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# RESPONSE OF NEMATODE-INFESTED PINEAPPLE CROPS TO INCREASING N-P-K FERTILIZATION

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ABSTRACT

This trial was to determine if the widespread unthriftiness, nutrient deficiency symptoms, low production and poor ratooning observed in pineapple plantings were due to underfertilization or nematode damage, and the response of nematode-damaged plants to increasing N-P-K fertilization. A plot heavily infested with Helicotylenchus multicinctus and Pratylenchus sp. was fumigated with a DD/DBCP mixture before and treated with phenamiphos after planting. A 12-8-30 N-P-K fertilizer was applied to the Smooth Cayenne, Red Spanish or Sugar Loaf varieties at 560, 1120 or 1680 kg/ha/year.

At 5, 9, 13 and 17 months, plants of the 3 varieties in the nematicide-treated plots were significantly bigger, had much longer roots and significantly less of them were nutrient deficient compared with infested plots. Many more plants in the nematicide-treated areas bore and fruits were significantly larger than in the untreated plots.

In the ratoon crop, the majority of plants in the untreated plots were nutrient deficient compared with significantly less in the nematicide-treated plots. More and larger fruits were borne, particularly with the Sugar Loaf variety, in the nematicide-treated plots.

There was no influence of increasing fertilization whether in nematicide-treated or untreated plots in either crop for any variety. Nematode-damaged pineapple plants were nutrient deficient and grew and produced poorly even with adequate fertilization. The greatest responses to nematode suppression were observed with the Smooth Cayenne variety.

## INTRODUCTION

From 1965 to 1985, pineapple (Ananas comosus (L.) Merr.) production in Jamaica ranged between 6.3 and 14.3 (avg. 10.9) tons/ha (Data Collection and Statistics Branch, Ministry of Agriculture, Kingston 6, Jamaica). These yields are extremely low compared with those reported from other countries. It is generally accepted that pineapple crops in Jamaica have traditionally been underfertilized (Beckford, 1975; Parke, 1976). In almost all fields, many if not most plants exhibit symptoms of N, P or K deficiency such as leaves being light green to yellow or lemon coloured, leaves drying from the tips (starting with older leaves), necrotic spots and/or blisters on leaves, older leaves turning brown and drying up, retarded plant growth, reduced root systems, poor slip, sucker and fruit production, small fruits with large crowns and uneven ripening of fruits (Albrigo, 1966; Beckford, 1975; Cibes & Samuels, 1958 and 1961).

Parasitic nematodes cause significant damage to pineapple roots resulting in retarded plant growth and drastically reduced production (Ayala et al, 1969; Hutton, 1979; Lacoeuilhe, 1978). Hutton (1974 and 1979) found that pineapple plants growing in nematode-infested plots exhibited distinct symptoms of nutrient deficiency, apparently induced as the damaged roots could not take up water and nutrients effectively, but plants in plots treated to control nematodes grew relatively free of nutrient deficiency symptoms; all plants had been adequately fertilized. Several genera of nematodes having the potential to cause substantial damage to the crop are associated with pineapple plantings all over Jamaica (Hutton et al, 1982). There was a question then as to whether the widespread nutrient deficiency observed in pineapple fields in Jamaica was due to lack of or insufficient fertilization and/or to root damage by nematodes.

This trial investigated how pineapple plants would respond to increasing levels of N-P-K fertilization where populations of parasitic nematodes were high or suppressed.

MATERIALS AND METHODS

Red Spanish, Smooth Cayenne and Sugar Loaf, the 3 pineapple varieties mainly grown in Jamaica were used. The trial plot, a 80 x 12.5 m bed recently taken out of pineapple, was extremely heavily infested with Helicotylenchus multicinctus (Cobb) Golden (over 800/100 ml soil) and Pratylenchus sp. (over 40/gm root) at the end of the crop. The soil was a heavy clay of pH 5.0 - 5.5.

