

Soil-leaf tissue analysis

for nutrient management in fruit crops

Sarvpriya Singh* and Jagdish Singh

Punjab Agricultural University, Krishi Vigyan Kendra, Bathinda, Punjab 151 001

Nutrients are generally supplied taking account of current fruits and vegetative growth. Variability has been observed in nutrient removal and uptake from the soil. The mismanagement of fertilizers like excessive use of fertilizers, not only leads to economic losses, but also leads to serious nutrient imbalances, nutrient leaching and environmental pollution. Nutrient management through the combination of soil and leaf tissue analysis for nutrient diagnosis and recommendation is emerging as better tool. The present article highlights the do's and don'ts during index leaf sample collection, analysis and interpretation of results. Soil test and plant response correlation may help in working out specific nutrients needed based on soil fertility status and crop need. There is a need to have synergies between requirement and supply of fertilizer to get higher yield and profitability.

Keywords: Critical limits, Fruit crops, Leaf analysis, Soil analysis

RAPIDLY growing population has encouraged the exploration of more innovative and cost-effective methods of food production that may achieve higher and sustainable food production. The amount of nutrients removed from soil increase with increase in crop yields and such nutrients must be replenished for sustainable yields. The deficiency of any of nutrient elements can cause serious metabolic disturbances reducing the yield, quality and marketability of the product.

The leaf tissue analysis has emerged as a better tool for diagnosis of nutrient status in foliage that act as sink/source during vegetative and reproductive phases of horticultural crops. The nutritional status of leaves is directly related to the crop performance at particular growth stage. It helps in identifying nutrient deficiency well in advance or before the appearance of deficiency symptom. Soil testing of orchards may complement leaf tissue analysis for nutrient recommendation considering planting density, bud differentiation and specific

root distribution. The data of leaf analysis along with soil analysis helps in deciding the manurial requirements of horticultural crops for achieving economic yields and produce quality fruits.

Symptoms of nutrient deficiency

Nutrient deficiency symptoms may be identified by the knowledge of the plant functions and the relative nutrient mobility within the plant system. The mobile nutrients in the plants such as nitrogen, phosphorus, potassium, magnesium and chlorine, remobilize within the plants and move from older leaves to younger leaves and thus, their deficiency appears on older leaves. Some nutrients are slightly mobile and produce symptoms on mature or fully opened leaves. The micro-nutrients such as iron, copper, manganese, boron and calcium are not easily remobilized within the plant and their deficiency occurs on young leaves or stem tips. General nutrient deficiency includes chlorosis, necrosis, accumulation of anthocyanins resulting in purple

or reddish discolouration of stems and leaves, lack of new growth and stunted or reduced growth. Chlorosis refers to yellowing of plant tissue due to limitations of chlorophyll synthesis which may be generalized over the entire plant, localized over entire leaves or isolated between some leaf veins (i.e. interveinal chlorosis) while necrosis refers to the death of plant tissue, sometimes in spots. Chlorosis or chlorotic leaves can become green again after the missing nutrient is added while necrosis is irreversible. The deficiency symptoms may serve as a guide for diagnosing limiting nutrients, however, plant have already suffered from deficiency and resulted in yield reductions.

Recognizing visual deficiency symptoms: The horticultural crops face many nutritional problems, which require to be identified in the field for immediate correction based on the visual symptoms. Therefore, nutritional deficiency may be identified as the field to forecast problems as well as to develop remedies. If the deficiency

Table 1. Leaf tissue sampling technique and optimal leaf nutrient content in various fruit crops

