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Nutrient status of grape orchards of Jammu and Kashmir, India

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Abstract
Fifteen grape orchards of district Ganderbal, Jammu and Kashmir with uniform age and vigour were selected and surveyed (simple random survey) for the purpose of collection of petiole samples. Petiole nitrogen, phosphorus, potassium, calcium, magnesium and sulphur content varied statistically from 1.71 to 1.87, 0.17 to 0.20, 1.60 to 1.67, 1.04 to 1.30, 0.19 to 0.29 and 0.14 to 0.18 per cent with an average value of 1.79, 0.18, 1.64, 1.17, 0.24 and 0.16 per cent, respectively. Iron, manganese, zinc, copper, boron and molybdenum content of vineyards varied statistically from 131.88 to 139.19, 35.70 to 40.90, 29.68 to 37.00, 11.40 to 12.73, 22.95 to 26.07 and 0.33 to 0.42 ppm with mean values of 135.53, 38.30, 33.34, 12.06, 24.51 and 0.37 ppm, respectively. Petiole analysis revealed that 20, 33, 67, 33, 53 and13 per cent, vineyards were low in phosphorus, calcium, magnesium, zinc, boron and molybdenum, contents, respectively whereas, no deficiency of nitrogen, potassium, sulphur, iron, manganese and copper was observed in grape orchards of Jammu and Kashmir.

Keywords: Grape orchards, nutrients, petiole, Kashmir

1. Introduction
Grape (*Vitisvinifera* L) belongs to family vitaceae, originated in Western Asia and Europe and brought to India by Persian invaders in 1300 A.D. Grapes have a permanent place in human diet being the rich sources of minerals like calcium, phosphorus, iron and vitamins like B1 and B2. The by- products from grapes are rasins, sweet juice, beverages, wine, dry fruits, manuka, kismis etc. which are the only processed products in India. The peel of grapes is the source of essential oil and pectin. It can also serve as a raw material for the production of cattle feed and in preparation of candies. Raisins are rich source of sugar most of which is fructose and antioxidants. Grapes occupy a predominant position in terms of world fruit production, accounting for about 16% of the global fruit production. In India grapes are cultivated on an area of 0.12 lakh hectares with an annual production of 24.83 lakh tonnes with a productivity of 21.1 t ha^{-1} (N.R.C, 22) and the main grape producing states are Maharashtra, Karnataka, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Haryana and Punjab. In Jammu and Kashmir it is cultivated on an area of 329 ha producing 803 M tonnes and the cultivation is mainly confined to district Ganderbal having an area of 128 ha with an annual production of 231 M tonnes Anonymous, [2]. In J&K the main varieties grown are Anab-e-shahi, Sahibi, Himrod, Hussaini and Thomson seedless.

An adequate supply of nutrients is required by grapevines for growth and fruiting and the nutrient deficiencies affect the grape quantity and quality. According to Awasthi *et al.* [3] deficiency or excess of an essential nutrient element may cause disturbance in the plant metabolism and its vital functioning may fail, leading to poor growth and yield. Leaf analysis helps to provide an indication of nutrient status of a crop and thus can help in formulation of fertilizer recommendations. Mineral nutrient evaluation of fruit trees is different from annual crops as tree crops are perennial, large and deep rooted and thus require more exact nutritional need evaluation. It has been observed that nutritional needs of plants can be assessed through visual symptoms, soil tests or plant analysis, but identification and quantification of nutrient deficiencies through visual analysis is not easy and therefore soil or plant analysis has to be used for the same. In fruit crops soil analysis has been reported to be of lesser value because of tree root penetration to a greater depth and encountered greater variation Shah and Shahzad, [27]. The total quantity of nutrients in the soil may be adequate but nutrient translocation and uptake doesn't match with the growth and development of a crop as the unavailability and deficiency is a combination of large number of factors Shah *et al.* [28]. Plant analysis has been reported as a more direct method and has been, and is being considered as a more reliable diagnostic tool for assessing the nutrient status of fruit crops Ibrahim *et al.* [16].

