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Effect of different organo-mineral fertilizers on growth, yield and quality of Perlette grape

I. Effect on growth

by

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Einfluß verschiedener organisch-mineralischer Dünger auf Wachstum, Ertrag und Qualität bei der Rebensorte Perlette

I. Beeinflussung des Wachstums

Zusammenfassung. — Von einer Reihe organisch-mineralischer Düngergemische, die in einem dreijährigen Versuch (1971 bis 1974) geprüft wurden, wirkten sich die Dünger folgender Zusammensetzung am günstigsten auf das Wachstum der Reben aus: T_{15} (0,5 kg Knochenmehl + 0,5 kg Zedrach-Preßkuchen[1]) + 0,5 kg Blutmehl + 0,990 kg Kalkammonsalpeter + 0,456 kg Superphosphat + 0,831 kg Chlorkalium), T_{13} (0,5 kg Knochenmehl + 0,5 kg Blutmehl + 1,220 kg Kalkammonsalpeter + 0,487 kg Superphosphat + 0,825 kg Chlorkalium) und T_{12} (0,5 kg Knochenmehl + 0,5 kg Zedrach-Preßkuchen + 1,014 kg Kalkammonsalpeter + 0,500 kg Superphosphat + 0.822 kg Chlorkalium).

Die vorliegenden Ergebnisse zeigen deutlich, daß durch Düngung mit T_{15} in allen Versuchsjahren der größte Stammumfang erzielt wurde und T_{13} sowie T_{12} fast ebenso wirksam waren. Ähnliche Verhältnisse wurden hinsichtlich des Schenkeldurchmessers beobachtet: T_{15} erbrachte einen maximalen Zuwachs; anschließend folgten T_{12} und T_{13}, wobei das Gesamtwachstum des Schenkeldurchmessers in den Jahren 1971 bis 1974 durch T_{12} stärker gefördert wurde als durch T_{13}. In den beiden Versuchsjahren 1972—73 und 1973—74 wurden unter dem Einfluß von T_{15} die meisten Blätter je Rebe gebildet; es folgten wiederum T_{13} (1972—73) und T_{12} (1973—74). Die größte Blattfläche wurde 1972 nach Düngung mit T_{13} sowie mit T_{15} gebildet. Die höchste Trockensubstanzmenge wurde im ersten Versuchsjahr mit T_{15}, ferner mit T_{13} vor T_{12} erzeugt; im zweiten Jahr war die Reihenfolge der beiden letzteren Dünger vertauscht. Die Wirkung der übrigen Düngermischungen war sehr schwankend.

Introduction

Grape cultivation has received an unprecedented impetus all over India in recent years. Excellent vineyards now exist in Andhra Pradesh, Madras and Mysore but, of late, the Northern States have also been vying with each other for advancing grape culture in their suitable areas. In this region hundreds of new vineyards have sprung up within the past few years. In Western Uttar Pradesh also the expansion in grape cultivation is taking place at a fast rate.

Despite the fact that grapes now constitute an important fruit crop in several states of India, attention has not been given to solving various aspects of viticulture. One of the most important factors which can ensure lucrative income from grape growing continuously over a number of years is the judicious nutrition of the vine,

[1]) Preßrückstände der Samen des indischen Zedrach (*Melia azadirachta*).

but nutritional requirement even for some important varieties has not been worked out comprehensively. Studies so far conducted have sufficiently revealed the effectiveness of NPK fertilizer on the crop. There is, however, paucity of information about the effect of different sources of NPK nutrients. Such information has become important in view of changing fertilizer technology and reduced availability of traditional sources of NPK. Studies were, therefore, conducted to gain informations on the efficiency of different sources of N, P and K on growth characters of Perlette grape at Meerut, located in Western Uttar Pradesh.

Materials and methods

The present investigation on the effect of different organo-mineral fertilizers on growth of Perlette grape was carried out at the experimental orchard of the Institute of Advanced Studies.

One and a half year old vines of Perlette having uniform vigour were selected for the investigations. The plants were spaced 2.47 × 2.47 m. The experiment was laid out in randomized block design, each plot consisting of a single plant. There were 16 treatment combinations, each treatment being replicated 10 times. The treatment combinations were assigned randomly in each replication. In each year, organo-mineral fertilizers were applied in January. The doses were 0.250 kg N, 0.125 kg P_2O_5 and 0.500 kg K_2O per plant and year of age. The experiment was continued for three years i.e., 1971—72, 72—73 and 73—74. The same amount of NPK was applied to each plant in different forms i.e., farm yard manure (FYM), bone meal, neem cake[1]) and blood meal were used as organic sources and calcium ammonium nitrate (CAN), superphosphate and muriate of potash as inorganic sources. Since it was not possible to adjust the desired amount of NPK in each treatment with the help of organic sources alone, inorganic fertilizers were added to achieve this objective taking into account the NPK content of organic sources. The chemical composition of various sources and details of treatment combinations are given below.

