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Evaluation Effect of Spray Micronutrient Elements (Mn, Zn) on Seed Yields, Its Components and Protein Percentage of Wheat (*Triticum aestivum* L.)

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ABSTRACT

BACKGROUND: Addition of fertilizers to supplement the natural soil fertility is essential for modern crop production, and precise management of nutrient elements is essential for a sustainable agriculture production.

OBJECTIVES: Current study was conducted to assessment effect of different level of micronutrient crop production and seed protein content of wheat.

METHODS: This research was carried out via factorial experiment based on randomized complete blocks design with three replications along 2018 year. The first factor included spray different level of Zinc (0, 2.5, 5 and 10 $kg.ha^{-1}$) and second factor consisted spray Manganese at three level (0, 2 and 4 $gr.1000L^{-1}$).

RESULT: Result of analysis of variance revealed effect of zinc and manganese on all measured traits (instead protein percentage) was significant also interaction effect of treatments on all measured traits (instead plant height, spike length and protein percentage) was significant. Mean comparison result of different level of zinc indicated the highest amount of plant height (89 cm), spike length (11cm), number of spike per square meter (403), number of seed per spike (42), 1000-seed weight (40gr), seed yield (5595 $kg.ha^{-1}$), biologic yield (10364 $kg.ha^{-1}$), harvest index (54%) and protein percentage (13%) was noted for 10 $kg.ha^{-1}$ zinc fertilizer. Also compare different level of manganese and interaction effect of treatments showed similar result.

CONCLUSION: According result of current research the maximum amount of seed yield, its components, harvest index and protein percentage was belonged to consume spray 10 $kg.ha^{-1}$ zinc and 4 $gr.1000L^{-1}$ manganese fertilizer and it can be advised to producers.

KEYWORDS: *Harvest index, Nutrition, Plant height, Qualitative trait, Spike number.*

