SCREENING OF FIVE ELITE SWEET POTATO CULTIVARS AGAINST RENIFORM NEMATODE (*Rotylenchulus reniformis*) UNDER HUMID AND SEMI-ARID CONDITIONS OF PAPUA NEW GUINEA.

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ABSTRACT

Five elite sweet potato cultivars were tested against reniform nematode to determine the resistance/ tolerance status and the yield losses under wet coastal lowlands and dry lowland conditions of PNG. The cultivars showed varying degrees of above and underground symptoms of nematode infection. The overall nematode population per kilogram of soil was much higher at the Wawin farm than at the Unitech farm irrespective of cultivars. The cultivars B11 and RAB 36 had the highest and lowest nematodes populations but yield/plot in the reverse order respectively, irrespective of the location. Yield losses as non-marketable tuber for B11 ranged from 36.2 – 40.1%, but in case of RAB 36 it was only 4.6 – 8.22%. B11 had the highest tuber cracking of 10 – 22.3% and L676 had between 6.5 – 11.9%. The other three cultivars did not show any cracking symptoms.

Key words. *Sweet potato, resistance, reniform nematode, tuber cracking, yield loss.*

INTRODUCTION

Sweet potato *(Ipomoea batatas* (L.) Lam) is the most common staple food in the highlands and the coastal regions of Papua New Guinea. Most parts of the sweet potato are consumed directly by humans or animals. There are several hundreds of cultivars that grow well both in the highlands and coastal regions of Papua New Guinea (Bourke 1982).

The optimum growing temperature for the growth of sweet potato is 25°C with a pH of 4.3 to 8.7 and rainfall of 900 mm to 1300 mm annually (Hector *et al.* 2002). Sweet potato yields best in sandy loam soil with 25 per cent moisture content than with 40, 60 and 80 per cent moisture content (Hector *et al.* 2002). Production or yield decline in sweet potato may be due to adverse environmental and production factors, such as temperature, rainfall, soil fertility and soil pH, etc. However, diseases can also play a significant role in reducing the yield (Clark and Moyer 1988).

Plant parasitic nematodes are recognized worldwide as a potentially serious constrains to crop productivity. The reniform nematode (*Rotylenchulus spp.*), primarily occurs in tropical and sub-tropical area; and also occurs in some temperate areas. It is one of the most destructive pathogens of sweet potato affecting both yield and quality of the crop (Clark and Moyer 1988). Reniform nematode can cause substantial yield loss in sweet potato (Clark and Wright 1983; Thomas and Clark 1983), if proper management is not practiced.

Rotylenchulus reniformis is an important semi-endoparasitic pest of many crops, especially in warmer climates. It is the principal nematode damaging cotton in Egypt and in parts of the United States. This nematode also attacks tomato, soybean, and pineapple among other crops. It is also found in other tropical and subtropical areas of the world where sweet potato is grown (Birchfield and Martin 1965).

Evidence of root damage by *Rotylenchulus reniformis* is clear. Population can rise to very high levels; up to almost 10,000/100 cm^3 of soil and at this level the mineral balance of the host is disturbed. The reniform nematodes also cause severe cracking on roots (Clark and Wright 1983) affecting the quality and making them unsuitable for selling and human consumption.

Rotylenchulus reniformis is present in several Pacific Island nations, including Papua New Guinea and has been rated as an important and destructive nematode of sweet potato throughout the world (Birchfield and Martin 1965; Bridge 1988). In Papua New Guinea, however, there is inadequate information on this pathogen infecting sweet potato. As the high status food security crop in this nation, it is important that any pathogenic agents affecting its productivity are ade-

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quately investigated and documented so that the stakeholders, researchers and others can benefit from this information. So, two field experiments were conducted with the following objectives:

1. To screen five elite sweet potato cultivars against the reniform nematode to determine their resistance/tolerance levels.

2. To estimate the yield losses due to reniform nematode under field conditions of humid lowlands and semi-arid regions of Papua New Guinea.

MATERIALS AND METHODS

Site Selection

The field experiments were conducted at two locations, namely Wawin National High School farm, in Morobe Province and Agriculture Farm of the Papua New Guinea University of Technology during 2006 to 2007.