The increasing importance of leave analysis of vineyards have prompted different researchers to determine nutrient element reference values for different parts of leaves in different physiological periods (Larsen *et al*. 20 and Cahoon, 8). In order to harvest a good yield, leaf samples should be taken during blooming time, and contents on leaf petiole should consist of 2.5 to 5.0 per cent N, 0.3 to 0.6 per cent P, 1.5 to 2.5 per cent K and 0.5 to 0.8 per cent Mg approximately. Petioles show a greater range in values for nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), and zinc (Zn) and therefore fertilizer response and deficient and excess values of these elements are more easily defined with petioles. Therefore, assessment of nutritional status and nutritional requirements of vineyards assumes a great significance for successful viticulture, so the present investigation was undertaken in the district Ganderbal of Jammu and Kashmir which is the main grape growing area of the state and the study undertaken is first of its kind.

2. Material and Methods

A systematic investigation was carried out to study the nutrient status of vineyards of district Ganderbal, Jammu and Kashmir. District Ganderbal is bordered by district Srinagar in South, Bandipora to the North, Kargil in North-East, Anantnag to the South-East and Baramulla in South-West. Petiole samples were collected from fifteen [15] orchards of uniform age and vigour as per the procedure of Chapman [10].Petioles were separated from leaf blades and were decontaminated using 2 per cent teepol solution and 0.1 N HCl and washed by double distilled water in a series. Samples were air dried on filter papers and then oven dried at 60+5 ºC for 24 hours Chapman, [10]. The samples were then crushed in stainless steel blender to pass through 2 mm mesh and stored in polythene bags for subsequent chemical analysis.

Total nitrogen was determined by micro-kjeldahl method by involving digestion, distillation and titration of plant samples as described by Jackson [17].

To estimate nutrient elements other than nitrogen viz; phospjorus, potassium, calciuym, magnesium, sulphur, iron, manganese, zinc and copper, petiole samples were digested separately in diacid mixture of nitric acid and perchloric acid. The digested material was diluted in double distilled water and filtered in 100 ml volumetric flask. In order to ensure complete transfer of digested material, about six washings were given with double distilled water and final volume was made to 100 ml.

Phosphorus content was estimated from digested samples by the vanado molybdate colour reaction method with the help of the spectrophotometer Jackson, [17]. Potassium content was determined by flame photometer Jackson, [17].Calcium and magnesium content were determined by versenate titration method (Jackson, [17]. Plant sulphur was determined by turbidometric method Chesnin and Yien, [11].The micronutrient cations like Zn, Cu, Fe and Mn were estimated on atomic absorption spectrophotometer. The boron was estimated by azomethine-H method (Berger and Truog, 4).The molybdenum (Mo) was estimated by method outlined by Johnson and Arkley [18]. The 95% confidence interval (C.I) was worked out using the procedure of Neyman [23].

Table-1: Tentative working standards for grapes (petioles)

Nutrient element	Macronutrient (per cent)			
	Deficient	Low	Sufficient	High
N	0.6	0.6-0.8	0.9-1.3	>1.4
P	0.12	0.13-0.15	0.16-0.30	>0.30
K	0.5-1.0	1.1-1.4	1.5-2.5	>2.5
Ca	0.5-0.8	0.81-1.0	1.0-1.8	>1.8
Mg	0.14	0.15-0.25	0.26-0.45	>0.45
S	<0.12	0.12-0.26	0.27-0.56	>0.57

Table-2: Tentative working standards for grapes (petioles)

Nutrient element	Micronutrient (ppm)			
	Deficient	Low	Sufficient	High
Fe	10-20	21-30	30-50	>50
Mn	10-24	25-30	30-150	>150
Zn	0-15	16-29	30-50	>50
Cu	0-2	3-4	5-15	>15
B	14-19	20-25	26-50	>50
Mo	-	0.29	0.3-1.5	>1.5

(Midwest Small Fruit Pest Management Handbook. Ohio State Bul. 861.)

