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Research Article

THE EFFECTS OF TRIPLE SUPERPHOSPHATE FERTILIZER AND BIOLOGICAL PHOSPHATE FERTILIZER (FERTILE 2) ON YIELD AND YIELD COMPONENTS OF SESAME IN HAMIDIYEH WEATHER CONDITIONS

Seyed Mehdi Hashemi and *Mani Mojaddam
Department of Agronomy, College of Agriculture, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran
**Author for Correspondence*

ABSTRACT
In order to investigate the effect of triple superphosphate and biological phosphate fertilizer (fertile 2) on yield and yield components of sesame in Hamidiyeh weather conditions, a factorial experiment in the form of randomized complete block design with four replications was carried out in Hamidiyeh in 2014. The studied treatments consisted of three levels of pure phosphorus from the source of triple superphosphate (P2O5) including 0, 45, 90 kg/ha and the second factor consisted of three levels of biological phosphate fertilizer (fertile 2) including 0, 100, 200 g/ha. The results showed that triple superphosphate and biological phosphate fertilizer (fertile 2) significantly increased the grain yield, number of capsules per plant, number of grains per capsule, and 1000-grain weight, but the interactive effect of chemical and biological fertilizers had only a significant effect on the grain yield. The highest grain yield, number of capsules per plant, number of grains per capsule, and 1000-grain weight belonged to the treatment with 90 kg/ha triple superphosphate and 200 g/ha biological fertilizer and the lowest rate of these traits belonged to the control treatment (without triple superphosphate). The results indicated the significant role of phosphorus in increasing the grain yield and yield components and in general improving the sesame production compared with the control treatment (without chemical and biological fertilizers). Investigating the interactive effect of triple superphosphate and biological phosphate fertilizer (fertile 2) showed that the highest grain yield by 713.21 kg/ha belonged to the treatment with 90 kg/ha triple superphosphate and 200 g/ha biological phosphate fertilizer (fertile 2) and the lowest grain by 574.49 kg/ha yield belonged to the control treatment (without chemical and biological fertilizers).

Keywords: *Sesame, Triple Superphosphate, Yield and Yield Components, Phosphate Fertilizer (Fertile 2)*

INTRODUCTION
Sesame with the scientific name of (*Sesumum indicum* L.) is one of the oil production sources and since each year a large amount of currency (over 90% of the oil import) is spent to import oil into the country it seems necessary to pay attention to this plant and enhancing its production (Veis, 2000). In this regard, supplying adequate nutrients for plant such as phosphorus is one of the most important aspects of agriculture management and can play an important role in increasing production and improving the yield (Singh *et al.*, 2007). One of the sources that can supply phosphorus is triple superphosphate. Since the high efficiency of fertilizer consumption by plants reduces the fertilizer input costs and nutrient losses and improves the yield, in order to improve the efficiency of nutrients consumption, the fertilizer consumption methods should be changed in such a way that necessary nutrients could be provided for plants within a long time and without any losses. Given the mentioned points, it seems necessary to revise the use of chemical phosphate fertilizers and to apply new methods such as the consumption of biological fertilizers. Biological phosphate fertilizer (fertile 2) contains preservatives with a dense population of one or more beneficial soil microorganisms or their metabolic products which are used to improve the soil fertility and to supply adequate phosphorus for plants in a sustainable agricultural system (Jot and Shaktwat, 2003). Lafond *et al.,* (2008) found that the increase in phosphorus consumption improved the reproduction strength of plant, number of flowers, and ultimately increased the number of capsules per plant. Zafarian *et al.*, (2011) reported that the highest number of bolls in plant in safflower was obtained by the use of different levels of chemical triple superphosphate fertilizer. Qush and Mohieodin (2000) reported that

