants were selected from the middle of the plots and then, they were measured. Also, to measure seed and biological yields, the plants were harvested from the 3 middle rows in an area of 2 m^2. The harvest index (HI) of seed was determined by:

HI= (seed yield/ biological yield) ×100

Statistical analysis

The analysis of variance was done by SAS software and Duncan's multi range test at 5% probability level was used to compare the means.

Results and discussion

Morphological traits

The results showed that simple and interaction effects of superabsorbent and auxin hormone on the height of plant and the length of pod were significant in mung (table 2). Comparison of the means showed that as the consumption of superabsorbent increased from 0 to 120 kg/ha, the height of plant and the length of pod significantly increased by 14.91 and 13.26% respectively (Table 3).

Table 1. Physical and chemical characteristics of study field at the depth of 0-60 cm.

Type of Soil	Percentage of soil components (%)			Lime (%)	Organic materials (%)	Saturation Percentage(SP)	pH	Ec*10^ mmoh/cm	Soil depth (cm)
	Sand	Silt	Clay						
Clay silt	21	39	41	38	0.624	54.97	7.74	4.64	0-30
loam	18	40	42	39	0.702	57.94	7.76	6.56	30-60

It seems that superabsorbent has caused the increase of growth rate of crop and dry matter accumulation (Hady *et al*., 2006) and finally the significant increase of plant height by decreasing the loss of water and nutrients and increasing their consumption efficiency during the growth season.

Daneshmand and Azizi (2009) studied the effect of superabsorbent on growth characteristics of basil and reported that as the consumption of superabsorbent increased up to 150 kg/ha, plant height increased significantly, but there was no significant difference between treatments with application of 150 and 300 kg/ha superabsorbent. The increase of pod length due to application of superabsorbent in red bean was reported by Poor Esmaeil *et al.* (2010).

Comparison of the means showed that as the consumption of auxin increased from 0 to 15 ppm, plant height and pod length increased 14.88 and 13.85 percent, respectively, but levels of 10 and 15 ppm auxin were placed in the same statistical group in this regard (Table 3). These results were consistent with the findings of Saki Nejad *et al.* (2011) about mung.

It seems that application of 60 kg/ha superabsorbent and 15 ppm auxin rather than 10 ppm auxin inhibited the length growth of mung stem and significantly decreased it by 84.54%; however, lack of application of superabsorbent and increase of auxin consumption from 10 to 15 ppm significantly increased the plant height by 16.36 %. Moreover, application of 120 kg/ha superabsorbent and increase of auxin consumption from 10 to 15 ppm did not result in significant increase of plant height (Table 4). Comparison of the means of interaction effect of superabsorbent and auxin showed that the highest length of pod by 12.62 cm was related to the treatment with application of 120 kg/ha superabsorbent and consumption of 10 ppm auxin and the lowest length by 9.37 cm belonged to the treatment without consumption of superabsorbent and auxin (Table 4).

Table 2. The ANOVA of the yield and morphological traits f mung bean affecting t different levels of superabsorbent and auxin hormone.

Sources of variations	df	Mean of squares				
		Stem Height	PodLength	Seedyield	Biological yield	Harvest index
Block	3	20.91	0.26	295.04	1936.52	0.21
Superabsorbent (A)	2	303.09 **	5.80 *	21772.07**	159679.71 **	1.77 **
Error (a)	6	6.02	0.56	668.95	5004.01	0.15
Auxin (B)	2	367.90 **	7.18 **	16949.02 **	150679.10 **	1.27 ns
A × B	4	227.79 **	3.53 **	3419.75 **	9537.62 **	3.91 ns
Error (b)	18	5.34	0.17	409.15	1520.01	1.13
CV (%)	-	3.26	3.71	4.60	2.87	4.22

Ns, *, ** respectively indicate non-significant difference, and significant difference at 5% and 1% probability level.

