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CONTENTS

SCREENING OF FIVE ELITE SWEET POTATO CULTIVARS AGAINST RENIFORM NEMATODE (*Rotylenchulus reniformis*) IN THE GREEN HOUSE

Gibson Kasi and Shamsul Akanda[1].

ABSTRACT

Five elite sweet potato cultivars/lines were screened in the greenhouse for resistance against Reniform Nematode (Rotilenchulus reniformis) *through artificial inoculation. The cultivars showed varying degrees of above and underground symptoms of nematode infection. The longest vine length of 122.28 cm was observed in RAB36 and the shortest in L676 being 72.85 cm. The RAB36 had significantly lowest number of nematode per gram of soil compared to other cultivars and B11 had the highest. The RAB36 had the highest mean tuber weight of 112.3 g compared to other cultivars and the lowest being 56.2 g in case of B11. The dry weight of the cultivars closely followed the pattern in fresh weight. Ninety per cent nematode mortality was observed in case of RAB36 compared to B11 with only 10 % in phenolic test. The mortality percentage in RAB32, DOY2 and L676 were 85, 50 and 25 respectively. The highest tuber crack of 10% was observed on B11 and only six per cent on L676. No tuber cracking was observed on the cultivars.*

Key words: *Sweet potato, reniform nematode, phenolic extract, tuber crack.*

INTRODUCTION

The sweet potato (*Ipomoea batatas*) is one of the most important food crops of Papua New Guinea (PNG) with an estimated annual production of 1,223,800 tonnes worth K150 million (Bourke 1982 a & b). It is predominantly a subsistence crop, more recently; however, sweet potato has emerged as a significant cash crop (Bourke 1982 a & b). It is the staple food in most highland areas and is increasingly important in parts of lowlands due to its agronomic superiority over the other crops, such as taro and yams. Sweet potato provides between 65-90% of people's energy intake (Bourke 1982a & b; Kimber 1972) and up to 2.5-7.5% (dry weight) of protein intake in some areas (Goodbody 1984).

In recent years, decline in sweet potato yield in Papua New Guinea is a major concern in sweet potato cultivation (Hartemink *et al.* 2000). Diseases are a major constraint to production of sweet potato in many parts of the world, particularly in the temperate regions (Clark and Moyer 1988). Only a few of the most serious diseases of sweet potato are present in PNG, and appear to cause significant crop damage in certain parts of the country (Kokoa 2004).

Plant parasitic nematodes are recognized world wide, as potentially serious constrains to crop productivity. The reniform nematode (*Rotylenchulus* spp.), primarily occurs not only in tropical and sub-tropical areas but also in some temperate areas. It is one of the destructive pathogens of sweet potato affecting both yield and quality of the crop (Clark and Moyer 1988). Twenty-two different genera of plant parasitic nematodes have been reported to be associated with sweet potato in PNG (Bridge and Page 1982; Kokoa 1986 a & b; Levett *et al.* 1987; Kokoa 1991 a) and plant parasitic nematodes can be a major problem in sweet potato production.

Reniform nematode is an important semi-endoparasitic pest of many crops, especially in warmer climates. It is the principal nematodes damaging cotton in Egypt and in parts of the United States. This nematode also attacks tomato, soybean, and pineapple among others. It is also found in other tropical and subtropical areas of the world where sweet potato is grown (Birchfield and Martin 1965). Host range of *Rotylenchulus* species includes more than 300 species in 77 plant families (Robinson *et al.* 1997).

The population of *Rotylenchulus reniformis* can rise to very high levels, up to almost 10,000/100 cm3 of

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soil and the mineral balance of the host is disturbed. The reniform nematode also cause severe cracks on the roots (Clark and Wright 1983) affecting the quality and making it unsuitable for selling and human consumption. The amount and type of damage incurred by *Rotylenchulus reniformis* often depends on the host species and/or cultivars as well as the nematode population. In sweet potato, they may cause surface cracking of tubers (Gaur and Perry 1991).

The *Rotylenchulus reniformis* is present in several Pacific Island nations, including Papua New Guinea and has been rated as an important nematode of sweet potato (Bridge 1988). In Papua New Guinea, there is inadequate information on this pathogen infecting sweet potato.

The prevention of epidemic and ultimately the reduction of losses in terms of yield and quality have been of great concern. Using chemicals may control the diseases, but chemicals create hazards to human health, produce undesirable side effects on non-target organisms and the environment as a whole.