Crop	Stage of leaf	Particular	Leaf Sample size	Optimal leaf nutrient concentration										
				Concentration (%)						Concentration (ppm)				
				N	P	K	Ca	Mg	S	B	Fe	Mn	Zn	Cu
Mango	5–7 month-old	Non-flushing and non-fruited twigs	30	1.23	0.06	0.54	1.71	0.91	0.12		171.0	66.0	25.0	12.0
Citrus	July–October	4–8 months old leaf of the shoot, immediately behind the fruit	100	2.50	0.14	0.90	4.20	0.43	0.25		90.0	112.5	62.5	10.5
Guava	August–October	Middle shoot leaves from non-fruited twigs	50	1.70	0.50	1.30	2.1	0.46	-	10.0		-	70.5	75.0
Litchi	3 months old autumn flush	2 nd and 3 rd pair of leaflets from the tip	50	1.5	0.14	0.70	0.6	0.3	-	-	50.0	100.0	15.0	10.0
Ber	November–January	5–7 months old leaf from the middle of shoot	70	2.60	0.25	1.82	1.21	0.45	-	-	-	-	-	-
Pear	July–September	Mid shoot leaves from current season's growth	50	1.8	0.12	1.0	0.8	0.25	0.01	20.0	61.0	21.0	21.0	5.0
Peach	Mid-May to Mid-July	Mid shoot leaves from current season's growth	100	2.7	0.10	1.2	1.0	0.25	0.2	20.0	57.0	20.0	20.0	4.0

symptoms appear on the older leaves, deficient nutrient may be N or P or K or Mg. N or P deficiency, if leaf chlorosis is uniform over leaf, while Mg is deficient if there is interveinal (inverted 'V' shape) chlorosis/necrosis. K may be deficient if chlorosis/necrosis appear on leaf margins. Sulphur shows deficiency symptom similar to N but appears on younger leaves. The deficiency symptoms of Ca, B and Cu appears on the terminal or growing tips on younger leaves, while interveinal chlorosis and short internodes appear under the deficiency of Zn, Fe and Mn.

Leaf or tissue analysis

Leaf analysis is chemical analysis of index tissue of plant to know the nutrient concentration in the index tissues. The index tissue is a plant tissue that gives the reliable values of nutrient content in plant tissue (such as leaf, leaf petiole, leaf lamina or its parts, flowers, etc.) correlated with the optimum yield. Leaf is considered as best index tissue in many fruit crops as the supply rate of nutrients is clearly reflected in the recently matured leaf. The leaves distinctly express nutrient deficiency and toxicity. Leaf analysis is based on 4 basic assumptions i.e. (1) leaf is the principal site of metabolic activities and; (2) leaf nutrient concentration changes in response to nutrient supply. (3) These responses are more pronounced at certain

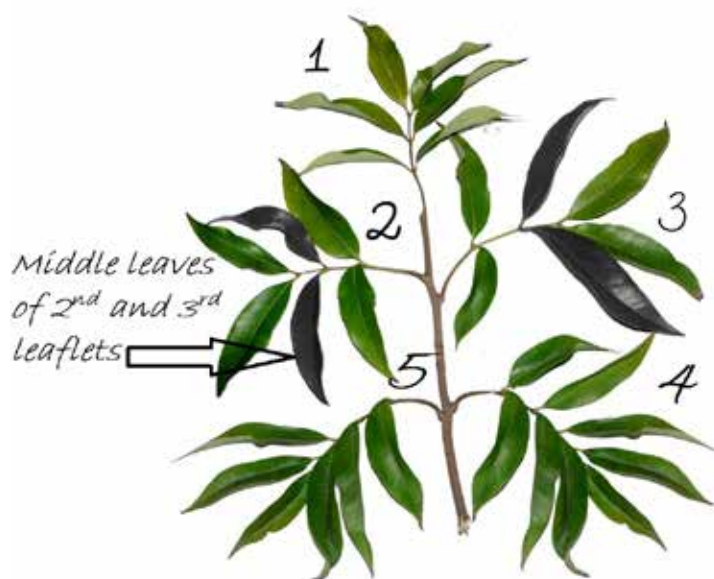
developmental stages than others; (4) The leaf nutrient concentrations at a specific growth stage are related to the crop performance.

General guidelines for collection of index tissues: The index tissue sample shall be vegetative terminal unless otherwise specified collected at chest height or at two meters height from the ground as per Table 1. A composite sample of leaves fully exposed to the sunlight may be collected from the centre, north, south, east, and west side of the plant. Sample may be collected prior to irrigation, manure and fertilizer application. Leaves under shade, soiled, diseased and insect or mechanically damaged may be avoided. Avoid sampling from the

plant under temperature or moisture stress.

