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Studies on physico-chemical properties of different vineyards in Bijapur Taluk, Karnataka

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Nutritional survey carried out in different grape growing regions of the country have revealed that the grape growers are applying as high as 600 to 800 kg each of N, P_2O_5 and K_2O per ha every year accounting for 30 to 40% of an annual occurring costs. Nutrients influence yield and quality of grapes through vine growth. A systematic investigation was conducted on soil fertility status of the low and high yielding vineyards in Bijapur taluk. Sixty vineyards were surveyed. Out of 60, 30 vineyards were selected based on previous year yield data for the purpose of collecting soil and petiole samples. The vineyards which produced less than 10 tonnes per acre and those which produced more than 10 tonnes per acre were categorized as low yielding and high yielding vineyards, respectively. All the soils belong to clay in texture. The pH of soils was alkaline in reaction (8.19 to 8.50). The soils were non saline. The organic carbon content of the soils ranged from medium to high. The CEC of the soil ranged from 49.45 to 55.05 and 50.03 to 57.75 coml. (p+) kg^{-1}. The available nitrogen content of the soils ranged from 161.90 to 212.21 and 193.50 to 233.47 kg ha^{-1}. The available phosphorus content in the soils ranged from 18.64 to 31.42 and 22.45 to 34.50 kg ha^{-1}. The available potassium content of the soil ranged from 432.64 to 472.81 and 430.64 to 543.39 kg ha^{-1} in the low and high yielding vineyards, respectively.

Key words: Vineyards, nutrition, texture, alkaline.

INTRODUCTION

The popular grape varieties of South India are Anab-e-Shahi, Thompson Seedless, Gulabi and Bangalore Blue. These grape varieties are becoming increasingly popular in peninsular parts of India. In Karnataka, grape is commercially cultivated in northern parts of the state. Thompson Seedless, Tar-A-Ganesh, Sonaka and Arkavathi are important seedless cultivars of grape under cultivation in the state. Thompson seedless is gaining more popularity both as table purpose and raisin making because of its high total soluble solids, thin skin and desired shape. Commercial viticulture in India is hardly a few decades old and major grape growing states are Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Punjab and Haryana. Among all the grape growing states, Maharashtra occupies the largest area (16,000 ha) followed by Karnataka (8,500 ha). As far as productivity is concerned, Karnataka stands first followed by Maharashtra (Negi, 1999).

The fertility status of soil is of prime importance for the optimum use of land to increased crop production.

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Table 1. Physical and chemical properties of soils of low yielding vineyards.

Farmer's name (code)	Particle size distribution (%)			Texture	pH (1:2.5)	EC (dS m^{-1})	Organic carbon (g kg^{-1})	CEC [cmol (p+) kg^{-1}]	Available		
	Sand	Silt	Clay						Nitrogen	Phosphorus	Potassium
									(kg ha^{-1})		
S. S. Patil (LYF$_1$)	10.17	22.61	65.41	Clay	8.35	0.26	6.8	53.67	196.82	28.47	465.72
B. S. Patil (LYF$_2$)	10.55	22.03	66.28	Clay	8.42	0.28	5.7	51.10	189.20	25.26	452.86
P. S. Kori (LYF$_3$)	11.16	20.63	66.72	Clay	8.46	0.29	6.3	51.11	182.43	22.92	446.20
S. H. Lagali (LYF$_4$)	10.46	20.38	66.30	Clay	8.33	0.30	7.0	54.15	203.18	29.84	472.81
Mallappa Umbrani (LYF$_5$)	11.06	21.01	66.16	Clay	8.29	0.36	7.2	55.05	212.21	31.42	473.13
Sivanand Patil (LYF$_6$)	11.12	21.03	65.18	Clay	8.23	0.24	6.7	51.43	161.90	20.93	432.64
J. K. Matapathi (LYF$_7$)	11.12	21.13	66.07	Clay	8.40	0.29	6.5	52.69	196.72	27.82	463.46
Ashokgouda Biradar (LYF$_8$)	10.68	21.36	65.89	Clay	8.19	0.31	5.7	50.31	164.20	19.46	439.42
Horticulture Research Station (LYF$_9$)	11.18	19.64	67.14	Clay	8.38	0.22	6.4	52.13	210.36	27.10	468.42
Suryakanth R. Biradar (LYF$_{10}$)	10.37	21.48	66.46	Clay	8.32	0.25	6.2	49.45	172.81	18.64	470.12
Kalavathi C. Biradar (LYF$_{11}$)	10.53	21.67	65.89	Clay	8.47	0.39	5.8	50.46	181.76	24.72	448.50
S. R. Biradar (LYF$_{12}$)	10.47	22.16	66.76	Clay	8.43	0.38	7.1	51.85	202.10	28.72	460.72
Somaninga (LYF$_{13}$)	11.29	21.17	66.18	Clay	8.38	0.31	6.9	50.56	194.62	26.80	452.62
Mallikarjuna Shilavantha (LYF$_{14}$)	10.49	20.12	66.70	Clay	8.44	0.37	6.6	54.01	203.46	29.20	463.17
Shivappa Godekar (LYF$_{15}$)	11.08	21.04	66.43	Clay	8.29	0.30	6.4	50.67	192.87	23.82	450.62
Mean	10.78	21.16	66.24		8.36	0.30	6.5	51.91	190.98	25.67	457.36