Recently harvested suckers, stripped and treated to control the mealy bug (Dysmicoccus brevipes, Ckll.), were planted in double rows along the bed. Suckers were spaced 0.6 m across the double row and 0.3 m in the row with an interval of 1.3 m between double rows giving a plant population of 35,800/ha. A plot was 6.4 m of a double row (40 plants/plot).

Three weeks before planting, a mixture of DD (1,3-dichloropropene and 1,2-dichloropropane), 390 l/ha and DBCP (1,2-dibromo-3-chloropropane), 16.8 l/ha was applied to designated plots with a hand injector. This mixture, previously recommended for fumigating pineapple fields, was regarded as the best treatment to disinfest the plots for the purposes of this trial. Phenamiphos (Ethyl-3-methyl-4-(methyl thio) phenyl(1-methylethyl) phosphoramidate) was applied to these plots every 4 months for 1 year after planting at the rate of 20 kg a.i./ha/application; the granules were sprinkled over the plants to make some fall into the leaf axils and some to the ground. A 12-8-30 N-P-K inorganic fertilizer was applied to nematicide-treated and untreated plots in 3 applications per year to give total rates of 560, 1120 or 1680 kg/ha; the lowest was the recommended rate. The 6 treatments were replicated 4 times in a randomised complete block design per variety, each variety occupying a block of the bed.

The entire bed received a blanket treatment of urea at 336 kg/ha/year in 3 applications. Other cultural practices (insect and weed control, etc.) were those normally carried out at Broom Hall Estate, Cave Valley, St. Ann where this trial was sited.

Plant Crop

Five, 9, 13 and 17 months after planting, a randomly selected plant was carefully dug up and removed from each plot; the plant was weighed and the 3 longest roots measured. At the same intervals, the plants exhibiting nutrient deficiency symptoms were estimated.

Three, 7 and 11 months after planting, parasitic nematodes occurring in soil and root samples taken from each plot were identified and counted.

The number of plants that bore and weight of the fruits harvested from each plot were recorded up to 19 months; at 20 months after planting, slips and suckers borne by the Smooth Cayenne plants were counted.

Ratoon Crop

At 28 months, the plants exhibiting nutrient deficiency symptoms were estimated. Up to 30 months, records were made of plants per plot that bore and of fruit weights. Suckers borne by Smooth Cayenne plants were counted at 30 months when the trial was terminated.

RESULTS

Plant Crop

At 5, 9, 13 and 17 months after planting, Red Spanish, Smooth Cayenne or Sugar Loaf pineapple plants in the nematicide-treated plots were significantly bigger than those in untreated plots (Table 1). Overall, Sugar Loaf plants were largest. Plants in the nematicide-treated plots also bore significantly longer roots than those in nematode-infested plots (Table 2); Red Spanish plant roots were longest and Smooth Cayenne roots shortest.

For the first 17 months after planting, only a small proportion of Red Spanish, Smooth Cayenne or Sugar Loaf plants in the nematicide-treated plots displayed symptoms of nutrient deficiency but significantly more Red Spanish and Sugar Loaf and virtually all Smooth Cayenne plants in the untreated plots were nutrient deficient (Table 3). In the untreated plots, less Sugar Loaf plants manifested nutrient deficiency symptoms compared with the 2 other varieties but in the nematicide-treated plots, more Smooth Cayenne and Sugar Loaf plants were nutrient deficient than Red Spanish plants.

For the 3 pineapple varieties, significantly more plants from the nematicide-treated plots bore compared with untreated plots and fruits from the treated plots were significantly larger. Thus, highest overall yields were produced in the nematicide-treated plots. The Smooth Cayenne and Red Spanish varieties had the highest percentages of bearing plants in the nematicide-treated plots while Sugar Loaf and Smooth Cayenne varieties bore the largest fruits (Table 4).

Twenty months after planting, Smooth Cayenne plants in the nematicide-treated plots bore significantly more slips and suckers than plants in the untreated plots (Table 4).