3. Results and Discussion

Petiole samples of grape (variety - Sahibi) were analyzed for macro and micronutrient composition. The results of chemical analysis of grape petioles are tabulated in Table 3 and 4 and compared with the standard values in Table 1 and 2 and reproduced in Table 5.

3.1 Macronutrients

Petiole nitrogen content of different vineyards varied statistically from 1.71 to 1.87 per cent with an average value of 1.79 per cent (Table 3). The maximum petiole nitrogen content (2.00 per cent) was observed in Waliwar, whereas, minimum (1.45 per cent) was reported from Benihama grape orchards. The variation of petiole nitrogen content among different vineyards could be due variation in available soil nitrogen and orchard management practices. Similar range of petiole nitrogen was reported by Brent *et al*. [7]. The nitrogen content in all the vineyards was in high range (Table 5), which might be attributed to annual application of larger quantity of manures and fertilizers. These results are supported by the findings of Shaaban and El-Fouly [26]. Phosphorus content of petioles varied statistically from 0.17 to 0.20 per cent with a mean value of 0.18 per cent. Highest (0.25 per cent) and lowest (0.14 per cent) petiole phosphorus content was recorded at Waliwar and Takibbal, respectively. The variation of petiole phosphorus among different orchards might be due to variation in available phosphorus, soil pH, climatic conditions, elevation and slope and other associated factors. Petiole phosphorus content of similar magnitude has also been observed by Bhargava and Raghupathi, [5] and

Muftuoglu *et al.* [21]. The phosphorus content of grape orchards was in low to sufficient range, as 20 per cent orchards were low and 80 per cent vineyards were sufficient. The results could be due to low to medium available phosphorus content of these soils. Similar results were recorded by Yogeeshappa *et al.* [31].Petiole potassium statistically varied from 1.60 to 1.67 per cent with an average value of 1.64 per cent. Highest content (1.75 per cent) was observed at Khranihama, whileeas, lowest content (1.55 per cent) was recorded at Reporapayeen. The variation of petiole potassium among different vineyards could be due to variation in soil potassium and other associated factors. The petiole potassium content in similar magnitude was also reported by Ahlawat and Yamadagni [1]. Table 5 revealed that all the vineyards under study were sufficient in petiole potassium, which probably could be due to high available potassium in soils and application of manures and fertilizers which resulted in higher uptake and in turn high potassium content in petioles. The results are in accordance with those of Bhargava and Raghupathi [6] and Demirer *et al.* [13].

Perusal of data in Table 3 indicated that petiole calcium content varied statistically from 1.04 to 1.30 per cent with a mean value of 1.17 per cent. The maximum petiole calcium content (1.50 per cent) was found at Takibal and minimum (0.80 per cent) was reported from Chanthan. The different grape orchards varied with respect to petiole calcium content which might be attributed to difference in available calcium content, nutrient ion interactions and other associated factors. Petiole calcium content in similar range was supported by the previous findings of Yogeeshappa *et al.* [31]. The vineyards were low to sufficient in petiole calcium content, as 7 per cent samples were deficient, 26 per cent were low and 67 per cent were sufficient in petiole calcium, which possibly could due to nutrient ion interactions. The results are in accordance with the findings of Muftuoglu *et al.* [21] and Bhargava and Raghupathi [6]. The magnesium content ranged statistically from 0.19 to 0.29 percent with a mean value of 0.24 per cent. Highest (0.45 per cent) and lowest (0.13 per cent) mean petiole magnesium content was recorded from Takibal and Chanthan, respectively. The variation in petiole magnesium content could be ascribed to variation in soil available magnesium content and overall pedoclimatic conditions (Canali *et al.* [9]. The magnitude of these results is in agreement with those of Bhargava and Raghupathi [5]. Further it was observed that 67 per cent orchards were low and 33 per cent were sufficient in leaf magnesium content. The low to adequate range of leaf magnesium could be due to nutrient ion interactions, root ramification, orchard management practices and methods used for analysis. Similar results were reported by Muftuoglu *et al.* [21], Demirer *et al.* [13] andBhargava and Raghupati [6].The sulphur content varied statistically from 0.14 to 0.18 per cent with an average value of 0.16 per cent. Highest content (0.22 per cent) was recorded from Waliwar and lowest (0.16 per cent) from Takibal. The magnitude of these values is in line with those of Gathala *et al.* [15] and Qayum and Misgar [24]. All the vineyards were sufficiently supplied with leaf sulphur, which probably could be ascribed to adequate available sulphur and application of high quantity of manures, fertilizers and sulphur containing fungicides. The results are in line with the findings of Bhargava and Raghupathi [5] and Dar *et al.* [12].