Information about the present status of soil fertility is of vital importance. Grape cultivation has assumed great significance in semi-arid region of Karnataka. Now, there is an increasing area under grape cultivation in Bijapur district. It has been experiencing decline in grape production also. Studies in the country have shown that the problem is mainly related to nutrient imbalance.

MATERIALS AND METHODS

Bijapur taluk is situated in the Northern Dry Zone (Region II and Zone-3) of Karnataka at 15°49' N latitude, 75°43' E longitude and altitude of 573 m above the mean sea level. The composite soil samples from the low and high yielding vineyards of Bijapur taluk were collected from a depth of 0 to 30 cm during summer season of 2006 before application of nutrients. The soils of the investigation site were shallow black, having alkaline pH and belongs to the Vertisol. Composite soil samples from a depth of 0 to 30 cm were collected in the low and high yielding vineyards before application of nutrients. Soil samples were also collected after October pruning for analysis.

Particle size analysis of the soil sample was carried out by International Pipette method using sodium hexametaphoshate as the dispersing agent as described by Piper (1966). Soil pH was determined in 1:2.5 soil:water suspension using pH meter with glass electrode as described by Jackson (1967). Electrical conductivity was determined in the supernatant solution of 1:2.5 soil:water suspension using digital conductivity bridge (Jackson, 1967). The organic carbon content was determined by Walkley and Black wet oxidation method (Jackson, 1967). The cation exchange capacity (CEC) of soil was determined by leaching the soil with neutral normal sodium acetate after removing the excess salts using 95 percent ethanol. The adsorbed sodium was replaced by neutral normal NH_4OAc and the concentration of sodium in the leachate was determined by flame photometer (Black, 1965).

Available N of soil was determined by alkaline potassium permanganate distillation method as described by Subbiah and Asija (1956). Available P content of the soil was determined by Olsen's method as outlined by Jackson (1967). Available potassium was extracted with neutral normal ammonium acetate at 1:5 soil to extract ratio. The content of potassium in the extract was estimated by Flamephotometer (Jackson, 1967).

RESULTS AND DISCUSSION

The results on particle size analysis and chemical properties of soils in low and high yielding vineyards were the sand, silt and clay content in soils of low yielding vineyards ranged from 10.17

Table 2. Physical and chemical properties of soils of high yielding vineyards.

Farmer's name (code)	Particle size distribution (%)			Texture	pH (1:2.5)	EC (dS m^{-1})	Organic carbon (g kg^{-1})	CEC [cmol (p+) kg^{-1}]	Available		
									Nitrogen	Phosphorus	Potassium
	Sand	Silt	Clay						(kg ha^{-1})		
S. S. Gigini (HYF_1)	10.55	22.12	66.26	Clay	8.47	0.14	7.1	52.25	215.94	32.20	522.81
Mallappa Umbrani (HYF_2)	9.57	22.61	66.73	Clay	8.38	0.27	6.6	53.04	208.67	29.56	510.42
Rajashekhar S. Patil (HYF_3)	10.13	21.92	66.06	Clay	8.45	0.26	6.7	52.89	205.82	25.43	508.86
Ganesh N. Nellandagi (HYF_4)	10.55	20.83	66.81	Clay	8.46	0.26	7.4	52.96	228.31	33.86	543.39
Shettappa S. Kichadi (HYF_5)	11.04	21.54	65.91	Clay	8.27	0.27	6.8	57.75	202.43	27.84	483.21
S. S. Kichadi (HYF_6)	10.51	21.16	66.24	Clay	8.41	0.16	7.0	50.96	204.14	28.12	487.03
Shivanand Holasanga (HYF_7)	10.67	21.39	66.34	Clay	8.43	0.17	7.3	54.08	218.76	32.31	536.81
Bhumray M. Ittanghal (HYF_8)	11.01	20.64	65.86	Clay	8.32	0.17	6.7	55.90	193.50	22.45	430.64
S. J. Biradar (HYF_9)	11.06	21.07	66.23	Clay	8.29	0.14	7.2	50.55	210.12	31.81	515.86
Sivanand N. Biradar (HYF_{10})	10.86	20.95	67.14	Clay	8.47	0.25	7.5	56.01	233.47	34.50	479.12
V. R. Biradar (HYF_{11})	10.43	21.58	66.63	Clay	8.31	0.28	6.9	50.03	197.26	23.61	445.85
Mahadev Gondali (HYF_{12})	11.16	20.43	66.54	Clay	8.28	0.15	6.9	50.57	204.63	27.92	486.74
Revanasidda Belvundigi (HYF_{13})	11.08	22.09	65.12	Clay	8.29	0.21	6.8	50.94	201.87	26.74	497.63
Vijay Patil (HYF_{14})	11.32	21.21	65.51	Clay	8.28	0.22	7.1	51.60	208.25	29.23	506.90
Prakash Murigappa (HYF_{15})	9.83	21.65	66.72	Clay	8.39	0.18	6.7	53.44	212.47	31.18	518.42
Mean	10.65	21.41	66.27		8.37	0.21	7.0	52.86	209.71	29.12	498.25

