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Effect of Different Organic Manure Applications on Grapevine Nutrient Values

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This study was conducted to elucidate the effects of pruning residue of grapevine, farmyard manure, green manure plant (barley + vetch), straw mulch and combinations of these materials on nutrient uptake of grapevine (*V. vinifera* L. Çilores). Leaf samples were taken during full bloom and verasion periods and analyzed for concentrations (%) of macro elements N, P, K, Ca, Mg and micro elements (ppm) Fe, Zn, Cu, Mn per leaf. Results suggested that the applications led to significant increases in uptake of both macro (N, P, K, Ca and Mg) and micro elements (Fe, Zn, Cu and Mn) by grapevine leaves. The research showed that these environment-friendly organic material applications help increasing nutrient level of grapevine.

Key Words: Organic manure, Grapevine, Nutrient values, Organic viticulture.

INTRODUCTION

To increase quality and yield of grapevine special emphasis should be given to its nutrition as well as irrigation, soil treatment, training system and pruning. In organic grape growing systems, suitable soil fertilization is possible by organic manures due to its environment-friendly feature. Adding the plant parts resulted from pruning can be a tool for plant nutrition to enrich soil in terms of plant nutrient elements. However, totally 6-8 kg of N, 1.5-2.0 kg of P_2O_5 and 7.0-9.0 kg of K_2O macro and some amount of micro elements removed from soil for each ton of yield including pruning residues. Applying natural minerals, organic manures, green manure crops and biological methods are suggested to uptake these elements[1-3].

Several reviews on the effect of different organic manure applications on grapevine cultivars are available, covering, the effect of green manure applications on grapevine cultivar *Vitisi vinifera* L. Tempranilla[4], the effects of different organic manures on the characteristics and maturation of round seedless grape cultivar[5]. The effects of green manure applications

in Italy on the chemical texture of the soil in vineyards and quality of grapes[6], the effect of applying organic substance in the vineyard soil where Terrebiano Toscana grape cultivar[7], the effects of various ground cover crops on the growth of grapevine, characteristics of cluster, berry and must and microbial activities in the soil in the Merlot grape cultivar[8], the effects of various ground cover crops on N dynamics of vineyard soils[9]. As it can be seen clearly in the other researches summarized above, the effects of applications carried out in the context of organic manure application on the ecology in which they are carried out in accordance with the cultivar used in the experiment.

The object of present study was to compare the effects of different organic manure applications on nutrient uptake of grapevine *Vitis vinifera* L. Çilores.

EXPERIMENTAL

The experiments were carried out in a 10 years old private vineyard in the years of 2000 and 2001. The grapevines used in the experiment were planted own rooted *Vitis vinifera* L. cultivar Çilores which is one of the most important grape cultivars of the Southeastern Anatolia region in Turkey.

12 Different organic manure applications were performed in this research. These applications comprised from ; A) Control: Clean soil treatment; treatment of the soil with hoe and wild herb. B) Farmyard manure: In this application, 3000 kg/da burned farmyard manure was mixed within 0-20 cm deep soil during the spring plowing. C) Straw mulch: For this application, 500 kg/da straw[3] was mixed in 0-20 cm deep soil during the spring plow. D) Pruning residue: Ground pruning residue of grapevine. Following the winter pruning in February, sticks obtained as pruning residue were grinded and mixed in 0-20 cm deep soil during plow. E) Green manure plant (barley + vetch): In this application, vetch and barley mixture of 75 % vetch and 25 % barley (3:1 proportion) was cultivated as 9:3 (vetch:barley) kg/da taking the seed amount of vetch into consideration. Cultivation was made in 2-3 cm depth in October and November. The crops were grinded and mixed in the soil when vetch bloomed *ca.* 50 % (in March-April) taking the opinions of same researchers into consideration. Following the applications regarding the combinations including farmyard manure (B), straw mulch (C), pruning residue (D) and green manure plant (barley + vetch). The experiment field was plowed crosswise in 15-20 cm depth and the substances were buried in the soil.

In order to determine the general characteristics of the experiment vinerayd soil, soil samples were taken from 0-20, 20-40 and 40-60 cm depths. pH, total lime (%), solvable total salt (%), organic substance (%), macro element (variable potassium (mg/kg), calcium (mg/kg), magnesium

(mg/kg), absorbable phosphor (mg/kg) and micro element [iron (ppm), manganese (ppm), copper (ppm), zinc (ppm)] determinations were made in the samples. In the samples, absorbable phosphor spectrophotometer, variable potassium, calcium, magnesium and iron, zinc, manganese, copper determinations were made in atomic absorption spectrophotometer.

