STUDY EFFECTS OF NITROGEN FERTILIZER MANAGEMENT UNDER NANO IRON CHELATE FOLIAR SPRAYING ON YIELD AND YIELD COMPONENTS OF EGGPLANT (*Solanum melongena* L.)

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ABSTRACT

A field experiments was conducted during growing season of 2011 in Astaneh Ashrafiyeh Township (north of Iran), to investigate the application of nitrogen fertilizer and nano iron chelate fertilizer on Eggplant (*Solanum melongena* L.). Factors of experiment was consist of nano iron chelate fertilizer foliar spraying in three levels (I_1: control (without foliar spraying of nano iron chelate fertilizer), I_2: 1 g/L and I_3: 2 g/L foliar spraying) and nitrogen fertilizer management with four levels (N1: control (without nitrogen fertilizer application), N2: 30 kg/ha, N3: 60 kg/ha and N4: 90 kg/ha pure nitrogen from source of urea (46% pure nitrogen)). In maturity time, fruit yield, number of fruits per plant, plant height, number of branches per plant, fruit length and fruit width were measured. Application of nitrogen and iron fertilizer showed significant effects on all studied traits at 1% probability level. Interaction effect of nitrogen and iron on fruit yield, number of fruits per plant, plant height and number of branches per plant showed significant differences at 5% probability level. Between nitrogen treatments, application of 60 kg/ha nitrogen and between nano iron treatments, foliar spraying of 2 g/L nano iron chelate, respectively with 34.63 and 38.03 ton/ha were recorded the highest fruit yield between other treatments in this study.

Keywords: eggplant, nano iron, nitrogen fertilizer, yield, Iran.

INTRODUCTION

Eggplant (*Solanum melongena* L.), also known as Aubergine, Brinjal or Guinea squash is one of the non-tuberous species of the night shade family Solananceae (Kantharajah and Golegaonkar, 2004). The varieties of *Solanum melongena* L. show a wide range of fruit shapes and colors, ranging from oval or egg-shaped to long club-shaped; and from white, yellow, green through degrees of purple pigmentation to almost black. It is an economically important crop in Asia, Africa and the sub-tropics (India, Central America) and it is also cultivated in some warm temperate regions of the Mediterranean and South America (Sihachkr *et al*., 1993). Eggplant fruits are known for being low in calories and having a mineral composition beneficial for human health. They are also a rich source of potassium, magnesium, calcium and iron (Zenia and Halina, 2008). Nitrogen is considered as one of the essential macronutrients required by the plants for their growth, development and yield (Singh *et al*., 2003). Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle. The presence of N in excess promotes development of the above ground organs with abundant dark green (high chlorophyll) tissues of soft consistency and relatively poor root growth. This increases the risk of lodging and reduces the plants resistance to harsh climatic conditions and to foliar diseases (Lincoln and Edvardo, 2006). Nitrogen (N) fertilizer use has played a significant role in increase of crop yield (Modhej *et al*., 2008). Aminifard *et al*., (2010) with study responses of eggplant to different rates of nitrogen under field conditions were reported that fertilization with 100 Kg/ha nitrogen resulted in the highest average fruit weight and fruit yield. Pal *et al*., (2002) were reported that eggplant fruit yield increased with increase in nitrogen up to187.5 kg/ha. Sat and Saimbhi, (2003) observed that increasing the nitrogen significantly delayed flowering of eggplant and increased the number of days taken to fruit setting of eggplant. In plant, micronutrients play an important role in the production and productivity. Among micronutrients, Iron (Fe) is a cofactor for approximately 140 enzymes that catalyze unique biochemical reactions (Brittenham, 1994). Hence, iron fills many essential roles in plant growth and development, including chlorophyll synthesis, thylakoid synthesis and chloroplast development (Miller *et al*., 1995). Iron is required at several steps in the biosynthetic pathways. Singh and Dayal, (1992) concluded that spraying iron would cause a 38-42% increase in the peanut yield in alkaline soils. Zareie *et al*., (2011) with study effect of nitrogen and iron fertilizers on seed yield and yield components of safflower genotypes was reported that, use of foliar spraying of iron fertilizer (sulphate of iron) had significant effect on seeds per head and seed yield of safflower genotypes. Abdzad Gohari and Noorhosseini Niyaki (2010) with study effects of iron foliar spraying in four levels (0, 1.5, 3 and 4.5 g/l per plot) and nitrogen fertilizers in four levels (0, 30, 60 and 90 Kg/ha on yield and yield components of Peanut (*Arachis hypogaea* L.) was reported that among iron fertilizer treatments, maximum pod yield with 2916 kg/ha and seed yield with 1828 kg/ha were recorded from the 4.5 g/l iron foliar spraying treatment. The objectives of the present research are to determine the effect of nitrogen fertilizer management and also foliar spraying of nano iron chelate fertilizer on yield and yield components of Eggplant (*Solanum melongena* L.) in Iran.