A. Sources of nutrients and their chemical composition (NPK contents only)

Sources	Per cent		
	N	P_2O_5	K_2O
I. Inorganic sources			
1. Calcium ammonium nitrate (CAN)	26.00	—	—
2. Superphosphate	—	16.00	—
3. Muriate of potash	—	—	60.00
II. Organic sources			
1. Farm yard manure (FYM)	0.93	1.00	1.31
2. Bone meal	3.00	8.00	Trace
3. Neem cake	5.40	1.10	1.50
4. Blood meal	11.00	1.50	1.00

[1]) Residues of neem seeds after pressing for oil (*Melia azadirachta*).

B. Details of treatment combinations

Treatment No.	Constituents of the treatment	Amount in kg
T_1	CAN + superphosphate + muriate of potash	(1.220 + 0.782 + 0.833)
T_2	FYM + CAN + superphosphate + muriate of potash	(8 + 0.869 + 0.282 + 0.659)
T_3	Bone meal + CAN + muriate of potash	(1.50 + 1.000 + 0.834)
T_4	Neem cake + superphosphate + CAN + muriate of potash	(4.50 + 0.468 + 0.342 + 0.707)
T_5	Blood meal + superphosphate + muriate of potash	(2.27 + 0.569 + 0.796)
T_6	FYM + bone meal + CAN + muriate of potash	(8 + 0.50 + 0.785 + 0.660)
T_7	FYM + neem cake + CAN + superphosphate + muriate of potash	(8 + 0.50 + 0.726 + 0.250 + 0.646)
T_8	FYM + blood meal + CAN + superphosphate + muriate of potash	(8 + 0.50 + 0.590 + 2.237 + 0.651)
T_9	FYM + bone meal + neem cake + CAN + muriate of potash	(8 + 0.50 + 0.50 + 0.653 + 0.650)
T_{10}	FYM + bone meal + blood meal + CAN + muriate of potash	(8 + 0.50 + 0.50 + 0.517 + 0.652)
T_{11}	FYM + neem cake + blood meal + CAN + superphosphate + muriate of potash	(8 + 0.50 + 0.50 + 0.702 + 0.206 + 0.640)
T_{12}	Bone meal + neem cake + CAN + superphosphate + muriate of potash	(0.50 + 0.50 + 1.014 + 0.500 + 0.822)
T_{13}	Bone meal + blood meal + CAN + superphosphate + muriate of potash	(0.50 + 0.50 + 1.220 + 0.487 + 0.825)
T_{14}	Neem cake + blood meal + CAN + superphosphate + muriate of potash	(0.50 + 0.50 + 1.200 + 0.706 + 0.814)
T_{15}	Bone meal + neem cake + blood meal + CAN + superphosphate + muriate of potash	(0.50 + 0.50 + 0.50 + 0.990 + 0.456 + 0.813)
T_{16}	FYM + bone meal + neem cake + blood meal + CAN + muriate of potash	(8 + 0.50 + 0.50 + 0.50 + 0.629 + 0.640)

Growth records of stem girth and arm diameter were maintained from the years 1971 to 1974. The vines were trained on two wire Kniffin and the spur system of pruning at 5 buds was adopted. Stem girth and arm diameter were measured at a distance of 15 cm from the ground level and 8 cm from the basal end where a fixed mark was made with white paint. The first observation of girth and diameter was recorded in the last week of December. The subsequent observations were recorded yearly at the same time. Total number of leaves were counted on each plant in the month of April 1972—73 and 1973—74. In addition, the leaf area of the plants was also recorded by taking 10 leaves randomly from each plant and the area of these leaves was measured with the help of a planimeter. The area of ten leaves was

Table 1

Effect of different organo-mineral fertilizers on stem girth of Perlette grape
Einfluß verschiedener organisch-mineralischer Dünger auf den Stammumfang der Rebensorte Perlette