The nematicide treatments effectively suppressed populations of parasitic nematodes over the first year as 3, 7, and 11 months after planting, substantially higher numbers of them were found in soil and root samples from untreated plots than in the nematicide-treated plots (Table 5). Helicotylenchus multicinctus was found in every soil sample and Pratylenchus sp. in every root sample. Criconemoides sp. was also present in many soil samples.

There was no evidence that any of the 3 pineapple varieties showed a noticeable response to the increasing levels of fertilization as measured by plant size, root length, nutrient deficient or healthy plants nor in bearing plants and fruit size whether in nematicide-treated or untreated plots, nor in slip or sucker production by Smooth Cayenne plants.

Table 1. Weight of pineapple plants in nematode-infested or nematicide-treated plots receiving varying amounts of a N-P-K fertilizer.

| Pineapple Varieties | Treatments* | Plant weight (kg) | | | |
|---|---|---|---|---|---|
| | | 5 months | 9 months | 13 months | 17 months |
| Red Spanish | N- and F low | $0.45^{a}$ | $1.11^{b}$ | $1.05^{b}$ | $1.39^{a}$ |
| | N- and F med. | $0.68^{b}$ | $0.60^{a}$ | $0.68^{a}$ | $1.56^{a}$ |
| | N- and F high | $0.40^{a}$ | $0.77^{a}$ | $0.94^{b}$ | $1.48^{a}$ |
| | N+ and F low | $0.94^{c}$ | $1.28^{b}$ | $2.10^{c}$ | $2.07^{b}$ |
| | N+ and F med. | $0.99^{c}$ | $1.11^{b}$ | $1.59^{c}$ | $2.95^{c}$ |
| | N+ and F high | $0.82^{c}$ | $1.16^{b}$ | $1.50^{c}$ | $2.70^{c}$ |
| Smooth Cayenne | N- and F low | $0.34^{a}$ | $0.37^{a}$ | $0.34^{a}$ | $0.45^{a}$ |
| | N- and F med. | $0.54^{a}$ | $0.67^{ab}$ | $0.48^{a}$ | $0.65^{a}$ |
| | N- and F high | $0.40^{a}$ | $0.45^{a}$ | $0.34^{a}$ | $0.43^{a}$ |
| | N+ and F low | $0.65^{b}$ | $1.18^{c}$ | $1.05^{b}$ | $1.62^{b}$ |
| | N+ and F med. | $0.74^{b}$ | $0.87^{b}$ | $1.50^{c}$ | $2.24^{c}$ |
| | N+ and F high | $0.71^{b}$ | $1.38^{c}$ | $1.61^{c}$ | $1.56^{b}$ |
| Sugar Loaf | N- and F low | $0.94^{b}$ | $0.96^{a}$ | $1.90^{a}$ | $2.36^{b}$ |
| | N- and F med. | $1.08^{bc}$ | $1.70^{bc}$ | $1.59^{a}$ | $0.85^{a}$ |
| | N- and F high | $0.48^{a}$ | $1.49^{b}$ | $1.90^{a}$ | $2.64^{b}$ |
| | N+ and F low | $1.02^{bc}$ | $1.46^{b}$ | $1.70^{a}$ | $3.35^{c}$ |
| | N+ and F med. | $1.05^{bc}$ | $2.20^{c}$ | $2.64^{b}$ | $3.89^{c}$ |
| | N+ and F high | $1.56^{c}$ | $1.87^{bc}$ | $2.50^{b}$ | $3.06^{c}$ |

*N- = no nematicidal treatment. N+ = nematicidal treatment (a mixture of DD (390 l/ha) and DBCP (16.8 l/ha) before planting then phenamiphos (20 kg a.i./ha) every 4 months for a year after planting).
F low, F med., F high = 560, 1120 or 1680 kg/ha of a 12-8-30 fertilizer per year in 3 applications.
abc
For each pineapple variety, means in any column followed by different letters are significantly different (5%, Duncan's Multiple Range Test).

