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PRELIMINARY STUDY INTO NUTRIENT EFFECT ON PLANT GROWTH, PRODUCTION AND SELECTED PESTS AND DISEASES INCIDENCE IN SCOTCH BONNET PEPPER

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ABSTRACT

Scotch Bonnet pepper is a non-traditional export crop, with an expanding market. It is also an important ingredient in jerk seasonings and the local cuisine. Production and productivity are often hampered by poor agronomic management and attacks from a range of pests and diseases particularly TEV and PVY. Previous studies have shown varying response to nutrient application. On the basis of the crop demand and preliminary pot studies, levels of N, P, and K were proposed. The study was a RCB with four replicates of five treatments.

Seedlings were established 60 cm apart in rows that were 90 cm apart. The levels of nutrient used were: T1 (control, no fertilizer); T2 (187 kg N/ha, 31 kg P/ha, 75 kg K/ha); T3 (374 kg N/ha, 62 kg P/ha, 150 kg K/ha); T4 (748 kg N/ha, 62 kg P/ha, 300 kg K/ha); and T5 (foliar application of N15:P30:K30). The N and K were split into three applications. The P was applied with a third of the N and K seven days after transplanting. The nutrient effect on plant growth, production and the relationships between nutrient levels and pest and disease incidence were studied on the Bodles Research Station.

The results showed significant impact of fertilizer on plant height ($P<0.05$), and spread (length x width) ($P<0.05$) as well as number of fruits ($P=0.036$). There were also significant differences among treatments for aphids and mites ($P<0.001$). The study with several modifications is being evaluated for a second season.

INTRODUCTION

Pepper production

Hot peppers (*Capsicum spp.*) are grown throughout Jamaica and the wider Caribbean. Over the past decade Scotch Bonnet pepper has played an important part in the Jamaican economy being the third largest non-traditional agricultural export crop. Its market potential has been recently reviewed by Reid and Graham (1997). Pepper has found wide-scale use as part of the Caribbean cuisine. It is used in soups and stews for the flavour but it also forms part of the ingredients for salads and a number of dishes. Spicy food is now a specialty even with the fast food industry. Jerk seasoning is peculiar to Jamaica and is now growing in export. The hot pepper fruit is a rich source of Vitamins C and A and can also be used fresh, dried or processed into sauces or pickles.

The hot pepper crop can be produced from sea level to 2000m in areas with precipitation between 750 and 1500mm. Ideally, the rainfall should be well distributed throughout the growing season. However, for optimum production irrigation is strongly recommended, as the crop is susceptible to drought especially in the early stages.

The production of hot pepper in Jamaica increased from 1700 tonnes in 1989 to 9000 tonnes in 1996. There was a decline in production in 1997 which may have been associated with severe drought conditions experienced locally at that time. Hot pepper production (Scotch Bonnet in particular) has also been affected by an increased incidence of viruses.

Although the crop can be grown on a range of soils, a well drained fertile loam or clay loam is desirable. The most suitable pH range is between 6.0 and 7.5. Soil nutrient management is a major problem in need of further study. The soil nutrient requirement and plant nutrient sufficiency levels in *Capsicum spp.* are summarised in Tables 1 and 2.

In recent years several arthropod pests and diseases, especially viruses, have been severely restricting production. The most common viruses include Tobacco etch (TEV), Tobacco mosaic (TMV) and Potato Y (PYV). Tobacco etch and PYV are transmitted by aphids. Other arthropod pests (thrips, gall midges, fruit worms and mealybugs) are proving problematic especially for the export market. The seasonal incidence of hot pepper pests in the major pepper growing areas of Jamaica has been recently reported by Martin et al (1998) while some of the important diseases of hot pepper in the Caribbean have been noted by McDonald and Muller (1992).

Table 1. Generalized nutrient NPK suggestions for soil applications for hot pepper.

Nutrient	Soil nutrient Status	Soil Nutrient Requirement (kg/ha)
N	Low	100-130
P_2O_5	Low High	200 100
K_2O	Low High	200 100

Table 2. Sufficiency range of selected macro-nutrients in pepper leaves.

Macro-nutrients	Sufficiency Range (%)
Nitrogen	4.00 - 6.00
Phosphorus	0.35 - 1,00
Potassium	4.00 - 6.00
Calcium	1.00 - 2.50
Magnesium	0.30 - 1.00

Nutrient studies in hot peppers

There have been several studies on the nutrient requirements of peppers. Robinson and Baker (1992) showed that N had a positive effect on yield, P had a negative effect and the NxP interaction was significant. The levels of N used were 0, 83.5, 194.2, 229.2 kg/ha. For P the values used were 0, 65.5, 98.2, and 196.3 kg/ha. Smith and McGlashan (pers communication) have done a recent pot study to assess different levels of nutrients on Scotch Bonnet pepper. On the basis of their findings and the suggestion of nutrient levels for peppers by Lorenz and Maynard (1986) the treatments used in this study were selected.

