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Evaluation Crop Production, Nitrogen Content and Oil yield of Corn in Affected Vermicompost and Iron Nano Fertilizer

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RESEARCH ARTICLE

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ABSTRACT

BACKGROUND: Iron (Fe) is one of the essential elements for the plant and plays an important role in the many plant processes such as photosynthesis, respiration, nitrogen uptake and construction, and also in construction and development of chloroplasts in plants. Bio-fertilizers are more environmental friendly and in many cases, they have given the same or even better crop yields compared to mineral fertilizers.

OBJECTIVES: This study was carried out to determine effect of different level of vermicompost and Nano iron fertilizer on quantitative and qualitative traits of corn.

METHODS: This research was conducted according split plot experiment based on randomized complete blocks design with three replications along 2018 year in research farm of Islamic Azad University of Ahvaz Branch. Main plot included three level of vermicompost (V_0: nonuse of vermicompost or control, V_1: 5 $t.ha^{-1}$ vermicompost, V_2: 10 $t.ha^{-1}$ vermicompost) was consumed at planting stage. Also subplots consisted four level of Nano iron fertilizer (F_0: Nonuse of Nano iron fertilizer or control, F_1: 0.002 $L.ha^{-1}$, F_2: 0.004 $L.ha^{-1}$ and F_3: 0.006 $L.ha^{-1}$ Nano iron fertilizer) was used at 3 to 4 leaves stage.

RESULT: Based on result of analysis of variance effect of different level of vermicompost, Nano iron fertilizer and interaction effect of treatments on all studied traits was significant. Evaluation mean comparison result of interaction effect of treatments indicated the maximum amount of seed yield (545.7 $gr.m^{-2}$), protein content (15.75%), protein yield (120.8 $gr.m^{-2}$), Oil content (9.44%) and Oil yield (51.69 $gr.m^{-2}$) were for 10 $t.ha^{-1}$ vermicompost with 0.006 $L.ha^{-1}$ iron Nano fertilizer, also lowest amount of measured traits was for nonuse of vermicompost and iron Nano fertilizer (control) treatments.

CONCLUSION: Generally according result of current research the maximum amount of seed yield, protein and oil content and protein and oil yield belonged to use 10 $t.ha^{-1}$ vermicompost with 0.006 $L.ha^{-1}$ iron Nano fertilizer.

KEYWORDS: *Fertilizer, Nutrition, Qualitative traits, Seed, Yield.*

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1. BACKGROUND

Organic farming has emerged as an important priority area globally in view of the growing demand for safe and healthy food and long term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals. Though the use of chemical inputs in agriculture is inevitable to meet the growing demand for food in world, there are opportunities in selected crops and niche areas where organic production can be encouraged to tape the domestic export market (Venkatash Warlu, 2008). Biofertilizers are more environmental friendly and in many cases, they have given the same or even better crop yields compared to mineral fertilizers (Saghir Khan *et al.,* 2007). Iron (Fe) is one of the essential elements for the plant and plays an important role in the many plant processes such as photosynthesis, respiration, nitrogen uptake and construction, and also in construction and development of chloroplasts in the plants (Ghafari and Razmjoo, 2015). Movahhedi Dehnavi and Jalil Sheshbahre (2017) reported that photosystem II of soybean leaves impressed by drought stress and photosynthesis reduced but application of iron and zinc fertilizers retrieved it. Also Ahmadi *et al*. (2016) obtained similar results about iron fertilizer on chick pea photosynthesis under drought stress. Goleg *et al*. (2016) indicated foliar application of ferrous nano oxide one kg.ha-1 prevented the effects of drought stress on sesame. Kutman *et al*. (2011) in the study of the effect of supply of nitrogen (N) by amount of 50 mg N (for low N plants) and 250 mg N (for high N plants) per kg dry soil in the form of $Ca(NO_3)_2.4H_2O$ on durum wheat, stated that the Zn and Fe uptake per plant was enhanced up to 4-fold by high N supply. It appears likely that the mechanisms contributing to root uptake and root to shoot transport of Fe and Zn are positively affected by improving plant N status (Aciksoz *et al*., 2011). studies under both field and greenhouse conditions demonstrated that increasing soil N application significantly improved shoot and seed Fe concentrations (Kutman *et al*., 2010; Shi *et al*., 2010). Dindoost and Yousefzadeh (2014) found that foliar application of iron fertilizer increased sunflower yield and oil percent under drought stress.

