Influence of the Number of Fertilizer Applications on Pineapple Yields

George Samuels and Héctor Gandía Díaz[1]

INTRODUCTION

It has been the custom of pineapple growers in Puerto Rico to use large quantities of fertilizers in split applications. The fertilizer is supplied to pineapples in commercial production in from four to six applications per crop, using hand labor, with placement at the base of the plant to leave a good portion in the axils of the leaves. The average application per plant is about 1 ounce of mixed commercial fertilizer which, on a basis of 12,000 plants per acre, amounts to 750 pounds of fertilizer per acre per application. This amounts to 3,000 pounds of fertilizer for four applications and to 4,500 pounds for six.

Until work had been carried out on the control of biological parasitic factors it was the general opinion of many pineapple growers and research workers that, at least under Puerto Rican conditions, the pineapple plant had a poor root system, rooted very slowly, and was a poor feeder. Hence it must be fertilized heavily if good yields were to be obtained. However, this concept has since changed. We now realize that heavy nematode infestation and other insect and disease damage may weaken pineapple plants so that they no longer give a true picture of their own actual nutrient requirements.

It has been shown that pineapple yields can be doubled by treating soils against nematodes and soil-borne insects and by treating the plants against mealybugs (*1*).[2] Fertilizer experiments have revealed that optimum yields of pineapples can be obtained with much lower rates of fertilizer than were formerly used, if soils and plants are properly treated for control of insects (*4*).

After seeing that pineapple plants could grow vigorously and with less fertilizer, if properly treated, it was only natural for the grower to wonder how many fertilizer applications were necessary for good pineapple yields. The answer to this question is most important to the grower, as farm-labor wages are increasing rapidly. Therefore, any change which would decrease man-hours of labor by decreasing the number of fertilizer applications would be welcome. In order to determine whether fertilizer applications could be decreased for pineapples, if they were kept free from diseases and insects,

[1] Agronomist and Associate Horticulturist, respectively, Agricultural Experiment Station, University of Puerto Rico, Río Piedras, P. R.

[2] Italic numbers in parenthesis refer to Literature Cited p. 11.

experiments were initiated by the Agricultural Experiment Station of the University of Puerto Rico. This paper reports the results of such a pineapple-fertilizer experiment at Arecibo.

PROCEDURE

The experiment was planted on a Bayamón sandy clay at Bajadero, Arecibo. This soil is acid, browish-red, permeable, overlaying a deep-red slightly plastic but permeable clay subsoil. Limestone is present at a depth ranging from 6 to 10 feet. The pH of the topsoil and subsoil was 4.5. The field selected was treated with DD mixture (dichloropropane and dichloropropene) to control nematodes and with Aldrin to control white grubs and ants.

The plots consisted of three-row plantings of the Red Spanish variety, 20 plants to a row, or 60 per plot. The plants were 18 inches apart in the row and 1½ feet apart between rows, with a 4½ feet passageway between plots. This gave a plot size of 9 by 30 feet, or about $\frac{1}{161}$ acre. The slips were planted on July 16, 1954, and the fruit was harvested August 9–23, 1955. The fertilizer sources were as follows: Nitrogen from ammonium sulfate (20-percent N), phosphorus from superphosphate (20-percent P_2O_5), and potassium from potassium chloride (60-percent K_2O). The plants were sprayed with iron sulfate ($FeSO_4 \cdot 7H_2O$), on March 16, 1955 and May 15, 1955.

RESULTS

The yields obtained from the various fertilizer treatments are given in table 1. Application at time of planting was equal to or better than two or three applications of the same quantity of fertilizer. For example, 300 pounds of N, 60 pounds of P_2O_5, and 225 of K_2O per acre, when applied at time of planting (treatment 3, table 1), was equally as good if applied in two (treatment 7, table 1) or three applications (treatment 8, table 1).

Aside from this experiment, there has been evidence from other experiments in favor of a lower number of fertilizer applications for pineapples. This evidence is presented in table 2. For the experiment on Coto clay at Isabela (*5*), we see that in all cases yields were not significantly lowered when the lesser number of applications was used. This also held true for the pineapples grown on a Lares clay at Corozal (*4*).

DISCUSSION

The application of all of the fertilizer at time of planting was sufficient to supply the nutrient needs of the crop throughout its growing period without resort to split fertilizer applications. The use of one fertilizer application versus several has been shown to be a valid practice for sugarcane in Puerto Rico (*3*). This, of course, applies to those soils the texture of which

TABLE 1.—*Influence of time and number of fertilizer applications on the yields of a plant crop of Red Spanish pineapples at Arecibo, 1954–55*

Treatment No.	Treatment in pounds per acre			Time and number of fertilizer applications	Mean fruit weight	Yield of fruit per acre
	N	P_2O_5	K_2O			
					Pounds	*Tons*
1	100	20	75	All at time of planting	2.75	16.1
2	150	30	113	do.	2.94	17.2
3	200	40	150	do.	3.11	18.2
4	300	60	225	do.	3.19	18.6
5	150	30	113	½ at planting, ½ at 8 months	2.63	15.3
6	200	40	150	do.	2.86	16.7
7	300	60	225	do.	3.08	18.0
8	300	60	225	3 applications at 1, 4, and 8 months	3.06	17.9
Least significant difference needed between treatments at:						
5-percent level					0.19	1.11
1-percent level					.25	1.46

TABLE 2.—*The influence of the number of fertilizer applications on the yields of pineapples on various soils*

Amount of nitrogen applied per acre		Number of applications	Yields of fruit per acre
Soil and weight of each application	Weight of all applications		
Pounds	*Pounds*		*Tons*
Coto clay:			
80	160	2	12.7
40	160	4	13.3
120	240	2	13.0
80	240	3	13.9
Lares clay:			
84	84	1	12.0
28	84	3	13.0
56	112	2	13.7
28	112	4	13.6
84	168	2	15.8
56	168	3	15.0

Least significant differences needed between treatments at 5-percent level: 2.6.

is heavy enough, or their exchange capacity is high enough, that excessive leaching of plant nutrients does not occur.

