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Research article

INFLUENCE OF FE AND ZN FOLIAR APPLICATION ON FRUIT AND GRAIN YIELD OF SAVORY UNDER DIFFERENT PLANT DENSITIES

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ABSTRACT: In order to evaluate the effect of Fe and Zn foliar application on agronomical characteristics of savory under different plant densities, a split plot experiment as randomized complete design with 3 replications was conducted at spring and summer seasons in Qazvin, Iran, during 2012. Foliar application in 4 levels (M_1: water, M2: Fe, M3: Zn and M4: Fe + Zn) as main plots and plant density in 4 levels (P1: 50, P2: 75, P3: 100 and P4: 125 plant.m^{-2}) as sob plots were considered. The results at final harvest showed that plant density had significant effect on fruit and grain yield. So that increasing plant density until 100 plant.m^{-2} resulted to increase fruit and grain, but effect of foliar application was not significant on fruit and grain yield. On the other hand, interaction of treatments showed that grain number was diminished per fruit with increase plant density. So that density of 125 plant.m^{-2} had the lowest grain number per fruit. But foliar application of Fe + Zn could be increased the grain number per fruit under density of 125 plant.m^{-2}

Key words: Savory, Plant density, Micronutrients, Grain yield

INTRODUCTION

Aromatic plants have been used for medicinal and culinary herbs in Indo-Iranian tradition. The genus *Satureja* L. (*Labiatae*, *Mentheae*) comprises over 30 species with wide distribution in the Mediterranean region [9]. According to [16], there are only 12 species of the genus *Satureja* reported from Europe [3]. Pharmacological and biological investigations justified the traditional application of *S. hortensis* L. as a natural source of compounds for food conservation, as well as in the treatment of ailments including inflammatory diseases, cramps, muscle pains, nausea, indigestion, diarrhea, and infectious diseases [12], due to its antispasmodic, anti-diarrhoeal [10], antioxidant [7], antibacterial [6] and antifungal properties as reported in literature [4]. Although growth, yield and essential oil of medicinal plants are under control of genetically factors; however, these features are affected by the environmental factors too. In recent years, researchers have conducted experiments on medicinal plants to increase their yield by improving the conditions of their growth area [2]. Optimum planting density is required to enable plants to take the best advantages of light, air, water and nutrients, and to prevent them from competition. The optimum planting density is determined by various plant and environmental factors. Planting density is one of the most important factors affecting plant morphology, yield and essential oil. Recent studies showed that relatively high plant densities were required to obtain the highest seed yield and quality in watermelon [8] and muskmelon [11]. These results are in line with several vegetable crops like onion [11] and cabbage [17]in which high seed yields were achieved at high plant densities. Application of microelements fertilizers can enhance plants resistance to environmental stresses and caused in produced potential yield [5]. Foliar fertilization is an effective practice for the application of some micronutrients, since it uses low rates and the micronutrient does not directly contact the soil, avoiding losses through fixation [19]. Foliar spray of different micronutrients has also been reported to be equally or more effective as soil application by different researchers [18]. This study was conducted to determine the effects of foliar application of Fe and Zn on fruit and grain yield of savory under different plant densities in Qazvin area.

MATERIALS AND METHODS

This study was conducted as a split plot experiment as randomized complete design with 3 replications at spring and summer seasons of 2012 in Qazvin, Iran. Foliar application in 4 levels (M_1: water, M_2: Fe, M_3: Zn and M_4: Fe + Zn) as main plots and plant density in 4 levels (P_1: 50, P_2: 75, P_3: 100 and P_4: 125 plant/m^2) as sob plots were considered. Sampling was done at 3 stages (first cutting, second cutting and final harvest stage). The soil tissue was Silt-Clay-Loam with pH: 7.6 (Table1). Each replication of this design consisted of 16 treatments and total of 48 plots were analyzed.

Foliar application of micronutrients was done with concentrate of 2000 ppm. In control treatment plants were sprayed by water. Plants were spraying 2 times. The initial foliar treatments were applied 46 days after planting date and subsequent applications was done after 11 days.

