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A STUDY ON THE IMPACT OF AMINO ACID STATUS OF LEAVES AND FLOWERS ON THE PRODUCTIVITY OF SWEET LIMES (*CITRUS LIMETTIOIDES* TAN)

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To establish relationship with productivity, some bearing trees were selected and amino acid analysis of their leaves and flowers (males and hermaphrodite separately) was conducted. It was observed that hermaphrodite flowers had higher total amino acids concentration followed by leaves and male flowers irrespective of the productivity of the trees. Aspartic acid and glutamic acid were found in higher concentration both in the leaves and flowers but in the reversed order.

INTRODUCTION

Sweet lime occupies a third important position among different commercial citrus species both in acreage and production after mandarins and sweet oranges in Pakistan. Since it arrives in the market during July-September when no other table citrus cv. is available, it fetches profound return for the farmers. Sweet lime is conventionally considered useful against malaria and jaundice, therefore, popular in summer. Unfortunately, the trees are frequently erratic in bearing.

Nitrogen status of trees is generally considered agreed for the fruit production. Present studies were carried out on amino acids known as the nitrogen metabolites in order to ascertain if some relationship could be established.

Arginine was reported major storage form of nitrogen (Oland, 1959). Proline and aspargine being in the largest concentration, twelve other amino acids were common in citrus leaves (Stewart, 1961). Quite a high level of proline, while smaller percentages of aspargine, aspartic acid and arginine were also detected as nitrogen storing compounds ion citrus tracheal sap (Moreno and Martinez, 1981).

a number of mineral elements like potassium, (Labanauskas and Handy, 1970), phosphorus (Rabe and Lovatt, 1984), magnesium and several trace elements (Stewart, 1961) were reported associated with altered amino acid metabolism in citrus. The present study was, however, pursued to investigate if amino acids content of tress (as nitrogenous reserves) could be linked with the bearing habit of sweet limes.

MATERIALS AND METHODS

Ten year old five trees raised from stem cuttings on sandy loam soil (pH 8.2) were selected. All the trees remained under observation for two years prior to their selection for the studies, particularly for their yield and cultural practices. Then two of the trees were categorised as poorly bearing (130 fruit average of two years) and a standard bearing tree (500 fruit/tree). These trees were supplied with nitrogen @ 1.0 kg per tree in two equal splits either in spring, summer or autumn. These were also supplied with P, K at standard dose i.e. 750 g

of P_2O_5 and 500 g of K_2O during second week of February during spring season only.

For the determination of amino acids, 4-7 months' healthy leaves were picked. Immediately were washed and dried in an oven at 65 °C. Similarly, both the male and hermaphrodite flowers were picked at the peak blooming period separately from only the standard and poorly bearing trees. Dried samples of leaves and flowers were ground in a stainless steel grinder to a fine powder and stored in plastic jars at 20 °C until analysis of the samples according to acid hydrolysis method on E.E.L. model-193 high speed amino acid analyser.

RESULTS AND DISCUSSION

Perusal of the data (Table 1) indicated that sweet lime leaves contained 16 amino acids in variable concentration but in a similar general trend in all the categories of the trees. Glutamic acid was higher in all the trees, being the highest (2.33%) in trees fertilized in September, followed by February treated tree (2.14%) in the leaves. Aspartic acid was the second important amino acid in sweet lime leaves being maximum (1.71%) in the trees where nitrogen was supplied during February followed by the one termed as a standard tree and the one where nitrogen was supplied during the month of September, concentration being 1.61 and 1.46%, respectively. Arginine and proline were in considerable concentration in almost all the trees, arginine being more than proline. Arginine was high (1.37%) in the tree where nitrogen was supplied in August followed by the standard tree (1.35%). Poorly bearing tree contained the minimum quantity of arginine. Besides, some other amino acids like lysine, there was a considerable concentration of leucine and valine. It was, however, observed that none of the trees had an exclusive higher level in all the amino acids but it varied in each case.

