Effect of Some Plant Activators on Plant NutrientsContent of Melon

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ABSTRACT

The effects of plant activators on yield, fruit quality, plant growth and nutrient uptake is well known. The experiment was conducted in Adiyaman conditions to examine the effect of plant activators on leaf nutrient content of organic melon (Galia C8 and Kirkagac 637) cultivation in Spring 2011 and 2013 and *Bacillus subtilis* (OSU 142), *Bacillus megatorium* (M3), *Azospirillum* spp. (SP 245), Bioplin, Phosfert, EM1, Bio-one, Endoroots, Sim-Derma and *Spirulina* spp. were used as plant activators. They are used alone and with organic fertilizers which are Çamlıbesi Bioaktif Compost, Çamlıbesi Liquid Organic Fertilizer and K-Humat for comparing with conventional fertilizers and control treatments. Different plant activators were observed to effect on different element levels of mineral contents of leaves (N, P, K, Fe, Zn, Mn, Cu, Ca, Mg). Plant activators applications had no effect on leaf content of N and K %. When varieties compared, Kirkagac 637 means increased on leaf content of P %, Ca % and Cu mgl^{-1}. Analyzing application means, OSU 142 effected on P (0.38 %) leaf content. Conventional fertilizers effected on Ca (15.71 %), Fe and Zn (412.93; 46.62 mgl^{-1}). Endoroots+OG effected on leaf content of Mn (220.19 mgl^{-1}). Spirulina+OG effected on leaf content of Cu (23.51 mgl^{-1}).

Key words: Melon; Plant Activators; Plant Nutrients

Introduction

Melon production is around 31.225 million tonnes which is produced in 1.291 million ha in the world. This production is 1.69 million tonnes in Turkey (FAO, 2013). In our country, melon is the third produced specie in cucurbitaceae family after watermelon and cucumber (FAO, 2013). Melon is second important crop after watermelon in Adiyaman's vegetable production (TUIK, 2009). Nowadays organic farming has been selected farming all around the world although there is no organic melon production in Adıyaman. According tofield observations, farmers areusing minumum synthetic pesticides and passing good agricultural practices. Organic fertilizer is defined as, incorporating all nutrients for plant nutrition, composing physical and chemical structure of soil, made by plant, fossil either animal waste or produced naturally (Anonim, 2013). The advantages of organic fertilizer enhance the fertility of soil, resistance to lack of water. Benefits of microorganisms for plants can be classified as 3 groups: a) Nitrogen fixing organisms b) Mycorrhiza fungi c) PGPR (Arcak and Güven, 2004). Now, PGPR bacterial izolations are using on different plants. Root bacteria, due to the presence beneficial effects on plant growth are named as "Plant Growth Promoting Rhizobacterias (PGPR)". These PGPRs' can be colonized in microflora of roots (Van Loon et.all., 1998).Near the PGPR's microalgae which are one of the organism groups are used as plant activators. Microalgae is contained high levels of protein, vitamins, minerals, fatty acids and pigment is one of the most focused on in recent times (Kendirli, 2010). **Conventional production has many negative effects on human and ecological**. Organic farming is rapidly improving as an alternative farming system cause of negative effect of using lots of synthetic pesticides. One of the fundamentals of organic farming is no usage of chemical fertilizer which has harmful effect (Akgün, 2011).

Adiyaman province could be thought having a big potential for organic farming due to no contamination of soil and having the large lands for agriculture. Furthermore it could be the most incentive factor for development of organic farming that farmers are need of alternative crops after tobacco. İn this way reference information could be presented to different provinces and regions by this example field trial in Adiyaman.

Material & Methods

Field Experiment

This study is carried out at the experimental field of Adiyaman University Agricultural and Field Management Research Centre in Hasancık/Adiyaman (37° 46' 39.11" N, 38° 25' 39.63" E). Soil texture was loamy and no pesticides were used.

Seedlings have been planted in open field conditions on the 5^{th} of May of 2011 and 2013 spring growing period, row spacing and within row distances were 1.8 m and 0.5 m respectively, the trial had 4 replications and each repetition had 10 plants. Plants have been irrigated by drip irrigation system.

Plant Material

Galia C8 Fı (*Cucumismelo* var. *cantalupensis*) has high yield, round fruit shape, peel color is dark yellow and netting, average fruit weight is 1.5-2 kg, fruit fleshis nice,juicy, sweetandverytasty. Kirkagac 637(*Cucumismelo* var. *inodorus*) is standard open pollinated melon. Plant structure is strength, side shoots are long and has lots of leaves. Fruits are round oval and have 2.5- kg weights. Fruit peel is dark yellow on mottled green and surface is wrinkled.

Plant Activators and Fertilizers

Bacillus subtilis (OSU 142), *Bacillus megatorium* (M3), *Azospirillum spp*. (SP 245) were obtained from Prof. Dr.FikretttinSahin which have great potential as plant activators on fruit quality and element content of leaves (Karlidag et al. 2007; Esitken et al. 2006; Pirlak and Kose 2009). The plant activators, OSU 142, M3 and SP 245, have been augmented at the broth medium for the isolate, young population, which has been developed at agar medium, and applied by being saturated to the melon plant's roots at 10^9 cell.mL^{-1} populations. Isolates have been kept at -80 ^{o}C. The seedling roots have been dipped to the preparatefor 20 minutes, before being surprised to the field.

