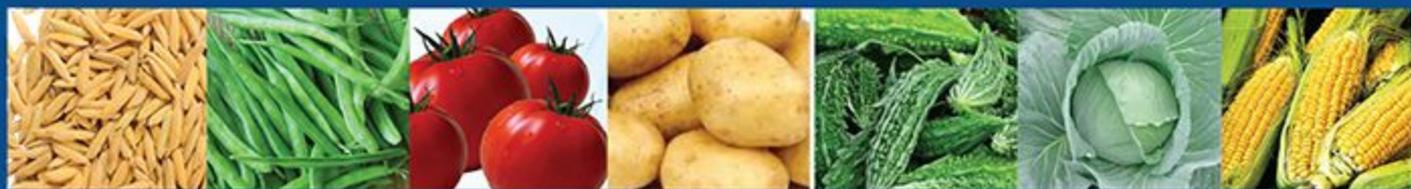


SITE SPECIFIC FERTILIZER RECOMMENDATION (SSFR) USING PLANT TEST KIT



Food and Agriculture
Organization of the
United Nations



**SITE SPECIFIC FERTILIZER
RECOMMENDATION (SSFR) USING
PLANT TEST KIT**

Development of Site Specific Fertilizer Recommendation (SSFR)
for Sustainable Food Crop Production
(FAO - TCP/SRL /3606)

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1. Introduction

Since general public is highly concerned about the increase in environmental pollution and fertilizer prices, efficient utilization of fertilizer should be given the highest priority in sustainable agriculture. Therefore, fertilizer application based on plant demand is an important practice in safe use of fertilizer. Plant testing to decide its nutrient demand can be done at any time of the growing season. Most of the time farmers examine the crop using the naked eye before applying fertilizer, and plant testing at laboratories rarely done before fertilizer application. This is because; there is no regularized mechanism to test plant samples at laboratories belonging to the Department of Agriculture (DOA). On the other hand farmers are hesitant to test plant samples at Department of Agriculture (DOA) laboratories due to many reasons. i) Plant samples collected from their fields have to be transported to testing laboratories situated in far-away places for testing, ii). Twelve soil science laboratories established island wide have not enough man power and capacity to analyse plant samples from all farmers in Sri Lanka, iii). Farmers have to wait for 3 to 4 weeks to get plant test results. To overcome the above constrains, a method was developed to analyse the sap extracted from leaf tissue of plants which could be utilized to monitor the plants' nutrient status. The sap test is based on the nutrient content of the fluid released from the freshly squeezed leaf tissue. This method is faster and less expensive to run than the traditional analysis. Preliminary studies indicate that in other countries this test is more sensitive to changes and it may be possible to detect nutrient imbalances before visual symptoms occur and this practices can be implemented immediately to prevent yield loss.

Several plant testing kits are currently available in the world. So, it is necessary to find out the most suitable test kits that can be used to test different crops grown in Sri Lanka. To identify the most suitable sap testing kit, a widely used plant testing kit branded LaMotte (Figure 1) was evaluated over 12 months at Gannoruwa, Batalagoda, Mahailuppallama, Bandarawela, Makandura, Sitaeliya, Bombuwala Angunakolepelessa, Thirunnaweli and Kalpitiya Research Stations using Rice, Maize, and Vegetables as Food Crops under the Development of site-specific fertilizer management systems for sustainable crop production project funded by the FAO. Plant samples collected from potato, tomato, cabbage, maize, rice, beans and bitter gourd in the field treated and non-treated with major nutrients were tested for nutrient concentrations in leaves and stems. Since it gives fair values for N, P and K in plant samples, this plant test kit was selected as a suitable test kit for plant sap testing in Sri Lanka.



Figure 1. LaMotte plant sap test Kit

2. Collecting of plant samples for sap testing

- Three Three or four leaves and petioles are enough to produce a sufficient (essentially stopped expanding in size). Leaves should have changed from a juvenile light green colour to a dark green colour.
- Usually about 20 leaves are enough to adequately represent a 5 to 10 acre field, if that field is judged to be uniform.
- A sub sample of the leaves and petiole pieces should be used for the final sample to crush.
- The leaves and petioles should be cutted in to 1/8 – 1/16 inch parts, chopped and mixed.
- Measurement of the pressed sap nutrient content should be made within one or two minutes of pressing.
- Mortar and pestle can be used to squeeze the sap from the leaves and petiole pieces of rice and maize.