2. OBJECTIVES

This study was conducted to determine effect of different level of vermicompost and Nano iron fertilizer on quantitative and qualitative characteristics of corn.

3. MATERIALS AND METHODS

3.1. Field and Treatments Information

This research was conducted according split plot experiment based on randomized complete blocks design with three replications along 2018 year in research farm of Islamic Azad University of Ahvaz Branch. Place of research was located in Vis city at longitude 48°40'E and latitude 31°20'N in Khuzestan province (Southwest of Iran). Main plot included three level of vermicompost (V_0: nonuse of vermicompost or control, V_1: 5 $t.ha^{-1}$ ver-

micompost, V_2: 10 t.ha^{-1} vermicompost) was consumed at planting stage. Also subplots consisted four level of Nano iron fertilizer (F_0: Nonuse of Nano iron fertilizer or control, F_1: 0.002 L.ha^{-1}, F_2: 0.004 L.ha^{-1} and F_3: 0.006 L.ha^{-1} Nano iron fertilizer) was used at 3 to 4 leaves stage. The average annual rainfall, temperature and evaporation in region are 240 mm, 22 °C and 3000 mm, respectively.

3.2. Farm Management

Each sub plot included the 6 planting lines with a length of 5 m. The distance between row and seed on the row were 75 cm and 18 cm respectively. Irrigation was done every 3 or 4 days and after the plant establishment it was done every 7 to 10 days if necessary. The weeds were controlled via Cruise herbicide by 2 L.ha^{-1} at 4-to-5-leaf stage, also Krakrown pesticide by 1 L.ha^{-1} against leaf and stem borer larvae.

3.3. Measured Traits

The final harvest area of each plot was 1.5 m^2. Seed yield, its components and the qualitative traits were estimated after the physiological maturity stage. After separating seed from selected plants and weighing them, seed yield was calculated based on 14% moisture. In order to estimate 100 seed weigh, 10 samples of seed containing 10 seed were separated and the means was calculated. To measure the protein percentage, the Kjeldahl method was applied (Bremner and Breitenbeck, 1983). Also to measure the oil percentage, the Soxhlet method was used and oil yield obtained from multiplying the seed yield by oil percentage (Cox and Cherney, 2005).

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. Seed yield

Result of analysis of variance showed effect of different level of vermicompost and Nano iron fertilizer on seed yield was significant at 1% probability level but interaction effect of treatments was significant at 5% probability level (Table 1). Mean comparison result of different level of vermicompost indicated that maximum seed yield (490.9 gr.m^{-2}) was noted for 10 t.ha^{-1} vermicompost and minimum of that (214.5 gr.m^{-2}) belonged to control treatment (Table 2). As for Duncan classification made with respect to different level of Nano iron fertilizer maximum and minimum amount of seed yield belonged to 0.006 L.ha^{-1} (419.1 gr.m^{-2}) and control (277.2 gr.m^{-2}) (Table 2). Evaluation mean comparison result of interaction effect of treatments indicated maximum seed yield (545.7 gr.m^{-2}) was noted for 10 t.ha^{-1} vermicompost and 0.006 L.ha^{-1} Nano iron fertilizer and lowest one (189.1 gr.m^{-2}) belonged to control treatment (Table 3). Considering the importance of chlorophyll in production and the direct relationship between this trait and seed yield, researchers believe that increasing the amount of organic fertilizers and vermicompost in the soil leads to an in-

crease in nutrients such as nitrogen, iron and magnesium, so mentioned nutrient have important role for chlorophyll production, more availability of nutrient for sink (seeds) and improve crop production. The effect of vermicompost from 0 to 10 tons per hectare on seed yield of corn showed that seed yield increased significantly showed the positive effect vermicompost on crop production because of stored assimilates (Amyanpoori *et al*., 2015). The most important effect of iron application is increasing in the rate of photosynthesis and improving the leaf area index, which results in increased seed yield compared with non-iron application conditions (Singh, 2000). Bybordi and Mamedov (2010) reported iron Nano fertilizer application on canola led to improve seed yield. Also Nazari *et al*. (2006) reported consume organic fertilizer led to increase the corn production, which consisted the result of current research.