application of biological fertilizers in sesame significantly increased the number of capsules per plant and the grain yield. Ghorbani (2010), in an experiment stated that the highest number of grain row per corn ear was obtained through the use of biological phosphate (fertile 2). Ojaghloo stated that the use of biological phosphate fertilizer (fertile 2) in safflower increased the number of bolls per plant. Zafarian *et al.,* (2011) stated that application of triple superphosphate in safflower (Goldasht cultivar) allocated 36 grains per boll to the plant. Qush and Mohieodin (2000) reported that application of biological fertilizers in sesame significantly increased the number of grains per capsule. Ghorbani (2010) showed that the use of biological phosphate (fertile 2) led to the increase of number of grains per row in different maize cultivars. Lafond *et al.,* (2008) stated that the increase of application of phosphorus fertilizer would increase the weight of 1000-grain in flax due to increasing the reproduction strength of plant, number of flowers, and production of more seeds. Eftekhari *et al.,* (2006) conducted a research on rice and stated that the highest weight of 1000-grain (31.13 g) was observed in the treatment with consumption of 75 kg/ha triple superphosphate. Parhizkar *et al.,* (2011) reported in a research that the highest weight of 1000-grain in flax belonged to the treatment with consumption of 120 kg/ha phosphorus. The increase of consumption of phosphorus leads to the increase of grain yield in flax due to increasing the reproduction strength of plant, number of flowers, and production of more seeds (Lafond *et al.,* 2008). Parhizkar *et al.,* (2011) reported in a research that the highest grain yield in flax belonged to the treatment with consumption of 120 kg/ha phosphorus. Yasari and Pato (2007) reported the increase of sesame grain yield due to the consumption of bio-fertilizers. Ghasem *et al.,* (2009) investigated the effect of biological phosphate fertilizer (fertile 2) on the yield of tomato and showed that the treatment with consumption of 200 g/ha phosphate (fertile 2) had a higher yield than the treatment with consumption of 100 g/ha phosphate (fertile 2).

With regard to appropriate conditions in Khuzestan for planting sesame and lack of adequate research on the effect of biological fertilizers on this plant, the present research was conducted to investigate the effect of triple superphosphate and biological phosphate (fertile 2) on the yield and yield components of sesame in Hamidiyeh weather conditions.

MATERIALS AND METHODS

Experimental Location

The research was carried out in 2014 in Hamidiyeh Town at latitude 31°4´N and longitude 48°10´E and 13 meters above the sea level. The soil of the experiment site had clay-loam texture with ph=7.7 and EC=4.6. The research was conducted as a factorial experiment in the form of randomized complete block design with four replications. The studied treatments in the study consisted of three levels of phosphorus from the source of triple superphosphate (P205) including 0, 45, and 90 kg/ha and 3 levels of biological phosphate (fertile 2) including 0, 100, 200 kg/ha. Land preparing operation included irrigation, plowing to the depth of 30 cm, disc to the depth of 15 cm, and trowel. Then the grooves were created with a distance of 50 cm from each other by the furrower. After the preparation the land was plotted according to the map. The experiment included 36 plots totally and each experimental plot contained 6 planting lines as long as 5 m and the distance between the plants on each row was considered to be 10 cm. the distance between the replications was 1 m. In order to supply the required nitrogen, urea fertilizer was added to the soil according to the soil test as 50% base and 50% surplus in the vegetative state (5-6-leaf stage). Planting was done manually on July 1, 2014. Irrigation was done immediately after the planting. Weeding was done manually after the seeds germination and stem strengthening. Measurement of the Studied Traits: In order to calculate the grain yield at the mature stage and after the elimination of 0.5 from the beginning and end, the plants were harvested from an area of 1.5 m^2 and were kept standing in the fresh air and after the plants dried the grains separating operation stated in several steps by shaking the plants in the bags. When the plants and seeds got dry completely the grains were weighed and the grain yield was calculated at the moisture of 14%. In order to determine the number of capsules per square meter the total number of harvested capsules within an area of 1.5 m^2 was counted and was considered as the number of capsules per square meter. In order to obtain the number of grains per capsule, 10 capsules were randomly

separated from the totals capsules of the same area of $1.5m^2$ and after separating all the grains, they were counted and the number of grains per capsule was obtained via dividing the number of grains by the number of capsules. In order to calculate the weight of 1000-grain, first the seeds got clean and then two 500-seed samples were counted and weighed. Data analysis was done in the form of factorial design and with through SAS software and the means were compared through Duncan's multiple range tests at 5% level.

