EFFECT OF ORGANIC PRACTICES ON KIWI PRODUCTIVITY LEVELS AND SOME SOIL PROPERTIES FOR ORGANIC KIWI CULTIVATION

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Abstract

This research was completed in Yalova state using the variety Hayward (A.deliciosa). Some soil improvers and organic-origin plant food sources were applied to kiwis grown under organic farming conditions.

The study was completed in divided parcels in randomized blocks according to the study design with 4 repetitions and 6 vines in each parcel. Materials used in applications were administered to plants in a fertigation program. With applications beginning in the 2nd year after the orchard was planted, materials were administered to plants in a fertigation program.

The results of this study investigating the effects of different applications on organic kiwi productivity and some soil properties found;

For productivity increase, composted cattle manure+K_2O (potassium-weighted fertilizer allowed in organic farming) provided best results.

Applications increased the water-holding capacity of soil and organic material content by significant levels compared to initial values.

Key words: *Organic kiwifruit, organic plant nutrition, soil good agents*

1. INTRODUCTION

Kiwi (A.deliciosa) is a perennial, climbing, strongly developing plant with a root structure spreading broadly at depth and laterally. Fruiting kiwi removes 38 kg N, 5.5 kg P and about 75 kg K of macro nutrient material from a one hectare area each year (Ferguson and Elseman 1983).

Fertilizing is the most important factor increasing the productivity and quality of kiwi. Cangi et al. (2002) recommended 200-250 g K_2O per plant to obtain high productivity from 6-7 year old kiwi plants. Bijan (2013) researched the effects of plant food applications on productivity and quality of Hayward kiwi variety in northern Iran. Fertilizer studies lasting 3 years were made on a 5 x 3 m planting interval planted in 2006 with 12 different applications in 4 repetitions in a randomized block trial design. The results of the study found 500 ppm (N-P-K-Mg-Zn) fertigation application at 15 day intervals increased fruit size and fruit quality classification with larger fruit ratio.

Organic kiwi cultivation studies first began in 1991 in New Zealand. Initially IPM programs were applied with medication use levels reduced to minimum; however later due to high demand for organic kiwi, organic cultivation studies for kiwi accelerated (Campbell et al, 1997).

The literature on the specific topic of kiwi cultivation with organic methods is very limited. Perham (1999) in a two year study of 4 applications in a certified organic kiwi orchard with 5 Bio-Gro used control (only water), Ocean Brew Soil Condition, Ocean Brew Liquid Foliar Spray and a combination of both, administered according to label amounts and times. The best result from these applications was obtained from the OB mixture.

To determine the applicability of organic kiwi cultivation, another study by Hasey et al. compared two systems over two years using the calculation of 16.8 N per decare with chicken manure applied to the organic parcel and NH_4NO_3 + $CaNH_4(NO_3)_3$ applied through a mini sprinkler irrigation system to the inorganic parcel. At the end of this duration, soil analysis results found increased soil pH, NH_4-N, and organic material in the organic production parcel with a reduction in NO_3-N concentration recorded.

Investigations of fruit found that both at harvest and after 4 months of storage measurements for hardness were higher for fruit from the organic plot.

Cayrol et al. (1991) applied mulch prepared by mixing equal amounts of cattle manure and compost over 3 months of summer to kiwis. In the fall, 600 g/tree mulch fertilization was applied.

In another study by Hasey et al. (1992) to determine the applicability of organic kiwi cultivation in terms of fruit quality, fruit cultivated with organic methods were found to be better quality.

This study was planned with the aims of determining how the rapidly expanding cultivation of kiwis can be completed using organic methods, encouraging organic cultivators and thus creating a foundation for organic kiwi producers in the global market.

2. MATERIALS AND METHODS

Trials were completed in Yalova state. The female variety Hayward and pollinator variety of Mantua were used. Plants were planted 4 m apart in rows with 5 m intervals between rows. The study used a split plot trial design, with each parcel containing 6 vines.