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1. BACKGROUND

Suitable and useful usage of different kind of fertilizers is the main way for reformation and potential of soil fertility and increasing of crops yield (Talaei, 2012). Addition of fertilizers to supplement the natural soil fertility is essential for modern crop production, and precise management of nutrient elements is essential for a sustainable agriculture production (Barker and Pilbeam, 2006). Foods derived from plants are major contributors to the micronutrients requirements for most people in the world, especially in developing countries and/or in regions with predominantly cereal-based diets. Nevertheless, staple food crops (such as cereals, especially maize, rice, and wheat) have not enough grain zinc and iron concentrations to meet human nutrition requirement. When plant crops are cultivated on micronutrient-deficient soils, they have low Zn and Fe content and also low consequently bioavailability (Cakmak *et al*., 2010). So that, improvement and increasing Fe and Zn concentration in food crops is an important global challenge due to high incidence of micronutrients deficiency in human populations (White and Broadley, 2009; Bouis *et al*., 2011). Each plant needs to certain fertilizers according to its needs and soil analyze results. Also microelements are the critical elements for plants; however, microelements play the important role in crop productivity where it is used in low rate. Optimum plant nutrition and maximum yield is achieved when nutrient elements are available for plant during the growing season (Malakooti and Tabataei, 1998). Soil fertility is an important factor, which determines the growth of plant. Soil fertility is determined by the presence or absence of nutrients i.e. macro and micronutrients, which are required in minute quantities for plant growth (Zayed *et al*., 2011). Increasing price of fertilizers worldwide, necessary for production economy, ground water pollution, and soil structure degradation due to uncontrolled and unwise consumption of chemical fertilizers are the problems that have to be solved by proper methods. Spraying or foliar nutrition is a method for decreasing chemical fertilizers consumption and their environmental hazards, especially nowadays that toxin reduction policy and optimizing fertilizer consumption is under discussion. An important strategy to increase the concentration of trace elements in grains is fertilizing the plants with soil or spraying (Cakmack, 2002). In Iran calcareous soil conditions lead to imbalance use of chemical fertilizer (especially high use of phosphorus), lack of crop rotation, low use of manure fertilizer, unused of macronutrient in past, nowadays the lack of these elements in soil and human food is more evident and it makes the community suffer from deficiencies of these elements. The important combined effects of Fe and Zn lack is low blood Iranian (Persian anemia), which is also mentioned in foreign sources. However, the carried research in this field in Iran indicated the impact of micronutrients in increasing the yield quality and quantity in different crops (Ghazvineh and Yousefi, 2012). Quantitative and qualitative yield of crops can be affected by the utilization of micronutrient fertilizer (Abadia *et al.,* 2011). Intensive and multiple cropping, cultivation of crop varieties with heavy nutrient requirements, and the unbalanced use of chemical fertilizers, especially nitrogen and phosphorus fertilizers, have caused a reduction in yields with symptoms of micronutrient deficiencies in crops. While balanced fertilization and micronutrient applications will increase yield and crop quality, it will also insure better peoples' health (Seilsepour, 2005). The purpose of the use of micronutrient elements in the process of crop production is to improve the quality and quantity of products and to enrich them in addition to increasing production. So far, much many studies have been done on the effect of each micronutrient on increasing the quality and quantity of wheat (Hung *et al.,* 2009). Nutritional disorders creating deficiency symptoms can be affected by other factors such as poor drainage, soil salinity and unbalanced fertilizer application. Availability of micronutrients such as Fe, Mn and Zn is much affected by pH and $CaCO_3$ content and soil texture usually micronutrient-deficiency problems are bound in calcareous soil of arid and semi-arid regions (Zeidan *et al*., 2010). Wheat grown under such deficient condition has low yield and micronutrients contents in grains (Amberger, 1991). Wheat grown under such deficient condition has low yield and micronutrients contents in grain. Each element of these micronutrients has its own function in plant growth for example. Potarzycki and Grzebisz (2009) reported that zinc exerts a great influence on basic plant life processes, such as (i) nitrogen metabolism-uptake of nitrogen and protein quality; (ii) photosynthesis-chlorophyll synthesis, carbon anhydrase activity; reported that Zn-deficient plants reduce the rate of protein synthesis and protein content drastically Mn is required for biological redo system, enzyme activation, oxygen carrier in nitrogen fixation (Romheld and Marachner, 1995). Micronutrient deficiency can greatly disturb plant yield and quality, and the health of domestic animals and humans (Welch, 2003). The role of microelements in maintaining balanced plant physiology is becoming clearer every day as a result of studies on their reactions and the disturbances caused by their deficiency. Micronutrients are essential elements for life (Malakouti, 2008). Micronutrients also play key roles in the release of carbon dioxide, and in optimizing the function of vitamin A and the immune system (Marschner, 1995). Zinc (Zn) is one of the essential micronutrients for plants, and Zn deficiency is common in many crops (Ojeda-Barrios *et al*., 2014). Zinc deficiencies are mainly found on sandy soils low in organic matter and on alkaline soils. Uptake of zinc also is adversely affected by high pH, high levels of available phosphorus and iron in soils (Ghasemi-Fasaei and Ronaghi, 2008). Zinc is required for the activity of different enzymes, including dehydrogenases, aldolases, iso-merases, trans-phospho rylases, RNA and DNA polymerases, and is also involved in the synthesis of tryptophan, cell division, maintenance of membrane structure and photosynthesis, and acts as a regulatory cofactor in protein synthesis (Marschner, 2012). Zinc is an essential element for plants and animals and plays an important role in plants metabolic system. This element activates enzymes and involved in protein, lipids, carbohydrates and nucleic acid metabolism (Zlatimira and Doncheva, 2002). Nearly 200 enzymes and transcription elements of zinc need it as one of the most essential components. Zinc plays an important role in protein and carbohydrates syntheses. It also has effects on growth of stem and root (Kabata-Pendias and Pendias, 1999).

2. OBJECTIVES

Current study was conducted to assessment effect of different level of micronutrient crop production and seed protein percentage of wheat.

3. MATERIALS AND METHODS

3.1. Field and Treatments Information

This research was carried out to evaluate micronutrient (Z, Mn) on crop production and protein concentration of wheat via factorial experiment based on randomized complete blocks design with three replications along 2018 year. Place of research was located in Ahvaz city at longitude 48°32'E and latitude 32°22'N in Khuzestan province (Southwest of Iran). The first factor included spray different level of Zinc (0, 2.5, 5 and 10 $kg.ha^{-1}$) and second factor consisted spray Manganese at three level (0, 2 and 4 $gr.1000L^{-1}$). This experiment had 27 plots. Each plot consisted of 6 lines with a distance of 60 cm and 6 meters length. The distance between the shrubs on every row was 10 cm. The climate of Khuzestan province is subtropical, with hot and dry summers and rainy and humid winters. Most of the winds are south, southwest to north, northeast. The sunshine totals over 2700 hours per year and evaporates to over 2400 mm. According to the Domarten climate classification mentioned region is part of the semi-arid region, but according to the Amberjeh classification, it has warm climates. The average annual rainfall, temperature, and evaporation in the region are 242 mm, 24 C and 3000 mm, respectively.