The leaf samples for determining macro (N, P, K, Ca and Mg) and micro element (Fe, Zn, Cu and Mn) concentrations of grapevines were taken from the opposite sides of clusters in full bloom and verasion periods and their palms were used in analysis[1,3,10,11]. In accordance with nitrogen Kjeldahl, phosphor spectrophotometer, potassium, calcium and magnesium and micro elements (Fe, Zn, Cu and Mn) were analyzed by atomic absorption spectrophotometer.

The experiment was established in randomized block design with three replications. Two vines were placed in each parcel and inter row was arranged to be 2 m and intra row was arranged to be 3 m. Least significant difference (LSD) test was used in determination of different groups.

RESULTS AND DISCUSSION

The findings obtained as a result of analysis of samples taken from different depths in order to display some physical and chemical characteristics of the experiment field soil are given in Table-1. When the table was examined, as a result of the analysis, the organic substance amount in the experiment field soil was determined to be little with 1.44 %; its pH to be light alkali with 7.63; the salt to be unsalted with 0.11 % and calcareous to be high with 20.04 %. Texture of the experiment soil was determined to be argillaceous[12].

TABLE-1
PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE EXPERIMENTAL SOIL

Characters	Soil depth (cm)			Average
	0-20	20-40	40-60	
Organic substance (%)	1.61	1.40	1.31	1.44
pH	7.62	7.64	7.64	7.63
Salt (%)	0.12	0.13	0.09	0.11
Calcareous (%)	19.55	20.00	20.57	20.04
P (mg/kg)	20.17	180.84	6.75	12.59
K (mg/kg)	73.10	59.42	54.85	62.46
Ca (mg/kg)	9206.74	9189.22	9399.43	9265.13
Mg (mg/kg)	360.24	349.02	360.85	356.70
Fe (ppm)	2.09	1.96	2.16	2.07
Zn (ppm)	0.12	0.08	0.07	0.09
Cu (ppm)	0.87	0.81	0.81	0.83
Mn (ppm)	4.57	4.06	4.23	4.29

In the experiment vineyard soil, macro element P was determined to be sufficient (12.59 mg kg^{-1}), K to be insufficient (62.46 mg kg^{-1}), Ca to be excessive (9265.13 mg kg^{-1}) and Mg to be sufficient (356.70 mg kg^{-1}). When micro element concentrations were examined, Fe was determined to be moderate (2.07 mg kg^{-1}), Zn to be exiguous (0.09 mg kg^{-1}), Cu to be sufficient (0.83 mg kg^{-1}) and Mn to be insufficient (4.29 mg kg^{-1})[13,14].

N, P, K, Ca and Mg values found in the grapevine leaf samples taken in 2000 and 2001 full bloom and verasion periods are presented in Tables 2 and 3.

In the first year of the experiment (2000), the average values found in full bloom and verasion periods are 3.05 % and 2.26 for N; 0.24 % and 0.14 for P; 0.91 % and 0.63 for K; 3.21 % and 4.81 for Ca and 0.42 % and 0.67 for Mg, respectively (Table-2). When the values obtained in the second year are examined, it was determined that there were significant statistical differences between applications N in verasion; P in full bloom; Ca in verasion and Mg in both periods. The effects applications on leaves K content was non significant (Table-3).

TABLE-2
EFFECT OF DIFFERENT ORGANIC MANURE APPLICATIONS ON GRAPEVINE LEAVES N (%), P (%), K (%), Ca (%) AND Mg (%) CONCENTRATIONS (FIRST YEAR)