Bioplin (*Azotobacter vinelandii x A. chroococcum*), as a result of bio-chemical reactions called biologic nitrogen fixation, contains azotobacters existing freely in soil.

Phosfert (*Azotobacter vinelandii* x *A. chroococcum* x *Bacillus polymyxa*) increases the benefits of phosphate. Bioplin and Phosfert, throughout the growing season seedling roots have been dipped to 100mL/7L water, for one time only, kept for 20 minutes and then the seedlings were transplanted around the field.

EM1 (*Sacchoromyces cerevisiae* + lacticacid, localbacterias), synthesizes beneficial matters (amino acids, nucleic acids, bioactive matters and sucrose) from root secretions, organic matter and gasses (hydrogen sulphide). It helps the plant to grow and develop. EM1, has been diluted to the scale of 1/1000 per decare per fortnight, mixed with 500 cc EM 45 l water and has been applied through soil in 200 cc quantities per plant.

Bio-one (*A.vinelandii* x *Clostridium pasteurianum*), provides moisture in enough levels to protect the plants from stress during arid times. 21,6 cc Bio-One has been mixed with 1.3 lt water, in addition 154 g refined sugar has been mixed with 7.2 lt water in one place, and these two mixtures have been mixed and has been applied through the soil in 21.6 cc quantities once per plant.

Endoroots (*Glomus intraradices* (% 25), *G. mosseae* (% 24), *G. aggregatum* (% 1), *G. monosporum*(% 1), *G. deseticola* (% 1), *G. brasilianum* (% 1), *G. etunicatum* (% 1), *G. margarita* (% 1)), are mycorrhiza funguses that display a symbiotic life style with plant roots and they enhance the water and nutrition intake capacity of the plant.

Sim-derma (*Trichoderma harzianum* KUEN1585), is a microbial fertilizer which solves earth bound substances such as phosphor, manganese, copper and iron, develops the green component, facilitates blossoming, ensures high productivity, partially replaces chemical fertilizers and provides an effective protection against pathogenic funguses, as it completely blankets the roots. 5 g Sim-Derma of has been mixed with 5 lt of water and the roots of the seedlings, ready for sewing, have been kept within this mixture for 30 minutes, and then the seedlings have been surprised to the field.

Lastly, 45 $g.1t^{-1}$*Spirulina* spp. solution has been prepared, and 200 cc of this solution has been applied to the plants, near the seedling roots.

As organic fertilizers (OG), Camli Bioactive Organic Fertilizer, Biofarm Liquid, Organic Fertilizer and K-Humate have been used. The ingrediants are given in Table 1. Each one of the plant activator has been applied separately along with the organic fertilizer applications.

Table 1. Ingredients of Organic Fertilizers

Camli Bioactive Organic Fertilizer	Biofarm Liquid Organic Fertilizer	K-Humat
60 % organic matter	35% organic matter	16 % organic matter
3 % nitrogen (N)	4 % nitrogen (N)	15 % total humic and fulvic acid content
2.5 % P_2O_5	2 % P_2O_5	2.5 % K_2O
2.5% K_2O	3.5 % K_2O	pH: 9-11
25 % humic and fulvik acid	5 % humic acid	
	19 % fulvic acid	
	pH: 6	

Each one of the plant activator has been applied separately along with the organic fertilizer applications.

DAP (Diamonium Phosphate) and Urea have been used conventionally.

During the control application, no plant activator and/or organic/conventional applications has been made.

Plant Analysis

The macro and micro nutritional element levels of the leaves have been measured, and for this purpose, the most immature leaves (8^{th} leave from the growth end), have been sampled from the trial field after they have completed their growth at the full blossoming period (mid-phases of vegetation period). The sample leaves have been dried at 65 ^{o}C for 48 hours before being milled, and then 0.2 g of dry leaf sample has been taken for 0.2 g of dry leaf sample has been taken for P (Phosphor), K (Potassium), Ca (Calcium) and Mg (Magnesium), Fe (Iron), Zn (Zinc), Cu (Copper) and Mn (Lindsay and Norvell, 1978). N (Nitrogen) determined via Kjehldal method (Bremner, 1965)

Statistical Analysis

Statistical analyses have been performed by the use of the JMP 5.1 program and LSD test has been used to compare and group the averages.