Handling, processing and decontamination of leaf sample:

The handling, processing and decontamination of index tissues shall be done carefully to get representative and reliable results. Sampling should be done early morning with clean hands. The sample should be shifted immediately to the cool containers (Ice chest) and be stored in a refrigerator at 5°C. Contact of samples with metals for micro-nutrient determination should be avoided. The salt deposits or any deposition on sample surface should be removed with the cotton soaked in 0.2% detergent solution.



Position of leaf to be collected for leaf analysis in Litchi

The samples may be washed at the sampling site using 0.2% detergent solution followed by 0.1N HCl solution, distilled water and finally through deionized water or double distilled water. The distilled water used in decontamination process for boron estimation must be free from boron. The washing may be completed in minimum possible time (30–40 sec) to avoid loss of some nutrients from cut ends.

Soil analysis: The soil analysis determines the present status of plant available nutrient in the soil. The soil samples at the depth of 0–15 cm and 15–30 cm from the orchards should be tested after 2–3 years so that nutrient status may be judged well in advance before the appearance of any nutritional deficiency. The soil sample of about 500 g may be collected separately from each soil layer with the help of soil sampling auger. Each soil sample shall be put into separate clean cloth bags with proper labelling of the information such as field number, name of the farmer, address, date of sampling, depth of sampling etc. The samples

may be air dried in the shade before putting into the cloth bag. The properly labelled samples may be sent to the Soil Testing Laboratories. Based on soil test reports, fertilizers and manures are recommended for different fruit crops. These fertilizers are recommended for medium fertility soils, if as soil is high in fertility, nutrient dose may be reduced by 25% and if under low category, then nutrient dose may be increased by 25%.

Time and method of fertilizer application: Correct timing of fertilizer application is important for optimum nutrient management and to get higher fertilizer use efficiency. Time of fertilizer application ensures nutrients availability when the crop needs them. Nutrients are used most efficiently when their availability is synchronized with crop demand. Thus, all the manures and fertilizers may be applied as per the schedule.

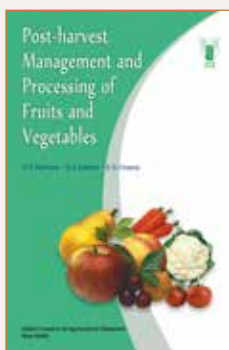
SUMMARY

The advanced knowledge of the nutrient management in the plant may help in realizing better

yield with the help of leaf tissue analysis. It helps in identifying the nutrient status of the plant before it suffers from any nutrient deficiency and toxicity. The selection of leaf index tissue and time of collection are most important steps to be followed in leaf tissue analysis for estimation of nutrient reserve in the plant system. Soil testing helps in identifying constraints to nutrient supply and nutrient supplying capacity of soil. The application of fertilizer as per recommendation and at right time not only enhances yield and profitability, but also reduces environmental pollution by checking nutrient losses through volatilization, leaching, etc. The leaf tissue analysis in combination with soil testing may be helpful in achieving sustainable higher yields, quality fruits along with minimal fertilizer inputs.

*Corresponding author's e-mail: sarvpriya90@pau.edu

Post-harvest Management and Processing of Fruits and Vegetables



Post-harvest management technology offers promising option for increasing production of vegetables and fruits quantity-wise and also in maintaining quality of the products. It involves all the activities that occur after production or harvesting of commodities, including procurement, removal of field heat, sorting, grading, packaging, storage, transportation, primary and secondary processing and marketing of agricultural products from farm-gate to distributors. This book is an effort to document vast available knowledge on the various aspects of post-harvest management and processing, and it will prove worthy for teachers, students and extension workers for understanding post-harvest management and processing of fruits and vegetables. It has 16 chapters covering storage, packaging, advanced preservation technology and value-addition of fruits and vegetables.

TECHNICAL SPECIFICATIONS

Size	: Royal Octavo (16 cm x 24 cm)
No. of pages	: i-viii + 250
Price	: Rs 350
Postage	: Rs 50
Binding	: Paper Back
ISBN No.	: 978-81-7161-115-4

For obtaining copies:

Business Unit

Directorate of Knowledge Management in Agriculture
Krishi Anusandhan Bhavan-I, Pusa, New Delhi 110 012
Tel : 011-25843657, Fax 91-11-25841282; e-mail : bmicar@icar.org.in