The Wawin experimental site is located 74 kilometers west of Lae city along the Markham Highway at latitude of 6° 5' south and a longitude of 146° 8' east and an elevation of about 100 meters above sea level with grassland vegetation. The average rainfall is about 2000-3000 mm or less per year. The mean temperature ranges from 25°C-36°C and the soil is of sandy loam to loam type with a pH of 4.5 to 5.0. This area represents the dry lowland agro-ecological zone.

The agriculture farm of the Papua New Guinea University of Technology is located 10 kilometers north west of Lae City at a latitude of 6° 41' south, a longitude of 147° east and an altitude of 65 meter above sea level. The mean annual rainfall at this location is about 3800 mm and the average mean temperature ranges from 22°C to 32°C. Annual evaporation is 2139 mm, and the rainfall exceeds evaporation in each month. The soil in the farm is well drained, derived from the alluvial deposits and classed as loamy sand with a pH of 5.0-6.0 (Tumana 1986). The farm represents the wet coastal areas.

Land Preparation

An area of 200m^2 measuring 20m x 10m was selected for each of the two trials. The land was prepared for good tilth with tractor driven disc plough followed by harrowing. It was divided into five blocks and each block was divided into five plots, each measuring 4m x 2m. Drains of 50cm wide were made between blocks to drain out excess rain water. Raised bed was prepared in each plot with soil digging from the drain.

Soil samples were collected from each unit plot and soil texture, moisture content and the pH were determined. Plant parasitic nematodes associated with the soil samples collected from the experimental plots were extracted following Bearmann tray technique. Four nematode species, namely *Rotylenchulus, Meloidogyne, Paratylenchus* and *Pratylenchus* were found to be present in the experimental fields. To make the soil free from nematode infestation, marigold *(Tagetes patula* and *Tagetes erecta)* was planted in each bed. The plants were allowed to grow for two months so that roots can release the alleochemical compound called polythienyls, which kills or suppresses the nematodes present in the soil (Oostenbrink 1960). After two months of planting, the marigold plants were uprooted, cut into pieces and buried into the soil and were allowed to decompose as plant residues. Some marigold plants were left to grow at the edges of the experimental plots to prevent the movement of nematodes in/out of the field after inoculation commences.

Selection of Sweet Potato Cultivars and Planting of Cuttings

Five elite sweet potato cultivars were selected based on the tuber shape, tuber skin colour, tuber flesh colour, time of maturity, flesh texture after boiling. The flesh colour ranged from white to orange white while the flesh texture after boiling ranged from firm to soft and the maturity duration was from 4.5 to 5 months. All the cultivars were grown at the Unitech farm of PNGUT as the stock material for further plantings. All the precautions, including spraying with an insecticide (Karate) were taken to keep the stock materials pest free.

The planting of sweet potato was done four weeks after the marigold plants were mixed with the soil. Holes of 15cm deep were made into the soil of each unit plot maintaining 100cm distances from hole to hole and sweet potato cuttings of 50cm length were planted in each hole.

Experimental Design

The experiments at both the locations were carried out in randomized complete block design with five replications

Inoculation of experimental soils with *R. reniformis*

Soils were collected from *R. reniformis* infested fields of sweet potato at PNGUT Agriculture farm and Bayun High School farm. Adults and juveniles of the nematode were extracted from the soil following the Baermann's tray method (Agrios 1997) and used as inocula. The inocula were suspended in water and injected into the soil near the base of the plant. Each plant received 10,000 inocula. Additional 4,000 nematodes were added to each bed every 10 days to maintain the population.

Inter-cultural Practices

Hand weeding was done after the second week of planting and continued throughout the five-month growing period. Fields were kept clean all the time to avoid the buildup of any pests. All the insect pests appeared in the fields were controlled by hand picking and the use of other trapping devices. No spraying of insecticide was done as this might affect the nematode survival. Disease presence, such as sweet potato scab and the little leaf were noted and the infected vines were removed from the field to minimize the spread of the diseases to other plants. No chemicals were used against the diseases. .

