Popular Article Chapter- 13

NUTRIENT MANAGEMENT PRACTICES IN QUALITY GRAPES PRODUCTION

Prashant Joshi

ABSTRACT

Nutrition remains an important part of managing a vineyard since it impacts on vine growth, crop yield, berry composition and ultimately, must and wine quality. A "one program fits all" approach is not achievable since nutritional requirements must tailor to a range of variables including grape variety, rootstock, vine age, soil type and properties, water and irrigation supply, production and wine quality expectations, and management history.In order to develop a suitable nutrition program on an individual block basis, growers need to approach nutrition in a holistic manner using the latest technology and suitable fertilizer products, with a focus on improving or maintaining soil health so vines can access the majority of their nutrient requirements. The nutrients in the soil and vines must be monitored on a continual basis and maintained for optimal efficiency. Since this is a constantly changing situation, it is best to set up a regular program of soil and tissue (e.g., petiole or leaf blade) sampling and analysis to avoid mineral deficiencies and unnecessary application of fertilizers. The interpretation from the analysis of the tissue and soil samples should always be used together with visual observations made in the vineyard. Although the mineral elements are needed in different quantities, each one plays an essential role in completing the vine's life cycle. Macronutrients such as nitrogen, phosphorous, potassium, and magnesium are used in relatively large quantities by vines. Micronutrients such as boron, iron, manganese, zinc, and molybdenum, although no less essential, are needed in very small quantities. When one or more of these elements is deficient, vines may exhibit reduced growth or yield and greater susceptibility to diseases and winter injury. This may also result in other problems such as fruit with a low or high pH, poor colour, low phenolic, stuck fermentations, and undesirable flavours. The availability of essential nutrients is, therefore, critical for optimum vine.

Keywords: Nutrition, Soil, Tissue, Petiole, Leaf blade

College of Agriculture, Dr. PDKV, Akola (M.S) 444001
E-mail: psjoshihort@gmail.com

Introduction

Grape is one of the finest fruits and the healthiest food. Grapes are a rich source of vitamins and minerals that can contribute to a balanced healthy life. In addition, it has commendable medicinal qualities and has been used in naturotheropy for centuries. Among the fruits, grape is a delicious, refreshing and nourishing fruit. Grape is one of the most important subtropical fruit crops. The crop has wide adaptability and it has been taken up under a wide range of soil types. In India 94 per cent of the cultivated area falls in the tropical region. Nowadays grapes have gained enormous commercial value because they not only serve as a table fruit but also are great by valued. Grape is a refreshing fruit and it is a good source for minerals like calcium and iron and vitamins A, C and B62.

Historical Background of Grapes

Vitisvinifera L. is the principle source of all the cultivated varieties of grapes throughout the world. This type of vine was grafted from the Vitissilvestries, the wild vine found in the earlier times of the tertiary periods of the Geological era.

The seeds of both *vitissilvestris*and *vitisvinifera* L. have occurred in the pre-historic sites in Europe, in many of the Neolithic and Bronze Age lake-side villages of Switzerland, north of Italy and Yugoslavia.

According to the discoveries made recently by the scientists in Western Kazakhastan, grapes are among the oldest plants on earth. They have discovered clear imprints of vines and their leaves in Creataceous Chalk deposited, which dated back 90 to 95 million years, a time at which dinosaurs flourished. Therefore, it is evident that grape is possibly as old as mankind.

Present Status of Grape Cultivation in the Country

Grape is grown under a variety of soil and climatic conditions in three distinct agro-climatic zones, namely, sub-tropical, hot tropical and mild tropical climatic regions in India.

Sub-Tropical Region

This region covers the northwestern plains corresponding to 28° and 32° N latitude including Delhi; Meerut district of Uttar Pradesh; Hissar and Jind districts of Haryana; and Bhatinda, Ferozpur, Gurdaspur and Ludhiana districts of Punjab. Vines undergo dormancy and bud break starts in the first week of March while the rains arrive in the first week of June, and therefore, only 90-95 days are available from the initiation of growth to harvest. Consequently, 'Perlette' is the only early ripening variety grown in this region.