Under the existing circumstances, the use of resistant variety (-ies) is (are) one of the most attractive approaches for the management of plant diseases.

The natural genetic resistance of plants to pest and diseases has no doubt played a key role in crop production since the dawn of agriculture. Their use requires no particular action by the growers during the growth period, is environmentally friendly and sustainable, compatible to other management practices; and is sometimes singularly sufficient to suppress the disease to a tolerable level.

In this regard, it is utmost important to screen the existing cultivars/lines to find resistance sources with higher yield, quality and adaptability before being distributed to the farmers for widespread cultivation. If the growers know the resistance level of the cultivars well before planting, they would know what to expect during the growing season with respect to disease development and probable preventive measures to take.

Hence, a green house trial was conducted to screen five elite sweet potato varieties/lines for resistance against *Rotylenchulus reniformis*.

MATERIALS AND METHODS

Selection of cultivars/lines

Five elite sweet potato cultivars were selected based on tuber shape, tuber skin color, tuber flesh color, time of maturity, flesh of texture and taste after boiling (Table 1).

Table1. **Characteristics of five selected elite sweet potato cultivars used in the study**

Accession number, class and origin	Tuber shape	Tuber skin colour	Tuber flesh colour	Time to maturity (months)	Flesh texture after boiling	Taste after boiling**
B 11 1st Class PNG	Proximal end narrow, distal end broad	White	White	4.5	Firm	Not sweet
RAB 36 1st Class PNG	Proximal end narrow, distal end broad	Purple	Orange with white patches	5(best not later)	Firm	Slightly sweet
L 676 1st Class PNG	Fusiform	Purple	White	5	Intermediate	Slightly sweet
RAB 32 1st Class PNG	Proximal end broad, distal end narrow	Pink	Orange with white	4.5(best not later)	Soft	Slightly sweet
DOY 2 1st Class PNG	Fusiform	Purple	White	5	Intermediate	Slightly sweet

** = Showing peoples' preferences in relation to the characteristics.

Soil collection and sterilization

The humus soil was collected, placed and half filled in 44 gallon drum where the soil was sterilized using heat from the fire. It was left over night to cool down.

Pot preparation, vine planting

About two kilograms of sterilized soil was placed in a plastic bag within a plastic pot of 17.5cm diameter and 14.5cm deep. Two vines of about 15 cm in length per cultivar were planted at 5 cm deep in the soil in each of the pots.

Experimental design

The cultivars in the pots were organized in a randomized complete block design with each of the treatments (cultivars) replicated four times.

Nematode isolation and inoculation

The soil was collected from the old sweet potato garden at Wawin High School farm at the Markham Valley at a depth of 10 cm. The collected soil was cleaned and placed on the tissue paper with the strainer underneath and the nematodes were isolated using the Baermann's tray method. A thermometer was set to monitor the room temperature at 27-30°C and left for 72 hours. Later the nematodes were transferred into a beaker and filtered using a 20im strainer into 20-milliliter vials. From the vials, the nematodes were placed on a counting slide and observed through a microscope using a 40X power lenses. The *Rotylenchulus reniformis* adults and juveniles were selected using a fine point needle and placed into a 5 milliliter vial and kept in a cool room. These juveniles and adult reniform nematode population of 4,000-10,000 were inoculated into the soil in each pot.

Cultural practices

Watering of plants was done regularly to keep the soil at Field Capacity (FC). Over watering was avoided as this would drain out the nematodes from the pots. Weeds growing on the pots were removed manually from time to time. Hand picking of leaf miner was done without any chemical sprays as this would affect the nematodes.

Harvesting of sweet potato

Sweet potato was harvested 10 weeks after planting. Sweet potato plants from each of the pots were removed, the roots were thoroughly washed and placed on a clear plastic to dry so that further observations on the root gall formation and tuber cracks could be made.

Assessment of parameters

At the time of harvest, data on the following parameters like length of vines, above ground biomass (fresh and dry weights), degree of gall formation, nematode population was recorded.

Phenloic extract

Ten grams of fresh roots from each of the cultivars was taken and ddH20 added, crushed on the pestle and mortar and centrifuged at 10,000 rpm for 15 minutes. Five milliliters of the supernatant was placed in a plastic vial separately for each of the cultivars. Twenty live larvae (juveniles) of nematodes were selected and placed in the vial containing the root extract. The mortality of the nematodes in the phenolic extract from the roots was observed under the microscope after 30 minutes and the data was recorded. The second reading was taken after one hour, but there was no change in the mortality rate.