Data Collection

Weekly observations were made of the symptom development after the second month of planting till to the harvest. Initial symptoms in the form of yellowing of leaves, stunted growth and death of vines were observed after 60 days of inoculation. The symptoms observed were noted.

Sweet potato tubers were harvested manually with sticks. Harvested tubers were washed with tap water, air dried, graded and weighed with a weighing scale. The above ground biomass (fresh and dry weights of vines) weight of sweet potato was also recorded. The tubers were graded based on size and the quality. Tubers having small, cracked and damaged surface were graded as non-marketable ones. Good quality of tubers were graded as marketable produce and sold at the local markets.

Assessment of Parameters

Data on gall development on roots, nematode population in soils of experimental plots, tuber cracking and marketability were recorded following standard methods.

i) Root gall formation - Roots of each cultivar in each plot were washed and checked for galls on the roots. Total number of galls were counted and recorded.
ii) Tuber cracking effect – Tubers in each plot were checked for cracking, and their incidence was recorded.
iii) Marketable and non-marketable tubers - All the tubers harvested from each of the cultivars were graded as marketable and non-marketable weights (marketable ≥500g with no tuber cracks and non-marketable ≤500g with tuber cracks).
iv) Nematode population - One kilogram of soil was collected from each of the treatment plots at the time of harvest to estimate the nematode population. The nematodes were isolated following the Baermann's tray method. Nematodes were transferred into 20ml vials, observed under a compound microscope and counted to estimate the total population.

The fresh weight of the above ground biomass (leaves and vines) of each cultivar was recorded. The vines were left to dry for two weeks in the fields and dry weight of the sweet potato vines were also recorded.

Data Analysis

The data on the nematode population, fresh and dry above ground biomass weight, total tuber yield and marketable yield were analyzed using Minitab Student Release Version 12 computer software. The data on the selected parameters were subjected to ANOVA and means were compared (LSD) using the same software.

Results of the Experiment conducted at Wawin Farm

At Wawin farm, above ground symptoms of reniform nematode infection with varying degrees of severity were observed on five sweet potato cultivars (Plate 1). The leaves and vines of RAB 36, RAB 32 and DOY 2 were healthy and free from visible symptoms of reniform nematode infection. However, a few plots of RAB 32 were infected with leaf miner. Cultivar B 11 and L 676 showed moderate to severe symptoms of leaf yellowing at the base of the plants and dead vines.

Deformities/cracks appeared on sweet potato tubers due to infection of reniform nematode. Severe to moderate deformities/cracks on tubers were found in B 11, whereas tuber deformities were moderate to low in L 676. The tubers from other cultivars did not show any symptoms of deformities/cracks. Symptoms of gall formation were not found in any of the five cultivars (Plate 2).

The mean nematode population per kilogram of soil ranged from 172.6-986.0 (Table 1). The results show that the highest number of nematodes (986) was observed in plots with B 11 and the lowest being 172.6 in RAB 36. The difference in nematode populations between these two cultivars was significant at $p \leq 0.05$ (LSD). The nematode population in RAB 36 was also significantly lower than DOY 2 and L 676. However, there was no statistical difference between the nematode population in RAB 36 and RAB 32. The case was

Plate 1. Photographs showing above ground symptoms observed on five sweet potato cultivars due to infection with reniform nematode (*Rotylenchulus reniformis*) under field conditions at Wawin Farm.

DOY 2

B 11

L 676

RAB 36

RAB 32

similar for 32 and DOY 2.

The result shows that the fresh biomass weight was the highest in RAB 36 (17.30kg) and the lowest in L 676 (12.40kg) and this is significant at p≤0.05 (LSD). There was no significant difference in the fresh biomass weights of RAB 36 (17.30kg), RAB 32 (16.74kg) and DOY 2 (16.06kg) but were significantly higher than B 11 (13.86kg) and L 676 (12.40kg). The difference in fresh biomass weights of B 11 and L 676 cultivars was also non-significant at p≤0.05 (Table 1).

The dry biomass weight was the highest in RAB 36 (8.18kg) and the lowest in L 676 (4.50kg), which was significantly different at p≤0.05 level. The dry biomass weight of RAB 32 (6.52kg) and DOY 2 (6.16kg) was not significantly different, but was significantly higher than B 11 (4.56kg) and L 676 (4.50kg). The biomass dry weights of B 11 and L 676 were not significantly different at p≤0.05 (Table 1).