Seed and biological yield

According to the analysis of variance (ANOVA) results, simple and interaction effects of superabsorbent and auxin hormone on grain yield and yield components of mung were significant at 1% level (Table 2). Comparison of means indicate that although the consumption of 120 kg/ha superabsorbent significantly increased the grain yield by 11.17% in comparison to the treatment without consumption of superabsorbent, there was no significant difference between the treatments with application of 60 and 120 kg/ha superabsorbent in terms of grain yield (Table 3). The results were consistent with the findings of Padman *et al.* (1994) on the increase of seed yield of Indian mustard in the treatments modified by Jalas hakti. The reason could be associated with the increase of seed yield in case of consumption of superabsorbent and consequently improvement of photosynthesis conditions and assimilates mobilization and lack of water deficit stress during the growth stage of plant in comparison to the treatment without application of superabsorbent.

Table 3. Means comparison of simple effects of different levels of superabsorbent and auxin hormone on yield and morphological traits of mung bean.

Tratments	Stemheight (cm)	Pod length (cm)	Seedyield (g/m²)	Biological yield (g/m²)	Harvest Index(%)
Superabsorbent levels (kg/ha)					
0	65.36 c	10.33 b	435.66 b	1247.79 c	32.02 b
60	72.35 b	11.18 a	484.29 a	1353.23 b	32.16 b
120	75.11 a	11.70 a	484.33 a	1478.22 a	32.74 a
Auxin levels (PPM)					
0	64.55 b	10.18 b	402.46 c	1256.16 c	32.02 a
10	74.11 a	11.44 a	439.35 b	1344.38 b	32.66 a
15	74.16 a	11.59 a	477.62 a	1478.69 a	32.24 a

According to Duncan's multi range test, the means of treatments with similar letters are not significantly different from each other at 5% level.

As the consumption of superabsorbent increased from 0 to 60 and 120 kg/ha, biological yield of mung increased 8.45 and 18.46% respectively and all levels of superabsorbent were placed in statistical groups (Table 3). The significant increase of biological yield due to the increase of superabsorbent consumption could be attributed to providing good conditions for mung to make use of moisture and other resources in making materials and accumulating dry matter. Rahmani *et al.* (2009) observed that the highest biological yield in mustard was related to the application of 7% superabsorbent and the lowest biological yield was related to lack of consumption of superabsorbent.

Table 4. Mean comparison of interaction effects of different levels of superabsorbent and auxin hormonr on yield and traits of mung bean.

Treatments		Mean of traits				
Superab-sorbent levels (kg/ha)	Auxin levels (PPM)	Stemheight (cm)	Pod length (cm)	Seedyield (g/m^2)	Biological yield (g/m^2)	Harvest index (%)
0	0	59.78 d	9.37 e	369.43 e	1165.23 e	31.70 ab
	10	63.00 cd	11.31 b	428.22 cd	1273.43 d	33.52 a
	15	73.31 b	10.29 cd	400.68 de	1304.70 cd	30.82 b
60	0	71.22 b	11.02 bc	398.69 de	1252.80 d	31.82 ab
	10	79.02 a	10.39 cd	419.18 cd	1312.74 cd	31.93 ab
	15	66.81 c	12.14 a	489.12 b	1494.14 b	32.73 a
120	0	62.64 d	10.15 d	439.28 c	1350.45 c	32.53 ab
	10	80.32 a	12.62 a	470.64 b	1446.97 b	32.53 ab
	15	82.38 a	12.34 a	543.07 a	1637.23 a	33.17 a

According to Duncan's multi range test, the means of treatments with similar letters are not significantly different from each other at 5% level.

Fazeli Rostampoor *et al.* (2011) stated that superabsorbent has caused the reduction of abortion and consequently the increase of seed yield by supplying water and some nutrients at critical stage of formation of corn grain. Through increasing water-holding capacity of soil, superabsorbent has probably been able to increase the relative water content in plant at grain filling stage and consequently to increase water potential of the cells and reservoir power; therefore, the weight and yield of grain has increased. Poorpasha *et al.* (2011) reported that the increase of yield via application of superabsorbent polymer was due to providing water and nutrients for plant at different growth stages which improved the yield of wheat.