Applications	N (%)		P (%)		K (%)		Ca (%)		Mg (%)	
	FB	V	FB	V	FB	V	FB	V	FB	V
Control (A)	2.86	2.22	0.19	0.14	0.94	0.59	3.17	4.98	0.49	0.71
Farmyard manure (B)	3.03	2.18	0.24	0.14	0.89	0.65	3.13	4.63	0.43	0.63
Straw mulch (C)	3.06	2.24	0.21	0.15	0.87	0.67	3.11	4.72	0.33	0.69
Pruning residue (D)	3.24	2.38	0.25	0.15	0.95	0.61	3.02	4.42	0.45	0.63
Barley + Vetch (E)	3.25	2.37	0.28	0.15	0.92	0.60	3.09	4.90	0.44	0.65
B + C + E	3.00	2.23	0.30	0.13	0.94	0.58	3.41	5.61	0.57	0.72
B + D + E	2.94	2.18	0.22	0.13	0.90	0.62	3.41	4.98	0.38	0.65
B + E	2.98	2.23	0.26	0.17	0.86	0.69	3.23	4.98	0.42	0.67
B + C + D + E	3.23	2.25	0.23	0.14	0.98	0.65	3.06	4.95	0.34	0.70
C + D + E	3.11	2.30	0.24	0.15	0.87	0.64	3.25	4.57	0.48	0.71
C + E	3.12	2.32	0.21	0.12	1.00	0.62	3.12	4.57	0.36	0.60
D + E	2.80	2.18	0.21	0.14	0.85	0.59	3.50	4.39	0.39	0.71
Average	3.05	2.26	0.24	0.14	0.91	0.63	3.21	4.81	0.42	0.67

FB = Full bloom, V = Verasion

Fe (ppm), Zn (ppm), Cu (ppm) and Mn (ppm) values found in grapevine leaf samples taken in 2000 and 2001 full bloom and verasion periods are presented in Tables 4 and 5. Average Fe, Zn, Cu and Mn values found in palms of the leaves in the first year of the experiment are 118.4 and

TABLE-3
EFFECT OF DIFFERENT ORGANIC MANURE APPLICATIONS ON GRAPEVINE LEAVES N (%), P (%), K (%), Ca (%) AND Mg (%) CONCENTRATIONS (SECOND YEAR)

Applications	N (%)		P (%)		K (%)		Ca (%)		Mg (%)	
	FB	V	FB	V	FB	V	FB	V	FB	V
Control (A)	3.00	2.12a	0.16ab	0.16	0.54	0.30	2.84	4.12a	0.28c	0.43cd
Farmyard manure (B)	3.16	1.95ab	0.20 a	0.15	0.55	0.32	2.67	3.79ab	0.30bc	0.40cd
Straw mulch (C)	3.12	1.74b	0.20a	0.16	0.62	0.39	2.69	4.01ab	0.32abc	0.49ab
Pruning residue (D)	3.16	1.92ab	0.19ab	0.15	0.64	0.35	3.01	3.82ab	0.36ab	0.50a
Barley + Vetch (E)	3.20	2.03ab	0.20a	0.16	0.63	0.32	2.88	3.78ab	0.31bc	0.51a
B + C + E	3.13	1.97ab	0.19ab	0.15	0.57	0.27	2.68	3.77ab	0.34abc	0.39d
B + D + E	2.91	2.05ab	0.17ab	0.16	0.61	0.32	2.69	3.93ab	0.39a	0.44bcd
B + E	3.09	2.11ab	0.18ab	0.16	0.56	0.35	2.95	3.84ab	0.29bc	0.40cd
B + C + D + E	3.05	1.82ab	0.18ab	0.16	0.51	0.30	2.97	3.96ab	0.33abc	0.42cd
C + D + E	3.02	2.01ab	0.16ab	0.15	0.63	0.29	2.93	3.54ab	0.29bc	0.48abc
C + E	3.21	2.14a	0.18ab	0.15	0.64	0.36	2.91	3.06b	0.33abc	0.50a
D + E	3.08	1.89ab	0.15b	0.15	0.61	0.32	2.96	4.13a	0.39a	0.50a
Average	3.09	1.98	0.18	0.16	0.59	0.32	2.85	3.81	0.33	0.46
LSD 5 %	N.S.	0.38	0.04	N.S.	N.S.	N.S.	N.S.	0.95	0.07	0.05

FB = Full bloom, V = Verasion

125.8 ppm for Fe; 19.5 and 14.6 ppm for Zn; 11.2 and 6.1 ppm for Cu and Mn 314.9 and 372.1 ppm for Mn in full bloom and verasion periods, respectively (Table-4).