Determinate traits included biological yield, fruit yield, grain number per fruit and grain yield that measured after final maturity stage.

Data were subjected to analysis of variance (ANOVA) using the MSTATC software and significant treatment means were separated by DMRT.

Table 1. Physical and chemical properties of experimental soil before planting

SD (cm)	O.C. (%)	N (%)	P (ppm)	K (ppm)	ST	pH	EC (ds/m)	Fe (ppm)	Zn (ppm)
0-30	0.82	0.08	6	465	Silt.Clay.Loam	7.6	0.724	3.648	0.45

Note. SD–Soil depth; ST– Soil texture

RESULTS AND DISCUSSION

The result of ANOVA showed that plant density (*P<0.01*) had significant effect on biological yield, but effect of foliar application and its interaction with plant density were not significant (Table 2). The results showed that biological yield was increased with increasing plant density. So that plant density of 125 plant.m^{-2} had the highest biological yield with mean of 739.5 g.m^{-2} and lowest value belonged to 50 plant.m^2 with mean of 559.5 g.m^{-2} (Figure 1).

The results of analysis variance revealed that fruit yield influenced by plant density (*P<0.01*). Results also demonstrated effect of foliar application and interaction of treatments had not significant difference on this trait (Table 2). Investigation of mean comparison of fruit yield simple effect showed that density of 100 plant.m^2 had the most fruit yield with mean of 99.58 g.m^2 and the least of fruit yield was gained from density of 50 plant.m^2 (Figure 2). The Analysis of the variances indicated the significant effect of plant density (*P<0.01*) and interaction of plant density and foliar application of foliar application of Fe and Zn (*P<0.01*) on grain number per fruit (Table 2). The obtained results revealed that grain number was diminished per fruit with increase plant density. So that density of 125 plant.m^{-2} had the lowest grain number per fruit. Furthermore, there was no significantly difference among foliar application treatments under 50 and 75 plant.m^{-2} densities. While foliar application treatments had significantly difference under density of 125 plant.m^{-2}. Foliar application of Fe + Zn could be increased the grain number per fruit under density of 125 plant.m^{-2} (Figure 3).

Table 2: Mean squares of tested treatments effect on agronomical traits.

S.O.V	DF	Biological yield	Fruit yield	Grain number per fruit	Grain yield
R	2	297.275	3205.747	0.006	2867.831
F	2	51882.434 ns	3448.797 ns	0.364 ns	3563.852 ns
E_a	4	16236.492	1017.270	0.089	1091.611
P	3	74779.551 **	2375.539 **	0.986 **	2091.714 **
I × P	6	1553.166 ns	77.230 ns	0.094 **	56.925 ns
E_b	18	1311.086	133.351	0.019	104.024
CV%		5.71%	13.12%	3.44%	15.91%

Note. ** – p < 0.01, ns – non significant. R – Replication, F – Foliar application, P – Plant density effect. F×P represent interaction terms between the treatment factors

Evaluating of the results during maturity stage showed that effect of plant density (*P<0.01*) was significant on grain yield (Table 2). The mean comparison indicated increasing plant density until 100 plant.m^{-2} caused to promote grain yield. The plant density of 100 plant.m^{-2} had the highest grain yield and plant density of 50 plant.m^{-2} had the lowest value (Figure 4).

