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The effect of N fertilizer and plant density on green peppers yield and its components

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Abstract

Pepper is one of the nutrition demanding vegetable. In order to compare N fertilizer uptake and plant numbers per area unit, an experiment was conducted with replications. In which fertilizer was the main factor and included Ammonium nitrate in 7 levels (0, 80, 160, 240 kg /ha^{-1}) and 40+40, 80+80, 120+120 kg/ha^{-1} (in 2 stages i.e. Half of these amounts appliedpre planting and the other half of itside dressed in flowering stage).The second factor (plant density) comprised of 3 levels (25000, 35000 and 50000). The data such as: fruit numbers per plot and per plant, plant's height yield per plant, fruit weight and prematurity percentage were detemined. According to the results simple and interaction effects of factors on yield and fruit numbers were significant, but N fertilizer had no significant effect on plant's height. Data means comparison showed that green pepper's yield was 100% higher than the control when using 240 kg N ha^{-1}. Resultsalso showed that by increasing the plant numbers per area unit, the yield of each plant and fruit numbers in each plant were decreased.

Key words: *Capsicum annuum*, yield, Nitrogen (N), plant density

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1. Introduction

Green pepper (*Capsicum annuum* L.) belongs to Capsicum genus and Solanaceae family (Rodriguez *et al*, 2008), similar to tomato's it was known in Peru scinceold times and had been cultivated in southern and central America (Csillery, 2006). Pepper has 22 wild and 5 domestic species (Patricia Toquica *et al.*, 2003). Although cultivars have been derived from *Capsicum annuum*, some types of this crop grow in tropics which have been derived from *Capsicum frutescens* confluence (Csillery, 2006). Green peppers are among nutrition demanding vegetables. For instance, each 100gr of green pepper contains 564 mg potassium (K), 25-49 mg phosphorus (P), 10 mg magnesium (Mg), 10-16 mg calcium (Ca) and 0.7-1.4 mg ferrous (Fe) which are absorbed from soil (Agheli, 2005). As nitrogen (N) sourceinfluence on fruitquality (Csillery, 2006) the time and type of uptake is important, N fertilizer amount is a crucial factor (Ali Ahmadi *et al.*, 2004).

This amount was variable, so that Sapanjani (2006) had been used 50-80-100 $kgha^{-1}$ of $N - P_2O_5 - K_2O$ in his experiment (Sapanjani, 2006). Libnernonneke (1989) by using 1961 $khha^{-1}$ of N, 224.2 $kgha^{-1}$ P_2O_5 and 224.2 $kgha^{-1}$ K_2O was effective in pepper's yield. Guertal (2000), applied 4 N fertilizer levels (90, 135, 180 and 225 $kgha^{-1}$) and recommended 135 kg N per ha^{-1}as the best dose for this crop. In addition to fertilizer factor, plant density also showed significant effect on growth and development (Yildiz and Abak, 2003). Cushman and Horgan (2001) studied the effect of 4 plant populationsviz, 29040, 14520, 9860 and 7260 plant per acre with 0.5, 1.0, 1.5, 2.0 feet distance between plants in each row, concluded that 9860 plant per acre was the optimum population. Some studies showed that, by increasing plant density, salable product will increase linearly (Cavero et al., 2001; Motsenbocker, 1996; Yildiz and Abak, 2003). Yildiz and Abak (2003) suggested that plant yield can be variable in high density according to branch numbers per plant, and proposed that 80 × 15 cm is the best distance for each plant. Regarding to fertilizer need and economical value of green pepper, the experiment was done to investigate the effect of N fertilizer and plant density on green pepper's yield and components.

2. Material and Methods

This experiment was done in a field in Ghare Bolagh in Zanjan, its longitude was eastern 5^o and its latitude was northern 35^o. Soil experiment is shown in table 1.

In doing this experiment, 2 factors were considered: the N fertilizer and plant density. It was done with replications. The fertilizer was the main factor and included Ammonium nitrate in 7 levels (0, 80, 160, 240 $kgha^{-1}$) and 40+40, 80+80, 120+120 $kgha^{-1}$ (in 2 stages i.e. Half applied before planting and half in flowering stage). Fertilizers levels performed in main plots and super phosphate triple and potash sulfate 50 $kgha^{-1}$a basal. Plant density or numbers of plant per area unit included 3 levels (25000, 35000 and 50000 plant per ha^{-1}). Distance between in rows was 10, 20 and 30 cm. between rows 1m. To nurture transplanting green peppers, California variety which is one of the full product variety and is resistance to diseases and is adaptable to different climates, was grown in small pots in April and after enough growth transferred to main field in June then irrigated immediately. During growth period, time of flowering and other features was recorded and plant's height was measured in July and…. Harvesting was started in ….and continued till Nov weekly. Harvesting was included 3 rows in the middle of each plot, 2

sides of each plot were considered as margins. Fruits was counted and weighted and some of them randomized selected to be analyzed chemically.