Vines were trained on a "T" system, with shape pruning performed at the end of the third year to create trunk and branches.

A micro jet sprinkler irrigation system was used, with equal amounts of water given to all applications. For weed control, the area between the rows was cut with a hand strimmer while within the rows weeds were mechanically checked with a hand hoe. Diseases or pests that may cause economic levels of damage to kiwis were not encountered. For white-colored mulberry scale insects observed on kiwis from time to time, organic-origin Neemazol T/S (200 ml/ 100 L water) and for Phyopthora Bioact-T (500 ml/ 100 l water) was used.

Before planting in the trial parcels, soil analysis was performed with results given in Table 1. Analysis results showed that in terms of salinity, pH and lime the soil properties were appropriate for cultivation of kiwi.

Table 1. Some physical and chemical properties of the soil before planting

Depth (cm)	Saturation (%)	EC (mmhos/cm)	pH (1:2.5)	$CaCO_3$ (%)	Organic Matter (%)	P (ppm)	K (ppm)
0-20	61.1	0.40	7.87	0.40	3.65	39	548
20-40	70.0	0.39	7.98	0.40	2.15	12	328

As kiwi is a plant with exposed roots, it has no tolerance for soil processing (apart from the 1st year). As a result, it was deemed appropriate to apply sheep manure (1 ton/da) + raw rock phosphate (30 kg/da) + natural slag (1.5 ton/da) in the first year to increase the organic material amount. From the natural slag used 1200 ppm K may be obtained, while raw rock phosphate contains 25-33% P_2O_5.

After the first year organic-origin plant food elements were given in liquid form together with irrigation water (fertigation).

The trial used the following fluid fertilizer or soil improvers:

1. Bioplasma (maxicrop)
2. Seaweed extract
3. Humic acid

4. Organic NP + K_2O (organic NP; composted cattle manure)

5. Inorganic NPK (Control)

The applications given under trial conditions according to year are given in Table 2, while the method of conduction of applications is given in Table 3.

Table 2. Fertilization materials applied during the years of the study

Treatments	**2.year**	**3.year**	**4.year**	**5.year**	**6.year**
Bioplasma cc/da	500	1000	2000	4000	8000
Liquid seaweed g/da	500	1000	2000	4000	8000
Humic acid g/vine	150	300	600	1200	2400
CFM+K_2O g/vine	75	150	300	600	1200
Inorganic NPK A.Sulfate, g/vine	100	300	500	700	1400
NPK+Mikro, g/vine	5	10	20	40	80

Note: 1 kg/vine sulfur powder applied to all applications

Table 3. Application methods for the materials

	Bioplasma	**Liquid seaweed**	**Humic acid**	**CFM+K_2O**	**İnorganic NPK**	**Sulfur**
	For all applications; 0.30 g/vine chelated Fe + Zn, 0.60 g/vine amino acid liquid fertilizer with the system					1 kg/vine
Method of Application	Spraying around the kiwifruit plant	Spraying around the kiwifruit plant	By hand spreader around the kiwifruit	By hand spreader around the kiwifruit	By hand spreader around the kiwifruit	By hand spreader around the kiwifruit

Soil samples were taken from 0-20 and 20-40 cm depths. The soil samples were analyzed for texture (Öztan and Munsuz, 1961), pH, EC and organic matter (Jackson, 1962), calcium carbonate (Çaglar, 1958), available P (Olsen and Dean, 1965) and exchangeable K (Anon., 1981).

Leaf samples were collected for the purpose of required analyses. 25-30 leaves from against the first flower were taken in August for leaf analysis. The leaf samples using wet digestion method were prepared for macro and micronutrient analyses after washing, drying and grinding procedures (Anon., 1980). N was analyzed by Kjeldahl method, P was analyzed spectrophotometrically by vanadomolybdate phosphoricacide method (Anon., 1980), K, Ca, Mg, Fe, Mn, Zn and Cu by AAS and B Azomethin -H method (Wolf, 1981).