Table 1. Result analysis of variance of vermicompost and iron nano fertilizer on measured traits

S.O.V	df	Seed yield	Protein content	Protein yield	Oil content	Oil yield
Replication	2	348.857^{ns}	1.592^{ns}	60.208^{ns}	0.334^{ns}	0.824^{ns}
Vermicompost (V)	2	229766.563**	44.586*	7636.105**	15.577*	21.485**
Error I	4	1085.941	1.612	18.038	0.408	0.914
Iron nano Fertilizer (I)	3	32518.706**	14.318*	2119.411**	6.136*	7.205**
V×I	6	1961.823*	4.395*	919.646**	2.784*	3.119*
Error II	18	546.401	1.588	46.651	0.358	0.987
CV (%)	-	6.71	12.03	11.55	10.76	9.03

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

4.2. Protein Content

According result of analysis of variance effect of different level of vermicompost, Nano iron fertilizer and interaction effect of treatments on protein content was significant at 5% probability level (Table 1). Mean comparison result of different level of vermicompost indicated that maximum protein content (12.42%) was noted for 10 t.ha^{-1} vermicompost and minimum of that (8.56%) belonged to control treatment (Table 2). As for Duncan classification made with respect to different level of Nano iron fertilizer maximum and minimum amount of protein content belonged to 0.006 L.ha^{-1} (12.09%) and control (9.03%) (Table 2). Assessment mean comparison result of interaction effect of treatments indicated maximum protein content (15.75%) was noted for 10 t.ha^{-1} vermicompost and 0.006 L.ha^{-1} Nano iron fertilizer and lowest one (6.22%) belonged to control treatment (Table 3). Caliskan *et al*. (2008) revealed application of 400 gr.ha^{-1} Fe-EDTA along with 80 kg.ha^{-1} nitrogen had the best soybean yield. They emphasized application of coated nitrogen fertilizer along with Fe-EDTA as starter

increased early plant growth. Janmohammadi *et al*. (2018) reported application of iron and zinc fertilizers along with manure had good results on pea yield. Like this maximum sweet corn seed yield obtained when enriched vermin compost with iron sulfate and zinc sulfate along with foliar application of zinc and iron sulfate applied 20 to 40 days after planting (Arabhanvi and Hulihalli, 2018).

4.3. Protein Yield

Result of analysis of variance showed effect of different level of vermicompost, Nano iron fertilizer and interaction effect of treatments on protein yield was significant at 1% probability level (Table 1). Mean comparison result of different level of vermicompost indicated that maximum protein yield (68.83 gr.m^{-2}) was noted for 10 t.ha^{-1} vermicompost and minimum of that (19.32 gr.m^{-2}) belonged to control treatment (Table 2). As for Duncan classification made with respect to different level of Nano iron fertilizer maximum and minimum amount of protein yield belonged to 0.006 L.ha^{-1} (63.04 gr.m^{-2}) and control (27.67 gr.m^{-2}) (Table 2). Evaluation mean comparison result of interaction effect of treatments indicated maximum protein yield (120.8 gr.m^{-2}) was noted for 10 t.ha^{-1} vermicompost and 0.006 L.ha^{-1} Nano iron fertilizer and lowest one (9.32 gr.m^{-2}) belonged to control treatment (Table 3). Shadab Niazi *et al*. (2017) by evaluate the effect of different level of vermicompost (0, 2.5 and 5 t.ha^{-1}) on Mung bean, reported the highest protein yield and seed yield were obtained from 5 t.ha^{-1} vermicompost and the least of these traits were due to non-use of the vermicompost treatment (control).

Table 2. Mean comparison effect of vermicompost and iron Nano fertilizer on studied traits

Vermicompost (t.ha^{-1})	Seed yield (gr.m^{-2})	Protein content (%)	Protein yield (gr.m^{-2})	Oil content (%)	Oil yield (gr.m^{-2})
0	214.5c	8.56b	19.32c	4.51c	9.91c
5	340.3b	10.43ab	35.67b	5.39b	18.68b
10	490.9a	12.42a	68.83a	6.77a	29.96a
Iron nano fertilizer (L.ha^{-1})					
0	277.2d	9.03c	27.67c	4.72c	13.33d
0.002	329.3c	10.19b	34.50bc	5.31bc	17.74c
0.004	368.7b	10.58ab	39.89b	5.52b	19.09b
0.006	419.1a	12.09a	63.04a	6.69a	28.45a

*Similar letters in each column show non-significant difference at 5% probability level in Duncan test.

