リン施用グァバ樹の葉分析

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Leaf Analysis and Phosphorus Fertilization of Guava (*Psidium guajava* L.)

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Summary

An experiment was carried out with young guava trees during the period from 1970 to 1972 with differential supplies of phosphorus as foliar spray to determine the nutrient content, seasonal variation of nutrients and to find out the most productive range.

Increasing the phosphorus supply tended to gradually increase the leaf P content. There was no effect on N and K contents of the leaves. Seasonal changes in the concentrations of N, P, K and dry matter have been studied over an annual growth cycle. The peak concentrations of each constituent in the tissues were found before the growth commenced and after the growth ceased, while minimal concentration was found at the end of the season, i. e., after full maturation of fruit. There were two periods in a year, viz., January-February and July-August when N, P and K concentrations in the leaves were stable. There was a significant increase in yield with application of superphosphate. More yield was recorded under the 4 per cent spray treatment in both the seasons and years. Significant positive correlation coefficients were found between yield and leaf P content. Quadratic regression equations were fitted to the relation between yield and rate of phosphorus application. The most productive range for P values was 0. 45 to 0. 65 per cent on the dry weight basis.

Introduction

It is universally recognized that the essential elements need to be applied to fruit trees annually in most fruit growing areas of the world in order to maintain the growth and yield potentials. The importance of phosphorus among essential elemets is well known in dry farming areas of India. In view of lack of information on many vital aspects of nutrition of guava it was considered essential to undertake an investigation on the nutritional needs of this crop. The present study relates to the mineral composition of guava leaves and fertilization responses. It is of major importance to understand what changes in composition take place during the relatively long period when the leaves persist on this evergreen fruit tree. In the case of fruit trees it is believed that leaf analysis is an indicator of the nutritional status of the tree, irrespective of the nutrient supply.

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The reports of Embleton *et al.* (1955, 1958) indicate that application of too little or too much fertilizer resulted in a reduced yield. To find out the critical level of nutrient, where symptoms are not clear as with other essential major elements, field data have been used to establish standard application rates for the fertilizers (Azad and Niggar, 1972). For this purpose leaf sampling must be on specific leaves, specific age and specific tree response.

Though some investigations have been conducted on these aspects of guava in the past, the results are not conclusive and inadequate. Therefore, it is rather imperative to have studies with the following objectives, i. e., (i) seasonal variation of mineral elements in guava leaves, (ii) the yield of fruit in different seasons, (iii) to see the correlation, if any, between leaf phosphorus and fruit yield, (iv) to find out the proper time of leaf analysis, and (v) to develop tentative standards for classification of nutrient status applicable to guava.

Material and Methods

The present experiments were conducted from 1970 to 1972 with young healthy bearing trees of guava cultivar, Allahabad Safeda, in the Experimental Orchard, Faculty of Agriculture, Banaras Hindu University, Varanasi, India. The trees chosen for this purpose showed approximately uniform growth and vigour. In order to study the significance of phosphorus in guava, double superphosphate (28% P) at 2, 4 and 6 per cent concentrations was sprayed. A control plot was also set up by spraying tap water alone. Spraying was done at two times in the year, once in mid-July and then in mid-January. Leaves were sampled at monthly intervals for determination of N, P, K and dry matter contents. On each sampling date twenty five leaves from each replication of a treatment were collected and then a representative sample of 25 leaves was used for the purpose of analysis. Procedures for handling of sample after collection were followed as suggested by Chapman (1964). The contents of N, P and K were expressed on an oven dry basis. Nitrogen was determined by the macro-kjeldahl method, phosphorus by the triacid and ammonium molybdate method and potassium by the flame photometer method.

Results and Discussion

Effect of foliar application of double superphosphate on the content of N, P, K and dry matter in leaves of guava plant and their seasonal variation are illustrated in Fig. 1. Phosphorus application gradually increased the P content in the leaves. There was no effect on N and K contents of the leaves as presented in Table 2. Similar findings have also been reported by Bansal and Motiramani (1968) in guava leaves. Reuther *et al.* (1949) and Smith *et al.* (1963) have reported that phosphorus treatment had no effect on leaf N at any time, but it reduced the K content. It is evident from the data that trees not receiving superphosphate spray had a very low phosphorus content in the leaves (Fig. 1 and Table 2). Such plants displayed stunted growth and reduced leaf size. Upper leaves were found to be greenish yellow and lower ones turned completely yellow. These symptoms had clearly been defined by Mallik and Singh (1960). Two per cent superphosphate sprayed trees showed an intermediate response in growth between the control and 4 per cent spray treatment. Higher leaf phosphorus values reduced the yield of the trees. The leaf P content was lowest (0.20%) in the control plants and highest (0.78%) under the six per