Ratoon Crop

At 28 months, significantly more Red Spanish, Smooth Cayenne or Sugar Loaf plants in untreated plots showed symptoms of nutrient deficiency than those in nematicide-treated plots (Table 6). In the nematicide-treated areas, the lowest proportions of nutrient deficient plants were found with the Sugar Loaf variety. For any variety, more ratoon plants in the nematicide-treated plots were nutrient deficient than first crop plants.

At 30 months, significantly more plants of any variety in the nematicide-treated plots had fruited than in the untreated plots. In the nematicide treated plots, more Sugar Loaf and Red Spanish plants bore than Smooth Cayenne plants but for the 3 varieties, significantly larger fruits were

Table 2. Length of roots of pineapple plants in nematode-infested or nematicide-treated plots receiving varying amounts of a N-P-K fertilizer.

| Pineapple Varieties | Treatments* | Root length (cm) | | | |
|---|---|---|---|---|---|
| | | 5 months | 7 months | 13 months | 17 months |
| Red Spanish | N- and F low | $11.0^{a}$ | $22.0^{a}$ | $20.3^{a}$ | $32.0^{a}$ |
| | N- and F med. | $7.8^{a}$ | $18.5^{a}$ | $18.0^{a}$ | $42.0^{b}$ |
| | N- and F high | $3.5^{a}$ | $18.0^{a}$ | $38.5^{b}$ | $26.0^{a}$ |
| | N+ and F low | $48.0^{b}$ | $40.8^{b}$ | $69.0^{c}$ | $41.0^{b}$ |
| | N+ and F med. | $33.3^{b}$ | $39.8^{b}$ | $47.5^{b}$ | $36.5^{c}$ |
| | N+ and F high | $40.8^{b}$ | $44.0^{b}$ | $70.8^{c}$ | $83.5^{c}$ |
| Smooth Cayenne | N- and F low | $3.0^{a}$ | $7.8^{a}$ | $6.3^{a}$ | $10.5^{a}$ |
| | N- and F med. | $6.8^{a}$ | $6.0^{a}$ | $8.0^{a}$ | $7.5^{a}$ |
| | N- and F high | $3.3^{a}$ | $7.8^{a}$ | $4.8^{a}$ | $12.5^{a}$ |
| | N+ and F low | $29.5^{b}$ | $41.0^{b}$ | $28.0^{b}$ | $41.5^{b}$ |
| | N+ and F med. | $28.3^{b}$ | $23.5^{b}$ | $54.3^{b}$ | $53.5^{b}$ |
| | N+ and F high | $23.5^{b}$ | $34.5^{b}$ | $41.5^{b}$ | $48.5^{b}$ |
| Sugar Loaf | N- and F low | $17.8^{a}$ | $20.0^{ab}$ | $26.0^{a}$ | $23.0^{a}$ |
| | N- and F med. | $17.3^{a}$ | $22.5^{ab}$ | $17.5^{ab}$ | $19.0^{a}$ |
| | N- and F high | $9.5^{a}$ | $14.5^{a}$ | $39.5^{b}$ | $56.5^{b}$ |
| | N+ and F low | $29.5^{b}$ | $38.0^{ab}$ | $40.2^{ab}$ | $47.5^{b}$ |
| | N+ and F med. | $34.5^{b}$ | $28.0^{b}$ | $41.2^{b}$ | $42.0^{b}$ |
| | N+ and F high | $40.5^{b}$ | $38.0^{b}$ | $53.5^{b}$ | $46.5^{b}$ |

*N- = no nematicidal treatment. N+ = nematicidal treatment (a mixture of DD (390 l/ha) and DBCP (16.8 l/ha) before planting then phenamiphos (20 kg a.i./ha) every 4 months for a year after planting).
F low, F med., F high = 560, 1120 or 1680 kg/ha of a 12-8-30 fertilizer per year in 3 applications.

$^{abc}$For each pineapple variety, means in any column followed by different letters are significantly different (5%; Duncan's Multiple Range Test).

borne in the treated plots; Sugar Loaf fruits were largest. Many more suckers were borne by Smooth Cayenne plants in the treated plots (Table 6).