RESULTS AND DISCUSSION

Macro and Micro Element Analysis

When the N, P, K element levels of the leaves have been statistically compared to control application, not significant results have been observed. Table2 and 3 shows measured of N, P, K levels on leaves. The highest values of N results in Galia C8 variety have been measured in Endoroots (4.99 %), Spirulina (4,95 %) and Bioplin (4,80 %) applications; while the respective highest values for Kirkagac 637 variety have been measured in O.G (5.08 %), M3 (5.01 %) and Spirulina (4.86 %) applications. When the P findings of Galia C8 variety have been compared to control application (0.20 %) Bioplin application (0.19 %) gave a lower result, while Bioplin+OG application provided the highest result with 0.34 %. This value has been followed by Spirulina+OG application (0.29 %), OSU 142 (0.27 %), and Sim-derma+OG. When the P averages are studied for Kirkagac 637 variety; OSU 142 is the highest by 0.54 %, and it is followed by DAP+Urea(0.45 %), OSU 142+OG(0.44 %), and Sim-derma+OG and Control applications. The lowest results were yielded by Spirulina, 0.37 %, Bio-one+OG and EM1+OG applications. Examining the K results has indicated that no matter what species, the values have always ranged between 4.25 % and 9.84 %. For the Galia C8 variety, M3+OG (9.84 %), Sim-derma+OG (7.10 %) and M3 (7.07 %) have been applications with the highest measured values, while OSU 142+ OG (7.20%), OSU 142 (7.11 %) and OG (6.99 %) applications yielded the highest values for Kirkagac 637 variety. The results of varieties and applications of Ca readings were statistically different (Table 3). The average value of Kirkagac 637 has been defined as 8.92 %; while the Galia C8 had a value of 7.34 %. Conventional application has yielded the highest result by 23.68 % in Kirkagac 637. The lowest values have been measured in the Galia C8's Phosphert+OG application by 5.73 %. No statistical differences have been observed when averages of applications and varieties of Mg results have been compared (Table 4). The highest values for the Galia C8 have been respectively measured in control, 3.27 %, Sim-derma+OG 2.94 % and OSU 142+OG 2.73 %. Examining the Kirkagac 637 variety's Mg averages, OG application has been calculated as 3.09 %, Phosfert application as 3.04 % and OSU 142 has been calculated as 3 %. When Kirkagac 637 and Galia C8 have been compared in terms of Fe results, the difference was not statistically significant (Table4). The comparisons of the applications yielded values ranging between 412.93 mgl^{-1} (DAP+Urea) and 184.73 mgl^{-1} (Bio-one). For the first year, the highest values for Galia C8 were observed in M3 application by 813.00 mgg^{-1}, and in OSU 142 application by 505.50 mgl^{-1}; while for the second year, Spirulina+OG (229.65 mgl^{-1}) yielded the highest value for Galia C8 , and M3 (278.38 mgl^{-1}) application provided the highest value for Kirkagac 637. No statistical differences have been observed between years and varieties when Zn averages were compared (Table5). The highest values for the Galia C8 during the first year has been recorded in Bio-one application by 45.25 mgl^{-1}, while the highest value for the second year was 56.43 mgl^{-1} in Endoroots application. For the Kirkagac 637, DAP+Urea have been the highest value yielding applications by 70.50 mgl^{-1} for the first year, and 47.20 mgl^{-1} for the second year. When the varieties have been compared, the averages were not statistically different. The average of Mn has been calculated as 153.35 mgl^{-1} for the Galia C8; and 143.15 mgl^{-1} for the Kirkagac 637 (Table5). For Galia C8, the highest values were observed in M3 (516.75 mgl^{-1}) application for the first year, and in EM1+OG (163.40 mgl-1) application for the second year. Endoroots+OG (402.25 mgl^{-1}) and Spirulina+OG (160.58 mgl^{-1}) applications have been observed to be important during the first year trial of Kirkagac 637. The averages of Cu results are shown on Table6. M3+OG application has provided the highest result by 21.28 mgl^{-1} for Galia C8; while the highest result for Kirkagac 637 was provided by Spirulina+OG application by 55.50 ppm. The highest values for the second year were obtained by Bioplin+OG, by 17.63 mgl^{-1}, for Galia C8; and again by Bioplin+OG by 19.23 mgl^{-1} for Kirkagac 637.

Vazquez- Hernandez et al. (2011), have studied the impact of *Glomus mosseae*(GM) and *Entrophospora colombiana* (EC) mycorrhizas on the mineral matter content of papaya leaves. Comparing the GM and EC mycorrhizas with the control application; they reported no statistical differences between average P, K, Mg, Mn, Cu values. Comparing GM (1.0 $g100g^{-}$

^{1}) and EC (0.6 g100g^{-1}) with control (0.4 g100g^{-1}), nitrogen content was higher. Ca averages had the highest value in EM by 0.7 g100g $^{-1}$. They observed no statistical differences between GM (6.5 mg100g^{-1}) and control (6.5 mg100g^{-1}) for Zn averages and reported that EM 3.7 g100g^{-1} yielded the lowest result. In terms of Fe averages, EM (89.8 mg100g^{-1}) and GM (90.2 mg100g^{-1}) yielded higher results when compared to control (74.5 mg100g^{-1}).

Orhan et al. (2006), have studied the impact of OSU 142, M3, OSU 142+M3 applications used in organic strawberry cultivation on leaf mineral matter content. They have measured the highest N (4.03 %), P (% 0.80), Ca (1.44 %) values from the OSU 142+ M3 applications. They reported that unlike OSU 14, M3 and OSU 142+ M3 are increasing the Fe and Mn contents.