RESULTS AND DISCUSSION

Number of Capsules per Plant

The ANOVA results showed that the effect of triple superphosphate and different levels of biological phosphate (fertile 2) on the number of capsules per plant was significant at 1% probability level. However, the interactive effect of triple superphosphate and different levels of biological phosphate (fertile 2) on the number of capsules per plant was not significant (Table 1). The increasing trend of the number of capsules per plant influenced by the increase of triple superphosphate fertilizer well indicates the positive effect of phosphorus on this trait. Mean comparison of the effect of different levels of triple superphosphate on the number of capsules per plant (Table 2) showed that the highest number of capsules per plant by 37 capsules belonged to the treatment with consumption of 90 kg/ha chemical triple superphosphate fertilizer and the lowest number of capsules per plant by 29.17 capsules belonged to the treatment without consumption of triple superphosphate fertilizer. The increase of consumption of phosphorus fertilizer led to the increase of reproductive strength of plants, number of flowers and finally the increase of number of capsules per plant. The results were consistent with the findings of Lafond *et al.,* (2008). As Sajadi *et al.,* (2011) claimed the place of capsule formation in sesame is near the junction of the petiole into the branch, and on the other hand, the consumption of phosphorus fertilizer affects biochemical reactions, photosynthesis, increase of the number of leaves, increase of length of growing season, and dry matter accumulation in plant shoots. So its effect on this trait seems to be obvious. Zafarian *et al.,* (2011) in a research reported that the highest number of bolls I plant in safflower was obtained via the consumption of different levels of chemical triple superphosphate fertilizer. Phosphorus is a necessary nutrient which leads to the storage and transfer of chemical energy in plant, acceleration of growth, and the product maturity and increase of flowering and consequently the increase of number of capsules per plant. The results were consistent with the findings of Hoking *et al.,* (1993). The results were also consistent with the findings of Nozari *et al.,* (2002) who showed that application of 100 kg/ha phosphorus could lead to the production of more tillers than the consumption of 50 kg/ha phosphorus. Mean comparison of the effect of phosphate fertilizer (fertile 2) on the number of capsules per plant (Table 2) showed that the highest number of capsules per plant by 35.67 capsules belonged to the treatment with consumption of 200 g/ha biological phosphate fertilizer (fertile 2) and the lowest number of capsules per plant by 30.5 capsules belonged to the treatment without consumption of biological phosphate fertilizer (fertile 2). Georg *et al.,* (2005) showed in their studies that adding nutrients such as phosphorus (fertile-2 phosphate) to the soil would lead to the increase of the rate of photosynthesis and its efficiency and finally the increase of grain yield and growth in sesame. Qush and Mohiodinn (2000) reported that application of biological fertilizers in sesame significantly increased the number of capsules per plant and the grain yield. In an experiment Ghorbani (2010) stated that the highest number of rows of grain per corn ear was obtained through the use of biological phosphate fertilizer (fertile 2). Ojaghloo (2007) stated that the use of biological phosphate fertilizer (fertile 2) in safflower led to the increase of the number of bolls per plant which was consistent with the findings of the present research.

Number of Grains per Capsule

The ANOVA results showed that the effect of triple superphosphate and different levels of biological phosphate (fertile 2) on the number of grains per capsule was significant at 1% probability level. However, the interactive effect of triple superphosphate and different levels of biological phosphate (fertile 2) on the number of grains per capsule was not significant (Table 1). Mean comparison of the effect of different levels of triple superphosphate on the number of grains per capsule (Table 2) showed