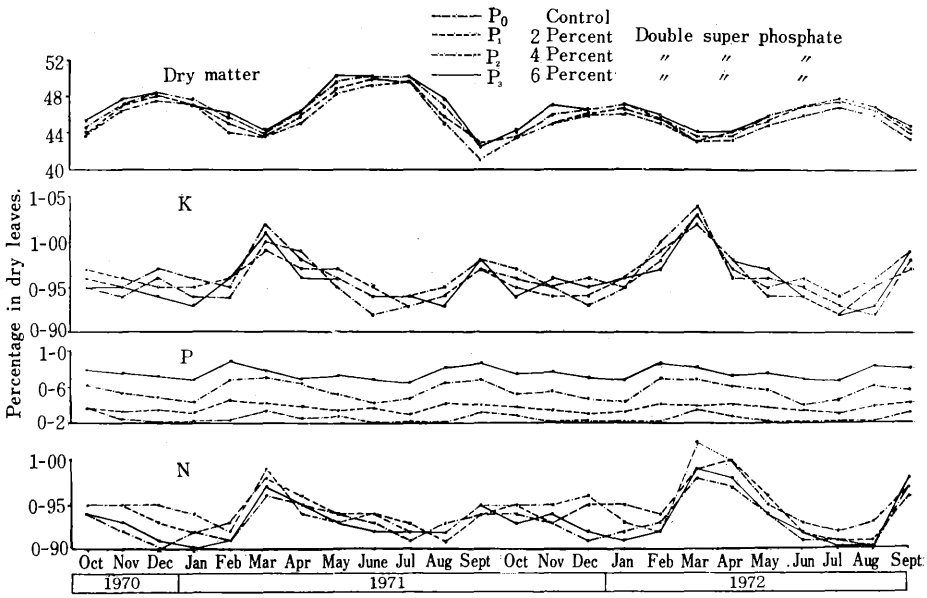

Fig. 1. Influence of phosphorus on seasonal changes in chemical composition of guava leaves.

Table 1. Seasonal changes in percentage of phosphorus in guava leaves

	Percentage of phosphorus in leaves on dry weight basis												
	October	November	December	January	February	March	April	May	June	July	Aug.	Sept.	Avg.
1970-71*	0.26	0.25	0.20	0.23	0.24	0.34	0.25	0.27	0.20	0.21	0.21	0.32	0.25
1971-72*	0.29	0.20	0.23	0.22	0.22	0.35	0.28	0.22	0.20	0.20	0.20	0.31	0.24
Average*	0.28	0.23	0.22	0.23	0.23	0.35	0.27	0.25	0.20	0.21	0.21	0.32	
1970-71**	0.59	0.54	0.52	0.47	0.67	0.63	0.57	0.53	0.49	0.47	0.62	0.65	0.56
1971-72**	0.55	0.56	0.50	0.47	0.66	0.63	0.58	0.56	0.48	0.47	0.61	0.60	0.55
Average**	0.57	0.55	0.51	0.47	0.67	0.63	0.58	0.55	0.49	0.47	0.62	0.63	

* Control plant

** Average of all treated plants, i.e., 2, 4 and 6 per cent sprays of double superphosphate

Table 2. Influence of double superphosphate application on the leaf nutrient content in guava

	Percent leaf nutrient content											
	1970-71						1971-72					
	Winter			Rainy			Winter			Rainy		
	N	P	K	N	P	K	N	P	M	N	P	K
Control	0.93	0.23	0.95	0.92	0.31	0.94	0.92	0.22	0.96	0.92	0.20	0.95
2%	0.92	0.38	0.95	0.92	0.35	0.93	0.94	0.36	0.97	0.91	0.34	0.93
4%	0.91	0.55	0.94	0.92	0.56	0.93	0.92	0.56	0.97	0.90	0.53	0.92
6%	0.90	0.78	0.94	0.92	0.73	0.93	0.91	0.77	0.96	0.90	0.75	0.92