Karlıdağ et al. (2007), have examined the effect of bacterial applications (M3, OSU 142, FS01, M3+OSU 142, M3+FS01, OSU 142+FS01 and M3+ OSU 412+FS01) on apple (Granny Smith) leaves. They report as OSU 142was fixed nitrogen, M3 was solved phosphorus and all bacteria applications were increased the content of Ca, Fe and Zn of leaves. The highest value of K (0.37 %) and Cu (41.7 mgl-1) were obtained M3 application. The highest Mn (45.8 mgl-1) valuewas obtained FS01 application.

Eşitken et al. (2006) investigated the effects of PGPRs on isolates of Pseudomonas BA-8 and Bacillus OSU 142 isolates and their combination on nutrient content of leaves. This study conducted in Konya with 0900 Ziraat cherry varieties between years 2003-2005. Pseudomonas BA-8, Bacillus OSU 142 isolates and BA-8 + OSU142 treatments increased the N, P, K content and Fe and Zn content of BA-8 + OSU 142 application; BA-8 and OSU 142 increased Mn content.

Uçgun et al. (2009) investigated the effects of mycorrhizal application on plant growth in MM106 apple clone rootstock. Rootstocks were planted in 4 different and 5 different mycorrhizal applications under field conditions. Parameters studied in the study; plant height, plant diameter, root age weight, root dry weight, mycosis infestation, P and Zn values on leaves. As a result, they found that mycorrhizae are effective in root development and they are no longer affected by adverse soil condition. P (0,12-0,25%) results were higher than critical limits and Zn (15-200 ppm) results were in critical limits.

Adesemoye et al. (2010), PGPR isolates (*Bacillus amyloliquefaciens* IN937ve *Bacillus pumilis*T4)were mixed and applied on tomato.These PGPRs' were compared not applied PGPR fertilizors. When examining the amounts of N in plant tissues, PGPR found that nitrogen was more abundant in added applications.

CONCLUSION

Applied plant activators on Galia C8 and Kırkağaç 637 varieties had no effect on leaf content of % N, % K, % Mg. However; plant activators had effect on micro elements (Fe, Zn, Mn and Cu) and other macro elements (P and Ca) on leaf content. Conventional applicaton for Ca, Fe and Zn, Endoroots for Mn and Osu 142 (*Bacillus subtilis*) for P were prominent applications. Generally the content of micro elements of leaveswas found very low. Micro-element application will shed new light on the region with the combination of plant activators. New farmer prescriptions can be created by testing the doses and the applications with the plant activators applied.

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Table 2. Nitrogen (N) and Phosphor levels (%) on 'Galia C8' and 'Kirkagac 637'leaves.

Applications	N (%) Galia C8 1st year	Galia C8 2nd year	Kirkagac 637 1st year	Kirkagac 637 2nd year	Means	P (%) Galia C8 1st year	Galia C8 2nd year	Kirkagac 637 1st year	Kirkagac 637 2nd year	Mean
OSU 142	4.71	4.02	4.74	4.77	4.56	0.27	0.23	0.50	0.51	0.38 a
M3	4.46	4.76	4.83	5.18	4.81	0.21	0.29	0.37	0.48	0.34 a-f
SP245	4.66	4.13	4.59	4.21	4.47	0.25	0.25	0.36	0.42	0.32 c-f
Bioplin	4.99	4.61	4.73	4.17	4.62	0.34	0.29	0.35	0.45	0.36 abc
Phosfert	5.00	4.13	4.59	4.15	4.47	0.23	0.26	0.41	0.41	0.33 b-f
Em1	4.64	4.38	5.14	4.07	4.56	0.25	0.28	0.42	0.40	0.34 a-f
Bio-One	5.51	4.02	4.76	4.14	4.61	0.21	0.21	0.46	0.36	0.31 def
Endoroots	5.07	4.90	4.76	4.52	4.81	0.25	0.29	0.41	0.38	0.33 b-f
Sim-Derma	4.80	4.45	3.38	4.45	4.27	0.22	0.22	0.41	0.43	0.32 c-f
Spirulina	5.30	4.59	5.09	4.62	4.90	0.21	0.24	0.36	0.38	0.30 f
OF	4.28	3.99	4.76	5.40	4.61	0.26	0.27	0.37	0.41	0.33 b-f
OSU142+OF	4.25	4.90	4.32	4.17	4.41	0.24	0.29	0.43	0.45	0.35 a-d
M3+OF	4.52	4.55	4.55	4.73	4.57	0.25	0.25	0.43	0.43	0.34 a-f
Sp245+OF	4.50	3.88	4.41	4.40	4.30	0.20	0.23	0.38	0.40	0.31 ef
Bioplin+OF	4.66	4.82	4.38	4.95	4.70	0.19	0.24	0.37	0.41	0.30 ef
Phosfert+OF	4.39	4.26	4.27	5.05	4.49	0.26	0.24	0.39	0.47	0.34 a-f
Em1+OF	4.52	4.52	4.57	4.39	4.50	0.22	0.30	0.35	0.38	0.31 def
Bio-One+OF	4.13	4.27	4.41	4.74	4.39	0.26	0.28	0.36	0.38	0.32 b-f
Endoroots+OF	4.15	5.09	4.11	4.44	4.45	0.25	0.32	0.47	0.36	0.35 a-d
Sim-Derma+OF	4.53	4.40	4.57	4.48	4.50	0.27	0.21	0.46	0.42	0.34 a-e
Spirulina+OF	4.53	4.90	4.55	5.04	4.73	0.29	0.24	0.30	0.52	0.34 a-f
DAP+Urea	4.62	4.81	4.46	4.88	4.69	0.26	0.30	0.43	0.46	0.36 ab
Control	4.50	4.52	4.50	4.33	4.45	0.20	0.30	0.47	0.41	0.34 a-e
Variety Mean	4.56		4.56			025 a		0.41 b		
Year Mean	1st Year = 4.58		2nd Year = 4.53			1st Year = 0.32 a		2nd Year = 0.34 b		