Hot Tropical Region

This region covers Nashik, Sangli, Solapur, Pune, Satara, Latur and Osmanabad districts of Maharashtra; Hyderabad, Ranga Reddy, Mahbubnagar, Anantapur and Medak districts of Andhra Pradesh; and Bijapur, Bagalkot, Belgaum, Gulberga districts of northern Karnataka lying between 15° and 20° N latitude. This is the major viticulture region

accounting for 70 percent of the area under grapes in the country. Vines do not undergo dormancy and double pruning and a single harvest is the general practice in this region. Maximum and minimum temperature is 42°C and 8°C, respectively. The major problems in this region are soil and water salinity and drought. Berry growth is impaired and in certain locations pink blush sometimes develops on green berries due to temperatures that drop to a low of 8°C. Thompson Seedless and its clones (Tas-A-Ganesh, Sonaka), Anab-e-Shahi, Sharad Seedless and Flame Seedless are the varieties grown in this region.

Mild Tropical Region

An area covered by 10° and 15° N latitude including Bangalore and Kolar districts of Karnataka; Chittoor district of Andhra Pradesh and Coimbatore; and Madurai and Theni districts of Tamil Nadu fall in this region. Maximum temperatures in a year seldom exceed 36°C, while the minimum is about 12°C. Principal varieties are Bangalore Blue (Syn. Isabella), Anab-e-Shahi , Gulabi (Syn. Muscat Hamburg), and Bhokri. Thompson Seedless is grown only with limited success. Except for Thompson Seedless, two crops are harvested in a year.

Varieties cultivated in different region of India

Regions	States	Varieties cultivated
Region - I. (Northern India)	Haryana, Punjab, Delhi, Western Uttar Pradesh, Rajasthan	Thompson Seedless, Perlette, Beauty Seedless, Anab-e-Shahi, Black Hamburg, Black Prince, Dakh, Foster's seedling, Kandhari, Khalili, PandhariSahebi, Watham Cross, Pusa Seedless, Hur, Black Muscat, Early Muscat, Banquiabyad, Cardinal, Kairon
Region – II (Peninsular India)	Telangana & Rayalseema regions of Andhra Pradesh Nasik, Pune, Solapur, Satara , Sangli, Bhir, Aurangabad and Ahmednagar districts of Maharashtra Bijapur,Gulbarga,Raichur, Bellary districts of Karnataka	Anab-e-Shahi, Thompson Seedless, CheemaSahebi, PandariSahebi, Gulabi, Bhokri, Kali Sahebi, Sonaka&Tas-A-Ganesh(clones of Thompson seedless).
Region – III (Peninsular India)	Madurai, Salem and Coimbatore districts of Tamil Nadu Bangalore, Kolar, Mysore &Tumkur districts of Karnataka	Bhokri, Anab-e-Shahi, Gulabi, Bangalore Blue, Black Champa, Convent Large Black, AngurKalan, TaifiRosovi, CoarnaResia, Queen of vineyard, Kandhari, Black Prince, Muscat, Pachadraksha

List of Commercial Varieties Utilized For Specific Purposes Is Given In the Following Table

Category	Varieties
Table grapes	Anab-e-Shahi, Bangalore Blue, Beauty Seedless, Bhokri (Pachadrakshi), CheemaSahebi, Delight, Gulabi (PanneerDrakshi, Muscat Hamburg), Himrod, Kali Sahebi,Kandhari, Khalili, PandariSahebi, Perlette, Selection 94, Pusa Seedless and Thompson Seedless.
Raisin Grapes	Thompson Seedless, Arkavati
Wine Grapes	Bangalore Blue, Thompson Seedless and ArkaKanchan

Commercial Varieties can be Grouped under Four categories based on Colour and Seeds

Coloured seeded	Bangalore Blue, Gulabi (Muscat)
Coloured seedless	Beauty seedless and Shared Seedless
White seeded	Anab-e-Shahi, Dilkhush (clone of Anab-e-Shahi)
White seedless	Perlette, Pusa Seedless, Thompson Seedless and its clones (Tas-A-Ganesh, Sonaka&ManikChaman)

Nutrient Management in Quality Grapes

Nutrients and their Role in Different Stages of Grapevines

1) Winter Rest – Budbreak

a) **Nitrogen** and **Potassium** – promote strong early growth and maximize leaf area.
b) **Phosphorus** – maintain long-term productivity
c) **Calcium** - boost new leaf and bud growth.
d) **Magnesium** – maximize photosynthetic activity and early growth.
e) **Sulfur** and **Manganese** – maximize photosynthetic activity.
f) **Iron** – strengthen leaf development and vine productivity.
g) **Boron** and **Zinc** – ensure good shoot growth and strong fruit set.
h) **Molybdenum** –maximize floral development.