This particular study was undertaken as part of the IPM strategy in Jamaica. The main objectives were to assess the effect of varying NPK levels on crop growth and fruit production and pest and disease incidence.

MATERIALS AND METHODS

Scotch Bonnet pepper seedlings were grown at the CARDI greenhouse facilities and transplanted to the experimental plots at Ministry of Agriculture, Bodles Research Station, St Catherine. The seedlings were planted 60 cm within rows and 90 cm between rows with a total of 30 plants per plot. Plots were watered by overhead sprinkler irrigation once or twice weekly.

to no treatment (control plots) showed no deficiency levels of nutrient for the efficient production of a crop.

Table 3. Levels of pH, organic matter, nitrogen, phosphorus, potassium, calcium and magnesium detected in soil samples collected from Scotch Bonnet pepper plots six weeks after transplanting.

Treatment	pH	OM (%)	N (%)	P_2O_5 (mg/kg)	K_2O (mg/kg)	Ca (mg/kg)	Mg (mg/kg)
T1	7.4	2.36	0.14	139	490	5925	1681
T2	7.0	2.67	0.15	315	609	5725	1594
T3	6.9	3.06	0.18	351	810	6050	1531
T4	6.6	2.40	0.17	350	679	5270	1641
T5	7.5	2.69	0.16	220	577	6563	1606
SED (11 df)	0.254	0.371	0.0267	124	153	598.4	177.7
P	0.029	0.387	0.634	0.394	0.355	0.349	0.934

Table 4. Levels of pH, organic matter, nitrogen, phosphorus, potassium, calcium and magnesium detected in soil samples collected from Scotch Bonnet pepper plots 12 weeks after transplanting.

Treatment	pH	OM (%)	N (%)	P_2O_5 (mg/kg)	K_2O (mg/kg)	Ca (mg/kg)	Mg (mg/kg)
T1	7.4	2.13	0.13	93	471	4625	1600
T2	7.2	2.38	0.13	166	556	5088	1528
T3	7.2	2.74	0.16	211	748	5063	1494
T4	7.2	2.02	0.14	81	459	4970	1659
T5	7.6	2.24	0.14	167	612	4738	1500
SED (11 df)	0.302	0.279	0.0189	78.0	131	602.0	103.5
P	0.603	0.167	0.635	0.450	0.237	0.914	0.473

A randomised complete block design was used with 4 replications and 5 treatments. The fertilizer treatments were as follows: T1 (control, no fertilizer); T2 (187 kg N/ha, 31 kg P/ha, 75 kg K/ha); T3 (374 kg N/ha, 62 kg P/ha, 150 kg K/ha); T4 (748 kg N/ha, 62 kg P/ha, 300 kg K/ha); T5 (foliar application of N15:P30:K30). Fertilizer treatments were chosen by consultation among collaborators (MOA, Lincoln University and CARDI) based on experience and published recommendations. The sources of fertilizers were ammonium sulphate, triple superphosphate and muriate of potash. The total amount of phosphorus in each treatment was applied five days after transplanting while N and K were divided into three equal portions and applied one week after transplanting, seven weeks after transplanting and 12 weeks after transplanting (after flowering). The fertilizers were applied in bands (ring) and incorporated into the soil. The fertilizer used in the foliar treatment was 15N:30P:30K soluble fertilizer which was applied every two weeks.

Before planting, composite soil samples were collected from the experimental plots and assessed for N, P, K, Ca, Mg, organic matter (OM) and pH. Additional samples were collected from each plot; 6 weeks after transplanting during vegetative growth of the crop; after flowering (12 weeks after transplanting) and at the end of the experiment (19 weeks after transplanting). These additional samples consisted of four cores taken 15 cm from each of four plants. The cores were taken from the top 15 cm of soil. Fifteen recently expanded leaves were also collected from each plot and assessed for N, P, K, Ca and Mg. The plots were visited weekly and six inner plants were assessed for virus disease symptoms, arthropod pests, plant height and spread and yield. Arthropod incidence was measured by dividing the plants into four sections based on the natural branching pattern and assigning a score from 0 to 4 based on presence or absence on each of these four sections. Yield was assessed as number and weight of fruit.