N: D 5% (App.)= ns D1 % (Var.) = ns D5% (Year)= ns
D 5% (Var. x Year)=ns D 1 % (App. x Year) = 0.53
D 5% (App. x Var.)= 0.53
D 5% (App. x Var. x Year) = ns

P: D 5% (App.)= 0.04 D 1% (Var.) = 0.01 D 1% (Year)= 0.01
D 5% (Var. x Year)= ns D 5% (App. x Year) = ns
D 5% (App. x Var.)= ns D 1% (App. x Var. x Year) = 0.02

Table 3. Potassium (K) (%) and Calsium (Ca) levels (%) on 'Galia C8' and 'Kirkagac 637'leaves.

Applications	K (%) Galia C8 1st year	K (%) Galia C8 2nd year	K (%) Kirkagac 637 1st year	K (%) Kirkagac 637 2nd year	K (%) Means	Ca (%) Galia C8 1st year	Ca (%) Galia C8 2nd year	Ca (%) Kirkagac 637 1st year	Ca (%) Kirkagac 637 2nd year	Ca (%) Mean
OSU 142	5.16	7.26	8.16	6.06	6.60	7.03 M-T	6.44 O-T	6.53 O-T	6.58 O-T	6.65 def
M3	7.63	6.50	5.52	5.33	6.25	7.85 J-S	6.31 O-T	9.02 F-Q	6.52 O-T	7.43 def
SP245	6.38	5.87	5.99	5.59	5.96	10.83 E-K	6.33 O-T	8.62 G-S	6.52 O-T	8.08 de
Bioplin	6.48	5.51	6.76	6.61	6.34	6.96 M-T	6.30 O-T	5.82 O-T	6.49 O-T	6.39 ef
Phosfert	5.73	6.83	6.60	6.78	6.49	8.40 G-S	6.33 O-T	9.05 F-Q	6.44 O-T	7.55 def
Em1	6.53	5.94	6.06	4.59	5.78	7.20 L-S	6.33 O-T	11.82 EFG	6.44 O-T	7.95 de
Bio-One	5.42	6.04	4.33	4.17	5.00	5.75 P-T	6.32 O-T	9.26 F-P	6.54 O-T	6.97 def
Endoroots	6.25	6.06	4.63	5.60	5.63	8.38 G-S	6.36 O-T	10.70 E-L	5.19 S-T	7.66 def
Sim-Derma	5.94	7.43	4.16	6.37	5.98	7.36 K-S	6.37 O-T	10.46 F-N	6.51 O-T	7.67 def
Spirulina	6.01	6.04	6.45	6.12	6.15	5.68 Q-T	6.33 O-T	9.02 F-Q	6.51 O-T	6.89 def
OF	5.40	6.82	6.90	7.07	6.53	6.87 O-T	6.30 O-T	11.44 E-İ	6.56 O-T	7.79 def
OSU142+OF	5.69	6.50	7.62	6.78	6.65	11.0 A-J	6.24 O-T	7.89 İ-S	6.56 O-T	7.92 de
M3+OF	5.92	13.75	6.04	6.10	7.95	7.50 J-S	6.41 O-T	3.56 T	6.56 O-T	6.01 f
Sp245+OF	6.10	6.53	5.80	5.58	6.00	6.87 O-T	6.50 O-T	10.91 E-K	6.60 O-T	7.72 def
Bioplin+OF	5.15	5.40	6.41	6.01	5.74	6.91 N-T	6.34 O-T	12.50 DEF	6.62 O-T	8.09 de
Phosfert+OF	4.92	4.75	5.03	5.41	5.22	5.07 S-T	6.38 O-T	8.98 F-Q	6.55 O-T	6.75 def
Em1+OF	5.79	7.06	6.06	4.93	5.96	8.25 H-S	6.47 O-T	11.66 E-H	5.42 RST	7.95 de
Bio-One+OF	4.73	6.51	5.60	4.58	5.35	7.51J-S	6.38 O-T	9.44 F-O	6.56 O-T	7.47 def
Endoroots+OF	5.64	5.34	5.59	5.32	5.47	6.34 O-T	6.41 O-T	14.08 DCE	6.49 O-T	8.33 cd
Sim-Derma+OF	7.19	7.01	5.48	5.10	6.20	5.08 S-T	6.39 O-T	8.77 G-R	6.48 O-T	6.68 def
Spirulina+OF	6.52	6.19	6.21	5.91	6.21	10.47 F-M	6.35 O-T	16.89 C	6.56 O-T	10.07 ac
DAP+Urea	6.28	7.64	7.55	6.24	6.93	8.95 F-R	6.56 O-T	40.89 A	6.46 O-T	15.71 a
Control	7.28	5.32	6.90	4.48	5.99	24.59 B	6.40 O-T	15.45 CD	6.40 Q-T	13.21 b
Variety Mean	6.31		5.90			7.34 b		8.92 a		
Year Mean	1st Year = 6.06		2nd Year = 6.15			1st Year = 9.86 a		2nd Year = 6.39 b		

