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RESPONSE OF CHEMICAL AND QUALITATIVE CONTENT OF ARMENIAN CUCUMBER TO ADDING N.P.K FERTILIZER AND SPRAYING NANO-BORON UNDER PROTECTED HOUSES CONDITIONS

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Abstract

Current study was carried out in Fadak farm, Najaf province during 2021 season to determine the effect of adding 60% of recommended level by manufactured company of traditional N.P.K fertilizer and spraying nano-boron on the chemical and qualitative content of Armenian cucumber in greenhouses. Randomized Complete Block Design (RCBD) was used to arrange the experiment with three replicates and two main factors. Different level of N.P.K including control treatment A0 (without adding fertilizer), adding the recommended level as one dose A1, divided the recommended level into two doses A2 and divided the recommended level into three doses A3 as well as spraying three concentrations of nano-boron (0, 5 and 10mg L^{-1}) represented as B0, B1 and B2. Least Significant Difference (L.S.D) was used to compare means of treatments at 0.05 level of probability. Results showed that A3 treatments and 10mg L-1concentration of nano-boron were significantly exceeded in the percentage of nitrogen, phosphorous and potassium in leaves and fruits content of carbohydrates, nitrates and fibers. The interaction treatment A3 + 10mg L-1concentration of nano-boron was significantly exceeded in all studied traits.

Key words: *Cucumis melo*, nano-boron, N.P.K fertilizer, chemical content, Fadak farm.

Introduction

Armenian cucumber (*Cucumis melo var flexuosus* L.) or snake melon is a vegetable plant belongs to Cucurbitaceae (Ali-Shtayeh et al. 2017), and members of this family are annual plants abundant in tropic areas (Omidbeigi 2005). Its fruits are very useful to obtain clear skin and treatment of kidney stones (Daraizadeh 2014), also, fruits are seasonal with a high water content and low in calories, fat and cholesterol (Sleiman et al. 2018). As a result of the cucumber medical and nutritional importance, it has become necessary to pay attention to the cultivation of this crop and all service operations that enable it to grow well including methods of plant feeding. The irregular and excessive chemical fertilization has a negative impact on the quality characteristics of the plant and soil as Mahdi et al. (2010) showed that excessive fertilization with N.P.K causes pollution of the agricultural ecosystem by polluting groundwater with nitrates and increasing its content in agricultural products as well which causes serious effects on human health, reducing soil fertility and microorganisms activity. In addition, the excessive use of fertilizers leads to the loss of a large amount of nutrients and a decrease in the utilization of fertilizers, thus reducing the productivity of crops (Wang et al. 2020). Therefore, appropriate mechanisms must be developed for fertilizations to achieve good growth and production. While, the boron improves the activity of enzymes, enhances plan hormones and nucleic acids, activates the absorption of nutrients, reduces the tolerance of plants to salinity, increases the distribution of carbohydrates and sugars as well as stimulates the metabolism of phenols (Khayyat et al. 2007; Yua and Ryan 2008; Marschner 2012).

Materials and methods

The experiment was conducted in one of greenhouses of Fadak farm, Najaf province during 2021 season. The land was divided into three blocks each block contains 12 treatments (experimental unit) and each treatment contains 18 plants, the distance between each plant was 40cm and the total plants was 648 in the experiment. The cultivation was done on lines and the distance between each line was $1m^2$ with $7.2m^2$ area for each experimental unit. Seeds were sawn in 1/10/2021 and the grafting process was carried out in the first week of cultivation, weeds were removed manually for all treatments during the growth season. Randomized Complete Block Design (RCBD) was used to arrange the experiment with three replicates and two main factors. Least Significant Difference (L.S.D) was used to compare means of treatments at 0.05 level of probability. The first factor was different level of traditional N.P.K as 60% of recommended level by the manufactured company ($30\text{-}50kg/500m^2$) as $40kg/500m^2$ level was used which is equivalent to 346g for each experimental unit ($7.2m^2$), this amount was added after dividing it on the number of plants in each experimental unit as follows:

- Control treatment: (without adding fertilizer) = A0.
- Adding the recommended level as one dose (19.2) = A1.
- Divided the recommended level into two doses (9.6 for each dose) = A2.
- Divided the recommended level into three doses (6.4 for each dose) = A3.