2) Berry Set – Veraison

a) **Nitrogen –** ensure strong set and early grape growth.
b) **Potassium** – maximize growth potential**.**
c) **Calcium** – maintain healthy vine growth and grape production
d) **Magnesium** – maintain growth and berry development
e) **Boron** and **Zinc** – maximize healthy berry development

3) Veraison – End of Harvest

a) **Nitrogen** – foliar forms to maximize crop potential and improve grape color.
b) **Potassium** – ensure good, strong fruit-fill, increase grape sugars, and provide K:N ratio to minimize Botrytis.
c) **Calcium** – ensure strong skins and minimize fruit disorders and diseases.
d) **Magnesium** – minimize bunch stem necrosis.
e) **Boron** – improve berry shape, size and sugars.
f) **Zinc** and **Iron** – increase grape sugars.

4) Post-Harvest

a) **Nitrogen** – build vine reserves before dormancy.
b) **Phosphorus** – build root system after harvest.
c) **Calcium** - boost root development and wood maturity (winter hardiness) after harvest.

Manuring and Fertilizers

At Pre-Bearing Age

- In India grapevines are pruned one year after planting.
- For developing adequate canopy, fast and profuse vegetative growth is encouraged. Thus, by giving 100g urea together with 200g of super phosphate at monthly intervals to each vine develops adequate branches in pre-bearing period.

At Bearing Age

- The efficiency of applied nutrients increases by placing them in the active feeder root zone.
- In grape vines fertilizers are placed around the vine at 10-15 cm depth in a shallow circular ring of 60-75 cm radius.
- Ring method is adopted to provide split doses of fertilizers to vines planted at wider spacing.
- Band method is adopted in case of vines spaced at a closer spacing within a row and widely spaced between the rows.
- A shallow trench is opened 45-60 cm away from the vine on either side of the row and fertilizers are placed along the length and covered with soil.

- In drip irrigated vineyards 10-15cm deep pit is excavated under the dripper. The number of pits depends on the number of drippers placed around the vine. Fertilizer is applied in the pit and covered by soil. Nutrient requirement in case of grapevines differs from variety, soil characteristics and cultural practices.

Relative Nutrient Requirement of Grapes at Different Stages of Growth is Given Below

Days After Back Pruning	**N**	**P**	**K**	**Mg**
0-30	High	Medium	Nil	Nil
32-60	Low	High	Low	Medium
61-90	Nil	Medium	High	Medium
91-120	Nil	Nil	Low	Nil
Days After Forward Pruning				
0-40	High	Low	Low	Low
41-70	Medium	Medium	Medium	Low
71-110	Low	Low	High	Medium
111-140	Nil	Nil	Medium	Nil

- To determine the nutrient needs of the grapevine it has been found that leaf analysis is better as compared to soil analysis.
- It is also useful in finding out the association of nutrients with some disorders.
- Normally petiole nutrient contents are analysed 45 days after back pruning. A critical level of petiole nutrient contents during bloom time has been worked out. The nutrient contents of the petiole below the critical level indicate the need for fertilization. If case of low nutrient level full dose of fertilizer is given, if adequate or normal 75% and if higher then 50% of the recommended dose is applied.

Recommended Doses Nutrients at Different Levels in the Petioles

Petiole content (%)	<0.87	0.87-1.54	1.54-2.66	>2.66
Dose of N (Kg/ha) Red Sandy Black clay	 300 666	 225 500	 150 333	 - -
Petiole content (%)	<0.19	0.19-0.32	0.32-0.95	>0.95
Dose of P (Kg/ha) Red Sandy Black clay	 500 888	 375 666	 250 444	 - -
Petiole content (%)	<0.60	0.60-2.24	-	>2.73
Dose of K (Kg/ha) Red Sandy Black clay	 1000 666	 750 500	 500 333	 - -
Petiole content (%)	<0.33	0.33-0.50	0.50-0.70	>0.70
Dose of MgSO4 (kg/ha) Red Sandy Black clay	180 180	135 135	90 90	- -

(Source: Pre-harvest Manual for Production of Table Grapes For Exports- APEDA, New Delhi).

Essential Plant Nutrients for Growth Derived from Soil and /or Fertilizer

Macronutrients
Primary

N – Nitrogen
P – Phosphorus
K – Potassium

Secondary
S – Sulfur
Mg – Magnesium

Micronutrients
Zn – Zinc
B – Boron
Fe – Iron
Mn - Manganese
Cu – Copper
Cl - Chlorine
Mo – Molybdenum
Ni – Nickel
Ca - Calcium

Obtained from Water and Air
Carbon, Hydrogen and Oxygen

Nutritional Deficiency

1) **Magnesium**

- This deficiency is mostly observed in Bangalore and Kolar in Karnataka.
- Symptoms appear as pronounced pattern of whitish yellow color between the veins with the areas adjacent to the larger veins remaining green. In advanced stages the margins of the leaves become brown.