TABLE-4
EFFECT OF DIFFERENT ORGANIC MANURE APPLICATIONS ON GRAPEVINE LEAVES Fe (ppm), Zn (ppm), Cu (ppm) AND Mn (ppm) CONCENTRATIONS (FIRST YEAR)

Applications	Fe (ppm)		Zn (ppm)		Cu (ppm)		Mn (ppm)	
	FB	V	FB	V	FB	V	FB	V
Control (A)	110.3	99.7	18.2	14.5	10.2	6.9	320.0	342.0
Farmyard manure (B)	109.1	107.7	20.0	14.3	11.0	5.3	307.9	392.5
Straw mulch (C)	111.9	111.7	18.8	15.0	11.3	6.2	345.9	358.4
Pruning residue (D)	108.6	128.6	19.7	16.1	11.1	7.2	308.2	375.6
Barley + Vetch (E)	109.3	175.3	18.4	14.2	12.6	6.5	366.5	372.8
B + C + E	139.4	171.3	21.4	13.9	11.0	5.5	285.2	349.6
B + D + E	103.6	110.9	18.8	14.3	12.0	5.2	321.2	369.9
B + E	106.4	104.0	19.3	15.3	11.1	6.5	308.8	399.6
B + C + D + E	107.4	120.0	21.1	16.2	12.1	6.5	328.9	392.6
C + D + E	137.2	104.9	22.2	14.2	12.2	6.1	257.0	368.3
C + E	142.9	127.0	19.0	13.5	10.4	5.7	337.4	391.3
D + E	133.8	143.5	17.6	13.7	9.7	6.0	291.8	353.0
Average	118.4	125.8	19.5	14.6	11.2	6.1	314.9	372.1

FB = Full bloom, V = Verasion

When the values obtained in the second year are examined, it was determined that there is a significant difference between applications in terms of only the Fe values found in leaf samples taken in verasion period. As a result of analysis of leaf samples taken in 2001 in full bloom and verasion periods. The values obtained are 161.02 and 126.11 ppm in Fe, 29.90 and 23.02 ppm in Zn; 9.90 and 5.57 ppm in Cu and 296.63 and 411.87 ppm in Mn (Table-5).

TABLE-5
EFFECT OF DIFFERENT ORGANIC MANURE APPLICATIONS ON GRAPEVINE LEAVES Fe (ppm), Zn (ppm), Cu (ppm) AND Mn (ppm) CONCENTRATIONS (SECOND YEAR)

Applications	Fe (ppm)		Zn (ppm)		Cu (ppm)		Mn (ppm)	
	FB	V	FB	V	FB	V	FB	V
Control (A)	161.10	127.17abc	26.17	25.17	9.73	3.63	235.33	430.03
Farmyard manure (B)	162.97	136.70abc	32.53	21.97	9.53	6.03	336.40	400.33
Straw mulch (C)	143.23	158.57a	30.77	24.43	9.23	6.43	320.60	423.60
Pruning residue (D)	152.97	139.30abc	31.77	25.13	10.83	3.70	378.97	456.23
Barley + Vetch (E)	142.30	127.30abc	28.83	23.47	11.60	3.53	338.60	422.57
B + C + E	185.33	82.40c	31.80	22.97	10.10	5.57	277.47	440.13
B + D + E	149.23	124.57abc	28.17	20.20	8.17	6.00	270.93	410.03
B + E	163.83	144.17ab	29.93	21.70	9.07	6.73	252.43	414.50
B + C + D + E	176.07	94.13bc	30.30	21.73	10.37	5.30	308.63	356.90
C + D + E	158.20	123.37abc	29.50	20.43	11.50	5.60	332.03	420.33
C + E	150.73	106.73abc	29.23	27.53	10.10	6.70	285.97	408.10
D + E	186.33	148.87ab	29.80	21.47	8.57	7.60	222.20	359.63
Average	161.02	126.11	29.90	23.02	9.90	5.57	296.63	411.87
LSD 5 %	N.S.	50.93	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

FB = Full bloom, V = Verasion

It was determined that as a result of the experiment that grapevine leaves Ca, Mg, Fe and Cu concentrations found were within the normal limits and N, P, K and Zn concentrations were within shortage limits and Mn concentrations were with in excess limits (Tables 2-5).

As a result of this research, when the findings regarding nutrition absorption of grapevine (*Vitis vinifera* cv. Çilores) after some organic manure applications are evaluated, it is seen that positive results are obtained through these organic manure applications in the first two years. When the results are examined, it was determined that these applications lead to significant increases in the amounts of N and P macro elements and Fe, Zn, Cu and Mn micro elements in grapevine leaves. Significant increases in nutrient uptake of grapevines can be expected in the following years of the research, which was carried out for 2 years.

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