3. Extraction of sap for testing

- Fill the extraction tube (0704) to lower line with the plant parts to be tested.
- Use a 1 ml pipette (0354) to add 2 ml of universal extracting solution, concentrated (5227).
- Fill the tube to the upper line with distilled or nitrate free water.
- Cap and shake vigorously for 5 minutes. Use a sheet of filter paper (0465) and the funnel to filter the tissue extract into a clean extraction tube.

4. Testing sap extraction for nitrogen

- Use a clean 1 ml pipette (0354) to transfer 1 ml of the filtered tissue extract to one of the larger depression of the spot plate (0159). Use the plastic pipette with cap (0392) to add 10 drops of the nitrate N1 (5146) to the filtrate in the spot plate.
- Use the 0.5 g spoon (0498) to add 0.5 g of nitrate reagent 2 powder (5147) stir thoroughly with the stirring rod (0519).
- Allow to stand for 5 minutes and observe for colour development.

Determine nitrogen content in plant using the following colour chart (Figure 2)



Figure 2. Colour variation of sap extraction content for different levels of plant nitrogen content

5. Nitrogen recommendation for crops based on sap test results

5.1 Recommendation of nitrogen fertilizer for rice based on sap test results

Given below is the required quantity of urea for rice, based on the above results (Table 1). Nitrogen should be applied to rice crop only when tested colour is at low level.

Table 1. Nitrogen recommendation for rice crop based on plant sap results

Agro-ecological zone and method of water supply	Quantity of urea recommended based on age of the crop (kg/ha) in week						
	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Dry zone irrigated	50	50	75	75	65	65	35
Dry zone rainfed	30	30	65	65	50	50	30
Wet zone irrigated	20	20	55	55	45	45	20
Wet zone rainfed	25	25	30	30	25	25	20

5.2 Recommendation of nitrogen fertilizer for maize based on plant sap test results

Plant testing should be carried out every week to determine the nitrogen requirement of the maize crop as well. Given below is the required quantity of urea for maize crop based on the sap test results (Table 2). Nitrogen should be applied to maize crop only when tested colour is at low level.

Table 2. Nitrogen recommendation for maize crop based on plant sap test results

Age of the crop (Week)	Quantity of Urea recommended (Kg/ha)
2	250
3	250
4	250
5	250

5.3 Recommendation of nitrogen fertilizer for vegetables based on sap test results

Plant sap testing should be carried out for vegetables every week to determine the nitrogen requirement. Given below is the required quantity of urea for vegetables based on the above results (Table 3). It is difficult to observe low level of nitrogen in vegetable crops. Therefore, nitrogen should be applied to vegetable crops only when tested colour is at medium level

Table 3. Nitrogen recommendation for vegetable crops based on plant sap test results

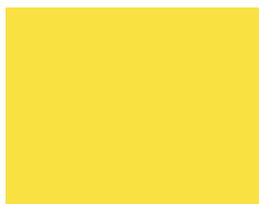
Age of the crop (Week)	Quantity of urea recommended for vegetable crops (kg/ha)				
	Bean	Tomato	Potato	Cabbage	Bitter gourd
2	110	65	110	110	35
3	110	65	110	110	35
4	110	65	165	110	35
5	-	65	-	-	35
6	-	65	-	-	35
7	-	-	-	-	35
8	-	-	-	-	35
9	-	-	-	-	35
10	-	-	-	-	35
11	-	-	-	-	35
12	-	-	-	-	35
13	-	-	-	-	35

6. Testing sap extraction for Pottasium

- Fill the Potash A tube (0254) to the lower line with the filtrated tissue extract
- Add one potassium reagent B tablet (5161A), Cap and shake until tablet dissolves.
- Use the transfer pipette (0364) to add potassium reagent C (5162) until the tube is filled to the upper line. Allow the Potassium reagent C to run slowly down the side of the tube. Swirl the tube gently to mix.
- Determine the potassium content in plants using the colour of the filtrate.



