ACTA AGROBOTANICA
Vol. 55, z. 2 – 2002
s. 51–55

The effect of biostimulator applications on nutrient composition of strawberries

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(Received: 3.04.2002)

Summary

This study was carried out in greenhouse on strawberries grown in a column system in Uzundere district, Erzurum, Turkey. The biostimulator 'Macrocrop' and 'Goldmarine' were foliar-applied to the cv. Fern at the rates of 250, 500 and 750 ppm 1, 2, 4 and 8 times at 15 days intervals beginning 15 days after planting. Two months after the last application, the content of N, P, K, Ca, Mg, Fe, Cu and Zn in the leaves was analyzed. According to the results, there were significant differences between the treatments. The nutrient composition was higher in the plants treated with the biostimulators than in the control. Nitrogen (N) content was 2.48% in the control whereas in the plants treated 4 times with 250 ppm it was 3.40% and those treated once with 250 ppm of Goldmarine had 3.06% of nitrogen. In all rates of biostimulator, there was a negative relationship between application frequency and N content. Calcium (Ca) content was 1.63% in the control plants whereas the plants that received Macrocrop once at the rate of 750 ppm and those to which Goldmarine was applied once at the rate of 750 ppm had 2.38%. Similarly, iron (Fe) content was 213 ppm in the control whereas in the plants that received Goldmarine four times at the rate of 500 ppm and in those with Macrocrop four times at the rate of 500 ppm, it was 1120 ppm.

Key words: strawberries; biostimulator application; plant nutrient element

INTRODUCTION

Biostimulator substances have positive effects on plant development. Due to their natural, cheaper and biologically breakdown properties, they are important for plant growth and include macro and micro nutrient element chelatte, vitamins, plant growth regulators and enzymes.

Biostimulator substances are naturally prepared from many seaweed species especially from *Ascopyllum nodosum* (Blunden and Gordon, 1989). These substances generally increased crop yield and quality and also stimulate plants resistance to drought, frost and salinity. In addition to above-mentioned properties, these substances generally increased the uptake of inorganic complexes from the soil (Blunden and Gordon, 1989).

Biostimulator substances have a wide range of uses in the field, for both edible and ornamental plants. They are widely used in vegetables but not in fruit and viticulture.

Villiers et al. (1983), determined that these substances had no positive effects on the fruit quality and yield in apple, grape and peach species, but increased the uptake of plant nutrients. In another study on grape cv. Karaerik in Erzincan, Turkey, 600 ppm of proton biostimulator increased Ca content of the leaves compared to control (Köse, 1997).

There was a little knowledge about effects of biostimulators in strawberry plants. Thus, the aim of this present study is to reveal the effects of some biostimulators on strawberry plants cv. Fern nutrition in greenhouse condition.

MATERIAL AND METHOD

This study was carried out under greenhouse conditions in a column system in Uzundere district, Erzurum, Turkey. Strawberry plants of cv. Fern were transplanted into a column system at 35 plants per column in the beginning of January 1999. The biostimulators 'Macrocrop' and 'Goldmarine' was foliar applied at the rates of 250, 500 and 750 ppm 1, 2, 4 and 8 times at 15 days intervals 15 days after planting. The 'Macrocrop' and 'Goldmarine' biostimulators include 45-50 % organic matter, 1.4–1.8 % N, 0.15–0.40% P, 15–17% K, 1–2% S, 1.5–2.0% Ca, 0.3–0.6% Mg, 25–40 ppm Mn, 30–45 ppm Cu, 155–260 ppm Fe, 10-20 ppm Zn, amino acids, biotin, carotene, folic acid, folinic acid, niacin, riboflavin, thiamine, tocopherols, ascorbic acid, vitamin B12 and vitamin K. The leaf samples were taken two months after last application. The matured leaves were sampled to determine the amount of N, P, K, Ca, Mg, Fe, Cu and Zn. The leaves were dried at 65–70°C for 24 h. Nitrogen analysis was done by the micro-Kjeldahl procedure. K, Ca, Mg, Fe, Cu and Zn were determined by atomic absorbtion spectrophotometry and phosphorus was determined by spectrophotometry after mineralization through wet combustion (Kacar, 1972).

RESULTS AND DISCUSSION

The effects of 'Macrocrop' and 'Goldmarine' biostimulator substances on the plant nutrient element (PNE) content of the leaves are shown in Table 1. The application of biostimulator substances significantly increased the PNE contents of leaves except for the P levels, which were unaffected (Table 1).

The N, P, K, Ca and Mg content of leaves were 2.48%, 0.26 %, 4,57%, 1.63% and 0.94%, respectively, in control treatment. The highest N, P and K contents of leaves were obtained from the application of 250 ppm 'Macrocrop' (3.40%, 0.35% and 5.62%) 4 times and application of 250 ppm 'Goldmarine' (3.06%, 0.32% and 5.47%) once. The N, P and K levels were higher with lower concentrations and fewer applications of 'Macrocrop' and 'Goldmarine'. The highest Ca content of leaves was obtained from the application of 750 ppm 'Macrocrop' and 750 ppm 'Goldmarine' (2.38%) once. The Mg levels were the highest when 'Macrocrop' was applied at 250 ppm 4 times and 'Goldmarine' as a single application of 750 ppm.