The second factor was spraying three concentrations of nano-boron (0, 5 and 10mg L^{-1}) represented as B0, B1 and B2. The spraying was repeated three times, the first one was applied after the emergence of four mature leaves, and the second was applied after 14 days of first one and the third after 14 days of second one. Leaves content of nitrogen (%) and phosphorous (%) was estimated according to Al-Sahaf (1989) method, while, fruits content of carbohydrates was estimated following Horneck and Hanson procedure, nitrates (mg $100g^{-1}$of dry weight) was estimated according to Cataldo et al. (1975) method and fibers (%) estimated following A.O.A.C (1980) procedure.

Results

Results of Table 1 showed that adding traditional N.P.K fertilizer to the soil in multiple doses was significantly increased leaves content of nitrogen as A3 treatment was exceeded all treatment (A0, A1 and A3) and gave the highest average amounted 1.7411%, while the lowest average 0.5311% was recorded in control treatment (A0). Spraying nano-boron in $10mg.L^{-1}$ concentration was exceeded other treatments significantly and gave the highest average of nitrogen amounted 1.2408% and the lowest average 0.9875% recorded in control (without spraying). The interaction between the two factors of the experiment showed that A3 + $10mg.L^{-1}$ concentration of boron was exceeded other treatments significantly and gave the highest average amounted 1.8100% compare to 0.4500% in B0 + 0mg.L^{-1} concentration of boron. Adding traditional N.P.K fertilizer to the soil in multiple doses was significantly increased leaves content of phosphorous as A3 treatment was exceeded all treatment (A0, A1 and A3) and gave the highest average amounted 0.5289%, while the lowest average 0.2978% was recorded in control treatment (A0). Spraying nano-boron in 10mg.L^{-1} concentration was exceeded other treatments significantly and gave the highest average of phosphorous amounted 0.4500% and the lowest average 0.3942% recorded in control (without spraying). The interaction between the two factors of the experiment showed that A3 + 10mg.L^{-1} concentration of boron was exceeded other treatments significantly and gave the highest average of phosphorous amounted 0.5500% compare to 0.2300% in B0 + 0mg.L^{-1} concentration of boron. Leaves content of potassium was also increased when adding traditional N.P.K fertilizer to the soil as A3 treatment was exceeded all treatment and gave the highest average of potassium amounted 2.4567%, while the lowest average 1.2467% was recorded in control treatment (A0). Spraying nano-boron in 10mg.L^{-1} concentration was exceeded other treatments significantly and gave the highest average of potassium amounted 1.9342% and the lowest average 1.5675% recorded in control (without spraying). The interaction between the two factors of the experiment showed that A3 + 10mg.L^{-1} concentration of boron treatment was exceeded other treatments significantly and gave the highest average amounted 2.7533% compare to 0.9167% in B0 + 0mg.L^{-1} concentration of boron treatment.

Table 1. Effect of traditional N.P.K. Fertilizer multiple doses and foliar application of Nano-Boron on leaves content of Nitrogen (%), Phosphorous (%) and Potassium (%)

N.P.K Fertilizer	**Leaves content of Nitrogen (%)**			
	Nano-Boron (mg l^{-1})			
	0	**5**	**10**	**Average of N.P.K Fertilizer**
A0	**0.4500**	**0.5667**	**0.5767**	**0.5311**
A1	**0.6500**	**0.7600**	**0.9633**	**0.7911**
A2	**1.1500**	**1.3733**	**1.6133**	**1.3789**
A3	**1.7000**	**1.7133**	**1.8100**	**1.7411**
Average of Nano-Boron	**0.9875**	**1.1033**	**1.2408**	**0.5311**
L.S.D.($P\leq0.05$)	**Nano-Boron =0.03118 N.P.K Fertilizer =0.03601 Interaction =0.06237**			
	the Phosphorous content of the leaves (%)			