The result on total yield of tubers in Table 1 shows that it was the highest in RAB 36 (15.66kg) and the lowest in B 11 (8.72kg) and the difference was significant at p≤0.05 (LSD). The yield difference of RAB 36 (15.66kg) and RAB 32 (14.68kg) was non-significant but were significantly higher than DOY 2 (10.02kg), L 676 (9.30kg) and B 11 (8.72kg). There was also no significant yield difference among DOY 2 (10.02kg), L 676 (9.30kg) and B 11 (8.72kg) at $p \leq 0.05$ (LSD).

Table 1 also shows the yield of marketable tubers. The highest marketable tuber yield was observed in RAB 36 (14.94kg) and the lowest in B 11 (5.22kg) and the difference was significant at $p \leq 0.05$ (LSD). The marketable tuber yield of RAB 36 (14.94kg) was significantly higher than all other cultivars. The marketable tuber yield of DOY 2 (7.2kg), L 676 (6.32kg) and B 11 (5.22kg) were non-significant at $p \leq 0.05$ (LSD), but were significantly lower than that of RAB 32.

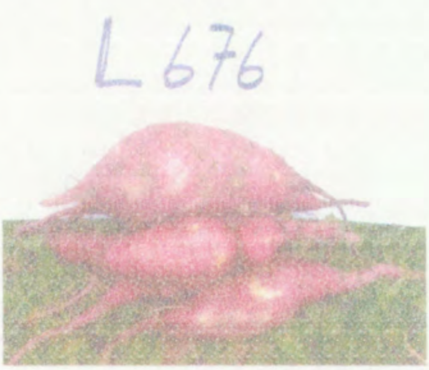
The percentage reduction in yield as non-marketable tuber is presented in Table 1. The highest reduction in yield (40.1%) was observed in B 11 and the lowest of 4.6% in RAB 36. Meanwhile, yield reduction in L 676, DOY 2 and RAB 32 was 32.0%, 28.1% and 17.8%, respectively.

Table 1 and Plate 2 show that B 11 and L 676 had cracks in their tubers. The highest cracking

Plate 2. Photographs showing symptoms of tuber cracks caused by reniform nematode (*Rotylenchulus reniformis)* under field condition at Wawin Farm.

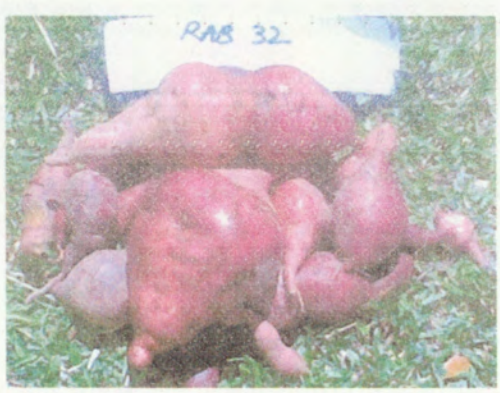
DOY 2

B 11



L 676

RAB 36



RAB 32

of 22.3% was observed in B 11 followed by L 676 with only 11.9% cracking, while no cracking was observed in RAB 36, RAB 32 and DOY

Results of the Experiment conducted at the Unitech Farm

The above-ground symptoms of *Rotylenchulus reniformis* infection on the five selected sweet potato cultivars at the Unitech farm are presented in Plate 3. The above-ground appearance of RAB 36 cultivar did not show any evidence of infections, however, B 11 showed symptoms of leaf yellowing and vines at the base of the plants. The cultivar RAB 32 was growing healthy, even though, a couple of plots were infected with sweet potato scab. The cultivar L 676 showed symptom of leaf yellowing and dead vines at the base of the plant, while DOY 2 did not show any symptom of infection.

The underground symptoms in Plate 4 show deformities/cracks on the tubers of B 11 and L 676, however, the other cultivars did not show any symptoms of deformities or tuber cracking.