3.2. Farm Management

After ground preparation, the soil feeding process was carried out based on the results of soil sample analysis in the laboratory. Nitrogen fertilizer from urea source was consumed at 252 g per plot. One-third deduction was applied before planting as basal, next section at end of tillering and final one-third deduction used at spike emergence stage. Phosphorus (P_2O_5) was obtained from triple super phosphate source and was applied in amount 120 gram per plot at pre-planting. Potassium fertilizer was applied from potassium sulfate source at 120 gr per plot. To combat broadleaf and narrow leaf weeds, Duplosan Super (2.5 $L.ha^{-1}$) and topic (1 $L.ha^{-1}$) herbicides was used at the end of tillage and before application of topdressing fertilizer, respectively. The physical and chemical properties of studied soil mentioned in table 1.

Table 1. Physical and chemical properties of studied field

Sand (%)	Silt (%)	Clay (%)	Potassium ($mg.kg^{-1}$)	Phosphorus ($mg.kg^{-1}$)	Nitrogen ($mg.kg^{-1}$)	pH	EC ($ds.m^{-1}$)
28	36	36	110	7.2	39	6.6	1.51

3.3. Measured Traits

In order to determine the yield two planting lines from each plot harvested and after the removal of marginal effect were carried to the laboratory and were placed in the oven at 75°C for 48 hours and after ensuring that the samples were completely dry, they were weighed and finally the total yield was measured. Harvest index (HI) was calculated according to formula of Gardner *et al.* (1985) as follows: **Equ.1.** HI= (Seed yield/Biologic yield) ×100.

To measure the seed nitrogen content and straw nitrogen content the Kjeldahl method was used. So, to calculate the seed protein content the following formula was used (Bremner *et al*., 1983): **Equ.2.** Seed protein content (%)= Nitrogen percentage × 5.8.

3.4. Statistical Analysis

Analysis of variance and mean comparisons were done via MSTAT-C software and Duncan multiple range test at 5% probability level.

4. RESULT AND DISCUSSION

4.1. Plant height

According result of analysis of variance effect of zinc and manganese on plant height was significant at 5% probability level but interaction effect of treatments was not significant (Table 2). Mean comparison result of different level of zinc indicated that maximum plant height (89 cm) was noted for 10 $kg.ha^{-1}$ zinc and minimum of that (82 cm) belonged to control treatment (Table 3). As for Duncan classification made with respect to different level of manganese Nano-chelate maximum and minimum amount of plant height belonged to 4 $gr.1000L^{-1}$ (91 cm) and control (81 cm) (Table 4). Kari (2018) reported soil and foliar application of manganese sulfate fertilizer increased wheat height compared to control. Also another researcher such as Sajedi and Ardakani (2008) consumption of iron and manganese micronutrients has a significant effect to improve plant height and crop production of maize.

4.2. Spike length

Result of analysis of variance revealed effect of zinc and manganese on spike length was significant at 5% probability level but interaction effect of treatments was not significant (Table 2). According result of mean comparison maximum of spike length (11 cm) was obtained for 10 $kg.ha^{-1}$ zinc and minimum of that (7 cm) was for control treatment (Table 3). Evaluation mean comparison result indicated in different level of manganese the maximum spike length (11.50 cm) was noted for 4 $gr.1000L^{-1}$ and minimum of that (8 cm) belonged to control treatment (Table 4).

4.3. Number of spike per square meter

According result of analysis of variance effect of zinc, manganese and interaction effect of treatments on number of spike per square meter was significant at 1% probability level (Table 2). Assessment mean comparison result of different level of zinc indicated the maximum number of spike per square meter (403) was noted for 10 kg.ha^{-1} and minimum of that (358) belonged to control treatment (Table 3).

Table 2. Result analysis of variance of measured traits

S.O.V	df	Plant height	Spike length	No. spike per square meter	No. seed per spike	1000-seed weight
Replication	2	6.71^{ns}	4.57^{ns}	2.1^{ns}	8.15^{*}	0.22^{ns}
Zinc (Z)	2	59.25^{*}	9.66^{*}	3120.12^{**}	140.15^{**}	48.25^{**}
Manganese (Mn)	2	52.93^{*}	10.85^{*}	1423.25^{**}	186.17^{**}	37.61^{**}
Z × Mg	4	9.21^{ns}	5.55^{ns}	1204.22^{**}	112.25^{**}	57.35^{**}
Error	16	41.45	8.11	6.95	7.21	3.25
CV (%)	-	12.15	10.21	7.11	9.55	9.14

$^{ns, *\ and\ **}$: no significant, significant at 5% and 1% of probability level, respectively.