The application of biostimulator substances significantly increased the Fe, Mn and Zn contents of leaves. The Fe, Mn and Zn contents were, respectively, 213, 18 and 24 ppm in control treatments whereas Fe content was 1120 ppm at four applications of 500 ppm 'Macrocrop' and 'Goldmarine', Mn was 66 ppm at 250 ppm 'Goldmarine' one application and Zn was 90 ppm at 8 times application of 'Macrocrop' at the concentration of 750 ppm and two applications of 250 ppm and 750 ppm 'Goldmarine'.

The applications of biostimulator substances increased the PNE contents of leaves compared to control. The PNE contents of leaves were lower in control treatments compared to the other treatments, but N, P and Ca contents of leaves in control treatments were adequate (Hancock, 1999), whereas the K and Mg contents of leaves in the control treatments were high (Hancock, 1999). Previous studies reported conflicting results for biostimulator substances effect on plants. Some results were similar to our results whereas other was different. Villiers et al. (1983) studying apple, pea and oat in greenhouse conditions, determined that biostimulator substances increased Ca uptake of plants but this effect varied with type and concentration of biostimulators. In some studies biostimulators had an inhibiting effect on ion uptake. In our study, the leaves in some treatments had lower PNE contents compared to control; this situation could be due to this blocking effect on ion uptake by biostimulators. In another study by Heckman (1995), the biostimulators did not increase PNE contents of cabbage.

Table 1.

The effects of biostimulator (M-Macrocrop, G-Goldmarine) doses and application frequency on plant nutrient contents in strawberry plants

Treatment	%					Ppm		
	N	P	K	Ca	Mg	Fe	Mn	Zn
Control	2.48	0.26	4.57	1.63	0.94	213	18	24
M250-1	2.92	0.29	4.49	1.68	1.01	640	10	65
M250-2	3.02	0.28	4.36	1.80	0.84	400	52	48
M250-4	3.40	0.35	5.62	2.04	1.15	960	50	42
M250-8	2.00	0.26	3.98	1.99	1.08	496	16	36
M500-1	3.15	0.32	4.62	2.18	1.08	560	40	36
M500-2	2.71	0.26	4.45	1.73	0.94	528	28	84
M500-4	2.90	0.26	3.74	1.63	1.01	1120	22	42
M500-8	2.62	0.30	5.06	1.61	0.91	800	14	48
M750-1	2.87	0.25	3.90	2.38	1.08	640	24	36
M750-2	3.11	0.29	4.55	1.97	1.10	544	34	42
M750-4	2.95	0.32	4.00	1.46	0.96	480	48	48
M750-8	2.42	0.26	4.49	1.08	1.08	640	30	90
G250-1	3.06	0.32	5.47	1.94	1.06	512	66	48
G250-2	2.91	0.24	4.69	2.04	1.08	672	50	90
G250-4	3.04	0.26	3.70	2.16	0.94	336	28	36
G250-8	2.66	0.25	4.46	2.28	1.01	800	18	42
G500-1	2.50	0.26	4.11	2.35	1.01	720	30	42
G500-2	3.04	0.27	4.72	1.68	0.89	528	36	48
G500-4	2.87	0.28	3.16	1.99	0.98	1120	50	42
G500-8	2.66	0.27	4.52	1.75	0.84	432	16	48
G750-1	2.84	0.31	4.30	2.38	1.15	400	12	42
G750-2	2.57	0.26	3.35	2.04	1.06	1040	16	90
G750-4	2.67	0.28	3.85	2.21	0.96	1040	14	54
G750-8	2.67	0.31	4.67	2.16	0.98	1040	12	30
SED	0.32**	NS	0.21***	0.12***	0.11**	47.55***	8.09**	8.67***

As a conclusion, low and medium levels of both biostimulators had positive effect plant nutrient composition of strawberry plants cv. Fern. The application of low or medium levels biostimulator may be benefit for nutrition of strawberry plants.

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Wpływ stosowania biostymulatorów na skład mineralny liści truskawki

Streszczenie

Badania wykonano w szklarni, stosując system kolumnowy w uprawie truskawki, w rejonie Uzundere, Erzurum, Turcja. Biostymulatory 'Macrocrop' i 'Goldmarine' były dolistnie stosowane na rośliny truskawki odmiany Fern w dawkach 250, 500 i 750 ppm, 1, 2, 4 i 8 razy co 15 dni, począwszy od 15 dnia po posadzeniu. Dwa miesiące po ostatnim oprysku określano zawartość N, P, K, Ca, Mg, Fe, Cu i Zn w liściach. Stwierdzono istotne różnice między zabiegami. Ogólnie zawartość badanych składników była wyższa w roślinach traktowanych biostymulatorami niż w kontrolnych. Poziom azotu wynosił 2,48% w kontroli, podczas gdy w liściach roślin traktowanych 4 razy roztworem o stężeniu 250 ppm – 3,40%, a po jednorazowym użyciu 250 ppm 'Goldmarine' – 3,06%. Niezależnie od dawki biostymulatorów, stwierdzono występowanie negatywnej korelacji między częstotliwością wykonywania zabiegów i poziomem azotu w liściach. Zawartość wapnia wynosiła 1,63% w liściach roślin kontrolnych, a w przypadku jednorazowej dawki 750 ppm 'Macrocrop' i 'Goldmarine' – 2,38%. Poziom żelaza wynosił 213 ppm w kontroli oraz 1120 ppm w liściach roślin truskawki traktowanych cztery razy preparatami 'Goldmarine' i 'Macrocrop' w stężeniu 500 ppm.