3. RESULTS AND DISCUSSION

The soil analysis results from the final year of the trial are given in Table 4. When the table is investigated, it is observed that according to the soil analysis results the applications caused changes in the soil saturation, pH and organic material values.

The effect on % water holding capacity (saturation) of soil is given in Table 5 according to year. The effect of applications was statistically significant, additionally the effect of the same application depending on year was also statistically significant. While bioplasma application is in first place from 0-20 cm, the bioplasma and seaweed extract applications increased the saturation values at 20-40 cm by a statistically significant amount compared to other applications.

When Table 6 is examined, for all applications according to year soil pH values reduced. It is thought that this reduction may be the effect of 1 kg sulfur powder applied to each kiwi vine.

The variation in soil organic content according to year and application is given in Table 7. When Table 7 is examined, according to year organic applications produced a statistically significant increase in organic material, with the highest value observed to be reached in the final year of the trial. There were statistically significant differences between applications in terms of soil organic material values, with the highest values reached for humic acid and organic NP+K2O applications. Hasey et al. (1995) identified that soil organic material increased during organic kiwi cultivation trials.

Table 4. Soil analysis results at the end of the study

Treatments	Depth cm	Saturation %	EC mmhos	pH 1:2.5	$CaCO_3$ %	O.M %	P ppm	K ppm
Bioplasma	0-20	65	0.23	7.63	0,69	3.34	28	321
	20-40	68	0.21	7.73	0,59	2.82	19	243
Liquid seaweed	0-20	62	0.22	7.96	0,88	3.26	50	431
	20-40	66	0.23	7.95	0,69	3.22	43	400
Humic acid	0-20	59	0.23	7.85	0,92	5.10	34	444
	20-40	61	0.23	7.83	0,83	4.41	36	442
CFM+K_2O	0-20	63	0.22	7.77	0,74	4.08	61	413
	20-40	66	0.22	7.87	0,39	4.13	64	495
İnorganic NPK	0-20	70	0.42	7.49	0,30	3.88	36	450
	20-40	66	0.35	7.59	0,39	3.49	59	426

Table 5. Saturation values of the experiment (%) under conditions of various material application during the years of the study

Year	Bioplasma	Liquid seaweed	Humic acid	CFM+K_2O	İnorganic NPK	Mean
	% saturation					
1.year	58 64	58 64	58 64	58 64	58 64	58.0 C 64.0 B
2.year	62 65	60 65	58 62	59 62	56 60	59.8 BC 63.6 C
3.year	63 66	62 65	58 64	61 64	60 65	60.8 B 64.8 B
4.year	65 68	62 66	59 65	63 66	62 58	62.6 AB 66.2 A
5.year	65 68	63 67	63 66	64 70	61 59	64.8 A 67.4 A
Mean	62.6 A 66.2 A	61.0 B 65.4 AB	59.2 B 64.2 B	61.0 B 65.2 AB	59.2 B 60.5 C	

Table 6. Changes in soil pH values according to materials and years

Treatments	Depth, cm	Years				
		1	2	3	4	5
Bioplasma	0-20	8.05	8.00	8.18	7.63	7.45
	20-40	7.95	7.89	8.13	7.73	7.80
Liquid seaweed	0-20	8.10	8.12	8.08	7.96	7.91
	20-40	8.00	8.06	8.12	7.95	7.92
Humic acid	0-20	8.00	7.92	7.98	7.85	7.43
	20-40	7.98	7.95	8.09	7.83	7.81
CFM+K_2O	0-20	8.01	7.91	7.94	7.77	6.67
	20-40	7.97	7.94	7.99	7.87	6.69
Inorganic NPK	0-20	8.03	8.05	7.97	7.49	6.90
	20-40	8.01	8.06	7.99	7.59	6.87

Table 7. The effect of the applied material on soil organic matter during the experimental period