that the highest number of grains per capsule by 46.5 grains belonged to the treatment with consumption of 90 kg/ha chemical triple superphosphate fertilizer and the lowest number of grains per capsule by 37.83 capsules belonged to the treatment without consumption of triple superphosphate fertilizer. The increase of consumption of phosphorus fertilizer led to the increase of reproductive strength of plants, number of flowers and production of more seeds in flax. The results were consistent with the findings of Lafond *et al.,* (2008). Parhizkar *et al.,* (2011) reported in a research that the effect of triple superphosphate on the number of grains per capsule was significant at 1% level which was consistent with the results of the research. The highest number of grains per capsule belonged to the treatment with application of 40 kg/ha phosphorus which was different from the results of the research that referred to the increasing trend of the number of grains per capsule influenced by the increase of triple superphosphate fertilizer. Zafarian *et al.,* (2011) stated that application of triple superphosphate in safflower (Goldasht cultivar) allocated 36 grains per boll to the plant. Najafpoor (2001) reported that the use of phosphorus fertilizers can significantly affect the rate of flowering and seeding in herbs. Mean comparison of the effect of phosphate fertilizer (fertile 2) on the number of grains per capsule (Table 2) showed that the highest number of grains per capsule by 44.58grains belonged to the treatment with consumption of 200 g/ha biological phosphate fertilizer (fertile 2) and the lowest number of grains per capsule by 41.08 belonged to the treatment without consumption of biological phosphate fertilizer (fertile 2). Georg *et al.,* (2005) showed in their studies that adding nutrients such as phosphorus (fertile-2 phosphate) to the soil would lead to the increase of the rate of photosynthesis and its efficiency and finally the increase of grain yield and growth in sesame. Qush and Mohiodinn (2000) reported that application of biological fertilizers in sesame significantly increased the number of grains per capsule and the grain yield. In an experiment Ghorbani (2010) stated that the use of biological phosphate fertilizer (fertile 2) increased the number of grains per row in different maize cultivars which was consistent with the findings of the research.

Table 1: The ANOVA results of the mean squares of the studied traits in sesame

Grain yield	1000-grain weight	Number of grains per capsule	Number of capsules per plant	Df	Source of variation
3068n.s	0.0079n.s	1.731n.s	3.074n.s	3	**Replication (R)**
908314**	0.699**	252.028**	185.444**	2	**Triple superphosphate fertilizer (P)**
277995**	0.2129**	38.111**	81.444**	2	**Biological phosphate fertilizer (Fertile 2) (B)**
12490*	0.0072 ns	1.861n.s	3.111 ns	4	**Interactive effect of P*B**
3019	0.021	4.336	1.574	24	**Error**
5.54	4.3	4.84	3.76	**(CV%)**	

*ns, **, * mean that mean squares are respectively non-significant, and significant at 1% and 5% probability levels*

1000-Grain Weight

The ANOVA results showed that the effect of triple superphosphate and different levels of biological phosphate (fertile 2) on 1000-grain weight was significant at 1% probability level. However, the interactive effect of triple superphosphate and different levels of biological phosphate (fertile 2) on 1000-grain weight was not significant (Table 1). Mean comparison of the effect of different levels of triple superphosphate on 1000-grain weight (Table 2) showed that the highest 1000-grain weight by 3.56 g belonged to the treatment with consumption of 90 kg/ha chemical triple superphosphate fertilizer and the lowest 1000-grain weight by 3.11 g belonged to the treatment without consumption of triple superphosphate fertilizer. It seems that as Lafond *et al.,* (2008) and Hoking and Penikerton (1991) stated the increase of consumption of phosphorus fertilizer led to the increase of reproductive strength of plants, number of flowers and production of more seeds which ultimately led to the increase of 1000-grain