Estimation of tuber cracks (%)

The tubers from each cultivar were washed, placed on a clear plastic and examined for any tuber cracks. The percentage of tuber cracks was calculated as equal to the number of cracking tubers divided by the total number of tubers, multiplied by one hundred.

$$\text{Tuber cracks (\%)} = \frac{\text{Number of tuber cracks}}{\text{Total number of tubers}} \times 100$$

Data Analysis

The data was analyzed using the Software Minitab Student Release 12 Version. Data on nematode population, vine length and biomass were subjected to analysis of variance and mean separation to determine the statistical differences among the treatment means.

RESULTS AND DISCUSSION

The general observations from the pot plants showed symptoms of infections by the reniform nematodes (*Rotylenchulus reniformis*) with varying degree of severity on the five elite (Plate 1) sweet potato cultivars in the green house. The cultivar DOY 2 was growing healthy with a couple of dead vines, B 11 cultivar had a few dead vines, stunted growth, leaves were smaller and turning yellow and leaf miner

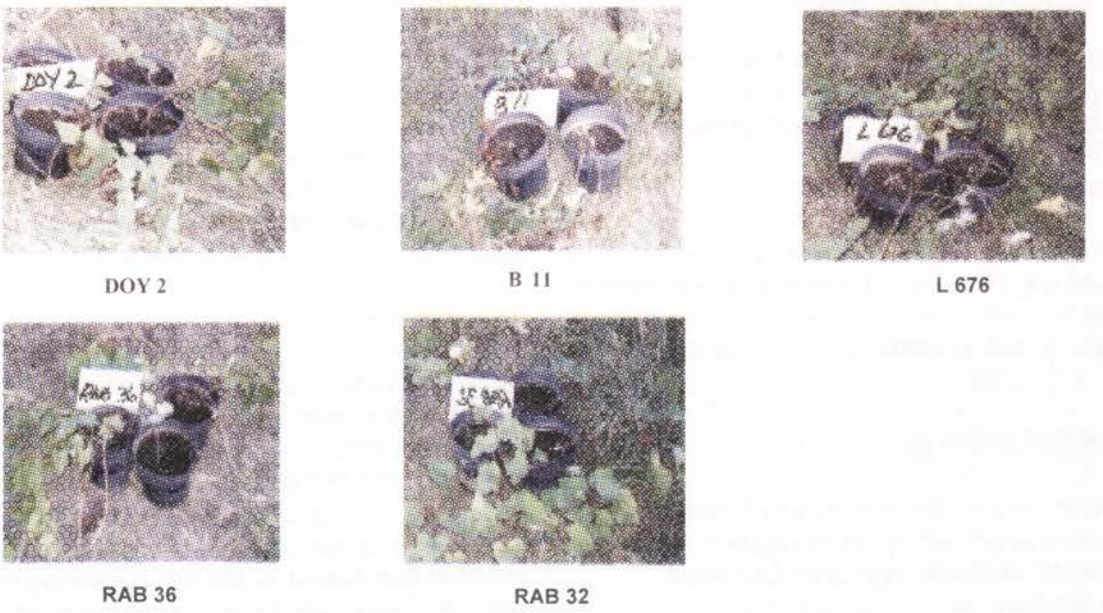

Plate 1. **Cultivars showing above ground symptoms of *Rotylenchulus reniformis* infection under Green house condition.**