N.P.K Fertilizer	0	5	10	Average of N.P.K Fertilizer
A0	0.2300	0.3167	0.3467	0.2978
A1	0.3733	0.3867	0.4200	0.3933
A2	0.4600	0.4700	0.4833	0.4711
A3	0.5133	0.5233	0.5500	0.5289
Average of Nano-Boron	0.3942	0.4242	0.4500	0.2978
L.S.D.(P≤0.05)	Nano-Boron =0.01059 N.P.K Fertilizer =0.01223 Interaction=0.02119			
N.P.K Fertilizer	Leaves content of potassium (%)			
	0	5	10	Average of N.P.K Fertilizer
A0	0.9167	1.3733	1.4500	1.2467
A1	1.4800	1.6233	1.6800	1.5944
A2	1.7433	1.7867	1.8533	1.7944
A3	2.1300	2.4867	2.7533	2.4567
Average of Nano-Boron	1.5675	1.8175	1.9342	1.2467
L.S.D.(P≤0.05)	Nano-Boron =0.03800 N.P.K Fertilizer =0.04388 Interaction=0.07599			

Results of Table 2 indicated that adding traditional N.P.K fertilizer to the soil in multiple doses was significantly increased fruits content of carbohydrates as A3 treatment was exceeded all treatment (A0, A1 and A3) and gave the highest average amounted 3.913%, while the lowest average 1.946% was recorded in control treatment (A0). Spraying nano-boron in 10mg.L^{-1} concentration was exceeded other treatments significantly and gave the highest average of carbohydrates amounted 3.267% and the lowest average 2.656% recorded in control (without spraying). The interaction between the two factors of the experiment showed that A3 + 10mg.L^{-1} concentration of boron was exceeded other treatments significantly and gave the highest average amounted 4.210% compare to 1.187% in B0 + 0mg.L^{-1} concentration of boron treatment. Adding traditional N.P.K fertilizer to the soil in multiple doses was significantly increased fruits content of nitrates as A0 treatment was exceeded all treatment (A1, A2 and A3) and gave the lowest average amounted 44.322mg 100g^{-1} dry weight, while the highest average 49.800mg 100g^{-1} dry weight was recorded in control treatment (A3). Spraying nano-boron in 10mg.L^{-1} concentration was exceeded other treatments significantly and gave the lowest average of nitrates amounted 47.783mg 100g^{-1} dry weight and the highest average 46.017mg 100g^{-1} dry weight recorded in control (without spraying). The interaction between the two factors of the experiment showed that

A3 + 10mg.L^{-1} concentration of boron was exceeded other treatments significantly and gave the highest average of nitrates amounted 51.467mg 100g^{-1} dry weight compare to the lowest average 43.567mg 100g^{-1} dry weight in B0 + 0mg.L^{-1} concentration of boron. Fruits content of fibers (%) was also increased when adding traditional N.P.K fertilizer to the soil as A3 treatment was exceeded all treatment and gave the highest average of fibers amounted 0.9800%, while the lowest average 0.4344% was recorded in control treatment (A0). Spraying nano-boron in 10mg.L^{-1} concentration was exceeded other treatments significantly and gave the highest average of fibers amounted 0.7958% and the lowest average 0.6133% recorded in control (without spraying). The interaction between the two factors of the experiment showed that A3 + 10mg.L^{-1} concentration of boron treatment was exceeded other treatments significantly and gave the highest average of fibers amounted 1.2033% compare to 0.3133% in B0 + 0mg.L^{-1} concentration of boron treatment.