Per cent increase in girth 1972 over 1971			Per cent increase in girth 1973 over 1972			Per cent increase in girth 1974 over 1973			Overall p.c. increase in girth over 1971 (initial year)		
T_{15}	172.91	a	T_{15}	72.94	a	T_{15}	32.41	a	T_{15}	429.38	a
T_{13}	172.88		T_{13}	60.76	b	T_{13}	26.80	ab	T_{13}	414.36	b
T_{12}	167.36	b	T_{12}	59.67	a c	T_{12}	26.72		T_{12}	389.76	c
T_{14}	165.63		T_{14}	52.56		T_{16}	26.49		T_{6}	376.64	a d
T_{6}	164.19		T_{6}	52.36		T_{9}	26.17		T_{14}	365.93	b
T_{3}	161.65		T_{16}	52.15		T_{3}	26.06		T_{3}	358.16	
T_{16}	156.73		T_{3}	52.12		T_{6}	25.90		T_{16}	358.04	
T_{9}	155.86		T_{9}	50.85		T_{5}	25.24		T_{9}	356.76	
T_{5}	155.07		T_{4}	49.85		T_{1}	25.17		T_{5}	352.38	
T_{4}	155.06		T_{5}	49.73		T_{10}	24.88		T_{11}	350.30	
T_{11}	154.34		T_{11}	49.47		T_{11}	24.65	c	T_{1}	348.00	
T_{1}	153.63		T_{1}	47.75		T_{14}	24.55		T_{4}	345.87	
T_{10}	153.31		T_{8}	46.25		T_{8}	23.93		T_{10}	342.78	c
T_{8}	151.43		T_{10}	46.25	b	T_{2}	23.69		T_{8}	334.31	
T_{2}	150.10	a	T_{2}	43.07		T_{7}	22.77	b	T_{2}	332.29	
T_{7}	130.02	b	T_{7}	41.66	c	T_{4}	19.88	c	T_{7}	331.03	d
SE/M	12.82		SE/M	5.53		SE/M	1.76		SE/M	19.03	
C.D. 5%	35.82		C.D. 5%	15.46		C.D. 5%	4.92		C.D. 5%	53.32	

totalled and then divided by 10 to get the average area of one leaf. For recording the moisture content, thirty leaves taken randomly from each plant were cleaned and oven-dried at 65 °C to constant weight.

Results

1. Effect on stem girth

It is evident from the data presented in Table 1 that T_{15}, T_{13} and T_{12} occupied the first three positions in the order of magnitude during 1971—72, 1972—73 and 1973—74 which indicated their consistency of performance. The same trend in their behaviour had also been observed in total per cent increase of stem girth over the initial year (1971). T_{15}, T_{13} and T_{12} did not differ significantly among themselves in the years 1971—72 and 1972—73, but differed significantly in the year 1973—74. Since T_{15} gave maximum per cent increase in stem girth in all the years, it would be considered as the best treatment for producing best increase in stem girth. The effect of the rest of the treatments has been more or less the same with slight changes in their positions.

2. Effect on arm diameter

The data on arm diameter presented in Table 2 indicate that maximum increase in arm diameter was observed with T_{15} closely followed by T_{12} and T_{13}. These treat-

Table 2

Effect of different organo-mineral fertilizers on arm diameter of Perlette grape
Einfluß verschiedener organisch-mineralischer Dünger auf den Schenkeldurchmesser der Rebensorte Perlette

Per cent increase in diameter 1973 over 1972			Per cent increase in diameter 1974 over 1973			Overall per cent increase in diameter over 1972 (initial year)		
T_{15}	52.54	a	T_{15}	32.66	a	T_{15}	101.61	a
T_{12}	52.36		T_{13}	32.28	b	T_{12}	87.75	b
T_{13}	48.86	b	T_{12}	29.61	c	T_{13}	85.78	
T_{14}	46.64	c	T_{16}	28.85		T_6	84.18	c
T_6	46.50		T_9	28.55		T_3	83.93	a
T_3	45.46	d	T_3	28.32	d	T_{16}	80.58	d
T_{16}	44.39		T_6	28.13		T_{14}	80.06	
T_9	43.89	a e	T_1	27.46	e	T_9	78.00	
T_4	41.84		T_7	27.41		T_{11}	77.44	
T_5	41.17		T_{10}	27.05		T_1	74.21	
T_{11}	40.66	b	T_{11}	26.85		T_{10}	73.74	
T_1	39.77		T_{14}	26.54	a	T_8	72.47	
T_{10}	38.40		T_8	25.90	b	T_5	71.97	b
T_8	38.08	c	T_2	24.87	c	T_4	67.12	
T_2	37.02	d	T_5	21.80	d	T_7	66.18	c
T_7	35.16	e	T_4	20.80	e	T_2	62.98	d
S/EM	3.13		SE/M	2.40		SE/M	6.47	
C.D. 5%	8.75		C.D. 5%	6.71		C.D. 5%	18.08	

ments fell in the same group. The differences were not significant among themselves, but T_{15} differed significantly from T_1 (which is completely inorganic in source) in total per cent increase in arm diameter. The effects of T_{16}, T_{14}, T_9 and T_{11} are intermediary with slight changes in their positions.