The result in Table 2 shows that the mean nematode population was the highest in B 11 (465.2) and the lowest in RAB 36 (150.8) and this difference was significant at $p \leq 0.05$ (LSD). The nematode population in B 11 was significantly higher than the rest of the cultivars. The nematode population in RAB 36 was significantly lower than the other cultivars. The nematode population in L 676 (345) was significantly higher than RAB 32 and DOY 2 (256.8) at $p \leq 0.05$ (LSD). The difference in nematode population in RAB 32 was significantly lower than DOY 2.

The fresh weight of above-ground biomass was highest in RAB 36 (17.92kg) and the lowest in L 676 (13.12kg) and this difference was significant at $p \leq 0.05$ (LSD). There was no significant difference between RAB 36 (17.92kg) and RAB 32 (16.78kg). The above-ground fresh weight difference for B 11 and L 676 was also non-significant at $p \leq 0.05$ (LSD). The fresh weight of RAB 36 was significantly higher than DOY 2, however, the difference between the fresh weights of RAB 32 and DOY 2 was non-significant.

Table 2 also shows the mean dry weights of the five different sweet potato cultivars. The results follow the similar trend as in the fresh biomass weight.

***Table 1*. Means of parameters used to assess resistance of five sweet potato cultivars under field conditions at the Wawin Farm.**

Cultivar	Nematode population/kg soil	Rank on nematode population	Above ground Biomass (kg/plot)		Tuber yield (kg/plot)		Marketable tuber yield (kg/plot)	Percent reduction as non-marketable tubers	Tuber cracking (%)
			Fresh weight	Dry weight	Total weight	Rank			
DOY 2	386.20c	3	16.06a	6.16b	10.02b	3	7.20c	28.10	0
B 11	986.00a	1	13.86b	4.56c	8.72b	5	5.22c	40.10	22.3
RAB 36	172.60d	5	17.30a	8.18a	15.66a	1	14.94a	4.60	0
L 676	680.00b	2	12.40b	4.50c	9.30b	4	6.32c	32.00	11.9
RAB 32	267.60cd	4	16.74a	6.52b	14.68a	2	12.06b	17.80	0

All the values are means of five replications and those within the same column having a common letter(s) do not differ significantly at $p \leq 0.05$ (LSD).

The results on the total mean tuber weight is presented in Table 2. The results show that RAB 36 had the highest tuber yield of 16.78kg and the lowest being 11.6kg in B 11 and the difference was significant at $p \leq 0.05$ (LSD). The mean total yield of RAB 36 was significantly higher than L 676 (12.66kg). There were no significant differences among the total tuber yields of DOY 2, RAB 32, L 676 and B 11 at $p \leq 0.05$ (LSD). Similarly, tuber yield differences in DOY 2, RAB 32 and RAB 36 were also non-significant at $p \leq 0.05$ (LSD).

The results of marketable yield of tubers are presented in Table 2. The RAB 36 had the highest yield of 15.4kg and the lowest was in B 11 (7.4kg) and the difference was significant at $p \leq 0.05$ (LSD). The marketable yield of RAB 36 was significantly higher than the rest of the cultivars. Meanwhile, the marketable tuber yield difference for B 11 and L 676 was non-significant at $p \leq 0.05$ (LSD). The marketable tuber yield of B 11 was significantly ($p \leq 0.05$) lower than DOY 2, RAB 32 and RAB 36.

The percentage of yield reduction as non-marketable tuber in Table 2 shows that it was the highest (36.2%) in B 11 and the lowest in RAB 36 (8.22%). The reduction in cultivars DOY 2, RAB 32 and L 676 were 21.2%, 19.17% and 34.59%

Plate 3. Photographs showing above ground symptoms observed on five sweet potato cultivars due to infection with reniform nematode (*Rotylenchulus reniformis*) under field condition at Unitech.


DOY 2


B 11


L 676


RAB 36


RAB 32

respectively.

The tuber cracking defect was found only on B 11 and L 676 (Table 2). The highest tuber cracking of 10% was observed in B 11 followed by L 676 with only 6.5% cracking. No tuber cracking was observed in other four cultivars. No root gall was also observed on the tubers of any of the sweet potato cultivars.