Table 3: Petiole macronutrient status of grape orchards of district Ganderbal

Sampled location	per cent					
	N	P	K	Ca	Mg	S
1	1.45	0.16	1.57	1.26	0.23	0.13
2	1.82	0.17	1.66	1.39	0.29	0.15
3	1.86	0.15	1.64	1.17	0.24	0.13
4	1.74	0.17	1.59	1.19	0.23	0.14
5	1.76	0.23	1.71	1.20	0.20	0.21
6	1.87	0.19	1.63	0.90	0.16	0.18
7	1.92	0.22	1.65	0.80	0.13	0.20
8	1.88	0.18	1.55	0.95	0.20	0.15
9	1.92	0.22	1.61	1.24	0.16	0.19
10	2.00	0.25	1.55	0.85	0.15	0.22
11	1.78	0.19	1.63	0.92	0.17	0.19
12	1.77	0.18	1.69	1.29	0.33	0.16
13	1.55	0.14	1.61	1.50	0.45	0.10
14	1.80	0.15	1.73	1.41	0.31	0.12
15	1.72	0.17	1.75	1.45	0.38	0.16
Mean	1.79	0.18	1.64	1.17	0.24	0.16
95% C.I	1.71-1.87	0.17-0.20	1.60-1.67	1.04-1.30	0.19-0.29	0.14-0.18
C.V (%)	7.82	16.67	3.66	19.65	37.50	25.00

3.2 Micronutrients

Petiole iron content of vineyards varied statistically from 131.88 to 139.19 ppm with an average value of 135.53 ppm (Table 4). The highest mean iron content (146.78 ppm) was recorded at Waliwar, whileas, lowest (121.17 ppm) was observed at Takibal. The leaf iron content in similar range was also reported by Bhargava and Raghupathi, [5] and Qayum and Misgar [24]. It was observed that 100 per cent vineyards were high in petiole iron content (Table 5), which could be due to application of large quantities of manures and fertilizers and presence of high organic matter in these soils which resulted in high uptake and in turn high petiole iron content. The results are in accordance with the observations of Khokhar *et al.* [19] and Shah *et al.* [28]. Manganese content in the vineyard petioles ranged statistically from 35.70 to 40.90 ppm with mean value of 38.30 ppm. The maximum (45.25 ppm) and minimum (30.21 ppm) petiole manganese content was observed at Kralbagh Govt. orchard and Lar, respectively. Similar range was observed by Khokhar *et al.* [19]. All vineyards under study were sufficient in petiole magnese content. The results might be due to high available manganese and soil organic matter and suitable pH for its uptake. The results are in conformity with those of Yogeeshappa *et al.* [31] and Qayum and Misgar [24].Petiole zinc content of different vine orchards statistically varied from 29.68 to 37.00 ppm with an average value of 33.34 ppm. The highest mean petiole zinc content (41.23 ppm) was recorded from Waliwar and lowest (23.00 ppm) from Takibal. The leaf zinc contents similar in magnitude were recorded by Fida *et al.* [14] and Bhargava and Raghupati [6]. Further it was observed that 33 per cent orchards were low and 67 per cent were sufficient in petiole zinc content and the vineyards were low to medium in leaf zinc content. The low to medium content could be due to different nutrient ion interactions and other associated factors. Samiullah *et al.* [25] and Demirer *et al.* [13] reported similar results. Petiole copper content of different grape orchards varied statistically from 11.40 to 12.73 ppm with mean value of 12.06 ppm. The highest and lowest petiole copper content was observed at Waliwar and Lar, respectively. The results are in line with those of Yogeeshappa *et al.* [31]. The vineyards were sufficient in petiole copper as 100 per cent orchards showed medium copper content, which might be ascribed to application of manures, fertilizers and copper containing fungicides. The results are in agreement with the findings of Yogeeshappa *et al.* [31].