3. Effect on leaf numbers

It is clear from the data in Table 3 that the maximum number of leaves per plant was observed under T_{15} in both years and it was significantly superior to T_1 (completely inorganic) in the year 1973—74. T_{13} and T_{12} also produced more or less consistent results in both years. It is interesting to note that T_1 which was completely inorganic in source did not perform well as regards the number of leaves per plant. It occupied the sixth position in the first year and the sixteenth position in the second year in the order of merit.

4. Effect on leaf area

The data on the average leaf area for the years 1972—73 and 1973—74 (Table 3) indicate that T_{13} and T_{15} produced larger leaves in both years, although their positions were not consistent. T_{13} having the fifth position during 1972—73 occupied the first position during 1973—74, whereas T_{15} occupying the third position during 1972—73 had the second position during 1973—74. T_{16} which was at the bottom in the first year, improved the performance of plants in the second year by occupying the fourth position in average leaf area production.

Table 3

Effect of different organo-mineral fertilizers on leaf number and leaf area of Perlette grape

Einfluß verschiedener organisch-mineralischer Dünger auf Anzahl und Fläche der Blätter bei der Rebensorte Perlette

Average leaf number per plant 1972—73			Average leaf number per plant 1973—74			Average area per leaf (cm²) 1972—73			Average area per leaf (cm²) 1973—74		
T_{15}	1312.30	a	T_{15}	2121.00	a	T_{11}	54.46	a	T_{13}	66.50	a
T_{13}	1286.90		T_{12}	2025.00	b	T_6	53.23	b	T_{15}	66.11	
T_3	1237.50		T_6	1939.80		T_{15}	52.86		T_5	62.00	b
T_{16}	1237.00		T_{13}	1903.20		T_{12}	51.33		T_{16}	61.26	
T_{12}	1198.10		T_{14}	1863.30		T_{13}	50.14		T_1	60.84.	
T_1	1196.00		T_{16}	1860.10		T_2	49.49		T_{12}	60.72	
T_5	1165.50		T_9	1853.50		T_9	48.64		T_9	60.65	
T_6	1095.00		T_{11}	1827.50		T_{10}	48.64		T_3	59.47	
T_7	1071.00	b	T_3	1822.80		T_4	48.57		T_4	58.28	
T_9	1067.00		T_8	1818.40		T_7	48.10		T_8	57.56	
T_{14}	1027.00		T_2	1802.50		T_8	47.78		T_6	56.61	
T_{11}	1017.70		T_{10}	1734.60		T_{14}	47.74		T_{10}	56.39	
T_8	960.50		T_7	1713.50		T_1	47.63		T_7	56.38	a
T_4	956.80		T_5	1705.20	a	T_5	47.56		T_{14}	53.22	
T_2	929.90	a	T_4	1610.80		T_3	46.51	a	T_{11}	52.59	
T_{10}	683.90	b	T_1	1604.80	b	T_{16}	45.88	b	T_2	51.51	b
SE/M	140.64		SE/M	157.27		SE/M	3.08		SE/M	4.11	
C.D. 5%	406.13		C.D. 5%	436.25		C.D. 5%	8.54		C.D. 5%	11.41	

5. Effect on moisture content of leaf blades

The data on moisture content of leaf blades during the years 1972—73 and 1973—74 (Table 4) revealed that T_{15}, T_{13} and T_{12} resulted in minimum moisture content in the leaf blades in both years. T_1, having complete inorganic constituents, was observed to have significantly higher moisture content as compared to T_{15} and T_{13} in both years. T_9, T_{11}, T_6 and T_3 showed almost consistent results in the years 1972—73 and 1973—74. No striking feature was observed with other treatments which were quite inconsistent in their performance.

Discussion

The findings of the present investigation indicate that T_{15} caused maximum increase in stem girth closely followed by T_{13} and T_{12}.