D 5% (App.)= ns D 5 % (Var.) = ns D 5% (Year)= ns
D 5% (Var. x Year)=0.59 D 1 % (App. x Year) = ns
D 5% (App. x Var.)= ns D 5% (App. x Var. x Year) = ns

D 1% (App.)= 1.78 D 1% (Var.) = 0.52 D 1% (Year)= 0.52
D 1% (Var. x Year)= 0.74 D 1% (App. x Year) = 2.52
D 1% (App. x Var.)= 2.52 D 1% (App. x Var. x Year) =0.74

Table 4. Magnesium (Mg) (%) and Iron (Fe) levels (mgl^{-1}) on 'Galia C8' and 'Kirkagac 637'leaves.

	Mg (%)					Fe (mgl^{-1})				
Applications	Galia C8		Kirkagac 637		Means	Galia C8		Kirkagac 637		Mean
	1st year	2nd year	1st year	2nd year		1st year	2nd year	1st year	2nd year	
OSU 142	1.77 J-O	1.62 K-O	4.51 ABC	1.49 L-O	2.35	272.6 G-U	201.9 M-V	505.50 CD	133.6 R-V	278.43c-f
M3	3.30 B-İ	1.35 N-O	2.16 İ-O	1.48 MNO	2.07	813.0 A	184.1 N-V	260.80 İ-V	278.4 G-S	384.08 ab
SP245	1.90 İ-O	1.47 M-N	3.60 A-H	1.41 N-O	2.10	423.5 D-G	186.1 N-V	500.75 CDE	159.1 Q-V	317.34 bcd
Bioplin	1.68 K-O	1.56 K-O	4.07 A-F	1.44 N-O	2.19	221.3 L-V	177.9 N-V	400.00 D-J	154.1 Q-V	238.31 efg
Phosfert	1.87 J-O	1.58 K-O	4.58 AB	1.50 K-O	2.38	398.5 D-J	188.9 N-V	418.68 D-H	136.1 R-V	285.55 cde
Em1	1.81 J-O	1.58 K-O	2.32 H-O	1.52 K-O	1.81	321.3 F-P	198.1 M-V	253.6 J-V	116.5 V	222.34 efg
Bio-One	1.46 N-O	1.60 K-O	1.91 İ-O	1.50 K-O	1.61	195.3 M-V	194.8 M-V	199.7 M-V	149.2 Q-V	184.73 g
Endoroots	2.53 G-O	1.56 K-O	2.13 İ-O	1.42 N-O	1.91	276.0 G-T	227.9 L-V	507.6 CD	121.6 TUV	283.27 cde
Sim-Derma	1.99 İ-O	1.59 K-O	1.66 K-O	1.37 N-O	1.65	287.3 G-R	209.9 M-V	318.7 F-P	135.0 R-V	237.71 efg
Spirulina	1.56 K-O	1.59 K-O	1.83 J-O	1.39 N-O	1.59	220.5 L-V	186.0 N-V	280.3 G-S	131.3 S-V	204.5 fg
OF	2.71 E-N	1.60 K-O	4.81 A	1.37 N-O	2.62	238.0 K-V	200.6 M-V	368.0 D-L	133.8 R-V	235.10 efg
OSU142+OF	3.87 A-G	1.58 K-O	1.86 J-O	1.36 N-O	2.17	326.5 F-O	200.5 M-V	389.5 D-K	153.7 Q-V	267.54 c-f
M3+OF	2.87 E-M	1.52 K-O	4.11 A-E	1.31 N-O	2.45	455.5 DEF	190.1 N-V	120.7 UV	174.9 O-V	235.30 efg
Sp245+OF	2.30 H-O	1.63 K-O	2.46 H-O	1.37 N-O	1.94	398.3 D-J	170.0 P-V	267.0 H-V	143.1 Q-V	244. 59 d-g
Bioplin+OF	1.64 K-O	1.60 K-O	2.90 D-K	1.43 NO	1.89	293.8 G-Q	207.5 M-V	409.7 D-İ	199.0 M-V	277.47 c-f
Phosfert+OF	2.17 İ-O	1.61 K-O	2.63 G-O	1.34 N-O	1.94	216.3 L-V	201.1 M-V	266.2 H-V	197.0 M-V	220.14 efg
Em1+OF	2.29 H-O	1.61 K-O	2.70 F-N	1.33 N-O	1.98	331.8 F-N	197.5 M-V	346.3 E-M	215.7 L-V	272.80 c-f
Bio-One+OF	1.96 İ-O	1.59 K-O	2.24 H-O	1.31 N-O	1.77	272.3 G-U	200.6 M-V	256.1 İ-V	199.8 M-V	232.20 efg
Endoroots+OF	2.89 D-L	1.60 K-O	2.58 G-O	1.34 N-O	2.10	280.8 G-S	197.1 M-V	496.3 CDE	208.1 M-V	295.53 cde
Sim-Derma+OF	4.29 A-D	1.59 K-O	1.89 İ-O	1.31 N-O	2.27	631.8 BC	195.2 M-V	265.3 H-V	201.8 M-V	323.50 bc
Spirulina+OF	2.36 H-O	1.61 K-O	3.59 A-H	1.30 O	2.21	256.8 İ-V	229.6 L-V	509.9 CD	160.1 Q-V	289.09 cde
DAP+Urea	2.60 G-O	1.57 K-O	3.17 C-J	1.28 O	2.15	513.8CD	248.0 J-V	700.0 AB	190.0 N-V	412.93 a
Control	4.97 A	1.57 K-O	3.63 A-H	1.28 O	2.86	367.8 D-L	227.4 L-V	276.3 G-T	170.6 P-V	260.50 c-g
Variety Mean	2.02		2.16			274.63		264.76		
Year Mean	1stYear = 32.70 a		2nd Year = 1.48 b			1st Year = 354.98		2nd Year = 184.41		