MATERIALS AND METHODS

In order to study the effects of nitrogen fertilizer management and foliar spraying of nano iron chelate fertilizer on yield and yield components of eggplant (*Solanum melongena* L.), an experiment in factorial format based on randomized complete block design with three replications in Astaneh Ashrafiyeh Township located in 37° 16' latitude and 49° 56' longitude (north of Iran) in 2011 was conducted. The physical and chemical properties of the experimental field soil were showed in Table-1. The soil texture was loam clay and pH, 7.2. Factors of experiment was consist of nano iron chelate fertilizer foliar spraying in three levels (I_1: control (without foliar spraying of nano iron chelate fertilizer), I_2: 1 g/L and I_3: 2 g/L foliar spraying) and nitrogen fertilizer management with four levels (N1: control (without nitrogen fertilizer application), N2: 30 kg/ha, N3: 60 kg/ha and N4: 90 kg/ha pure nitrogen from source of urea (46% pure nitrogen)). The experimental field was cleared, ploughed, harrowed and divided into plots, with 8 m^2 areas. Five-week-old eggplant plants were hand-transplanted into well-prepared beds in the field. The spacing between rows was 75cm and plants were 45cm. All practical managements included; mulching, weeding and other agronomic treatments were done mechanically. Irrigation was done based on plant requirements. In maturity time, fruit yield, number of fruits per plant, plant height, number of branches per plant, fruit length and fruit width were measured. The data was analyzed using MSTATC software. The Duncan's multiple range tests (DMRT) was used to compare the means at 5% of significant.

RESULTS AND DISCUSSIONS

Effect of nano iron chelate fertilizer application

Results of variance analysis showed that, the effect of nano iron chelate fertilizer on all traits was significant at 1% probability level (Table-2). Comparison of mean between nano iron chelate fertilizer treatments showed that, the highest fruit yield with 38.03 ton/ha, number of fruits per plant with 4.7 fruits, plant height with 112.3cm, number of branches per plant with 3.05 branches, fruit length with 26.42cm and fruit width with 4.56cm was obtained from 2 g/L nano iron chelate foliar spraying (Table-3). On the other hand the lowest fruit yield, number of fruits per plant, plant height, number of branches per plant, fruit length and fruit width, respectively with 21.19 ton/ha, 3.51 fruits, 87.21cm, 2.65 branches, 18.73cm and 2.65cm was recorded from control treatment (without foliar spraying of nano iron chelate fertilizer). Similar results about different plants were reported by (Horesh and Levy, 1981; Abbas *et al*., 2009; Abdzad Gohari and Noorhosseini Niyaki, 2010; Sheykhbaglou *et al*., 2010).

Effect of nitrogen fertilizer management

With attention to results of variance analysis (Table-2), the effect of nitrogen fertilizer management on all studied traits showed significant differences at 1% probability level. Comparison of mean between nitrogen fertilizer management levels showed that (Table-3), the highest fruit yield with 34.63 ton/ha, number of fruits per plant with 4.82 fruits, number of branches per plant with 3 branches, fruit length with 26.01cm and fruit width with 4.05cm was recorded from 60 kg/ha nitrogen fertilizer. The maximum amount of plant height with 111.5cm was found from 90 kg/ha nitrogen fertilizer application. The lowest fruit yield, number of fruits per plant, plant height, number of branches per plant, fruit length and fruit width respectively with 18.43 ton/ha, 3.35 fruits, 82cm, 2.73 branches, 19.38cm and 3.12cm from control treatment (without nitrogen fertilizer application). Similar results were reported by (Pal *et al*., 2002; Sat and Saimbhi, 2003; Akanbi *et al*., 2007 and Aujla *et al*., 2007).