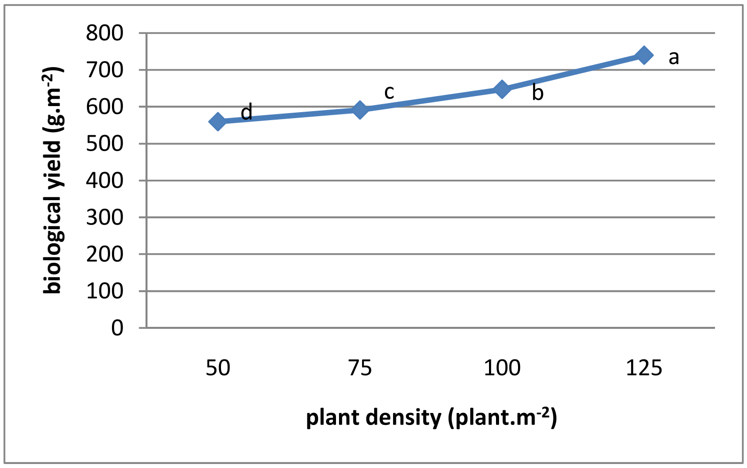


Figure 1. The mean comparison of plant density on biological yield

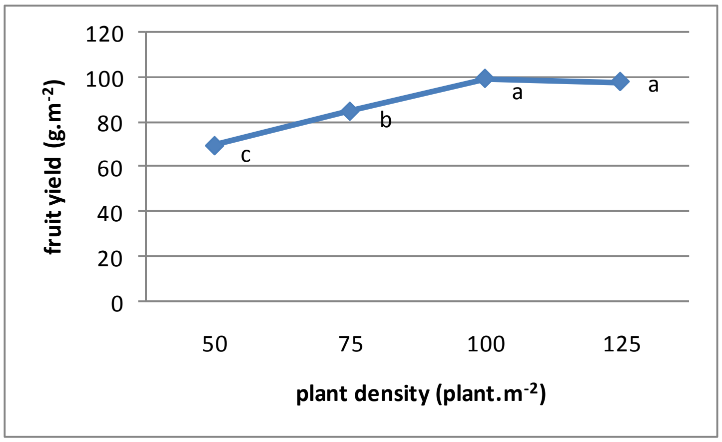
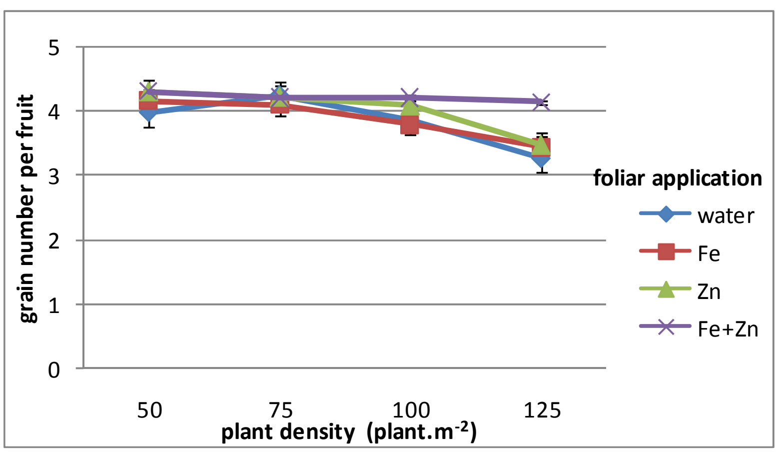


Figure 2. The mean comparison of plant density on fruit yield



Fruit 3. The mean comparison of foliar application and plant density interaction on grain number per fruit

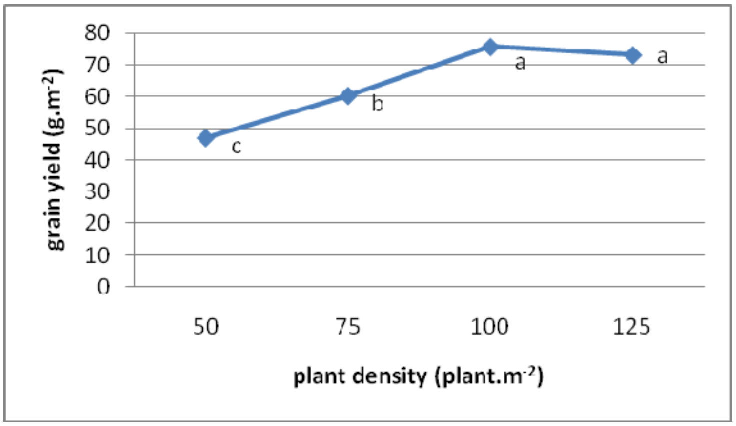


Figure 4. The mean comparison of plant density on grain yield

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