D 5% (App.)= 0.21 D1 % (Var.) = 0.21 D 5% (Year)= ns
D 1% (Var. x Year)=1.97 D 5 % (App. x Year) = 0.99
D 1% (App. x Var.)= 0.99
D 5% (App. x Var. x Year) = 1.97

D 1% (App.)= 77.54 D 1% (Var.) = 22.87 D 5% (Year)= ns
D 5% (Var. x Year)= 32.34 D 1% (App. x Year) = 109.66
D 1% (App. x Var.)= 109.66 D 1% (App. x Var. x Year) = 109.6

Table 5. Zinc (Zn) (mgl^{-1}) and Manganese (Mn) levels (mgl^{-1}) on 'Galia C8' and 'Kirkagac 637'leaves.

Applications	Zn (mgl^{-1}) Galia C8		Kirkagac 637		Means	Mn(mgl^{-1}) Galia C8		Kirkagac 637		Mean
	1st year	2nd year	1st year	2nd year		1st year	2nd year	1st year	2nd year	
OSU 142	30.08	47.05	27.65	22.96	31.93 e	119.50 K-T	127.40 J-T	370.25 BCD	108.08 N-T	181.19 a-d
M3	41.28	48.45	43.68	31.85	41.31 a-d	516.75 A	108.05 N-T	114.85 K-T	74.38 P-T	208.18 ab
SP245	35.28	45.08	36.80	26.53	35.91 cde	117.50 K-T	102.55 O-T	219.00 F-İ	71.75 RST	127.70 efg
Bioplin	29.85	46.60	60.05	30.10	41.65 ad	110.25 N-T	109.05 N-T	394.50 BC	69.40 RST	170.80 b-d
Phosfert	40.06	46.98	43.38	26.33	39.18 a-e	132.50 J-T	111.75 M-T	331.75 CDE	63.13 T	159.78 cde
Em1	40.25	45.53	44.55	25.58	38.98 b-e	175.75 H-O	113.13 L-T	112.72 L-T	67.00 ST	117.15 fg
Bio-One	45.25	46.75	42.25	33.63	41.98 abc	108.75 N-T	112.43 L-T	104.20 O-T	78.33 Q-T	100.93 g
Endoroots	43.60	56.43	49.64	36.85	46.63 a	199.00 G-J	121.33 J-T	116.07 K-T	67.35 ST	125.94 efg
Sim-Derma	42.15	47.20	31.67	38.63	39.91 a-d	172.75 H-O	124.40 J-T	97.675 O-T	73.90 RST	117.18 fg
Spirulina	35.85	45.58	34.93	37.58	38.48 b-e	190.50 H-L	120.08 K-T	184.58 H-N	73.43 RST	142.14 def
OF	30.40	49.80	43.58	32.95	39.18 a-e	142.75 İ-S	120.15 K-T	272.00 EFG	85.95 P-T	155.21 c-f
OSU142+OF	42.30	33.70	51.68	34.98	40.66 a-d	192.75 H-K	103.20 O-T	123.92 J-T	71.40 RST	122.82 efg
M3+OF	35.33	43.83	33.23	38.90	37.81 b-e	321.50 CDE	127.75 J-T	77.45 O	76.03Q-T	150.68 c-f
Sp245+OF	39.98	49.73	44.60	33.48	41.94 abc	113.00 L-T	81.93 Q-T	120.60 J-T	91.15 P-T	101.67 g
Bioplin+OF	36.20	41.68	69.38	31.90	44.79 ab	102.00 O-T	122.50 J-T	189.55 H-M	97.95 O-T	128.00 efg
Phosfert+OF	20.28	34.50	58.75	35.70	37.30 b-e	103.75 O-T	120.48 J-T	155.00 H-Q	89.48 P-T	117.18 fg
Em1+OF	40.08	30.38	56.78	31.83	39.76 a-d	121.50 J-T	163.40 H-P	121.52 J-T	88.40 P-T	123.71 efg
Bio-One+OF	33.03	30.70	44.90	38.88	36.88 cde	149.25 H-R	126.65 J-T	113.50 L-T	108.50 N-T	124.48 efg
Endoroots+OF	22.60	28.83	47.08	41.07	34.89 cde	225.25 FGH	121.70 J-T	420.25 B	113.58 L-T	220.19 a
Sim-Derma+OF	25.58	31.35	41.40	40.28	34.65 cde	370.50 BCD	126.78 J-T	115.78 K-T	127.08 J-T	185.03 abc
Spirulina+OF	32.68	45.83	36.95	38.15	38.40 b-e	124.75 J-T	113.3 L-T	222.50 FGH	160.58 H-P	155.30 c-f
DAP+Urea	23.78	45.00	70.50	47.20	46.62 a	217.50 CDE	116.80 K-T	293.75 DEF	128.68 J-T	189.18 abc
Control	41.08	27.45	25.33	42.42	34.37 de	321.25 F-İ	83.83 N-T	192.20 H-K	117.18 K-T	185.19 abc
Variety Mean	38.59		39.92			153.35		143.15		
Year Mean	1st Year = 40.12		2nd Year = 38.39			1st Year = 191.58		2nd Year = 104.92		