Continue Table 2.

S.O.V	df	Seed yield	Biologic yield	Harvest index	Protein percentage
Replication	2	6148.22^{**}	7163.22^{**}	7.74^{ns}	6.25^{*}
Zinc (Z)	2	5320114.22^{**}	21873001.14^{**}	45.65^{**}	7.81^{*}
Manganese (Mn)	2	4304781.33^{**}	14002983.27^{**}	52.12^{**}	2.38^{ns}
Z × Mg	4	6108450.22^{**}	30146825.34^{**}	67.52^{**}	4.33^{ns}
Error	16	5483	5014	9.81	5.22
CV (%)	-	10.55	13.33	7.04	4.35

$^{ns, *\ and\ **}$: no significant, significant at 5% and 1% of probability level, respectively.

Compare different level of manganese showed that the maximum and the minimum amount of number of spike per square meter belonged to 4 gr.1000L^{-1} (396) and control (374) treatments (Table 4). Evaluation mean comparison result of interaction effect of treatments indicated maximum number of spike per square meter (411) was noted for 10 kg.ha^{-1} zinc and 4 gr.1000L^{-1} manganese and lowest one (345) belonged to control treatment (Table 5).

4.4. Number of seed per spike

Result of analysis of variance showed effect of zinc and manganese Nano-chelate on number of seed per spike was significant at 1% probability level, but interaction effect of treatments was not significant (Table 2). Evaluation mean comparison result revealed in different level of zinc the maximum number of seed per spike (42) was noted for 10 kg.ha^{-1} and minimum of that (33) belonged to control treatment (Table 3). Between different levels of manganese the maximum number of seed per spike (41) was observed in 4 gr.1000L^{-1} and the lowest one (34) was found in control treatment (Table 4). Evaluation mean comparison result of interaction effect of treatments indicated maximum number of seed per spike (46) was noted for 10 kg.ha^{-1} zinc and 4 gr.1000L^{-1} manganese and lowest one (31) belonged to control treatment (Table 5). Shikhbeglo *et al*. (2009) reported that the highest number of seed per ear was obtained by spraying with zinc sulfate (at a concentration of 5/1000), which can be attributed to better inoculation in foliar spray treatments.

4.5. 1000-seed weight

According result of analysis of variance effect of zinc, manganese and interaction effect of treatments on 1000-seed weight was significant at 1% probability level (Table 2). Mean comparison result of different level of zinc indicated the maximum and the minimum amount of 1000-seed weight belonged to 10 $kg.ha^{-1}$ (40 gr) and control treatment (31 gr) (Table 3). Among different level of manganese maximum 1000-seed weight (39 gr) was obtained for 4 $gr.1000L^{-1}$ and minimum of that (31 gr) was for control treatment (Table 4). Assessment mean comparison result of interaction effect of treatments indicated maximum 1000-seed weight (44.6 gr) was noted for 10 $kg.ha^{-1}$ zinc and 4 $gr.1000L^{-1}$ manganese and lowest one (27 gr) belonged to control treatment (Table 5). Tabatabian (2009) obtained the highest seed weight of wheat by application of 2.5 $mg.kg^{-1}$ zinc sulphate. According his opinion, the presence of sufficient nutrients in plant organs will improve seed filling and increase seed weight. Zinc is an element involved in the building up of enzymes in plants and can play an important role in the synthesis of proteins and carbohydrates (Hemantaranjan, 2013).

Table 3. Mean comparison effect of different level of zinc on measured traits

Zinc ($kg.ha^{-1}$)	Plant height (cm)	Spike length (cm)	No. spike per square meter	No. seed per spike	1000-seed weight (gr)
Control	82^{b}	7^{b}	358^{b}	33^{b}	31^{c}
5	85^{ab}	9^{ab}	399^{a}	38^{ab}	36^{b}
10	89^{a}	11^{a}	403^{a}	42^{a}	40^{a}

*Means with similar letters in each column are not significantly differentt by Duncan's test at 5% probability level.

Continue Table 3.