Year	Bioplasma	Liquid seaweed	Humic acid	CFM+K_2O	Inorganic NPK	Mean
1	2.64* 2.36	2.64 2.36	2.64 2.36	2.64 2.36	2.64 2.36	2.64 C 2.36 C
2	2.75 2.35	2.78 2.45	2.87 2.65	2.86 2.80	2.68 2.52	2.79 C 2.55 C
3	2.94 2.66	2.96 2.56	3.87 2.97	3.96 2.97	3.18 2.64	3.38 B 2.76 C
4	3.00 2.69	3.11 3.02	4.16 3.51	4.00 3.52	2.56 2.78	3.57 AB 3.10 AB
5	3.34 2.82	3.26 3.22	5.10 4.41	4.08 4.13	2.88 2.49	3.93 A 3.61 A
Ort.	2.93 B 2.58 B	2.95 B 2.72 B	3.73 A 3.18 A	3.51 AB 3.16 A	2.84 C 2.56 B	

*The values of the first and second row belong to 0-20 and 20-40 cm depth respectively.

Analysis results from leaf sampling are presented in Table 8. When leaf sample analysis results are examined, it appears that micro elements were sufficient in all applications. In terms of macro elements, when the analysis results are investigated it can be said that nutrition was not a problem. Leaf nitrogen was found to be significant statistically between applications, with the highest values obtained for conventional application and for organic NP+K_2O. Leaf potassium values were found to be different by a statistically significant amount between applications, with the highest value provided by seaweed extract application. Leaf calcium was found to be statistically significant between applications, with the highest values obtained from bioplasma application.

The 3rd, 4th and 5th year productivity values are presented in Table 9. When Table 9 is investigated, it appears that applications affected productivity by a significant amount. While conventional methods left organic methods behind, no. 4 application (Biofarm+K_2O) was in second place. In organic methods it may be said that productivity approaches the productivity of conventional methods as the productivity duration lengthens (age of the plant increases). Studies by Hasey et al. (1992, 1995) found that organic kiwi productivity approached those of conventional methods.

Table 8. Leaf analysis results of the experimental treatments

Treatments	%					ppm				
	N	**P**	**K**	**Ca**	**Mg**	**Fe**	**Mn**	**Zn**	**Cu**	**B**
Bioplasma	1,71 B	0,15	1,98 B	2,99 A	0,51	90	21	41	3	74
Liquid seaweed	1,77 B	0,16	2,44 A	2,02 B	0,43	84	22	33	1	74
Humic acid	1,93 AB	0,18	1,98 B	1,84 C	0,37	89	23	32	1	114
Organic NP+K_2O	2,02 A	0,17	1,72BC	1,84 C	0,38	103	25	25	1	82
Inorganic NPK	2,04 A	0,16	1,62 C	1,48 D	0,39	93	28	39	1	69
Moltay et al.1996	1,7 2,4	0,14 0,24	1,4 3,2	1,4 3,3	0,21 0,62	56 322	22 108	11 48	4 14	

Table 9. Yield Values of kiwifruit obtained under conditions of various material application

Treatments	3.year kg/vine	4.year kg/vine	5.year kg/vine	Mean kg/vine
1 BP	1.56 D	3.62 D	8.95 E	4.71 D
2 YE	3.68 D	8.10 D	21.45 D	11.07 CD
3 HA	8.25 C	15.16 C	33.21 C	18.87 C
4 Or+K2O	12.21 B	21.72 AB	45.68 B	26.54 B
5 Inorganic ap..	13,48 A	26.14 A	64.21 A	34.61 A

In conclusion, in this study investigating the effects of different applications on organic kiwi productivity and some quality characteristics:

The highest productivity was obtained from traditional (inorganic) methods, with Biofarm+K_2O application in second place. Within the organic methods the best result was obtained from Biofarm+K_2O application.

Organic applications increased soil water-holding capacity and organic material content by significant levels compared to the initial values.

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