Control: Soil application of Magnesium Sulphate (250 kg/ha) at the pruning time is recommended.

2) Boron

- This deficiency is mostly observed in Chikaballapur in Kolar and Bangalore in Karnataka.
- Symptoms appear as death of shoot tips and leaves near the shoot tips with chlorotic areas between the veins.
- Necrosis of the old yellow tissues takes place. Uneven, compressed shot and immature berries.

Control: - Soil application of Borax or Boric Acid (10 kg/ha) or foliar spray of borax/boric acid (1g/litre) 4 times before flowering is recommended.

3) Iron

- This deficiency is observed in Nasik and Pune districts in Maharashtra. Symptoms appear as yellowing of younger leaves with small veins remaining green.

Control: Soil application of Fe-EDDHA or foliar application of Ferrous Sulphate (250g/100 litre water) + citric acid (50g) + liquid detergent (125 ml) is recommended.

4) Calcium

- This deficiency is mostly observed on Thompson Seedless variety in Pune district of Maharashtra. Calcium deficiency leads to grape bunch necrosis.

Control: Foliar spray of Calcium Acetate /Calcium Chloride /Calcium Nitrate (2g/litre water) + liquid detergent (50 ml) is recommended.

5) Potassium

- This deficiency symptom is mostly observed in Maharashtra. Symptoms appear as fading of green color from the leaf margins and areas adjacent to the main veins.
- In severe cases wilting and subsequent drying of rachis and attached berries is observed.

Control: - Application of Potash based on the petiole analysis done at full bloom stage is recommended.

6) Nitrogen

- Overall reduction in growth. Leaves become uniformly light-green or yellow. Reddening of petiole

- Berries may be small.

Control

- Soil application of urea @ 20-60 Kg/acre.
- Foliar spray of urea (0.3 – 0.5%) 1- 4 times along the growing season, depending on the deficiency severity.

7) Zinc

- Short internodes, resulting in shoots with a zigzag appearance.
- Shoot tips have small upward curling of leaves. Mottled, light coloured inter veinal colouring on leaves.
- Small, poorly developed bunches with hen and chicken berries.

Control

- Soil application borax (sodium tetraborate) 12-16 Kg/acre.
  Foliar sprays of zinc sulphate (0.5 -1.0%) neutralized with calcium carbonate,3 weeks before flowering.

8) Phosphorus

- Vines may have stunted shoots and fruitfulness is likely to be poor.
- red dots on basal leaves, especially on the mid or terminal lobes and at first distant from secondary veins.
- The red dots, at first randomly distributed, later line up at right angles to the secondary veins and form dark red bars, which coalesce into islands between green veins.

Control

- Apply ammonium mono phosphate as an N source (11-52-0).

Conclusion

Several production issues were highlighted as constraints to grape production in the Region. These were understanding and managing vine nutrition in the tropics, efficient irrigation management, manipulation of bud burst, optimizing crop load, maximizing bud fruitfulness, managing flowering, fruit set and berry growth and effective practices for grape production under protected (temporary and permanent) systems. The need to determine the nutrient requirements of vines under tropical conditions and petiole interpretation standards for the accurate monitoring of vine nutrients status was identified as important for effective and efficient vine nutrition management. This has implications for fruit quality, cost of production and environmental preservation.

Reference

Ayers, R. S. and D. W. Westcot. 1985. Water Quality for Agriculture. FAO irrigation and drainage paper No. 29. Rome: Food and Agriculture Organization of the United Nations.

California Plant Health Association. 2002. Western Fertilizer Handbook. Danville, Illinois: Interstate Publishers, Inc.

Campbell, Alan and Daniel Fey. 2003. Soil Management and Grapevine Nutrition. In: Oregon Viticulture (Edward W. Hellman, ed.) Corvallis, Oregon: Oregon State University Press.

Creasy, G.L. and L.L. Creasy. 2009. Grapes - Crop Production Science in Horticulture. Oxford shire, United Kingdom: CABI.

Dami, Imed, Bruce Bordelon, David C. Ferree, Maurus Brown, Michael A. Ellis, Roger N. Williams, and Douglas Doohan. 2005. Midwest Grape Production Guide. Columbus, Ohio: Ohio State University, Ohio State Extension. Bulletin 919.

Pre-harvest Manual For Production Of Table Grapes For Exports- APEDA, New Delhi).