No response was shown by any variety to the increasing levels of fertilization as indicated by plants exhibiting nutrient deficiency, bearing plants, fruit weight nor Smooth Cayenne plants which suckered.

DISCUSSION

Pre-planting fumigation of soil followed by after-planting nematicide treatments to plants and soil every 4 months for 1 year brought about and maintained suppression of populations of parasitic nematodes over this period allowing early development of good root systems and large Red Span-

Table 3. Nutrient deficient pineapple plants in nematode-infested or nematicide-treated plots receiving varying amounts of a N-P-K fertilizer.

| Pineapple Varieties | Treatments* | Nutrient deficient plants (%) | | | |
|---|---|---|---|---|---|
| | | 5 months | 9 months | 13 months | 17 months |
| Red Spanish | N- and F low | 79[a] | 60[a] | 83[a] | 80[a] |
| | N- and F med. | 100[a] | 74[a] | 99[a] | 84[a] |
| | N- and F high | 90[a] | 79[a] | 95[a] | 85[a] |
| | N+ and F low | 3[b] | 1[b] | 2[b] | 8[b] |
| | N+ and F med. | 3[b] | 3[b] | 3[b] | 6[b] |
| | N+ and F high | 1[b] | 0[b] | 0[b] | 4[b] |
| Smooth Cayenne | N- and F low | 100[a] | 100[a] | 100[a] | 99[a] |
| | N- and F med. | 100[a] | 100[a] | 99[a] | 98[a] |
| | N- and F high | 100[a] | 100[a] | 100[a] | 100[a] |
| | N+ and F low | 15[b] | 14[b] | 12[b] | 16[b] |
| | N+ and F med. | 9[b] | 8[b] | 7[b] | 13[b] |
| | N+ and F high | 11[b] | 15[b] | 20[b] | 23[b] |
| Sugar Loaf | N- and F low | 79[a] | 53[a] | 68[a] | 50[a] |
| | N- and F med. | 77[a] | 42[a] | 53[a] | 49[a] |
| | N- and F high | 88[a] | 58[a] | 59[a] | 44[a] |
| | N+ and F low | 8[b] | 4[b] | 16[b] | 16[b] |
| | N+ and F med. | 10[b] | 3[b] | 8[b] | 13[b] |
| | N+ and F high | 0[b] | 3[b] | 1[b] | 12[b] |

*N- = no nematicidal treatment. N+ = nematicidal treatment (a mixture of DD (390 l/ha) and DBCP (16.8 l/ha) before planting then phenamiphos (20 kg a.i./ha) every 4 months for a year after planting).
F low, F med., F high = 560, 1120 or 1680 kg/ha of a 12-8-30 fertilizer per year in 3 applications.

[ab] For each pineapple variety, means in any column followed by different letters are significantly different (5%; Duncan's Multiple Range Test).

Table 4. Fruit production by plant crop pineapple plants in nematode-infested or nematicide-treated plots receiving varying amounts of a N-P-K fertilizer.

| Pineapple Varieties | Treatments* | Plants bearing at 19 months (%) | Average fruit wt. (kg) | Calculated yield (tons/ha) | Slips/suckers per plot at 20 months |
|---|---|---|---|---|---|
| Red Spanish | N- and F low | 69[a] | 0.59[ab] | 12.5 | - |
| | N- and F med. | 59[a] | 0.56[ab] | 10.3 | - |
| | N- and F high | 72[ab] | 0.50[a] | 11.2 | - |
| | N+ and F low | 94[c] | 0.75[ab] | 22.2 | - |
| | N+ and F med. | 88[bc] | 0.91[b] | 25.0 | - |
| | N+ and F high | 95[c] | 0.91[b] | 27.0 | - |
| Smooth Cayenne | N- and F low | 11[a] | 0.62[a] | 2.1 | 1/2[a] |
| | N- and F med. | 14[a] | 0.47[a] | 2.2 | 0/2[a] |
| | N- and F high | 7[a] | 0.58[a] | 1.3 | 0/2[a] |
| | N+ and F low | 91[b] | 1.35[b] | 41.7 | 20/18[b] |
| | N+ and F med. | 90[b] | 1.43[b] | 43.9 | 24/18[b] |
| | N+ and F high | 90[b] | 1.34[b] | 40.9 | 24/21[b] |
| Sugar Loaf | N- and F low | 40[a] | 1.19[ab] | 13.1 | - |
| | N- and F med. | 54[ab] | 0.95[a] | 14.1 | - |
| | N- and F high | 49[ab] | 1.16[ab] | 14.8 | - |
| | N+ and F low | 53[ab] | 1.43[bc] | 20.9 | - |
| | N+ and F med. | 62[b] | 1.54[c] | 26.4 | - |
| | N+ and F high | 61[b] | 1.39[bc] | 23.2 | - |