4.4. *Oil Content*

According result of analysis of variance effect of different level of vermicompost, Nano iron fertilizer and interaction effect of treatments on oil content was significant at 5% probability level (Table 1). Mean comparison result of different level of vermicompost indi-

cated that maximum oil content (6.77%) was noted for 10 t.ha^{-1} vermicompost and minimum of that (4.51%) belonged to control treatment (Table 2). As for Duncan classification made with respect to different level of Nano iron fertilizer maximum and minimum amount of oil content belonged to 0.006 L.ha^{-1} (6.69%) and control (4.72%) (Table 2). Assessment mean comparison result of interaction effect of treatments indicated maximum oil content (9.44%) was noted for 10 t.ha^{-1} vermicompost and 0.006 L.ha^{-1} Nano iron fertilizer and lowest one (3.30%) belonged to control treatment (Table 3). Studies have shown that by increasing nitrogen consumption, the formation of nitrogenous protein foregoing increases and protein formation in photosynthetic material is increased, resulting in a decrease in the amount of material needed for conversion to oil (Taherkhani and Golchin, 2006). Sajadi Nik *et al.* (2011) stated that nitrogen fertilizer does not have much effect on the percentage of seed oil, but if nitrogen is consumed at its highest level, treatments such as inoculation with the nitrogen stabilizing bacteria due to excessive nitrogen element uptake.

Table 3. Mean comparison of interaction effect of vermicompost and iron nano fertilizer on studied traits

Vermicompost (t.ha^{-1})	Iron nano fertilizer (L.ha^{-1})	Seed yield (gr.m^{-2})	Protein content (%)	Protein yield (gr.m^{-2})	Oil content (%)	Oil yield (gr.m^{-2})
0	**0**	189.1d	6.22d	9.32g	3.30d	9.65f
	0.002	244.7c	8.91c	18.95fg	4.73c	11.88e
	0.004	248.0bc	9.49bc	23.75efg	4.96bc	12.55e
	0.006	256.7bc	9.64bc	25.25efg	5.05bc	15.10c
5	**0**	257.5bc	9.93bc	27.57def	5.12bc	13.33d
	0.002	263.6bc	10.32bc	34.04cdef	5.36bc	14.20c
	0.004	272.8bc	10.59bc	38.06cde	5.52bc	15.33c
	0.006	285.2bc	10.89bc	43.03bcd	5.57bc	18.11b
10	**0**	288.3bc	10.96bc	46.11bc	5.73bc	16.62bc
	0.002	296.3bc	11.33bc	50.52bc	5.84bc	17.40bc
	0.004	308.0b	11.65b	57.86b	6.07b	18.86b
	0.006	545.7a	15.75a	120.8a	9.44a	51.69a

*Similar letters in each column show non-significant difference at 5% probability level in Duncan test.

4.5. *Oil Yield*

Result of analysis of variance showed effect of different level of vermicompost, Nano iron fertilizer and interaction effect of treatments on oil yield was significant at 1% probability level (Table 1). Mean comparison result of different level of vermicompost indicated that maximum oil yield (29.9 gr.m^{-2}) was noted for 10 t.ha^{-1} vermicompost and minimum of that (9.91 gr.m^{-2}) belonged to control treatment (Table 2). As for Duncan classification made with respect to different level of Nano iron fertilizer maximum and minimum amount of oil yield belonged to 0.006 L.ha^{-1} (28.45 gr.m^{-2}) and control (13.33 gr.m^{-2}) (Table 2). Evaluation mean comparison result of interaction effect of treatments indicated maximum

oil yield (51.69 gr.m^{-2}) was noted for 10 t.ha^{-1} vermicompost and 0.006 L.ha^{-1} Nano iron fertilizer and lowest one (9.65 gr.m^{-2}) belonged to control treatment (Table 3). Roshdi *et al.* (2008) based on their two year research stated that inoculation of seed with Nitroxin plus 50% of urea required the most positive effect in increasing seed and oil yield and the use of biological fertilizers can improve the characteristics of the oil seed be useful.

5. CONCLUSION

Generally according result of current research the maximum amount of seed yield, protein and oil content and protein and oil yield belonged to application 10 t.ha^{-1} vermicompost with 0.006 L.ha^{-1} iron Nano fertilizer.

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FOOTNOTES

AUTHORS' CONTRIBUTION: All authors are equally involved.

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