Data pertaining to petiole boron content revealed that boron content in ranged statistically from 22.95 to 26.07 ppm with an average value of 24.51 ppm. The highest content (29.50 ppm) was recorded from Yenihama and lowest (20.63 ppm) from Lar. Similar results were reported by Zatylny and St-Pierre, [32]. Petiole boron content of was in low to medium being low in 53 per cent orchards and sufficient in 47 per cent grape orchards, which might be attributed to different nutrient ion interactions and loss of soluble boron due to high rainfall. The results are in agreement with those of Shah *et al.* [28].

Molybdenum content in the petiole of different grape orchards varied from 0.33-0.42 ppm with mean value of 0.37 ppm. The highest mean petiole molybdenum content was observed at Takibal and lowest at Waliwar. Similar magnitude of leaf molybdenum was observed by Singh [29]. Perusal of data in Table 5 revealed that 13 per cent vineyards were low and 87 per cent were sufficient in petiole boron content. Sufficient molybdenum in majority of grape orchards could be due to high organic matter and available molybdenum content. The results are supported by the observations of Williams *et al.* [30].

Table-4: Petiole micronutrient status of grape orchards of district Ganderbal

Sampled location	ppm					
	Fe	Mn	Zn	Cu	B	Mo
1	135.56	33.26	32.19	12.61	22.03	0.38
2	133.94	30.21	27.32	10.52	20.63	0.41
3	132.13	30.50	29.56	11.45	23.44	0.35
4	136.89	36.63	35.82	12.78	21.12	0.39
5	142.00	38.98	41.23	12.23	29.50	0.30
6	139.93	45.25	36.12	12.00	26.89	0.29
7	138.42	40.43	40.43	13.1	21.33	0.30
8	135.33	37.02	32.63	12.7	25.12	0.34
9	140.50	44.50	37.92	13.36	26.46	0.34
10	146.78	43.98	44.63	13.87	26.92	0.27
11	137.91	41.78	37.00	13.22	26.88	0.32
12	138.12	41.12	33.60	10.12	28.12	0.37
13	121.17	38.12	23.00	10.03	23.22	0.54
14	124.41	37.19	24.76	11.87	24.03	0.51
15	129.92	35.56	23.88	11.07	21.95	0.47
Mean	135.53	38.30	33.34	12.06	24.51	0.37
95% C.I	131.88-139.19	35.70-40.90	29.68-37.00	11.40-12.73	22.95-26.07	0.33-0.42
C.V (%)	4.69	12.27	19.80	9.95	11.50	21.62

Table- 5: Nutritional status grape orchards

Nutrient element	Nutritional level (Per cent samples)			
	Deficient	Low	Sufficient	High
N	-	-	-	100
P	-	20	80	-
K	-	-	100	-
Ca	7	26	67	-
Mg	-	67	33	-
S	-	-	100	-
Fe	-	-	-	100
Mn	-	-	100	-
Zn	-	33	67	-
Cu	-	-	100	-
B	-	53	47	-
Mo	-	13	87	-

4. Conclusion

Leaf analysis revealed that 20, 33, 67, 33,53 and13 per cent, vineyards were low in phosphorus, calcium, magnesium, zinc, boron and molybdenum, contents, respectively whereas, no deficiency of nitrogen, potassium, sulphur, iron, manganese and copper was observed in grape orchards of Jammu and Kashmir.

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