*N- = no nematicidal treatment. N+ = nematicidal treatment (a mixture of DD (390 l/ha) and DBCP (16.8 l/ha) before planting then phenamiphos (20 kg a.i./ha) every 4 months for a year after planting). F low, F med., F high = 560, 1120 or 1680 kg/ha of a 12-8-30 fertilizer per year in 3 applications.

[abc]For each pineapple variety, means in any column followed by different letters are significantly different (5%; Duncan's Multiple Range Test).

ish, Smooth Cayenne and Sugar Loaf pineapple plants few of which showed nutrient deficiency. Most of these plants bore a large fruit; in fact, production was substantially higher than normal for Jamaica and the over 40 tons/ha averaged by the Smooth Cayenne variety was comparable with yields realised in other countries where management is optimal.

On the other hand, soil about and roots of plants in the plots which did not receive the nematode control treatments were always heavily infested with parasitic nematodes. Plants in these plots had poorly developed root systems, were stunted, the majority if not all were nutrient deficient and in general, the greater proportion of them did not bear and mainly small fruits were produced. In this instance, production was at the same levels or even lower than normal for Jamaica.

The initial vigour and subsequent development of pineapple crops depend on the roots produced early in the life of the plants. The success of ratoon crops is determined by the health and vigour of the early root systems produced by the plant crop. Any condition detrimental to the develop-

Table 5. Numbers[a] of parasitic nematodes[b] associated with pineapple plants in nematode-infested or nematicide-treated plots receiving varying amounts of a N-P-K fertilizer.

| Pineapple Varieties | Treatments* | Three months (Soil) | Seven months (Soil/Root) | Eleven months (Soil/Root) |
|---|---|---|---|---|
| Red Spanish | N- and F1, Fm or Fh | 214 | 227/315 | 528/ 90 |
| | N+ and F1, Fm or Fh | 11 | 25/158 | 60/ 0 |
| Smooth Cayenne | N- and F1, Fm or Fh | 190 | 419/330 | 86/ 90 |
| | N+ and F1, Fm or Fh | 23 | 125/ 6 | 0/ 0 |
| Sugar Loaf | N- and F1, Fm or Fh | 126 | 161/223 | 360/125 |
| | N+ and F1, Fm or Fh | 5 | 10/120 | 9/ 0 |

[a]Counts represent nematodes per 100 ml soil or per gram root.

[b]Helicotylenchus multicinctus was present in every soil sample and Pratylenchus sp. in roots.

*N- = no nematicidal treatment. N+ = nematicidal treatment (a mixture of DD (390 l/ha) and DBCP (16.8 l/ha) before planting then phenamiphos (20 kg a.i./ha) every 4 months for a year after planting).
F1, Fm or Fh = 560, 1120 or 1680 kg/ha of a 12-8-30 fertilizer per year in 3 applications.