to 11.29, 19.64 to 22.61 and 65.41 to 67.14%, respectively with mean values of 10.78, 21.16 and66.24%, respectively (Table 1). In high yielding vineyards sand, silt and clay distribution ranged from 9.57 to 11.32, 20.43 to 22.61 and 65.12 to 67.14%, respectively with mean values of 10.65, 21.41 and 66.27%, respectively (Table 2). The low and high yielding vineyard soils were clay in texture. The perusal of data on mechanical analysis indicated that all the soil bodies studied were clay in texture. The clay content was more than 60% in all the soils. Govindarajan et al. (1979) also observed clay texture of black soils in Madurai Agricultural College Farm.

The pH of soil ranged from 8.19 to 8.47 with a mean of 8.36 at in initial soil samples of the low yielding vineyards (Table 1). The soil pH ranged from 8.20 to 8.41 with a mean of 8.32 at October pruning (Table 3). Soils were in alkaline in reaction. Under high yielding vineyards, the soil pH ranged from 8.27 to 8.47 with a mean of 8.37 in initial soil sample (Table 2), whereas, at October pruning, the soil pH ranged from 8.25 to 8.41 with a mean of 8.33 (Table 3). Soils were in alkaline in reaction. A perusal of the data on soil pH of the study area revealed that pH values varied from 8.2 to 8.5. The soils are classified as slightly to moderately alkaline. Bhargava and Raghupathi (2001) observed soil pH in the range of 6.06 to 8.57. The organic carbon content in the soils of low yielding vineyards ranged from 5.70 to 7.20 g kg^{-1} with a mean value of 6.50 g kg^{-1} in an initial soil samples (Table 1) and it was varied from 5.80 to 7.20 g kg^{-1} with a mean of 6.60 g kg^{-1} at the time of October pruning (Table 3). The organic carbon content in the soils of high yielding vineyards ranged from 6.60 to 7.50 g kg^{-1} with a mean value of 7.00 g kg^{-1} initially (Table 2). Whereas, after October pruning, the soil organic carbon content ranged from 6.70 to 7.50 g kg^{-1} with a mean of 7.00 g kg^{-1} (Table 3). Soils of the study area contained medium to high quantities of organic carbon. Higher organic carbon content is due to intensive agriculture. Decay of plant residue have added more organic carbon in irrigated soils and also cropping pattern followed.

The CEC of the low yielding vineyard soils ranged from 49.45 to 55.05 cmol (p+) kg^{-1} with an average of 51.91 cmol (p+) kg^{-1} in initial soil samples (Table 1). Whereas, the CEC in the soils of high yielding vineyards ranged from 50.03

Table 3. Chemical properties and available nutrient status of soils of low and high yielding vineyards after October pruning.