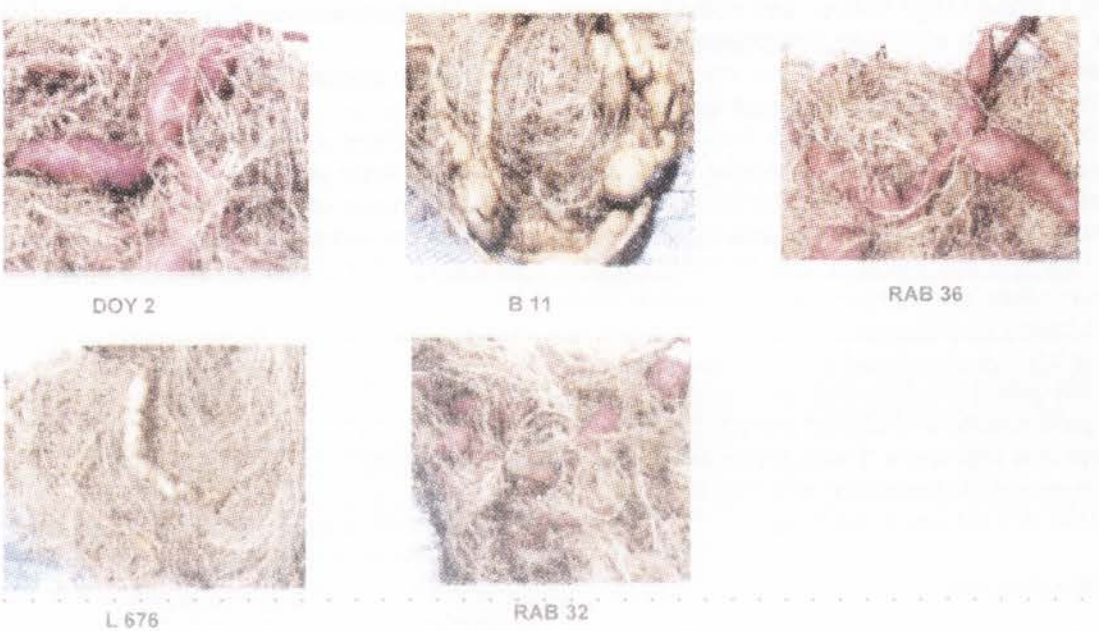

Plate 2: **Cultivars showing symptoms of root infection due to *Rotylenchulus reniformis* infection.**

attacking the leaves. The RAB 36 cultivar was growing healthier with long vines, L 676 cultivar had a few dead vines at the base with long vines; and RAB 32 cultivar was growing healthier without any visible symptoms of disease, however, there were a few leaf miner attacking the leaves.

The underground symptoms of *Rotylenchulus reniformis* are shown as varying degrees of deformities/abnormal growth on the tubers (Plate 2).

It is observed that moderate levels of abnormalities in the form of cracks were found in B 11 followed by L 676. The tubers of the other three cultivars looked fresh and smooth without any abnormalities.

The result on the nematode population isolated from each of the cultivars (Table 2) shows that the number of nematodes per kilogram of soil was highest in B11 (308.5) and the lowest in RAB 36 (164.5) and this difference was significant at pd"0.05 (LSD). The

Table 2: **The parameters used to assess resistance of five sweet potato cultivars to reniform nematode in the green house.**

Cultivars	Mean nematode population/kg of soil	Biomass			Phenolic test			Cracking defects (%)
		Length of vines (cm)	Fresh weight (g)	Dry weight (g)	Live (x/20)	Dead (x/20)	Mortality (%)	
DOY 2	186.5c	94.25b	82.4b	75.78b	10	10	50	0
B 11	308.5a	74.95c	56.2d	44.85d	18	2	10	10
RAB 36	164.5c	122.28a	112.13a	95.05a	2	18	90	0
L 676	291.25a	72.85c	62.93cd	52.40cd	15	5	25	6
RAB 32	217.5b	87.05bc	74.18bc	62.78bc	3	17	85	0

number of nematodes in L 676 was 291.25 per kilogram of soil and this was not statistically different from B 11 at pd"0.05 level, however, this was significantly (pd"0.05) higher than DOY 2, RAB 32 and RAB 36. Even though the nematode population was higher in DOY 2 (186.5) than RAB 36, this difference was not statistically significant at pd"0.05 level.

The numbers in a column representing nematode population; vine lengths and biomass weight are the means of four replications.

Means followed by the same letters within a column are not significantly different at Pd"0.05 (LSD).

The mean vine lengths ranged from 72.85cm to 122.28cm (Table 2). The longest vine length of 122.28cm was observed in RAB 36 and the shortest in L 676 being 72.85cm. The vine length in RAB 36 was significantly longer than the rest of the cultivars. The vine length of DOY 2 (94.25cm) was significantly longer than B 11 (74.94cm) and L 676 (72.85) but the vine length difference between DOY 2 (94.25cm) and RAB 32(87.05cm) was non-significant. Similar was the case among B 11, L 676 and RAB 32.