Data were analysed using GENSTAT statistical software. Overall treatment effects, on nutrient levels in soil and leaf samples as well as on pest incidence, were assessed using analysis of variance.

RESULTS AND DISCUSSION

The mean values for selected soil nutrients, 6, 12 and 19 days after transplanting, shown in Tables 3-5 indicate a difference only in pH value which was lowest for Treatment 4 which had the highest level of nitrogen (748 kg/ N). The nitrogen source used, ammonium sulfate, has an acidifying effect on the soil but this is probably short lived and localised. Organic matter, P, K, Ca and Mg contained in the soil seemed to be adequate for average growth and production of pepper because the plants subjected

Table 5. Levels of pH, organic matter, nitrogen, phosphorus, potassium, calcium and magnesium detected in soil samples collected from Scotch Bonnet pepper plots 19 weeks after transplanting.

Treatment	pH	OM (%)	N (%)	P_2O_5 (mg/kg)	K_2O (mg/kg)	Ca (mg/kg)	Mg (mg/kg)
T1	8.3	1.79	0.14	72	305	4725	1265
T2	7.4	2.26	0.15	124	535	4575	1197
T3	7.0	2.43	0.16	131	718	4425	1153
T4	6.5	2.06	0.16	67	678	4185	1173
T5	8.4	2.25	0.14	176	480	5050	1190
SED (11 df)	0.383	0.238	0.0101	76.4	134	472.3	148.1
P	0.002	0.151	0.159	0.605	0.064	0.475	0.952

Nutrient content in leaf samples collected 6, 12 and 19 weeks after transplanting are shown in Tables 6-8. These compare favourably with suggested values by Lorenz and Maynard (1986) with the exception of calcium which was low.

There were significant differences among fertilizer treatments in the incidence of aphids and mites ($P<0.001$ and $P<0.05$ respectively; Figs 3 and 4). Plots to which the highest amount of nutrients were applied (T4), and which had significantly higher leaf N over time, had significantly higher incidence of aphids and mites than the control. While no insecticides were used in this study, on farm, the higher levels of these pests may result in farmers applying higher levels of pesticides. Increased health and environmental concerns are therefore attached to the higher fertilizer application (T4). This makes the lower levels of fertilizer (T2 and T3) more

Table 8. Nutrient levels in leaf samples collected from Scotch Bonnet pepper plots 19 weeks after transplanting.

Treatment	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
T1	4.00	1.48	3.50	0.62	0.60
T2	4.35	1.18	4.05	0.54	0.52
T3	5.05	1.07	3.88	0.48	0.41
T4	4.76	1.33	3.96	0.51	0.46
T5	4.44	1.73	4.38	0.59	0.49
SED (11 df)	0.462	0.248	0.226	0.0979	0.069
P	0.133	0.136	0.033	0.570	0.151

Table 9. Weight (g) and total number of fruits per plot from eight harvests.

Treatment	ln Total weight (g)	SEM (11d.f)	Total weight of fruits	Ln Total number	Total number of fruits	SEM (11 d.f)
T1	5.22	0.443	185	3.03	20.7	0.376
T2	6.26	0.443	523	4.14	62.8	0.376
T3	6.37	0.443	584	4.25	70.1	0.376
T4	6.10	0.527	446	4.06	58.0	0.448
T5	4.59	0.443	98.5	2.62	13.7	0.376
P	0.069			0.036		