weight in flax. Moreover, it can be said that phosphorus is a necessary nutrient which leads to the storage and transfer of chemical energy in plant, acceleration of growth and the product maturity and increase of flowering. The results were consistent with the findings of the present research. Parhizkar *et al.,* (2011) reported in a research that the highest weight of 1000-grain in flax belonged to the treatment with consumption of 120 kg/ha phosphorus. Nozari *et al.*, (2002) showed that application of 50 kg/ha phosphorus could lead to the production of more 1000-grain weight although its difference with the application of 100 kg/ha phosphorus is not significant. Eftekhari *et al.,* (2006) conducted a research on rice and stated that the highest weight of 1000-grain (31.13 g) was observed in the treatment with consumption of 75 kg/ha triple superphosphate. Mean comparison of the effect of phosphate fertilizer (fertile 2) on 1000-grain weight (Table 2) showed that the highest 1000-graine weight by 3.49 belonged to the treatment with consumption of 200 g/ha biological phosphate fertilizer (fertile 2) and the lowest 1000-grain weight by 3.23 belonged to the treatment without consumption of biological phosphate fertilizer (fertile 2). Therefore, it can be concluded that the photosynthetic capacity of plants treated by biological fertilizer increased due to feeding more phosphorus and the weight of grains increases as well due to transfer of more assimilates into the grains (Koid, 1993). The results were consistent with the findings of the research. Qush and Mohiodin (2000) reported that application of biological fertilizers significantly increased the weight of 1000-grian in sesame. Poor *et al.,* (2008) showed in a research that inoculation with biological phosphate fertilizer (fertile 2) could increase the weight of 1000-grain in fleawort and improve the production in general. Some researchers believe that the increase of 1000-grain weight is due to the release of phosphorus and its absorption by phosphorus solubilizing microorganisms. The results are consistent with the findings of Mirza *et al.,* (2009) who showed that the use of biological fertilizer had a significant effect on the weight of 1000-grain weight in sunflower.

Table 2: The mean comparison results of the studied traits in sesame affected by different levels of triple superphosphate fertilizer and biological phosphate fertilizer (fertile2)

Grain yield (kg/ha)		1000-grain weight (g)		Number of grains per capsule		Number of capsules per plant		Treatment
								Triple superphosphate fertilizer
689.9	c	3.11	b	37.83	b	29.17	c	**0 kg/ha**
1052.22	b	3.46	a	44.75	a	33.67	b	**45 kg/ha**
1229.7	a	3.56	a	46.5	a	37	a	**90 kg/ha**
								Fertile 2
827.43	c	3.23	b	41.08	b	30.5	c	**0 kg/ha**
1015.67	b	3.41	a	43.42	a	33.67	b	**100 kg/ha**
1128.73	a	3.49	a	44.58	a	35.67	a	**200 kg/ha**

According to Duncan's multiple range test the means with similar letters in each column don't have significant difference at 5% level.

Grain Yield

The ANOVA results showed that the effect of triple superphosphate and different levels of biological phosphate (fertile 2) on grain yield was significant at 1% probability level. Moreover, the interactive effect of triple superphosphate and different levels of biological phosphate (fertile 2) on yield was significant at 5% probability level (Table 1). Mean comparison of the effect of different levels of triple superphosphate on grain yield (Table 2) showed that the highest grain yield by 1229.7 kg/ha belonged to the treatment with consumption of 90 kg/ha chemical triple superphosphate fertilizer and the lowest grain yield by 686.9 kg/ha belonged to the treatment without consumption of triple superphosphate fertilizer. The increase of consumption of phosphorus fertilizer leads to the increase of grain yield in flax due to the