The mean fresh weight (Table 2) was highest in RAB 36 (112.13g) and lowest in B 11(56.2g) and the difference between the two was significant at pd"0.05 (LSD). The fresh weight of RAB 36 was significantly higher than the rest of the cultivars. The fresh weight of DOY 2 (75.78g) was significantly higher than B 11(56.2g) and L 676 (62.93g) but the fresh weight difference between DOY 2 (82.4g) and RAB 32 (74.18g) was non-significant at pd"0.05 level (LSD). Similarly, the fresh weight difference between B 11 and L 676 cultivars are also non-significant. The dry weight of the cultivars closely follows the same pattern as in case of fresh weight.

Phenolic test (Table 2) shows that the highest mortality of 90% was observed in RAB 36 and the lowest mortality of 10% in B 11. The mortality of nematodes in case of RAB 36 (90%) was higher than RAB 32, DOY2 and L 676 that were 85, 50 and 25% respectively.

Table 2 further shows that only two of the cultivars had some tuber cracking. The highest tuber cracking of 10% was observed in case of B 11 followed by L 676 with 6% cracking. No tuber cracking was observed in RAB 32, RAB 36 and DOY2.

The use of varietal resistance is one of the most attractive, cheap, environmentally friendly and sustainable ways for the management of plant disease when highly resistant varieties are available. One of the most important requirements for the development of resistant variety is to screen/test the varieties against the pathogen concern.

Five elite sweet potato cultivars were tested in the greenhouse against the reniform nematodes (*Rotylenchulus reniformis*) through artificial inoculation.

The cultivars showed symptoms of leaf chlorosis, stunted growth (Plate 1) and tuber cracks (Plate 2) with varying level of severity because of the differences in the resistance/tolerance level of the cultivars. Most severe symptoms including stunting, leaf chlorosis, vine death and root deformation/crack was found in B11 and L676. The other cultivars showed very low to no infection at all. Similar results on symptoms development were also described by Thomas and Clark 1983; Robinson *et al.* 1997. The population of nematodes in different cultivars was affected by the resistance of the cultivars as demonstrated by the mortality of the nematodes in the phenolic test. These in turn affected the leaf size, vine length and vine death; leading to the reduction in photosynthetic areas that in turn led to significant yield reduction in susceptible cultivars. The concentration of phenolic compound was quite higher in RAB 36 and RAB 32 compared to the other three cultivars and that affected the nematode numbers on different cultivars.

The changes in leaf morphology are related to inadequate root function. The leaf tissues have compact cell resulting in leaves becoming smaller than normal and absorb less light than healthy leaves (Thomas and Clark 1983; Robinson *et al.* 1997) and this leads to reduced yield. Similar phenomenon might also have been responsible for stunted growth and significant yield reduction in case of B11 and L676 cultivars.

The evidence of root damage on B11 and L676 in the form of crack is quite clear affecting the quality and making unsuitable for selling and human consumption. Similar results were also suggested by Clark and Wright 1983.

Considering the assessment of the various important parameters in the greenhouse trial, RAB 36 could be categorized as resistant, RAB 32 and DOY as moderately resistant, L 676 as moderately susceptible and B 11 as highly susceptible.

The outcome of the greenhouse trial need to be tested in proper field experiments as the results of the greenhouse trials might be affected by the different levels of interaction in the filed.

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THE EFFECT OF ADDING A BINDING AGENT TO LAYER DIETS CONTAINING SORGHUM ERGOT *(Claviceps africana)*

G.K.Pranis [1,2] and J.G.Dingle [1]

ABSTRACT

Approximately 25% of the world's cereal grains are contaminated with known mycotoxins. Mycotoxins are now known as hidden killers that produce a wide range of harmful effects in animals and are a threat to humans. The pathogenic effect of aflatoxin (AF) on poultry has been well documented but the effects of a new mycotoxin to Australia, sorghum ergot (SE) **(Claviceps africana)** *alkaloid, have still to be fully explored.*

This study was undertaken to broaden our understanding of how to combat the effects of subtoxic levels of sorghum ergot alkaloids (SEA) on the egg production of layer chickens. After two weeks on the sorghum ergot diets it was found that laying hens fed a Mycosorb® (Alltech Inc.) supplement had greater feed intakes. After three weeks on the sorghum ergot diets, laying hens fed a Mycosorb® supplement had greater egg production and egg mass than the birds fed the non supplemented ergot diets. The egg production by layers fed the lower protein diets was poorer, but it recovered to be equal to the best production level , when Mycosorb® was added.