cent concentration of double superphosphate application. This shows that the application of superphosphate served as an efficient source of phosphorus in the leaves. In general, the trend of seasonal variation of N, P and K content in leaves in all the treatments was almost the same in these two year studies. However, the rate of change in P content was more rapid at higher doses of application. Just after the application of fertilizer in the months of January and July, there was a sharp increase in the P content of leaves. Peak concentrations of phosphorus in the leaves of the treated plants were observed at two times in the year, i. e., in February and September. In early stages of flush growth there was a more rapid decrease. The decreasing trend of phosphorus in the leaves was continued up to flowering and fruit development, It is concluded that the leaf P was utilized in the vegetative growth, flowering and fruit growth. Again it was raised at the beginning of the next season. The accumulated nutrients are mobilized for new growth during the next season. The percent dry matter of leaves reached a maximum at the end of the season and showed loss of weight at the time of the emergence of new vegetative shoots. This is in conformity with findings of Smith and Reuther (1950) and those of Embleton *et al.* (1958).

In the control plants there were two periods in a year when the P content was stabilized, i. e., January-February and July-August (Table 1). These are most suitable months for phosphorus analysis in guava plants. In other periods the P content in the leaves fluctuated more rapidly and produced difficulty in evaluating the results.

The data presented in Table 3 demonstrate a positive correlation between yield per tree

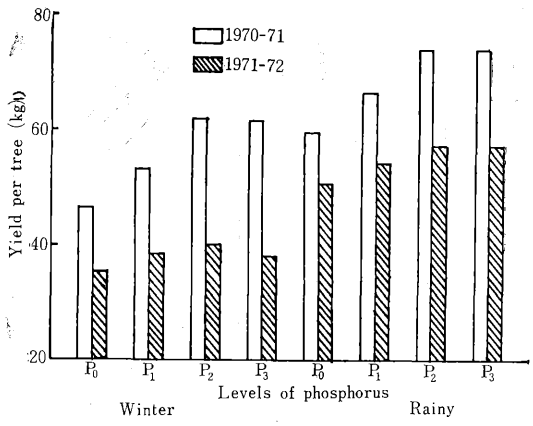

Fig. 2. Effect of phosphorus on fruit yield of guava

Table 3. Effect of double superphosphate on phosphorus content of leaves and yield of fruit in guava

	Winter				Rainy			
	Control	2%	4%	6%	Control	2%	4%	6%
				1970-71				
Leaf P content (%)	0.23	0.38	0.55	0.78	0.21	0.35	0.56	0.73
Yield/tree (kg)	46.57	53.23	61.93	61.53	59.43	66.37	73.90	78.80
Correlation coefficient	0.796**				0.978**			
Regression equation	$Y=45.37+11.67x-2.00x^2$				$Y=60.03+7.88x-1.00x^2$			
				1971-72				
Leaf P content (%)	0.22	0.36	0.56	0.77	0.20	0.34	0.53	0.75
Yield/tree (kg)	35.30	38.60	40.10	38.13	50.50	54.20	56.96	57.20
Correlation coefficient	0.507**				0.900**			
Regression equation	$Y=35.40+5.00x-1.32x^2$				$Y=50.43+4.83x-0.85x^2$			