The annual increase as well as the overall increase in the arm diameter were also influenced in the same manner as observed in case of stem girth. These results are in conformity with the findings of AKOPJAN and NAZARJAN (1965) and SERPUHOVITINA (1965) who reported that combined application of organo-mineral fertilizers resulted in more vegetative growth of grapevines as compared to inorganic fertilizers alone. The better efficiency of T_{15}, T_{13} and T_{12} as reflected in the vegetative growth of grapevines can be attributed to the fact that organic manures increase the soil nutrient availability to the plant and when combined with phosphate and potash they make an ideal fertilizer (BROWN 1938).

Table 4

Effect of different organo-mineral fertilizers on moisture content (per cent) of leaf blades of Perlette grape

Einfluß verschiedener organisch-mineralischer Dünger auf den Wassergehalt (%) der Blattspreiten bei der Rebensorte Perlette

1972—73			1973—74		
T_{10}	70.45	a	T_2	71.24	a
T_4	70.39		T_4	70.75	b
T_2	70.24		T_8	70.23	c
T_5	70.04		T_7	70.09	
T_8	69.68	b	T_5	69.55	
T_7	69.62		T_{10}	69.13	
T_9	69.43	c	T_{11}	69.04	
T_{14}	69.27		T_1	68.91	a
T_{11}	69.25		T_{14}	68.51	
T_6	69.16		T_9	68.40	
T_{16}	69.16		T_6	68.21	
T_1	69.10		T_3	68.20	b
T_3	69.09		T_{16}	68.14	
T_{12}	69.08	a	T_{13}	68.05	
T_{13}	68.21	b	T_{12}	67.78	
T_{15}	67.87		T_{15}	67.70	c
SE/M	0.78		SE/M	1.31	
C.D. 5%	1.52		C.D. 5%	2.57	

The number of leaves in T_{15} and T_1 were 2121.00 and 1604.80 per plant and their mean area 66.11 cm² and 60.84 cm² respectively (1973—1974). The difference in the number of leaves between T_{15} (organo-mineral fertilizers) and T_1 (completely inorganic) was 516.20 only, but the increase in leaf area in T_{15} over T_1 was found to be 5.27 cm² per leaf. Thus, while the differences in the number of leaves at bloom stage between the various treatments were not so marked, the effective leaf area was found to increase in treatments having organo-mineral fertilizer mixture because of larger leaf size.

The increase in various growth characters resulting from T_{15} and T_{13} can be explained by increased availability of nutrient elements in the soil in presence of organic matter (Brown 1938) and by the presence of other micronutrients in blood meal and bone meal, especially of iron. It is an established fact that iron is credited with a definite role in the formulation of chlorophyll in plants. This subsequently promotes a higher photosynthetic efficiency and mobilization of nutrients for better growth. A similar interpretation has been given by Abadia (1956) who found a close correlation between catalase activity and chlorophyll synthesis. When chlorotic quince pear trees were injected with ferrous sulphate, an increase in catalase activity was observed which preceded the increase in chlorophyll content. Hanin (1964) also reported a positive relationship between catalase activity and chlorophyll content of vines.

Summary

Of various organo-mineral fertilizers tried in the experiment, T_{15} (bone meal 0.5 kg + neem cake 0.5 kg + blood meal 0.5 kg + calcium ammonium nitrate 0.990 kg + superphosphate 0.456 kg + muriate of potash 0.813 kg), T_{13} (bone meal 0.5 kg + blood meal 0.5 kg + calcium ammonium nitrate 1.22 kg + superphosphate 0.487 kg + muriate of potash 0.825 kg) and T_{12} (bone meal 0.5 kg + neem cake 0.5 kg + calcium ammonium nitrate 1.014 kg + superphosphate 0.500 kg + muriate of potash 0.822 kg) were found to be quite effective in increasing the growth of the plants.

The results reported in the present investigation have clearly brought out that T_{15} produced maximum stem girth closely followed by T_{13} and T_{12}. A similar pattern was observed for arm diameter, T_{15} giving maximum increase followed by T_{12} and T_{13}. In case of overall increase in arm diameter from the years 1971 to 1974, T_{12} took lead over T_{13}. T_{15} produced the maximum number of leaves per plant in both years followed by T_{13} in the year 1972—73 and T_{12} in the year 1973—74. T_{13} gave maximum leaf area followed by T_{15} in the year 1972—73. Results indicated that T_{15} produced maximum dry matter content of leaves followed by T_{13} and T_{12} in the first year, while in the second year T_{13} and T_{12} exchanged their positions. The other treatments showed inconsistency in their behaviour.

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