DISCUSSION

Most sweet potato cultivars grown in Papua New Guinea are prone to diseases, most specifically to reniform nematodes (Birchfield and Martin

Plate 4. Photographs showing symptoms observed on edible roots of five sweet potato cultivars due to infection with reniform nematode (*Rotylenchulus reniformis*) under field condition at Unitech Farm.

DOY 2

B 11

L 676

RAB 36

RAB 32

***Table 2.* Means of parameters used to assess resistance of five sweet potato cultivars under field conditions at the Unitech Farm.**

Cultivars	Nematode population/Kg of soil	Rank Rank on nematode population	Above ground biomass (kg/plot)		Tuber weight (kg/plot)		Marketable tuber yield (kg/plot)	Percent reduction as Non-marketable tubers	Tuber cracking (%)
			Fresh weight	Dry weight	Total	Rank			
DOY 2	256.80c	3	16.14b	8.16b	13.84ab	3	10.90c	21.20	0
B 11	465.20a	1	13.68c	6.40c	11.60b	5	7.40d	36.20	10.0
RAB 36	150.80e	5	17.92a	11.22a	16.78a	1	15.40a	8.22	0
L 676	345.00b	2	13.12c	6.12c	12.66b	4	8.28d	34.59	6.5
RAB 32	193.00d	4	16.78ab	8.84b	14.92ab	2	12.06b	19.17	0

All the values are means of five replications and those within the same column having a common letter(s) do not differ significantly at p≤0.05 (LSD).

1965). Availability of resistant varieties can be of significant development in disease management as they are environmentally friendly, compatible with other disease management tactics, less costly and sustainable. However, with susceptible cultivars there could be substantial reduction both in terms of quality and quantity. Moreover, if the growers know the resistance status of the available cultivars they would know what to expect during the growing season. They can also plan well ahead of time as to the requirements in terms of management options and equipment, labour and costs rather than be caught by surprise. The five sweet potato cultivars that were previously tested in the greenhouse for resistance to reniform nematode were tested again under field conditions of humid lowlands and semi-arid regions of PNG to verify the resistance and estimate the yield losses in terms of quality and quantity.

Above ground symptoms of reniform nematode infection include leaf chlorosis, leaf yellowing, stunted growth and wilting (Clark and Moyer 1988). The visible effects of reniform nematodes on plants are usually subtle. The most obvious parameters to measure are yield reduction and plant stunting. In cotton, delayed flowering and fruit set are typical (Jones *et al.* 1959; Lawrence and McLean 1996). The *Rotylenchulus reniformis* also causes chlorosis in many plants and this has been shown to be related to potassium deficiency in roots as well as foliar tissues of cowpea and corn (Heffes *et al.* 1992). The test sweet potato cultivars at the Unitech and the Wawin farms showed similar symptoms including root cracks with varying degree of severity due to the difference in resistance/tolerance levels of the cultivars. The cultivars B 11 and L 676 showed leaf yellowing and vine death at both locations. The other cultivars did not show any above ground symptoms of nematode infection. Gaur and Perry (1991) also stated that in sweet potato, they might cause surface cracking of tubers. It does not cause galling of roots but causes reduction in root growth (Birchfield and Martin 1965; Bridge and Page 1982). The surface cracking was also observed in case of B 11 and L 676 in both the locations. The other three cultivars did not show any symptoms of surface cracking and this could be due to a higher level of varietal resistance. The tested cultivars also did not show any galling as was observed by Birchfield and Martin 1965; and Bridge and Page 1982; but root growth was affected in all the five cultivars.