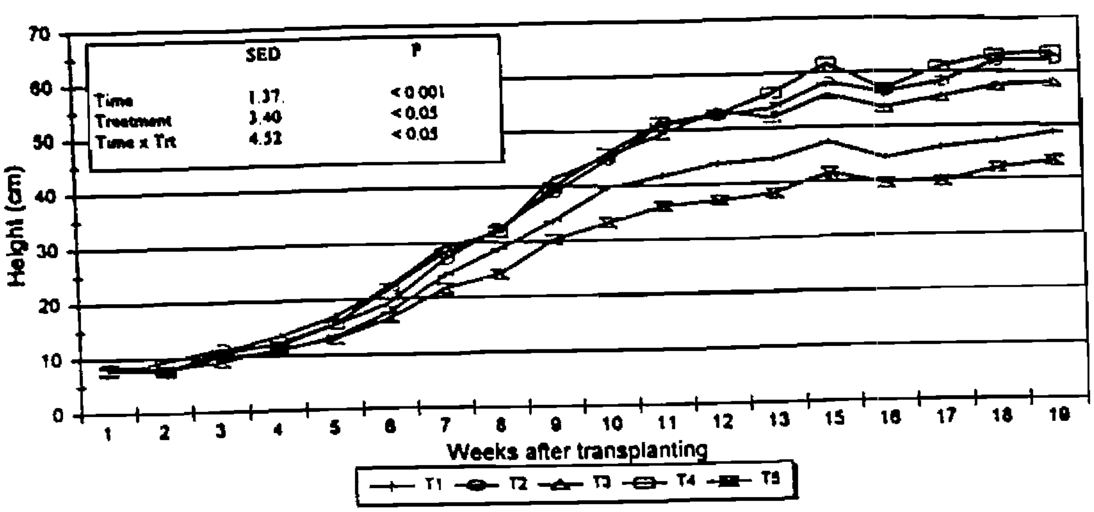

Figure 1. Effect of five fertilizer regimes on height of pepper plants

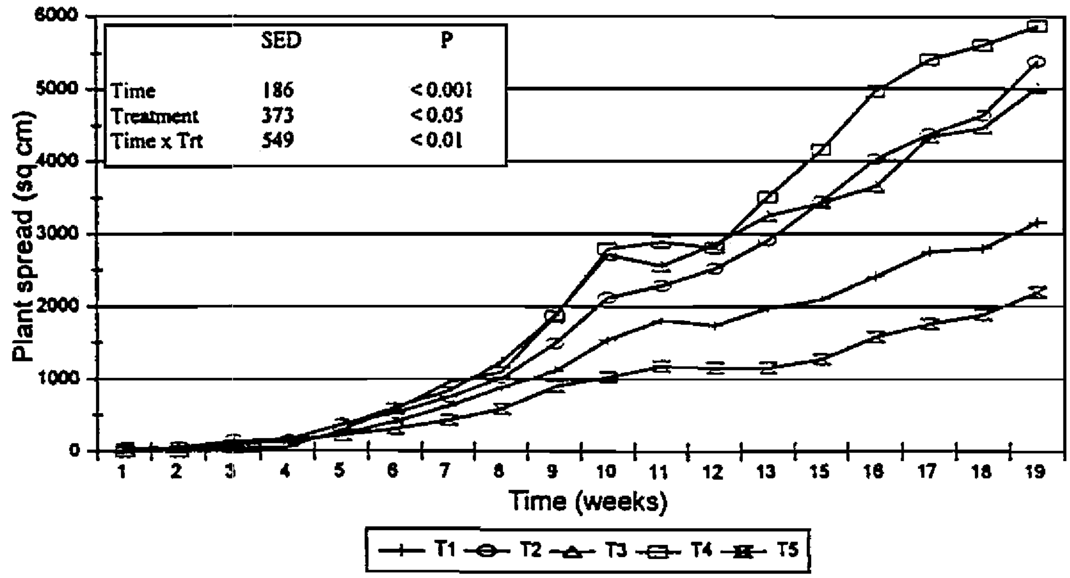

Figure 2. Effect of five fertilizer regimes on plant spread of pepper plants

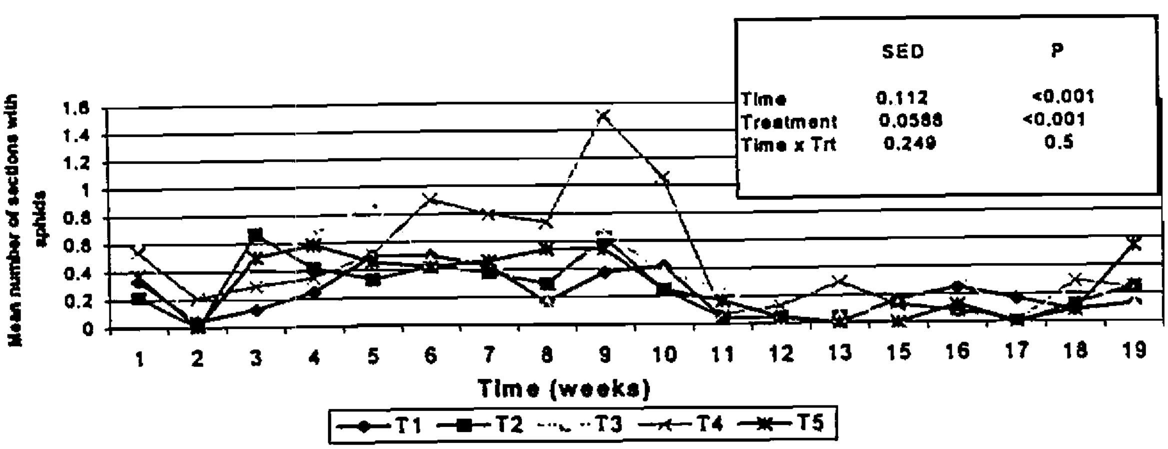

Figure 3. Effect of five fertilizer regimes on aphid count on hot pepper branches over time