No precipitation
Low potassium



Medium precipitation
Medium potassium



High precipitation
High potassium

Figure 3. Colour variation of sap extract for different levels of plant potassium

7. Potassium recommendation for food crops based on sap test results

Plant sap testing should be carried out every week to determine the potassium requirement of food crops.

7.1 Recommendation of nitrogen fertilizer for vegetables based on sap test results

Given below is the required quantity of MOP for rice, based on the above results (Table 4). The MOP should be applied to rice only when tested colour is at low potassium

Table 4. Potassium recommendation for rice based on plant sap results

Agro-ecological zone and method of water supply	Quantity of (kg/ha) of MOP recommended at different age of the crop					
	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Dry zone irrigated	25	25	25	35	35	35
Dry zone rainfed	25	25	25	25	25	25
Wet zone irrigated	25	25	25	25	25	25
Wet zone rainfed	235	35	45	45	30	30

7.2 Potassium recommendation for maize based on sap test results

Muriate of potash (MOP) should be applied to maize crop only when tested colour is at medium level. Rate of application of MOP is given in the Table 5.

Table 5. Potassium recommendation for maize crop based on plant sap test results

Age of the crop (Week)	Quantity of MOP recommended (Kg/ha)
2	50
3	50
4	50
5	50

7.3 Potassium recommendation for vegetable based on sap test results

Muriate of potash should be applied to vegetable crop only when tested colour is at low level. Rate of application of MOP is given in the Table 6.

Table 6. Potassium MOP recommendation for vegetable crops based on plant sap test results

Age of the crop (Week)	Quantity of urea recommended for vegetable crops (kg/ha)				
	Bean	Tomato	Potato	Cabbage	Bitter gourd
2	75	65	125	75	25
3	75	65	125	75	25
4	-	65	125	75	25
5	-	65	-	75	25
6	-	65	-	75	25
7	-	-	-	-	25
8	-	-	-	-	25
9	-	-	-	-	25
10	-	-	-	-	25
11	-	-	-	-	25
12	-	-	-	-	25
13	-	-	-	-	25

8. Testing sap extraction for Phosphorous

- Fill the Phosphorous B tube (0244) to the line with the filtered tissue extract.
- Use the glass pipette with screw cap (0341) to add 6 drop of Phosphorous Reagent N0. 2 (5156) to the tube containing the filtrate.
- Add one Phosphorous test tablet (5706 A). Cap and shake until tablet dissolves.
- Note the colour quickly.
- Estimate the phosphorus content in the plant as given colour chart

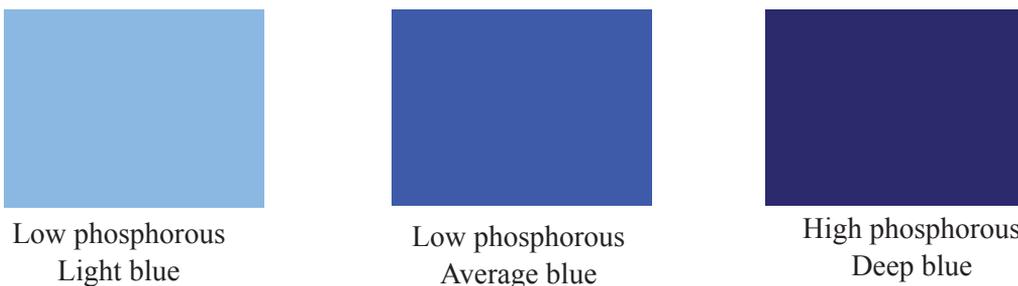


Figure 4. Colour variation of sap extraction for different levels of plant phosphorous content

9. Phosphorous recommendation for food crops based on sap test results

When phosphorous is at low level TSP application basal is essential for the next crop Application rate should be done as basal and given below (Table 7).

Table 7. Estimated phosphorous (kg/ha) fertilizer recommendation for food crop

Soil P levels	Quantity of TSP recommendation crops (kg/ha)						Bitter gourd	Potato
	Paddy	Maize	Cabbage	Bean	Tomato			
Low	55	100	270	270	215	225	275	

10. References

Testing procedure for plant sap, LaMotte Plant tissue kit, nitrate, phosphorous and potassium, LaMotte Company, P O Box 329, Chestertown, Maryland, 21620, USA