Table 2. Effect of traditional N.P.K. Fertilizer multiple doses and foliar application of Nano-Boron on fruits content of carbohydrates (%), nitrates (mg 100g^{-1} dry weight) and fibers (%)

N.P.K Fertilizer	Fruits content of Carbohydrates (%)			
	Nano-Boron (mg l^{-1})			
	0	5	10	Average of N.P.K Fertilizer
A0	1.187	2.223	2.427	1.946
A1	2.583	2.713	2.940	2.746
A2	3.213	3.370	3.493	3.359
A3	3.640	3.890	4.210	3.913
Average of Nano-Boron	2.656	3.049	3.267	1.946
L.S.D.$_{(P\leq 0.05)}$	Nano-Boron =0.0533 N.P.K Fertilizer =0.0616 Interaction=0.1066			
N.P.K Fertilizer	Fruits content of Nitrate (mg 100gm^{-1} dry weight)			
	0	5	10	Average of N.P.K Fertilizer
A0	43.567	44.533	44.867	44.322
A1	45.100	45.767	46.633	45.833
A2	46.867	47.167	48.167	47.400
A3	48.533	49.400	51.467	49.800
Average of Nano-Boron	46.017	46.717	47.783	44.322

L.S.D.$_{(P\leq0.05)}$	Nano-Boron =0.1380 N.P.K Fertilizer =0.1594 Interaction=0.2761			
N.P.K Fertilizer	Fruits content of Fibers (%)			
	0	5	10	Average of N.P.K Fertilizer
A0	0.3133	0.4600	0.5300	0.4344
A1	0.5767	0.6400	0.6800	0.6322
A2	0.7133	0.7500	0.7700	0.7444
A3	0.8500	0.8867	1.2033	0.9800
Average of Nano-Boron	0.6133	0.6842	0.7958	0.4344
L.S.D.$_{(P\leq0.05)}$	Nano-Boron =0.02193 N.P.K Fertilizer =0.02532 Interaction =0.04386			

Discussion

The significant exceeding that achieved by adding traditional N.P.K fertilizer in multiple doses on studied indicators may attributed to the providing of plant with nutrients for long period during the growth season by regulating the amount of added fertilizers, as Adhikari and Hartemink (2016) found that improving fertilization management is essential to provide nutritional requirements of plant, increasing the yield, developing the rural economy, maintaining sustainable agricultural development and achieving eco-friendly agriculture as well as nutrients are one of the determining factors responsible for the optimal growth of a plant after water. Therefore, the appropriate fertilizer recommendation that fits with the needs of the crop in terms of the right quantity and timing and from different sources (mineral, organic and biological) will result in a quality plant with good productivity, a healthy crop and a safe, sustainable environment (Ali and Aljutheri 2017). Providing plant with nutrients (N.P.K) in three doses made a continuing supplement with those nutrients for a longer period, and thus increasing their concentration in the leaves. The moral superiority that occurred as a result of the correct management of providing plant with N.P.K fertilizer had a positive effect on leaves content of those nutrients. The plant obtaining its nutritional requirements for a longer period will affect the rate of photosynthesis and increase it, and thus increase its output in fruits represented by carbohydrates and fibers and the increasing of nitrogen content in leaves was a reason for nitrates accumulation in the leaves and fruits.

Spraying nano-boron also significantly affect studied indicators as boron has a role in plant growth, cell wall elasticity and pectin production (Power and Woods 1997; Herrera-Rodriguez et al. 2010). In addition, it plays many important roles for the plant including the elongation of roots which contributes to increasing the amount of elements absorbed by plan. The effect of boron on the quantitative content (fruits content of carbohydrates, nitrates and fibers) including cell division, formation of cell walls and buds, and facilitating the movement and transmission of photosynthesis products from leaves to active areas in plant (Hu and Brown 1997; Brown et al. 2002). Boron also contributes to increasing vegetative growth by stimulating the production of growth hormones especially cytokinin (Mengel and Kirkby 1982), and increasing carbohydrates and fibers in fruits and also nitrogen content in leaves which was a reason for nitrates accumulation in the leaves and fruits.

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