Table 6. Plants exhibiting nutrient deficiency and fruit production by ratoon crop pineapple plants in nematode-infested or nematicide-treated plots receiving varying amounts of a N-P-K fertilizer.

| Pineapple Varieties | Treatments* | Plants with nutrient deficiency symptoms at 28 months (%) | Plants bearing at 30 months (%) | Avg. fruit wt. (kg) | Calculated yield (tons/ha) | Plants bearing suckers at 30 months (%) |
|---|---|---|---|---|---|---|
| Red Spanish | N- and P low | 93[a] | 24[a] | 0.80[ab] | 4.6 | - |
| | N- and P med. | 79[a] | 23[a] | 0.45[a] | 2.5 | - |
| | N- and P high | 85[a] | 20[a] | 0.68[a] | 3.3 | - |
| | N+ and P low | 37[b] | 54[b] | 0.91[b] | 11.9 | - |
| | N+ and P med. | 35[b] | 56[b] | 0.85[b] | 11.5 | - |
| | N+ and P high | 21[b] | 55[b] | 1.08[b] | 14.4 | - |
| Smooth Cayenne | N- and P low | 95[a] | 24[b] | 0.34[a] | 2.2 | 5[a] |
| | N- and P med. | 100[a] | 29[b] | 0.34[a] | 2.7 | 2[a] |
| | N- and P high | 100[a] | 9[a] | 0.23[a] | 0.6 | 1[a] |
| | N+ and P low | 74[b] | 29[b] | 0.80[b] | 6.2 | 28[b] |
| | N+ and P med. | 54[b] | 32[b] | 0.85[b] | 7.3 | 33[b] |
| | N+ and P high | 61[b] | 31[b] | 0.85[b] | 7.1 | 27[b] |
| Sugar Loaf | N- and P low | 90[a] | 38[ab] | 0.97[a] | 10.2 | - |
| | N- and P med. | 86[a] | 43[ab] | 0.97[a] | 11.5 | - |
| | N- and P high | 85[a] | 34[a] | 0.91[a] | 8.6 | - |
| | N+ and P low | 30[bc] | 58[c] | 1.70[b] | 27.5 | - |
| | N+ and P med. | 48[b] | 53[bc] | 1.31[b] | 19.2 | - |
| | N+ and P high | 25[c] | 64[c] | 1.42[b] | 25.3 | - |

*N- = no nematicidal treatment. N+ = nematicidal treatment (a mixture of DD (390 l/ha) and DBCP (16.8 l/ha) before planting then phenamiphos (20 kg a.i./ha) every 4 months for a year after planting). P low, P med., P high = 560, 1120 or 1680 kg/ha of a 12-8-30 fertilizer per year in 3 applications.

[a,b,c]For each pineapple variety, means in any column followed by different letters are significantly different (5%; Duncan's Multiple Range Test).

ment of good early root systems by pineapple plants will result in corresponding poor plant growth (Godfrey, 1936). Damage by parasitic nematodes will establish such conditions. It seems that pineapple plants recover slowly or not at all from severe damage to or loss of early roots and furthermore, these plants do not appear to have the capacity to replace damaged or lost roots. Nematode control would therefore ensure protection of early roots and facilitate subsequent good plant growth and development.

Pineapple growers derive some income from selling planting material, mainly suckers, and avoid expenditure by establishing new fields with their own. The Red Spanish and Sugar Loaf varieties sucker satisfactorily in Jamaica but the Smooth Cayenne has been noticed to sucker sparsely. This was evident in the untreated plots but every Smooth Cayenne plant in the nematicide-treated plots bore at least 1 sucker and several slips.

From the response of the pineapple varieties used in this trial, the Smooth Cayenne was determined to be most susceptible to nematode damage and the Sugar Loaf most resistant. Previous investigations have found that the Smooth Cayenne is more affected by nematode damage than Red Spanish (Ayala *et al*, 1969; Hutton, 1974).