As the application of auxin hormone increased, grain yield increased significantly, so that the highest grain yield by 477.62 g/m^2 belonged to the treatment with consumption of 15 ppm auxin which was 8.71% and 18.67% more than the treatments with application of 10 and 0 ppm auxin, respectively (Table 3). Moreover, as the application of auxin increased from 0 to 10 and 15 ppm biological yield of mung increased significantly by 7.02% and 17.71% respectively (Table 3). Saki Nejad *et al.* (2011) stated that auxinincreased grain yield and biological yield in mung bean. Auxins are directly involved in biosynthesis of materials and thus can produce more plant cells and consequently more dry matter and store them in grains as reservoir and thus increase the yield (Devlin and Withan, 1993).

It seems that, the increase of auxin application from 0 to 15ppm without consumption of superabsorbent couldn't increase the grain yield significantly while the increase of auxin application and consumption of 60 and 120 kg/ha superabsorbent significantly increased the grain yield (Table 4). The application of superabsorbent has probably provided more moisture for plant and consequently auxin has more efficiently contributed to the improvement of root growth and photosynthetic part of plant. Even though the increase of application of auxin at all levels of consumption of superabsorbent has increased the biological yield of mung bean, the consumption of 120 kg/ha superabsorbent has accelerated such an increase (Table 4).

Harvest index

The simple effect of superabsorbent on harvest index of grain per plant was significant at 1% level, while the simple effect of auxin and the interaction effect of superabsorbent and auxin on this trait were not significant (Table 2). As superabsorbent increased, harvest index increased too and among superabsorbent treatments, the highest rate of harvest index by 32.74% was related to the treatment with application of 120 kg/ha superabsorbent (Table 3).. It seems that application of 120 kg/ha superabsorbent has provided sufficient moisture within the growth environment of mung root and consequently better conditions have been provided during the growth stage for grain aggregation and assimilates mobilization into physiological reservoirs and thus the ratio of economic yield to biological yield (harvest index) has increased significantly. The obtained results were consistent with the findings of Rahmani (2007) and Poor Esmaeil *et al.* (2010).

Conclusion

The results of this research showed that the best treatment for optimal yield within the research condition was the one with application of 120 kg/ha superabsorbent and 15 ppm auxin.

References

Abedini AR, Sajedi NA. 2011. The effect of superabsorbent polymer on yield and yield components of different cultivars of rain fed wheat. The 6th national conference of new ideas in agriculture. Departement of Agriculture, Islamic Azad University, Khorasgan, Iran, 36-39 P.

Alahyari S, Golchin A, Vaezi A. 2013. The effect of application of superabsorbent polymer on yield and yield components of two pea cultivars under rain fed conditions. Journal of plant production research **20(1),** 125-140.

Allahdadi I, Yazdani F, Akbar GA, Behbahani SM. 2005. Evaluation of the effect of different rates of superabsorbent polymer (superab A200) on yield and yield components of soybean (*Glysin max* L.). 3 rd Specialized Training Course and Seminar on the Application of Superabsorbent Hydrogel in Agriculture, Iran, 20-32 P.

Chatzopoulos F, Fugit JF, Ouillous L. 2000. Etu deocation function do different parameters dolabsption *et al*la desorption do sodium retitule, European Polymer Journal **36,** 51-60.

Daneshmandi M, Azizi M. 2009. The effect of water superabsorbent polymer on physio-morphological characteristics, crop yield and accumulation of medicinal compatibility metabolites of modified basil. The 6th conference of iranian gardening science, Gilan, Iran.

Devlin RM, Withan FH. 1983. Plant physiology. 4th Ed. Wadsworth Publishing Company. A division of wads worth. Inc. Belmont, California.