* Significant at 5% level
** Significant at 1% level

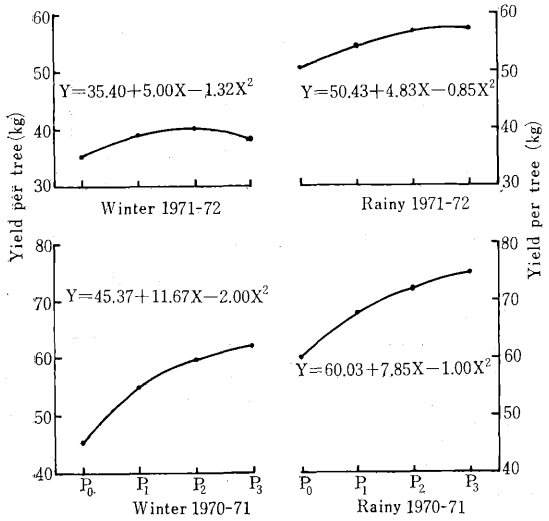

Fig. 3. Response curve for yield per tree

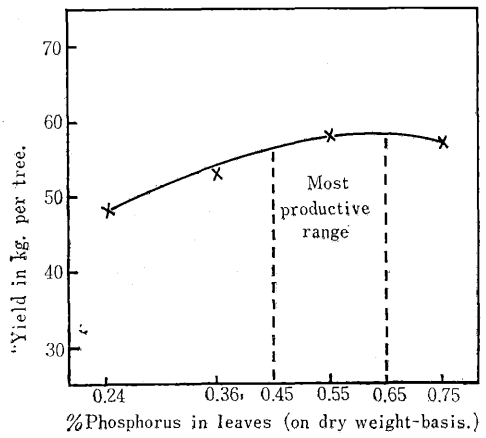

Fig. 4. Guava yield as related to percent of phosphorus in leaves

and leaf P content. The correlation coefficients were found to be statistically significant in both winter and rainy season crops in the two years of the study. Similar findings with cranberry have also been recorded by Eaton (1971). The response of guava in terms of yield to the rate of phosphorus application in both the seasons and years separately was calculated. The curves were fitted using a quadratic equation $y=a+bx+cx^2$. The equations for predicting yield as related to phosphorus application are illustrated in Fig. 3.

On the basis of these results, critical concentrations of leaf phosphorus were calibrated. The curve shown in Fig. 4 was drawn from experimental data in guava trees. It represents the curvilinear regression of fruit yield on the percentage of phosphorus in the leaves. The "most productive" range is rather broad and includes values from 0.45 to 0.65 per cent dry weight basis (Fig. 4).

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References

1. AZAD, K. C. and G. S. NIJJAR, 1972. Standardization of foliar sampling technique in litchi (*Litchi chinesis*), 3 rd Inter. Symp. on subtrop. and trop. Hort. Bangalore.
2. BANSAL, K. N. and D. P. MOTIRAMANI, 1968. Effect of varying levels of N, P, K on the leaf

composition of guava (*Psidium guajava* L.), J. N. K. V. V. Res. J. **2** : 100—104.

3. CHAPMAN, H. D., 1964. Foliar World Crops. Sept. : 36—46.
4. EATON, G. W., 1971. Effect of N, P and K fertilizer applications on cranberry leaf nutrient composition, fruit colour and yield in mature log. J. Amer. Soc. Hort. Sci. **96** (4) : 430.
5. EMBLETON, T. W., W. W. JONES and J. D. KIRKPATRICK, 1955. Avocado fertilizer experiment, Calif. Avocado Soc. Year Book **39** : 62—66.
6. ———, W. W. JONES, J. D. KIRKPATRICK, and A. D. GREGARY, 1958. Influence of sampling date, season and fertilization on macro-nutrient in Fuerte avacado leaves, Proc. Amer. Soc. Hort. Sci. **72** : 309—320.
7. MALIK, P. C. and D. L. SINGH, 1960. Deficiency symptoms of NPK in guava, Indian Agriculturist **4** : 44—49.
8. REUTHER, W., P. F. SMITH and A. W. SPECHT, 1949. A comparison of mineral composition of Valencia orange leaves from the major producing areas of the United States, Proc. Florida Stat. Hort. Soc. **62** : 38—45.
9. SMITH, P. F. and W. REUTHER, 1950. Seasonal changes in Valencia orange trees. I. Change in leaf dry weight, ash and macro-nutrient elements, Proc. Amer. Soc. Hort. Sci. **55** : 61—72.
10. ———, G. K. SCUDDER and G. H. HRNCIOUR, 1963. Twenty years of differential phosphate application on pineapple orange, Proc. Fla. State Hort. Soc. **76** : 7—12.

リン施用グァバ樹の葉分析

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摘　要

1970 から 1972 にかけて，リンの葉面散布量を異にしたグァバ樹について，葉内の要素含量，その季節的変動，および好適範囲を明らかにするための試験を実施した．

リンの施用量を増すにつれて，葉内のリン含有率は徐々に増加したが，NおよびK含量には影響しなかった．一年を越えた生長サイクルにわたって，N，P，Kおよび乾物含有率の季節的変化を調査したところ，各成分ともに，生長を開始する前と，生長を停止した後の時点で最も高い含有率を示し，また，最低値はシーズンの終り，すなわち果実の完熟後にみられた．年内で 1～2 月と 7～8 月の 2 期間中は，葉内のN，PおよびK含有率が安定した値を示した．過リン酸の施用によって収量は明らかに増加するが，両年ともに 4% 区で他の区よりも高い収量をえた．収量と葉内リン含量との間には有意な正の相関が認められ，収量とリン施用量との間の関係を二次回帰式で表わすことができた．乾物当り 0.45～0.65% のリン含量のときに収量が最大であった．