Zinc ($kg.ha^{-1}$)	Seed yield ($kg.ha^{-1}$)	Biologic yield ($kg.ha^{-1}$)	Harvest index (%)	Protein percentage
Control	3012^{c}	7895^{c}	38^{b}	9.8^{b}
5	4803^{b}	9426^{b}	51^{ab}	11.7^{ab}
10	5595^{a}	10364^{a}	54^{a}	13^{a}

*Means with similar letters in each column are not significantly differentt by Duncan's test at 5% probability level.

4.6. Seed yield

According result of analysis of variance effect of zinc, manganese and interaction effect of treatments on seed yield weight was significant at 1% probability level (Table 2). Mean comparison result of different level of zinc indicated the maximum seed yield (5595 $kg.ha^{-1}$) was obtained for 10 $kg.ha^{-1}$ and minimum of that (3012 $kg.ha^{-1}$) was for control treatment (Table 3). Compare different level of manganese showed that the maximum and the minimum amount of seed yield belonged to 4 $gr.1000L^{-1}$ (5258 $kg.ha^{-1}$) and control (3341 $kg.ha^{-1}$) treatments (Table 4). Evaluation mean comparison result of interaction effect of treatments indicated maximum seed yield (6191 kg.ha^{-1}) was noted for 10 kg.ha^{-1} zinc and 4 gr.1000L^{-1} manganese and lowest one (2430 kg.ha^{-1}) belonged to control treatment (Table 5). Tabatabaeian (2012) reported zinc sulfate application had a positive and significant effect on the most studied traits, so that application of 2.5 mg.kg^{-1} zinc sulfate at complete irrigation treatment increased grain yield up to 27%. Besides, zinc concentration of seeds increased as zinc sulfate was applied. Manojlovis (2012) reported that the use of zinc can increase corn yield by up to 50%. Thandon (2012) reported an increase in wheat yield due to zinc intake in compare to control was 860 kg.ha^{-1}. Mohseni *et al*. (2006) reported that zinc sulfate consumption had a significant effect on seed yield and improve crop production which was in agreement with the results of this study. Soleymani and Shahrajabian (2016) reported that application of zinc fertilizer treatment led to the highest biological yield and seed yield due to the positive effect of zinc on biosynthesis of auxin and positive effect of iron on photosynthesis and improved plant growth.

Table 4. Mean comparison effect of different level of Manganese on measured traits

Manganese (gr.1000L^{-1})	Plant height (cm)	Spike length (cm)	No. spike per square meter	No. seed per spike
Control	81^{b}	8^{b}	374^{c}	34^{c}
2	86^{ab}	9.5^{ab}	390^{b}	38^{b}
4	91^{a}	11.5^{a}	396^{a}	41^{a}

*Means with similar letters in each column are not significantly differentt by Duncan's test at 5% probability level.

Continue Table 4.

Manganese (gr.1000L^{-1})	1000-seed weight (gr)	Seed yield (kg.ha^{-1})	Biologic yield (kg.ha^{-1})	Harvest index (%)
Control	31^{c}	3341^{c}	8438^{c}	44^{b}
2	37^{b}	4525^{b}	9297^{b}	49^{a}
4	39^{a}	5258^{a}	9951^{a}	50^{a}

*Means with similar letters in each column are not significantly differentt by Duncan's test at 5% probability level.

4.7. Biologic yield

Result of analysis of variance revealed effect of zinc, manganese and interaction effect of treatments on biologic yield weight was significant at 1% probability level (Table 2). According mean comparison result of different level of zinc the maximum amount of biologic yield (10364 kg.ha^{-1}) was observed in 10 kg.ha^{-1} and the lowest one (7895 kg.ha^{-1}) was found in control treatments (Table 3). Between different levels of manganese highest value of biologic yield was belonged to the 4 gr.1000L^{-1} treatment (9951 kg.ha^{-1}) and the lowest one was found in the control treatment as 8431 kg.ha^{-1} (Table 4). Assessment mean comparison result of interaction effect of treatments indicated maximum biologic yield (11086 kg.ha^{-1}) was noted for 10 kg.ha^{-1} zinc and 4 gr.1000L^{-1} manganese and lowest one (7620 kg.ha^{-1}) belonged to control treatment (Table 5). Environmental factors (such as consumption of macro- and micro-fertilizers) and use of agronomic bio-fortification strategy can exert larger influences on grain yield (GY), agro-morphological traits and grain micronutrients concentration of food crops (Mishra *et al*., 2015; Esfandiari *et al*., 2016). Ziaian and Rajai (2009) reported that foliar application of zinc in six to seven leaf stage increased biological yield and seed yield of maize. Soil and foliar application of zinc and manganese led to increased corn production but the role of zinc to improve seed yield is more than manganese (Zeiaeianand and Malakouti, 2010).