increase of plant reproductive power, number of flowers, and production of more seeds (Lafond *et al.*, 2008). Moreover, it can be said that phosphorus is a necessary nutrient which leads to the storage and transfer of chemical energy in plant, acceleration of growth, and the product maturity and increase of flowering (Notal *et al.*, 1991). Therefore, it has a direct effect on the grain yield in flax and its adequate presence is necessary to improve the grain yield (Hoking and Penikerton, 1991). The results were consistent with the research findings. Haghighat and Alhani (2007) reported that the consumption of 40 kg/ha P2O5 increased the grain yield in sesame by at most 22/3%. Parhizkar *et al.*, (2011) reported that the highest grain yield in flax belonged to the treatment with 120 kg/ha phosphorus. In barley cultivated field, the highest grain yield belonged to the treatment with consumption of 60 kg/ha triples superphosphate (Hasan, 2007). Mean comparison of the effect of biological phosphate fertilizer (fertile 2) on grain yield (Table 2) showed that the highest grain yield by 1128.73 kg/ha belonged to the treatment with consumption of 200 g/ha biological phosphate fertilizer (fertile 2) and the lowest grain yield by 827.43 kg/ha belonged to the treatment without consumption of biological phosphate fertilizer (fertile 2). It seems that the solubility of insoluble phosphates by microorganisms through the production of organic acids and oxoacid chelating from sugars and exchanging some reactions in the root growth environment are the other mechanisms of the microorganisms to increase the absorption of nutrients and consequently to increase the grain yield. The findings of Yasari and Pato (2007) were consistent with the result of the research, so that they also reported the increase of grain yield in sesame due to the use of biological fertilizers. The results of a research showed that the use of biological fertilizer had a significant effect on the grain yield in sunflower, so that the highest grain yield by 2167 kg/ha belonged to the treatment with consumption of 100 g phosphate bio-fertilizer (Mirza, 2009). Ghorbani (2010) showed that the use of biological phosphate (fertile 2) increased the grain yield in maize cultivars. Ghasem *et al.*, (2009) investigated the effect of biological phosphate (fertile 2) on the yield of potato and showed that the yield of potato in the treatment with consumption of 200 g/ha phosphate (fertile 2) was higher than the one with consumption of 100 g/ha phosphate (fertile 2). The results were consistent with the findings of the research. Mean comparison of the interactive effect of triple superphosphate and different levels of biological phosphate (fertile 2) on the grain yield showed that the highest grain yield by 1335.21 kg/ha belonged to P3B3 treatment (200 g/ha phosphate fertile-2 plus 90 kg/ha triple superphosphate) and the lowest grain yield by 574.49 kg/ha belonged to P1B1 treatment (without phosphate fertile-2 and triple superphosphate) (Table 3). Investigations showed that even though chemical triple superphosphate and biological phosphate (fertile-2) both influenced the grain yield of maize significantly by themselves, when both of them were used together more optimal results were obtained (Beig *et al.*, 2013).

Table 3: The mean comparison results of the studied traits in sesame influenced by the interactive effect of different levels of triple superphosphate fertilizer and biological phosphate fertilizer (fertile 2)

Grain yield (kg/ha)		Biological phosphate fertilizer (Fertile 2)	Triple superphosphate fertilizer
574.49	g	0 g/ha	0 kg/ha
698.38	f	100 g/ha	
796.85	e	200 g/ha	
833.51	d	0 g/ha	45 kg/ha
1069.02	c	100 g/ha	
1254.13	b	200 g/ha	
1074.29	c	0 g/ha	90 kg/ha
1279.61	ab	100 g/ha	
1335.21	a	200 g/ha	

According to Duncan's test, the means with similar letters in each column are not significantly different at5% probability level.

Conclusion

The results showed that triple superphosphate fertilizer and phosphate fertile-2 significantly increased the grain yield and the number of capsules per plant, the number of grains per capsule, and 1000-grain weight, but the interactive effect of chemical and biological fertilizers only had a significant effect on the grain yield. The highest grain yield, number of capsules per plant, number of grains per capsule, and 1000-grain weight belonged to the treatment with 90 kg/ha triple superphosphate and 200 g/ha biological fertilizer and the lowest rate of these traits belonged to the control treatment (without triple superphosphate fertilizer). The results indicated the significant effect of phosphorus on increasing the grain yield and yield components and the improvement of sesame in general in comparison to the control treatment (without biological and chemical fertilizer). Investigating the interactive effect of triple superphosphate and different levels of biological phosphate (fertile 2) on the grain yield showed that the highest grain yield by 713.21 kg/ha belonged to the treatment with consumption of 90 kg/ha triple superphosphate and 200 g/ha phosphate fertile-2 and the lowest grain yield by 574.49 kg/ha belonged to the control treatment (without chemical and biological fertilizers). Generally, it can be concluded that the treatment with consumption of 90 kg/ha triple superphosphate and 200 g/ha biological phosphate fertilizer Fertile 2) had the highest potential to achieve the maximum yield in sesame.

REFERENCES

Beigzade M, Maleki A, Siaddat SA and Malek-Mohammadi M (2013). Effect of combined application of phosphate fertilizers and phosphate solubilizing bacteria on yield and yield components of maize single cross 704. *International Journal of Agriculture and Crop Sciences* **6**(17) 1179-1185.

Eftekhari S, Akbari Gh, Falah Nosrat Abadi Gh and Mohadesi A (2006). The effect of phosphate solubilizing bacteria in comparison to other phosphate fertilizers on the yield of rice. *9th Conference on Iranian Agronomy and Plant Breeding, Pardis Abureihan, Tehran University* 19.