Fazeli Rostampoor M, Seghatoleslami MJ, Mousavi SGR. 2011. The effect of water stress and polymer (superabsorbent 200A) on yield and efficiency of water consumption in maize (*Zea mays* L.) in Birjand Area. Journal of Environmental Stress in Crop Science **4(1),** 12-19.

Gadallah MAA. 2000. Effect of indole-3-acetic acid and zinc on the growth, osmotic potential and soluble carbon and nitrogen components of soybean plants growing under water deficit. Journal of Arid Environment **44,** 451-467. http://dx.doi.org/10.1006/jare.1999.0610

Habibzade Y, Mamghani R, Kashani A. 2007.

The effect of different densities of planting on grain yield, yield components, and protein in three mung cultivars in Ahvaz. Journal of Agriculture **30 (3),** 1-13.

Hady OA, Wanas SA. 2006. Water and fertilizer use efficiency by cucumber grown under stress on sandy soil treated with acrylamide hydrogels. Journal Applied Science Research **2(12),** 1293- 1297.

Harvey J. 2002. Use of hydrogels to reduce leaf loss haster root. Establishment Forest Research **45,** 220-228.
http://dx.doi.org/10.1176/x003.0610

Laosheng WU. 2002. Polyacrylamide (PAM)-effective erosion fighter andinfiltration enhancer but not a conserver of water. Available in http://kimberly.ars.usda.gov/pampage.shtml.

Marschner H. 1995. Mineral nutrition of higher plants. 2nd ed. Academic Press. 889.

Padman DR, Porwal BL, PatelJC. 1994. Effect of levels of irrigation nitrogen and jalas hakti on growth and yield indian mustard. Indian Journal of Agronomy **39,** 599-603.

Poor Esmaeil P, Habibi D, Tavasoli A. 2010. The Effect of superabsorbent polymer on yield and efficiency of water consumption in different cultivars of red bean under drought stress in greenhouse conditions. Journal of Agriculture **1(2),** 1-16.
http://dx.doi/10.1016/0378-23239-1231

PoorPasha M, Roshdi M, Rezaei M, Mosha'shaei K. 2011. The effect of different levels of nitrogen fertilizer and superabsorbent polymer on yield and yield components of wheat. Journal of Agricultural Science **3(12),** 85-97.

Rahmani M, Habibi D, Shirani Rad AH, Daneshian J, Valad Abadi SAR. 2009. The effect of superabsorbent polymer on yield, activity of oxidant enzymes (catalase and superoxide dismutase) and cytoplasmic membrane stability in mustard under water stress conditions. Journal of Plant and Ecosystem **6(22),** 19-37.

Rahmani N. 2007. The effect of irrigation time and application of nitrogen on quantitative and qualitative traits of evergreen herb, Master's Thesis, Faculty of Agriculture, Takestan Branch, Islamic Azad University, 35-52 P.

Saki Nejad T, Shoukofar AR, Tayebi A. 2011.The use of hormone auxin in the different period growth on yield components of plant vetch. World Academy of Science, Engineering and Technology **60,** 223-229.

Sarmad Nia Gh, Kouchaki A. 2007. Crops Physiology. Jihad Daneshgahi Publications, Mashhad University.

Tripathy SK, Patra AK, Samu SC. 1999. Effect of micro-nutrients on nodulation, growth, yield and nutrient uptake by groundnut (*Arachis hypogaea* L.). Indian Journal of Plant Physiology **4,** 207-209.

Tomar R, Kushwaha HS, Tomar SPS. 1990. Response of groundnut (*Arachis hypogaea* L.) varieties to phosphorus and zinc under rainfed conditions. Indian Journal of Agronomy **35,** 391-394.

Yazdani F, Allahdadi I, Akbari GA. 2007. Impact of superabsorbent polymer on yield and growth analysis of soybean (*Glycine max* L.) under drought stress condition. Pakistan Journal Biological Science **10,** 4190-4196.