4.8. Harvest index

According result of analysis of variance effect of zinc, manganese and interaction effect of treatments on harvest index weight was significant at 1% probability level (Table 2). Mean comparison result of different level of zinc indicated the maximum harvest index (54%) was obtained for 10 $kg.ha^{-1}$ and minimum of that (38%) was for control treatment (Table 3). Compare different level of manganese showed that the maximum and the minimum amount of harvest index belonged to 4 $gr.1000L^{-1}$ (50%) and control (44%) treatments (Table 4). Evaluation mean comparison result of interaction effect of treatments indicated maximum harvest index (55.4%) was noted for 10 $kg.ha^{-1}$ zinc and 4 $gr.1000L^{-1}$ manganese and lowest one (31.1%) belonged to control treatment (Table 5).

Table 5. Mean comparison interaction effect of treatments on measured traits

Zinc ($kg.ha^{-1}$)	Manganese (gr/1000L)	No. spike per square meter	No. seed per spike	1000-seed weight (gr)
Control	Control	345^{f}	31^{e}	27^{e}
	2	360^{e}	34^{d}	32^{d}
	4	370^{d}	35^{d}	32.3^{d}
5	Control	388^{cd}	34^{d}	31^{d}
	2	402^{b}	38^{c}	37.3^{c}
	4	407^{ab}	43^{b}	40^{b}
10	Control	390^{c}	37^{c}	35^{bc}
	2	408^{ab}	42^{b}	41.6^{b}
	4	411^{a}	46^{a}	44.6^{a}

*Means with similar letters in each column are not significantly differentt by Duncan's test at 5% probability level.

Continue Table 5.

Zinc ($kg.ha^{-1}$)	Manganese (gr/1000L)	Seed yield ($kg.ha^{-1}$)	Biologic yield ($kg.ha^{-1}$)	Harvest index (%)
Control	Control	2430^{g}	7620^{e}	31.1^{g}
	2	3131^{f}	7863^{de}	39.8^{f}
	4	3475^{e}	8203^{cd}	42.3^{e}
5	Control	4184^{d}	8603^{d}	48.6^{d}
	2	4824^{c}	9113^{c}	52.9^{b}
	4	5403^{b}	10563^{b}	51.1^{c}
10	Control	4760^{cd}	9090^{c}	52.3^{b}
	2	5834^{ab}	10916^{ab}	53.4^{ab}
	4	6191^{a}	11086^{a}	55.4^{a}

*Means with similar letters in each column are not significantly differentt by Duncan's test at 5% probability level.

4.9. Protein percentage

Result of analysis of variance revealed effect of zinc on protein percentage was significant at 5% probability level, but effect of manganese and interaction effect of treatments was not significant (Table 2). According mean comparison result of different level of zinc the maximum amount of protein percentage (13%) was observed in 10 $kg.ha^{-1}$ and the lowest one (9.8%) was found in control treatments (Table 3). Sarbandi and Madani (2014) reported that application of micronutrients (manganese and zinc) significantly improved yield, yield components, biological yield and protein percentage, the highest protein percentage belonged to micro fertilizer treatment and the lowest protein percentage belonged to control. Jalilshesh-Bahre (2014) reported that zinc and manganese significantly increased protein content of the seeds. These elements constitutes the structure of some enzymes, are involved in synthesis of amino acids, which are essential in synthesis of proteins. Therefore, application of these elements (manganese) increases protein content of the seeds. These results were consistent with the results of this study. Jafardoukht *et al.* (2015) showed that application of zinc increased the protein yield that indirectly increased absorption of nitrogen. In other words, micronutrients are available to plants at flowering stage. Therefore, the plants can use nitrogen content of the soil more efficiently. This enhances protein synthesis. These results were consistent with the findings of this study.

5. CONCLUSION

According result of current research the maximum amount of seed yield, its components, harvest index and protein percentage was belonged to consume spray 10 $kg.ha^{-1}$ zinc and 4 $gr.1000L^{-1}$ manganese fertilizer and it can be advised to producers.

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FOOTNOTES

AUTHORS' CONTRIBUTION: All authors are equally involved.

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