An indifferent response to increasing levels of fertilization was observed among the Red Spanish, Smooth Cayenne and Sugar Loaf pineapple varieties whether in nematicide-treated or nematode-infested areas. Lacoeuilhe (1978) showed that N-P-K fertilization of pineapple must be precise in timing and placement if crops are to utilize the fertilizer effectively. In this trial, application of the N-P-K fertilizer might not have been precise in timing or placement. Also, this trial was laid down on a bed just previously planted to pineapple and residual nutrients would have been available to the plants. It is difficult to find other explanations for the lack of response. However, this investigation confirmed that nematode-damaged pineapple plants will be nutrient deficient even in soils which are adequately fertilized. Apparently, damaged and severely reduced root systems are ineffective in taking up water and available nutrients. Lacoeuilhe (1978) found as well that nematode-damaged pineapple plants did not utilize adequate supplies of inorganic fertilizers, whatever the character of the fertilizers or the manner of placement; nematode effects were significant on the plant crop and moreso on the ratoon crop.

It seems clear that in nematode-infested pineapple fields, applying nematode control measures prior to and after planting is of paramount importance, but the pre-planting disinfestation treatment is highly significant. Heavy fertilization is of little benefit to nematode-damaged pineapple plants. It seems as well that the widespread nutrient deficiency symptoms observed in pineapple fields in Jamaica are due more to nematode damage than to insufficient fertilization.

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REFERENCES


Albrigo, L.G. 1966. Pineapple nutrition. In: N.F. Childers (Ed.) Nutrition of Fruit Crops: Tropical, Sub-Tropical, Temperate Tree and Small Fruits. Horticultural Publications, Rutgers - The State Univ., New Jersey, U.S.A. pp 611-650.

Ayala, A., E. Gonzalez-Tejera and H. Irizarry. 1969. Pineapple nematodes and their control. In: J.E. Peachey (Ed.) Nematodes of Tropical Crops. Technical Communication No. 40. Commonwealth Bureau of Helminthology, St Albans, Herts, England. C.A.B. pp 210-224.

Beckford, H.A. 1975. Growth and yield response of pineapple to nitrogen and potassium on two soil types in Jamaica. Ph.D. Thesis, Dept. of Botany, the University of the West Indies, Mona, Jamaica. 195pp.

Cibes, H. and G. Samuels. 1958. Mineral-deficiency symptoms displayed by Red Spanish pineapple plants grown under controlled conditions. University of Puerto Rico, Agr. Exp. Sta., Rio Piedras, Puerto Rico. Tech. Paper 25. 32pp.

Cibes, H. and G. Samuels. 1961. Mineral-deficiency symptoms displayed by Smooth Cayenne pineapple plants grown under controlled conditions. University of Puerto Rico, Agr. Exp. Sta., Rio Piedras, Puerto Rico. Tech. Paper 31. 30pp.

Godfrey, G.H. 1936. The pineapple root system as affected by the root-knot nematode. Phytopathology 26: 408-428.

Hutton, D.G. 1974. Response of two pineapple varieties to select nematicides. In: C.W.D. Brathwaite, R.H. Phelps and F.D. Bennett (Ed.) Crop Protection in the Caribbean. Proc. of a Symposium on the Protection of Horticultural Crops in the Caribbean, U.W.I., Trinidad, 1974. pp 107-117.

Hutton, D.G. 1979. Nematology. In: Investigations 1977/78. Bull. No. 67, (New Series), Ministry of Agriculture, Jamaica. pp 23-48.

Hutton, D.G., P.L. Coates-Beckford and S.A.E. Eason-Heath. 1982. Parasitic nematodes associated with various plant species in Jamaica, 1949-1981. In: Proceedings of the Third Research and Planning Conference on Root-Knot Nematodes, Meloidogyne spp. January, 1982. International Meloidogyne Project (Region 1), IDIAP, Panama City, Panama. pp 92-108.

Lacoeuilhe, J.J. 1978. La fumare N-K de l'ananas en Cote d'Ivoire. Fruits 33(5): 341-348.

Parke, A. 1976. Fertilizer trial on pineapples (Smooth Cayenne Variety) 1973-1974. In: Investigations 1970-1974. Bull. No. 64, (New Series), Ministry of Agriculture, Jamaica. p 21.