D 5% (App.)= 7.61 D5 % (Var.) = ns D5% (Year)= ns
D 1% (Var. x Year)= 3.17 D 5 % (App. x Year) = 10.76
D 1% (App. x Var.)= 10.76
D 1% (App. x Var. x Year) = 3.17

D 1% (App.)= 39.27 D 5% (Var.) = ns D 1% (Year)= 1.97
D 5% (Var. x Year)= 16.38 D 1% (App. x Year) = 55.54
D 1% (App. x Var.)= 55.54 D 1% (App. x Var. x Year) = 16.38

Table 6. Cupper (Cu) (mgl^{-1}) level on 'Galia C8' and 'Kirkagac 637'leaves.

Applications	Cu (mgl^{-1}) Galia C8 1st year	Galia C8 2nd year	Kirkagac 637 1st year	Kirkagac 637 2nd year	Means
OSU 142	9.50 M-R	16.18 F-Q	31.78 BC	14.85 H-R	18.08 b-e
M3	7.43 PQR	12.05 İ-R	11.43 İ-R	16.65 F-Q	11.89 g
SP245	12.10 İ-R	11.58 İ-R	24.18 C-H	13.58 İ-R	15.36 c-g
Bioplin	11.10 K-R	12.33 İ-R	50.00 A	11.10 K-R	21.13 ab
Phosfert	12.38 İ-R	12.90 İ-R	21.15 D-J	13.30 İ-R	14.93 c-g
Em1	14.45 H-R	11.70 İ-R	9.90 L-R	12.28 İ-R	12.08 fg
Bio-One	10.95 K-R	11.63 İ-R	9.20 N-R	13.10 İ-R	11.22 g
Endoroots	14.78 H-R	12.28 İ-R	12.58 İ-R	13.40 İ-R	13.26 efg
Sim-Derma	13.55 İ-R	12.68 İ-R	7.53 PQR	12.07 İ-R	11.45 g
Spirulina	8.58 O-R	12.63İ-R	21.12 D-J	17.03 F-P	14.84 c-g
OF	9.53 M-R	11.75 İ-R	15.40 F-Q	14.93 G-R	12.90 fg
OSU142+OF	13.62 İ-R	11.87 İ-R	12.13 İ-R	15.78 F-Q	13.35 efg
M3+OF	21.28 D-İ	13.58 İ-R	32.00 BC	16.55 F-Q	20.85 ab
Sp245+OF	9.18 N-R	11.75 İ-R	18.94 E-N	13.88 İ-R	13.43 d-g
Bioplin+OF	11.38 İ-R	17.63 F-O	19.56 E-L	19.23 E-M	16.95 b-f
Phosfert+OF	11.30 J-R	15.20 F-Q	36.00 B	16.25 F-Q	19.69 abc
Em1+OF	14.28 H-R	12.55 F-Q	30.68 BCD	16.08 İ-R	18.40 bcd
Bio-One+OF	8.75O-R	12.48 İ-R	14.15 İ-R	16.20 F-Q	12.89 fg
Endoroots+OF	6.83QR	14.10 İ-R	24.83 C-G	14.23 İ-R	14.99 c-g
Sim-Derma+OF	5.21 R	10.73 K-R	27.83 B-E	13.58 İ-R	14.33 d-g
Spirulina+OF	9.35 M-R	16.05 F-Q	55.50 A	13.13 İ-R	23.51 a
DAP+Urea	8.43 F-Q	13.28 İ-R	25.08 C-F	13.80 İ-R	15.14 c-g
Control	15.98 O-R	12.75 İ-R	20.16 E-K	13.10 İ-R	15.50 c-g
Variety Mean	12.16 b		18.81 a		
Year Mean	1st Year = 17.19 a		2nd Year = 13.77 b		

D 1% (App.)= 4.49 D1 % (Var.) = 1.46 D1% (Year)= 1.46
D 1% (Var. x Year)=2.06 D 1 % (App. x Year) = 7.02
D 1% (App. x Var.)= 7.02
D 1% (App. x Var. x Year) = 2.06