The quantity of fertilizer applied rather than the number of applications made appears to be the more important factor for increasing pineapple

yields. For one application at time of planting, doubling the rate of fertilizer application increased yields from 16.1 to 18.2 tons per acre (treatments 1 and 3, table 1). Raising application rates one-half again (treatment 4) did not give significantly higher yields than those for doubling the rate (treatment 3). Where two fertilizer applications were made, increasing the rate applied per application also increased yields. In this instance significant yield increases were obtained when rates were doubled and tripled (table 1, treatments 5, 6, and 7).

The entire matter of split applications of fertilizer for pineapples must be re-examined in light of our present-day knowledge of pineapple nutrition and culture. The practice of using numerous applications of fertilizer for pineapples was based on the knowledge that very poor yields were obtained in the past unless many applications were made. This, of course, was necessary, as the pineapple plant was sick, weak, and starved by the ravages of the biological parasitic factors which attacked it. Before proper attention was given to these factors the pineapple plant's root system was attacked and almost entirely destroyed by nematodes, white grubs, and root rots, and the leaves and stem were invaded by mealybugs. Such a plant could not function normally. The intake of nutrients through the root system was limited. Fertilizer was applied at the base and in the axils of the lower leaves to feed such plants. It was by such spoon-feeding in numerous applications that they were kept in production.

With the proper control of nematode infestation and other insect and disease damage, the pineapple has become almost a different plant in its growth habits. Now it produces a large vigorous root system quite soon after planting. No longer can the plant be uprooted easily at 4 to 5 months of age with a light pull. In this particular experiment at Palo Blanco, Arecibo, the use of two hands and much effort was needed to uproot plants just 1 month after planting. The pineapple plant with a large vigorous root system at its disposal has a large volume of soil from which to extract its nutrients. It is no longer limited to feeding from the axils of its leaves and a few cubic inches of soil surrounding the base of the plant. Therefore, with increases in root volume there is a decrease in number of applications and quantity of fertilizer needed.

Of vital interest to the farmer is the fact that fewer fertilizer applications are needed for growing pineapples. Farm-labor costs are increasing rapidly in Puerto Rico; thus a practice which can save labor means more return to the farmer.

Economic surveys have shown that in 1954–55 labor costs comprised 44 percent of farm costs, and fertilizers 19 percent (*2*). Therefore, if the number of fertilizer applications can be reduced from six to about two or three, and fertilizer rates decreased to about half in many cases, the saving in money to the farmer would be great. It would not be fair to say that

fertilizer applications should be cut to one at time of planting in all cases. However, the evidence presented clearly indicates that fertilizer applications can be reduced without any decrease in yields of pineapples. This, of course, is based on the fact that the pineapple plant is free from any limiting biological parasitic factors and is free to develop a large ample root system, which it is capable of doing.

SUMMARY

Investigation of the number of fertilizer applications needed for optimum yields of Red Spanish pineapple on a Bayamón silty clay at Bajadero, Arecibo showed that:

1. One application at time of planting was equal to, or better than, splitting the same quantities of fertilizer into two or three applications.
2. The total fertilizer applied was more important than number of applications made.

A discussion is presented in which the credit for the lesser number of fertilizer applications is given to the increased vigor of the pineapple plant when kept free from disease and insect attack.

RESUMEN

La investigación llevada a cabo con el objeto de determinar el número de aplicaciones de abono que son necesarias para obtener los rendimientos óptimos de la piña Española Roja, en un suelo Bayamón limo arcilloso ubicado en el barrio Bajadero de Arecibo, reveló lo siguiente:

1. Una sola aplicación de abono al tiempo de la siembra fué igual o mejor que el dividir la misma cantidad de abono y aplicarla en dos o tres ocasiones.
2. La cantidad de abono aplicado en total fué más importante que el número de sus aplicaciones.

En el texto de este trabajo se discute el hecho de que el mayor vigor de la planta de piña, cuando está libre de insectos y enfermedades contribuye al que no haya que hacerle más de una aplicación de abono.

LITERATURE CITED

1. Alvarez García, L. A., and López Matos, L., Influence of root knot nematodes on the decline in vigor of the Red Spanish variety of pineapple in Puerto Rico, *J. Agr. Univ. P. R.* **38** (1) 61–72, 1954.
2. Vázquez Calcerrada, Pablo, Costos e ingresos comparativos entre la empresa de piña y de la caña, Agricultural Economics and Rural Sociology Publication 14, Agr. Exp. Sta. Univ. P. R., Río Piedras, Dec. 1951.
3. Samuels, George, and Capó, B. G., Research with sugarcane fertilizers in Puerto Rico, 1910–54, Tech. Paper 16, Agr. Exp. Sta., Univ. P. R. March 1956.
4. Samuels, George, Landrau, P. Jr., and Olivencia, R., Response of pineapples to the application of fertilizers, *J. Agr. Univ. P. R.* **39** (1) 1–11, 1955.
5. Samuels, George, Alers-Alers, S., and Jackson, G. C., The influence of fertilizers on pineapple yields on a Coto clay, *J. Agr. Univ. P. R.* **42** (1) pp. 12–26, 1958.