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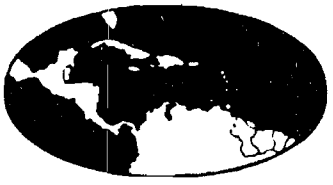

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RESPONSES OF RED SPANISH PINEAPPLE TO VARIOUS POTASSIUM LEVELS

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ABSTRACT

An experiment was initiated on December 1963, to determine the effect of various potassium levels upon the growth, chemical composition, fruit yield and quality of the Red Spanish pineapple grown in gravel culture.

Composite samples of "D" leaf were obtained at various time intervals during the growing period. The chemical data showed an increase concentration of potassium and a decrease concentration of calcium and magnesium in the foliage, as a result of potassium increments in the nutrient solution.

Slips-suckers production, green leaf weight and fresh stem weight increased significantly with addition of potassium.

There were significant differences in mean-fruit weight, Brix, and Total acidity of the juice which were affected favourably as a result of increments of potassium in the nutrient solution. However, the fruit-core diameter, fruit-to-crown ratio, crown weight and root weight were not affected significantly.

INTRODUCTION

Pineapple production in Puerto Rico has been increased from 8.3 tons per acre in 1940 (24,000 tons) to 15.4 tons in 1964 (66,000 tons). However, fruit quality is still a major problem. Our pineapples, particularly the Red Spanish, which is the leading variety is actually yielding fruit of low quality. Fruits are characterized by being soft watery, discoloured and low in acid content. The softness and watery condition of fruits interferes markedly with their keeping quality. Such fruits are subjected to mechanical injury and diseases during transit.

The above described condition is for the major part attributed to an unbalanced fertilization program. In fact, a series of experiments under controlled conditions have been initiated at this Agricultural Experiment Station to determine the role of the most important elements on the quality of the fruit. Potassium was given priority along this line of work inasmuch as potassium is known to be a controlling factor in fruit quality. (1, 2, 3, 9, 10). It is very important in the metabolism of the pineapple plant (6, 7, 8). Carbohydrates, proteins and organic acids synthesis is influenced by the potassium supply (4, 5). Potassium take active part in the transportation of the elaborated assimilates from the leaves to the organ of storage of the plant.

EXPERIMENTAL PROCEDURE

In November, 1963 one pineapple slip weighing from 125-150 grams was planted in each of 48, 5-gallons self-drained glazed stone crocks, filled with hydite. Hydite instead of white quartz sand was used as the growing media.

The plants were kept in the greenhouse for sometime until they developed roots and started to make good growth of leaves. As long as the material remained in the greenhouse they were supplied with one liter of half Strength Shive's solution every other day.

In December, 1963 the crocks were laid out on durotec topped tables under outdoor condition. The differential treatments were randomized in a complete block design with 6 treatments and 8 replications. Applications of two liters of Shive's nutrient solution were made every other day modified to give the following part per million of K-0, 44, 88, 175, 351 and 526. Solutions were applied by the slop culture method.

Leaf samples were taken at 3, 6 and 9 months after the experiment began. Flowering was induced with B.O.H. at 0.06% applied on August 25, 1964. Toxaphene solution was applied as Gummosis-control, when the first blue flowers came out, 51 days after Beta-hydroxyethyl-hydrazine was applied.

The criteria used to evaluate the effect of the various potassium levels on the growth and reproduction of Red Spanish pineapple were the following:

1. Leaf nutrient content
2. Fruit yield
3. Analysis of the juice
4. Slips-suckers production
5. Growth of roots, stem and leaves

RESULTS AND DISCUSSION

A. Leaf Analyses

Leaf samples were taken to determine how leaf nutrient content responded under the different potassium levels applied to the nutrient solution. It appeared that nitrogen did not change too much at various potassium increments. (See Table 1). Phosphorus tended to drop from 0.38% for no potassium to 0.26% at 526 ppm of K. The leaf-potassium content showed a continuous increase as the potassium application to the nutrient solution increased from 0.86% when no potassium was applied to 4.63% at 526 ppm K. This condition was expected. It is well known that pineapple has particularly high potassium requirements. (1, 4, 9). Calcium and magnesium showed the opposite,

a marked drop in Ca and Mg leaf content as potassium increased. Trace elements, Fe, Mn and B, did not show definite changes with different potassium treatments.

B. Fruit Yield

The increments of potassium significantly influenced the mean fruit weight (Table 2). With no potassium a mean fruit weight of 1842 grams (4.0#) was obtained compared with 2355 grams, (5.0#) in the 351 ppm K treatment. The fruit diameter was also favourably influenced by potassium increase. There was no significant response to crown weight and fruit core diameter regardless of various potassium levels.

C. Analysis of the Juice

The highest degree-brix value was 12.53 for the 526 ppm of K; the lowest value was 10.10 where potassium was omitted in the nutrient solution (Table 3). The data show very significant statistical difference between treatments. The total acidity of the juice expressed as milligrams of citric acid per 100 ml. of juice showed even more the relationship to treatment as did the Brix values; highest value for 526 ppm of K and lowest for no potassium applied.