Garg BK, Kathju S and Vyas SP (2005). Salinity-fertility interaction on growth photosynthesis and nitrate reductase activity in sesame. *Indian Journal of Plant Physiology* **10** 162-167.

Ghasem Khanloo Z, Nasrolah Zadeh Asl A and Alizadeh A (2009). The effect of biological phosphate fertilizer (fertile 2) on the yield and yield components of potato In Chaldoran Area. *Journal of Crop Science* **1**(3) 1-13.

Ghosh DC and Mohiuddin M (2000). Response of summer sesame to biofertilizer and growth regulater. *Agriculture Science* **20**(2) 90-92.

Gorbani A (2010). Effect of phosphor resourses on Agronomy propertie and yield of grain corn cultivars. M.Sc Thesis in Agronomy, Islamic Azad University of Khoy 78 (InPersian).

Hasanzadeh A, Mazaheri D, Chaei Chi MR and Khavazi K (2007). The efficacy of Phosphorus uptake facilitator bacteria and chemical phosphorus bacteria on yield and yield components of barley. *Journal of Agronomy and Horticulture Research and Construction* **77** 112-118.

Jat BL and Shaktawat MS (2003). Effect of residual phosphorus, sulphur and biofertilizers on productivity, economics and nutrient content of pearl millet (Pennisetum glaucum L.) in fenugreek (Trigonella foenum-graecum L.)-pearl millet cropping sequence. *Indian Journal of Agricultural Sciences* **73**(3) 134-137.

Koide R (1993). Physiology of the mycorrhizal plant. *Advance Plant Pathology* **9** 33-54.

Lafond GP, Irvine B, Johnston AM and May WE (2008). Impact of agronomic factors on seed yield formation and quality in flax. *Journal of Plant Science* **88**(19) 485–500.

Mirzabagheri M (2010). The effect of different levels of biological phosphate fertilizer on yield and yield components of sunflower cultivars, the 3rd International Seminar on oilseeds and edible oils 1-9.

Najafpour M (2001). Effect of chemical fertilizer nitrogen and phosphorus on seed nitrogen fixation and phosphate solubilizing bacteria on some of quantitative charactristics on Soybean (Glycine max L.). *In: Proceedings of 8th Iranian Crop Sciences Congress, Rasht, Iran* (In Persian) 148.

Nozari Sh (2002). Consideration of effects of different levels of nitrogen and plant density on yield and yield component of hybrid rice (HI78). Guilan University, *Agronomy* 120.

Ojaglu F (2007). The effect of bio-fertilizer inoculation on grain yield and its components of safflower. M.Sc Thesis, Islamic Azad University of Tabriz 89 (In Persian).
Parhizkar Khajani F, Iran Nejad H and Amiri R (2012). The effect of different levels of nitrogen, phosphorus, and potassium on qualitative and quantitative qualities of oily flax. *Electric Journal of Crop Production* **5**(1) 37 – 51.
Porr Yusef M, Mazaheri D, Chaei Chi MR Rahimi A and Tavakoli A (2010). The effect of different treatments of soil fertility on some agro-morphological and mucilage characteristics of fleawort. *Electric Journal of Crop Production* **3**(2) 193 -213.
Singh Y, Singh BV, Pabbi S and Singh PK (2007). Impact of organic farming on yield and quality of Basmati rice and soil properties. CCUBGA, Indian Agriculture Research Institute, New Delhi-110012, India.
Weiss EA (2000). *Oilseed Crops,* 2nd edition (Blackwell Science Ltd.) Bodmin, UK.
Yasari E and Patwardhan M (2007). Effects of Azotobacter and Azospirillum Inoculants and Chemical Fertilizers on Growth and Productivity of Canola (Brassica napus L.). *Asian Journal of Plant Sciences* **6**(1) 77-82.
Zafarian L, Eivazi A and Jalili F (2011). The effect of biological nitrogen and phosphorus fertilizers on grain yield and yield components of two Safflower cultivars. *Journal of Crop Science* **3**(12) 29-40.