The severity of symptoms due to reniform nematode infection and ultimately the damage in terms of deterioration in quality and quantity depends on the nematode population level. Damage by reniform nematode is greater when population densities are high in planting time and increases during the growing season (Clark and Moyer 1988). This was clearly demonstrated in all five sweet potato cultivars tested in two locations. Overall, the nematode population was much higher in Wawin compared to the Unitech farm and this might be due to the availability of higher soil potassium at Wawin (Muneer 2004). Thomas and Clark (1983) and Robinson *et al.* (1997) reported that the presence and high levels of potassium in the soil greatly influenced the survival and growth of nematode population. Moreover, the reniform nematode population is higher in case of heavier soils, like sandy loam, sandy clay or clay loam (Kinloch and Sprenkel 1994). The soils of Wawin farm are clay loam compared to loamy sand at the Unitech farm and also high in available potassium (Muneer 2004). Nematode reproduction is greatly affected by soil texture and structure. Nematode populations tend to reproduce best in fine sand, sandy loam, well-aggregated loams and clay loam (Cook *et al.* 1997) so that might also be a reason for overall higher nematode population levels at the Wawin site. The highest nematode population level was on B 11 followed by L 676, DOY 2, BAB 32 and RAB 36, respectively. However, the ranking of the populations on the five different cultivars did not change over the locations, even though the two sites are located in two different agro-ecological zones, with the Unitech site being wet coastal lowlands and the Wawin as a dry lowlands ecosystem.

There are various factors, like morphological traits, chemical, biochemical and physiological factors in plants that contribute to resistance against the invading pathogens. The resistance mechanisms tested in the sweet potato cultivars was significantly different amongst the cultivars. This translated into the difference supporting different numbers of nematodes and ultimately different level of yields for the tested cultivars.

A number of phenolic compounds, such as chlorogenic and caffeic acids are reported to be involved in the defense mechanisms operating in plants against nematode infection (Epstein 1974; Hung and Rohde 1973; Bajaj and Mahajan 1977; Giebel 1982). The levels of preformed phenols in roots have been correlated with resistance to nematode in certain plant cultivars (Cohn 1974; Narayano and Reddy 1980).

Presence of phenolic compound called *laxative ipomoein* in the roots of sweet potatoes has been shown to be involved in providing resistance/ tolerance against reniform nematode infection (Reed 1976; Kerry and Brown 1987). The amount of phenolic compounds produced by the tested cultivars differed significantly among the cultivars as evidenced from the mortality of nematodes in the phenolic extract test in the greenhouse. This in turn corresponded closely to the resistance/ tolerance levels of the cultivars and might have been responsible for supporting different levels of nematode populations and ultimately affecting the tuber yield.

The total tuber yield of the five cultivars closely followed the nematode population ranking in the reverse order, i.e. RAB 36 had the highest tuber yields followed by RAB 32, DOY 2, L 676 and B 11, respectively. The yields for all the five tested cultivars were higher at Unitech farm than that at Wawin Farm. This might be due to the fact that the rainfall at the Unitech was higher than at the Wawin being 3800mm/year and the loamy sand soils with a pH of 5.0 – 6.0 that was ideal for the growth of sweet potato. Hector *et al.* (2002) reported that sweet potato tolerates a rainfall of 500mm to 1300mm per growth cycle with optimum levels of 900mm to 1300mm as this increases the root development. Clark and Moyer (1988) also documented that rainfall is one of the major contributing factors towards the growth of sweet potato. Moreover, the total nematode population per kilogram of soil was much higher for all the treatments at Wawin farm compared to the Unitech site. This difference in the nematode population also had a significant effect on the tuber yield and tuber yield reduction in terms of non-marketable tubers.

The ranking of the cultivars for the total tuber yield did not change over the locations. This might be due to the fact that the resistance levels of the cultivars are quite stable.

Critical decision making in agriculture in terms of resource allocation, long term research goals and disease management requires the information on plant disease incidence, severity and yield losses. Studies on yield loss estimation are of special importance in terms of disease management decisions. All the cultivars tested in two different locations showed different levels of yield losses ranging from as low as 4.6% in case of RAB 36, the most resistant cultivar to as high as 40.1% in case of B 11, the most susceptible cultivar at the Wawin farm. These yield reductions as non-marketable tubers were in line with the ranking of the total nematode populations on each of the cultivars. Yield losses due to reniform nematodes on cotton were reported to be 9.5 17.4% in India and 40-60% in Egypt. However, in Louisiana and Mississippi, USA, yield losses as high as 40-60% and an average as little as 15-30% was reported (Bridge 1988; Robinson *et al.* 1997). Jones *et al.* (1959) and Overstreet (1996) reported a yield loss as low as 25% to as high as 60% from the reniform infested cotton fields in USA.

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