Interaction effects of nano iron and nitrogen fertilizer application

Results of variance analysis showed that, the interaction effect of nano iron chelate foliar spraying and nitrogen fertilizer management had significant differences at 5% probability level on fruit yield, number of fruits per plant, plant height and number of branches per plant. Also, was non significant on fruit length and fruit width (Table-2). The highest fruit yield with 46.30 ton/ha was recorded from I_3N3 (2 g/L nano iron chelate spraying and 60 kg/ha nitrogen fertilizer) treatment and the lowest amount of this trait was obtained by I_2N1 (1 g/L nano iron chelate and no nitrogen fertilizer) level with 14.57 ton/ha. The maximum number of fruits per plant with 5.93 fruits was recorded from I_3N3 (2 g/L nano iron chelate spraying and 60 kg/ha nitrogen fertilizer) treatment and the minimum amount of this trait was obtained from I_1N1 (without nano iron chelate and nitrogen fertilizer application) treatment with 2.63 fruits. The highest plant height and number of branches per plant, respectively with 122.6 cm and 3.13 branches (Table-4). On the other hand, the lowest plant height and number of branches per plant, respectively with 68.83 cm and 2.26 branches was found from I_1N_1 (without nano iron chelate and nitrogen fertilizer application) treatment. Similar results were reported by Chakralhoseini *et al*., 2002; Ghasemi Fasaei *et al*., 2006; Pal *et al*., 2002 and Sat and Saimbhi 2003).

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Table-1. Some physical and chemical properties of experimental filed soil.

Depth	0-30 cm	Soil texture	Loam clay
Clay (%)	46.58	E.C. (mmhos/cm)	1.32
Silt (%)	29.97	Total nitrogen (%)	0.194
Sand (%)	23.45	P (ppm)	9.1
pH	7.2	K (ppm)	197

Table-2. Analysis of variance studied traits of eggplant under different levels of nano iron chelate spraying and nitrogen fertilizer.

Source of variance	DF	Fruit yield (ton/ha)	No. of fruits per plant	Plant height (cm)	No. of branches per plant	Fruit length (cm)	Fruit width (cm)
		MS					
Nano iron chelate (I)	2	953.036**	4.229**	1885.302**	0.520**	181.064**	10.931**
Nitrogen (N)	3	472.860**	3.259**	1880.533**	0.129**	72.443**	1.771**
I×N	6	50.711*	0.336*	122.056*	0.070*	1.018ns	0.220ns
Error	22	16.646	0.125	45.118	0.023	4.885	0.303
Cv%		14.61	8.67	6.75	5.26	9.66	15.28

Ns, ** and * respectively: non significant, significant in 1% and 5% area

Table-3. Comparison of mean effect of nano iron spraying and nitrogen fertilizer management levels.

Treatments	Fruit yield (ton/ha)	No. of fruits per plant	Plant height (cm)	No. of branches per plant	Fruit length (cm)	Fruit width (cm)
Nano iron						
I_1	21.19b	3.51c	87.21c	2.65b	18.73c	2.65c
I_2	24.56b	4.02b	99.12b	2.95a	23.52b	3.57b
1_3	38.03a	4.70a	112.3a	3.05a	26.42a	4.56a
Nitrogen						
N1	18.43c	3.35c	82c	2.73b	19.38c	3.12b
N2	26.26b	4b	93.34b	2.84ab	22.08b	3.33b
N3	34.63a	4.82a	111.3a	3a	26.01a	4.05a
N4	32.37a	4.14b	111.5a	2.95a	24.08ab	3.88a

Within each column, means followed by the same letter do not differ significantly at $P<0.05$

Table-4. The interaction effects of nano iron chelate spraying and nitrogen fertilizer.

Treatments	**Fruit yield** (ton/ha)	**No. of fruits per plant**	**Plant height** (cm)	**No. of branches per plant**
I_1N1	17.50ef	2.63e	68.83e	2.26d
I_1N2	17.33ef	3.50d	76.73e	2.60c
I_1N3	24.78cde	4.13bcd	106.3bcd	2.93ab
I_1N4	25.15cd	3.8cd	96.097d	2.80bc
I_2N1	14.57f	3.50d	75.27e	2.93ab
I_2N2	21.10def	3.96bcd	95.87d	2.93ab
I_2N3	32.82b	4.40bc	110.5abc	3ab
I_2N4	29.74bc	4.23bc	114.9ab	2.93ab
I_3N1	23.24cde	3.93bcd	101.9cd	3ab
I_3N2	40.36a	4.53b	107.4bcd	3ab
I_3N3	46.30a	5.93a	117.1ab	3.06ab
I_3N4	42.23a	4.40bc	122.6a	3.13a

Within each column, means followed by the same letter do not differ significantly at $P<0.05$

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