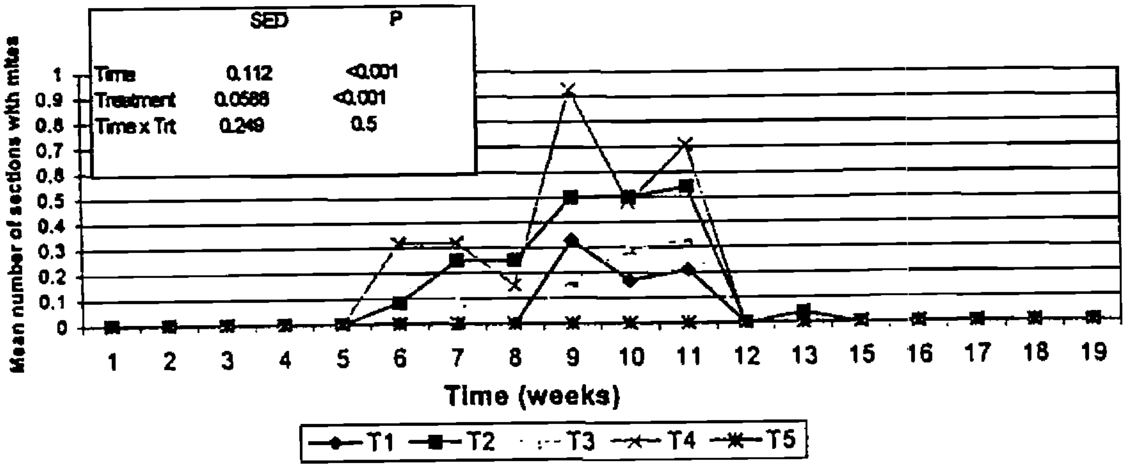

Figure 4. Effect of five fertilizer regimes on mite count on hot pepper branches over time

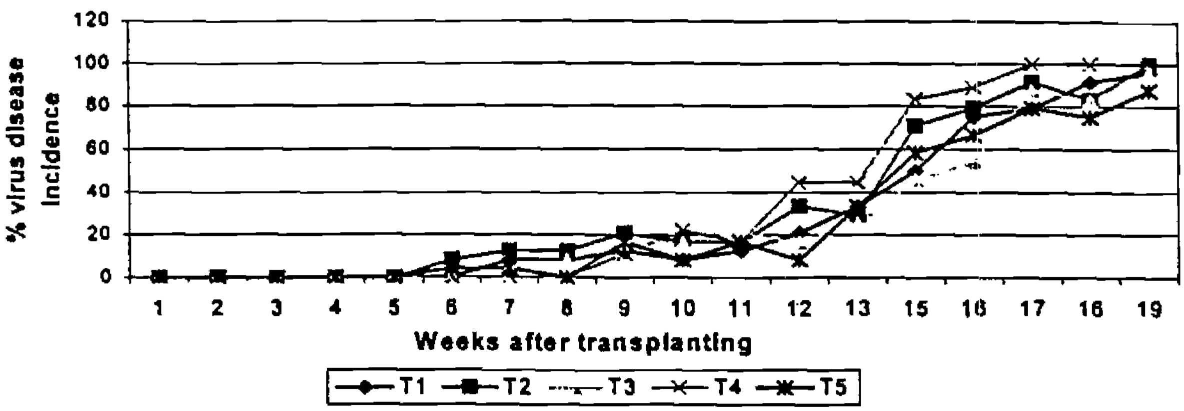

Figure 5 Effect of five fertilizer regimes on virus disease incidence over time

Figure 5. Effect of five fertilizer regimes on virus disease incidence over time

Symptoms of virus disease were detected 6 weeks after transplanting in T2. By week 6 virus disease was in all treatments. One hundred percent infection was reached in week 16 in T4 (Fig 5). The presence of viruses in the plots would have affected the results as other studies (CARDI Jamaica Annual Report, 1998), have shown that viruses reduce the yield of Scotch Bonnet by 50%. Some farmers apply foliar fertilizers to offset the impact of viruses on yield. This study shows that by itself foliar application does not provide adequate nutrient. However, further studies are required to assess the effect of using foliar applied fertilizers in conjunction with soil applied fertilizers.

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