D. Slips and Suckers Production

There were highly significant differences in number and weight of slips and suckers produced under the different potassium levels. The pineapple is commercially propagated from slips and suckers. It is therefore of interest to know the influence of each individual nutrient in their production. Table 4 shows the importance of potassium supply on number and weight of slips and suckers of the Red Spanish pineapple. The following conclusion may be drawn; that a good and early ratoon crop will be obtained by using ample supply of potassium in the pineapple manuring.

E. Growth of Stem, Leaves and Roots

It is evident from the data presented in Table 5 how much increase in stem weight the pineapple can obtain due to the presence of available potassium. There was a continuous gain in stem weight due to potassium increments in the nutrient solution. The stem is the most important storage organ from which reserves finally are removed and deposited in the ripening fruit. It has been observed that a high amount of potassium results in plants with strong stems which at the same time produce fruits free of sun-scald (10).

TABLE 1. Effect of various levels of potassium on the mean leaf-nutrient content of Red Spanish pineapple grown in gravel culture.

Potassium treatment P.p.m.	Leaf-nutrient content, dry weight basis							
	N	P	K	Ca	Mg	Fe	Mn	B
	Percent	Percent	Percent	Percent	Percent	P.p.m.	P.p.m.	P.p.m.
1. 0	1.87	0.38	0.86	1.42	0.71	49	52	40
2. 44	1.70	0.34	1.54	0.99	0.51	71	49	39
3. 88	1.73	0.33	2.41	0.89	0.46	54	44	36
4. 175	1.76	0.31	3.01	0.87	0.44	61	55	37
5. 351	1.74	0.28	4.01	0.71	0.37	65	54	32
6. 526	1.73	0.26	4.63	0.63	0.34	63	56	36

TABLE 2. Effect of various levels of potassium on the mean weight and diameter of the fruit of the Red Spanish pinapple grown in gravel culture.

Potassium treatment P.p.m.	Mean weight of fruit grams	Treatments significantly excelled
1. 0	1842	
2. 44	2166	1*
3. 88	2174	1*
4. 175	2195	1*
5. 351	2355	1**
6. 526	2282	1**
	Diameter of the Fruit (cms.	
1. 0	13.76	
2. 44	14.48	1*
3. 88	14.45	1*
4. 175	14.33	1*
5. 351	14.76	1**
6. 526	14.74	1**

* Significant at 5-percent level.

** Significant at 1-percent level.

TABLE 3. - Effect of various levels of potassium on the Brix and total acidity[1/] of the juice of Red Spanish pineapple grown in gravel culture

	Potassium treatment p.p.m.	Brix Degree	Treatments significantly excelled
1.	0	10.1	--
2.	44	11.6	1 **
3.	88	11.8	1 **
4.	175	12.1	1 **
5.	351	12.3	1 **
6.	526	12.5	1 ** 2 *
		Total acidity	
1.	0	568	--
2.	44	756	1 *
3.	88	855	1, 2 *
4.	175	922	1, 2 **
5.	351	927	1, 2 **
6.	526	1005	1, 2 ** 3 *

1/ Titrable acidity to pH 8.1 expressed as milligrams of citric acid per 100 ml. of juice.

TABLE 4. - Effect of various levels of potassium on the slips-suckers production of Red Spanish pineapple grown in gravel culture

	Potassium treatment p.p.m.	Mean number of slips	Treatments significantly excelled
1.	0	1.4	--
2.	44	1.7	--
3.	88	2.1	1 *
4.	175	2.3	1 *
5.	351	2.5	1 ** 2 *
6.	526	2.7	1 ** 2 *
		Mean weight of slips (grams)	
1.	0	203	--
2.	44	272	--
3.	88	443	--
4.	175	599	1 *
5.	351	742	1, 2 **
6.	526	851	1, 2 ** 3 *
		Mean number of suckers	
1.	0	0.70	--
2.	44	1.07	1 **
3.	88	1.20	1 **
4.	175	1.31	1 **
5.	351	1.44	1 ** 2 *
6.	526	1.45	1, 2 **
		Mean weight of suckers (grams)	
1.	0	000.0	--
2.	44	131.0	--
3.	88	238.0	--
4.	175	380.0	1 **
5.	351	448.0	1 ** 2 *
6.	526	390.0	1 **

Table 5. - Effect of various levels of potassium on the mean fresh weight of stem and leaves of Red Spanish pineapple grown in gravel culture

	Potassium treatment p.p.m.	Mean fresh stem weight Grams	Treatments significantly excelled
1.	0	545	--
2.	44	692	1 *
3.	88	777	1 **
4.	175	931	1, 2 ** 3 *
5.	351	1078	1, 2, 3 ** 4 *
6.	526	1271	1, 2, 3, 4 ** 5 *
		Mean leaves weight (Gms)	
1.	0	2383	--
2.	44	2849	1 *
3.	88	2906	1 *
4.	175	3144	1 **
5.	351	3649	1, 2, 3 ** 4 *
6.	526	4063	1, 2, 3, 4 **

Green leaf weight was influenced in a highly significant way as potassium increased in the nutrient solution. Leaves of plants with low potassium supply were shorter and narrower than with ample potassium supply.

Fresh-root weight was not significantly affected by the various levels of potassium; 460 grams for no K and 516 grams of roots per plant for the higher potassium level.

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