Table1: Soil experiment results

Soil tissue	pH	EC	Organic carbon (%)	Absorbable Nitrogen (%)	Absorbable phosphorus (%)	Absorbable potassium (%)	Absorbable calcium (%)
loam	8.1	0.46	0.25	0.71	0.17	0.52	0.71

3. Results and Discussions

Variance of analysis showed that, simple and interaction effects of factors on yield and fruit numbers were significant, but N fertilizer had no significant effect on plant's height and density effect and interaction effects of factors on these characteristics were significant in 1% of probable level. According to Libnernonneke suggestion (1989), results showed that the best yield was obtained from 224.2 $kgha^{-1}$ Nitrogen (N). But this result was in conflict with Thomas and Heilman's (1964) view; they suggested that application more than 134 $kgha^{-1}$ N will reduce pepper's yield. This response indicates that thecrop could absorb N in the same way.

The result of this study showed that dividing N fertilizer amounts and applying it in different stages will lead to relative increase, but this enhancement wasn't significant. According to the results, dividing fertilizers and applying in different stages will lead to yield loss. While 80 $kgha^{-1}$ N usage in 2 stages (40+40) had more yield than (80+80 and 120+120).

Adetula and Olakojo (2006) suggested that the best way of fertilizer application is once and 3 weeks after planting and the amount should be 140 $khha^{-1}$ Nitrogen (N) and 25 $kgha^{-1}$ P_2O_2 in 75×40 cm distance. Dimitrov and chevenkova (1978) obtained the best yield by using 180 $kgha^{-1}$ N in 2 stages. Peivast (2005) proposed 150 $kgha^{-1}$ N in 3 stages.

Plant density showed that by increasing plants' number per area unit, yields and fruits' numbers per plots will increase. The highest yield and fruit numbers belonged to 50000 plants per ha^{-1} and the lowest belonged to 25000 plants per ha^{-1}. Yildiz and Abak (2003) showed that more plant density in 80 × 15 in comparison with lower plant density in 80 × 30 and 80 × 45 will lead to higher yield.

Some other studies showed that increasing yield will follow by increasing that plant density (Cavero *et al.*, 2001; Motsenbocker, 1996; Nyambi *et al.*, 2004). There was no significant difference between the highest and shortest plant's height under density of50000 and 25000 plant per ha^{-1}).

Nyambi *et al* (2004) reported that plant distance had no significant effect on plant height. Means comparison of interaction effect of fertilizers' levels on yield, showed that the highest yields under interaction effect belonged to 240 $kgha^{-1}$ N and 50000 plants' density which was 2.8 times more than a the control and 25000 plants' density and 1.6 times more than the control and 50000 plants' density. Considering yield's components such as the weight of each fruit and yield in each plant and fruit numbers per plot it was seen that N fertilizer uptake on these 3 cases had significant effect.

The most effective treatment was 240 kgha^{-1} N, while the lowest fruit's weight and yield per plant and fruit numbers per plot, was related to control treatment yield weight per plant under 240 kgha^{-1} N was 2 times more than the control.

Applying N once was more productive than dividing it N fertilizer had no significant effect on fruit number per plant and precocity percentage. Means comparison of density effect on fruit number and fruit weight per plant, weight of each fruit and precocity percentage, showed that density has significant effect on all above ementioned characteristics. By increasing density (increasing plant numbers in ha^{-1}), product's weight and fruit number per plant will decrease, while the average fruit's weight and precocity percentage will increase. These are not in agreement with Yildiz and Abak (2003) views who suggested that the plant density had no effect on quantitative characteristic such as weight.

According to the results, the highest yield and fruit number per plant were related to 25000 plants per ha^{-1} and the least amounts related to 50000 plants per ha^{-1}, but this treatment produced the heaviest fruit and precocity percentage. According to this issue the highest yields produced in 50000 plants per ha^{-1}, despite of relative reduction in yield numbers and fruits' weights per plant explain this reduction, therefore the total yield will increase. Means comparison showed that N amount has no significant effect on precocity, but the low amount of N (80 kgha^{-1}) according to control leads to precocity and in contrast of this high amount of N, leads to serotinous. This experiment shows that N once application before planting is more beneficial and this view is opposite to Dimitrov and Chevenkova (1978) and Peivast (2005) views.

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