Low yielding vineyards							High yielding vineyards						
Farmer's code	pH (1:2.5)	EC (dS m^{-1})	Organic carbon (g kg^{-1})	Available (kg ha^{-1})			Farmer's code	pH (1:2.5)	EC (dS m^{-1})	Organic carbon (g kg^{-1})	Available (kg ha^{-1})		
				Nitrogen	Phosphorus	Potassium					Nitrogen	Phosphorus	Potassium
LYF_1	8.32	0.27	6.9	199.32	30.03	45.28	HYF_1	8.41	0.21	7.2	219.36	33.06	533.63
LYF_2	8.36	0.29	5.9	193.21	26.83	41.83	HYF_2	8.34	0.27	6.8	213.61	30.89	521.87
LYF_3	8.41	0.29	6.3	185.31	24.31	41.16	HYF_3	8.40	0.26	6.8	209.43	27.16	518.93
LYF_4	8.30	0.26	7.2	210.08	32.83	47.01	HYF_4	8.41	0.25	7.4	231.71	34.73	558.86
LYF_5	8.27	0.28	7.2	218.34	33.12	47.80	HYF_5	8.25	0.26	6.8	206.86	28.67	492.21
LYF_6	8.22	0.24	6.8	167.14	22.33	40.23	HYF_6	8.38	0.19	6.9	208.63	29.73	495.41
LYF_7	8.38	0.29	6.6	199.84	29.33	44.63	HYF_7	8.40	0.20	7.3	225.17	34.27	551.80
LYF_8	8.20	0.30	5.8	167.42	20.96	36.81	HYF_8	8.29	0.19	6.7	197.36	24.23	438.73
LYF_9	8.34	0.26	6.7	215.67	29.81	43.52	HYF_9	8.28	0.18	7.1	213.87	32.65	523.63
LYF_{10}	8.29	0.29	6.3	175.12	19.13	35.21	HYF_{10}	8.39	0.26	7.5	236.45	35.89	592.47
LYF_{11}	8.41	0.36	6.0	184.73	25.50	35.64	HYF_{11}	8.29	0.26	6.8	201.24	25.83	453.86
LYF_{12}	8.39	0.32	7.1	207.81	30.22	43.48	HYF_{12}	8.26	0.19	6.8	207.64	29.76	494.42
LYF_{13}	8.32	0.29	7.0	198.80	28.30	41.43	HYF_{13}	8.27	0.20	6.7	204.86	28.23	503.61
LYF_{14}	8.37	0.31	6.8	206.84	30.70	44.76	HYF_{14}	8.26	0.21	7.0	212.26	30.73	515.83
LYF_{15}	8.25	0.27	6.7	196.87	25.32	40.89	HYF_{15}	8.34	0.21	6.9	217.48	32.58	531.47
Mean	8.32	0.29	6.6	195.10	27.25	41.98	Mean	8.33	0.22	7.0	213.73	30.56	515.12

to57.75 cmol (p+) kg^{-1} with an average of 52.86 cmol (p+) kg^{-1} in an initial soil samples (Table 2). In the soils of low and high yielding vineyards, higher CEC was observed. It might be due to higher clay content. Similar observations were made by Conradie and Saayman (1989).

The available nitrogen in soils of low yielding vineyards varied from 161.90 to 212.21 kg ha^{-1} with an average of 190.98 kg ha^{-1} in initial soil samples (Table 1). Whereas at the time of October pruning, the available N in the soil varied from 167.42 to 218.34 kg ha^{-1} with an average of 195.10 kg ha^{-1} (Table 3). In the soils of high yielding vineyards, the available N ranged from 193.50 to 233.47 kg ha^{-1} with an average of 209.71 kg ha^{-1} in initial soil samples (Table 2). Whereas, at the time of October pruning, the available N in the soil ranged from 197.36 to 236.45 kg ha^{-1} with an average value of 213.73 kg ha^{-1} (Table 3). Most of the soils of vineyards area of Bijapur taluk were low in available nitrogen content (Tables 1 to 3). This might be due to higher rate of mineralization due to high temperature (dry zone) and loss of nitrogen in the form of ammonia as the soils are calcareous. Similar observations were reported by Nitant and Dargan (1974).

The available phosphorus in the soils of low yielding vineyards ranged from 18.64 to 31.42 kg ha^{-1} with a mean value of 25.67 kg ha^{-1} in initial soil samples (Table1) and at the time of October pruning, the available P ranged from 19.13 to 33.12 kg ha^{-1} with a mean of 27.25 kg ha^{-1} (Table 3). The available P in the high yielding vineyards ranged from 22.45 to 33.86 kg ha^{-1} with a mean 29.12 kg ha^{-1} at an initial soil samples (Table 2), whereas at the time of October pruning, the available P was ranged from 24.23 to 35.89 kg ha^{-1} with a mean of 30.56 kg ha^{-1} (Table 3). The available phosphorus content in both the soils of the low and high yielding vineyards was in the range of low to medium (Tables 1 to 3). This might be due to the presence of excess $CaCO_3$ and other soluble compounds of calcium. This present findings are in line with the results obtained by Ahlawat and Sindhu (1990) and Motsara (2002).

The available potassium in soils of low yielding vineyards, ranged from 432.64 to 473.13 kg ha^{-1}

with a mean value of 457.36 kg ha^{-1} at an initial soil samples (Table 1) and 441.56 to 484.19 kg ha^{-1} with a mean value of 466.05 kg ha^{-1} at the time of October pruning (Table 3). The available K in the initial soils (Table 2) of high yielding vineyards ranged from 430.64 to 543.39 kg ha^{-1} with an average of 498.25 kg ha^{-1} and at the time of October pruning, the available potassium in soils varied from 438.73 to 592.47 with an average of 515.12 kg ha^{-1} (Table 3).

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