Analysis of flowers indicated that hermaphrodite flowers had higher levels of total amino acids as well as total nitrogen as compared with the male flowers. Total amino acids in hermaphrodite flowers higher even than that of the leaves while male flowers contained less except that of aspartic acid which was invariably higher in male flowers than that in the leaves. The amino acid found in the highest quantity in hermaphrodite flowers was also aspartic acid. Flowers from poorly bearing tree had higher quantity of aspartic acid (3.50%) than that in the standard tree (3.32). Level of glutamic acid was higher (2.19%) hermaphrodite flowers plucked from standard tree as against the poorly bearing tree (1.87%). As indicated, aspartic acid was higher in flowers followed by glutamic acid and the same two acids were frequent in leaves but with a reverse order. In case of the other amino acids, the trend was almost similar as was found in leaves except the quantity being higher in some cases. Observations, however, divulged that the amino acid levels of leaves could not be taken as a valid parameter for measuring fruitfulness of a tree. The observations of interest were that hermaphrodite flowers has invariably higher contents than the male flowers.

These observations are not in consonance with the earlier findings of Stewart (1961 and 1962). According to his studies, proline was found in higher concentration in citrus leaves while in present studies aspartic acid and glutamic acid appeared predominating. The varied status of amino acids in leaves of different categories of trees may be attributed either to the nutritional status of these trees or species of citrus compared to the findings of Stewart (1961, 1962), Labanauskas and Handy (1970) and Rabe

Table 1. Amino acid spectra and total nitrogen (%) of sweet lime leaves and flowers and yield of the experimental trees

Amino acid	Leaves					Flowers			
						Standard tree		Poorly bearing tree	
	Poorly bearing tree	Standard tree	N-applied in August	N-applied in September	N-applied in February	Male flowers	Hermaphro-dite flowers	Male flowers	Hermaphro-dite flowers
Aspartic acid	1.39	1.61	1.18	1.46	1.71	2.35	3.32	2.85	3.50
Threonine	0.69	0.42	0.55	0.56	0.52	0.48	0.42	0.37	0.50
Serine	0.55	0.61	0.61	0.75	0.61	0.50	0.57	0.49	0.91
Glutamic acid	1.88	1.74	1.47	2.33	2.14	1.60	2.19	1.52	1.87
Proline	0.93	0.77	0.90	1.28	0.70	0.34	0.55	0.36	0.26
Glycine	0.80	0.79	0.87	0.70	0.75	0.55	0.66	0.61	0.67
Alanine	0.51	0.35	0.40	0.49	0.51	0.38	0.54	0.48	0.59
Valine	0.75	0.68	0.71	0.68	0.82	0.51	0.93	0.57	1.04
Methionine	Traces	0.24	0.12	0.11	0.17	0.05	0.12	0.12	0.10
Isoleucine	0.54	0.58	0.65	0.57	0.67	0.48	0.62	0.57	0.60
Leucine	0.80	0.87	0.88	0.91	0.94	0.65	0.86	0.75	0.78
Tyrosine	0.40	0.24	0.36	0.44	0.34	0.24	0.40	0.30	0.31
Phenyl alanine	0.50	0.55	0.56	0.69	0.60	0.37	0.79	0.48	0.47
Lysine	0.55	0.64	0.75	0.75	0.92	0.48	0.65	0.34	0.45
Histidine	0.22	0.31	0.07	0.29	0.37	0.24	0.22	0.13	0.23
Arginine	0.71	1.35	1.37	1.03	1.03	0.76	0.90	0.29	0.78
Total amino acids (%)	11.22	11.75	11.45	12.04	12.80	9.98	13.14	9.23	13.06
Total nitrogen (%)	1.90	2.10	1.95	2.10	2.30	1.40	2.10	1.39	2.15
Number of fruit/tree	145	657	386	793	195	657		145	

Sampling of leaves and flowers was done during peak bloom.

and Lovatt (1984). Higher contents of amino acids in hermaphrodite flowers than male flowers, as well as leaves appeared to be indicative as if higher nitrogen was needed for these flowers. The research reports were not available to compare, hence it was elicited that no earlier reports studies covered amino acids analyses of male and hermaphrodite flowers of citrus. The higher nitrogen requirements for expression of female characters was, however, reported in earlier work of Tiedjen (1962), Hartmann (1950) and Frost (1948). This observation leads us to infer that analysis of amino acid status for determining productivity of sweet lime will be misleading. However, higher status of hermaphrodite flowers both in total nitrogen and total amino acids invites further studies to establish some sort of relationship to induce more hermaphrodite flowers and fruitfulness.

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