It is recommended that layer diets that contain ergot contaminated sorghum should be supplemented with a binding agent such as Mycosorb®.

Keywords: *effect, binding agent, layer diets, sorghum ergot (Claviceps africana).*

INTRODUCTION

Sorghum ergot, a fungal disease of sorghum caused by **Claviceps africana**, produces a toxic alkaloid, dihydroergosine, which has been found to reduce productivity of dairy cattle, pigs and broiler chickens (Blaney *et al.* 1998). Its effect on laying chickens appears to be unknown.

Australia grows and uses sorghum grain as its main ingredient in producing its stock feed and Papua New Guinea imports its sorghum grain from Australia. Sorghum ergot affects the yield and will increase the cost of importing sorghum into Papua New Guinea.

The use of yeast and yeast products as mycotoxin binders was initially found by Professor Devegowda and his group in India, and by others in Canada and the United States of America, to ameliorate the effect of aflatoxin (AF) in chickens and ducklings (Anonymous 2001). Mycosorb® (a yeast product) is shown to be an effective binder, not only for AF but also for zearalenone, ochratoxin and fumonisin (Devegowda *et al.* 1998). Deo (2000) found that Mycosorb® was a good binding agent for AF and ergot alkaloid in feeds for broiler chickens. No reports on the use of the adsorbent to reduce the effects of ergot alkaloids in laying hens have been published.

In this trial, the effects of sorghum ergot alkaloid on the egg production of laying hens were estimated and Mycosorb® (a binding agent) tested for its efficacy in preventing any negative effects of sorghum ergot alkaloids on laying hens.

MATERIALS AND METHODS

Experimental Design

The experimental design was a 4 x 2 factorial. The factors were (1) level of sorghum ergot alkaloid ($24 mg kg^{-1}$, $12 mg kg^{-1}$, $6 mg kg^{-1}$ and $0 mg kg^{-1}$ alkaloid in the diet) and (2) with or without Mycosorb binding agent in each basal diet. There were six replications in a completely randomized design.

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Experimental Diets

Diets were formulated using the programme "User Friendly Feed Formula" (UFFF 1986).

The ingredient content of each treatment diet is shown in Table 1. The nutrient composition of the diets are shown in Table 2.

Half of each basal diet had a toxin binding agent (Mycosorb®) added, thus making eight diets for the experiment.

Assuming that the ergot contaminated sorghum contained 32 $mgkg^{-1}$ sorghum ergot alkaloid (SEA), the SEA of each basal diet was as shown in Table 2.

Bird Management and Measurement

Ninety-six ISA Brown layers (45 weeks old) were housed in wire back-to-back conventional cages. All chickens were fed a commercial layer diet with 17% crude protein and metabolisable energy of 13.8 MJ kg^{-1} for four days. On the fifth day the chickens were weighted and then randomly allocated two per cage to make 48 experimental units. The chickens were

Table 1. **Formulation of Basal Diets (percent).**

Ingredient	Diet 1(%)	Diet 2 (%)	Diet 3 (%)	Diet 4 (%)
Sorghum (Ergot) (14.7% CP)	76	38	19	0
Sorghum (Normal) (8.9% CP)	0	38	57	76
Fish Meal (65% CP)	13	13	13	13
Vegetable Oil	2	2	2	2
Limestone	9	9	9	9
Vit & Min Premix *	0.1	0.1	0.1	0.1
DL Methionine	0.1	0.1	0.1	0.1

*The vitamin and mineral premix added the following nutrients to the ration: vitamins A, 9.375 m i u; D_3, m i u; E, 512.5 i u; K, 1 087.5; B_2, 3737.5, Ca pantothenate, 2 200; nicotinamide, 5 000; Cobalt, 660; Copper, 2 200; Iron, 22 000; Manganese, 55 000; Iodine, 883.75; Molybdate, 500; Zinc, 40 000; Sodium, 12 500; Selenium, 45mgtonne^{-1}.

Table 2. **Calculated nutrient content of basal diets (percent)**

Nutrient Calculated	Diet 1	Diet 2	Diet 3	Diet 4	Recommended	
					NRC (1994)	ISA Brown (1996)
Crude Protein	19.6	17.6	16.6	15.7	15.0	19.5
ME ($MJkg^{-1}$)	11.4	12.0	12.3	12.6	12.1	11.6
Calcium	3.7	3.7	3.7	3.7	3.25	4.1
Av. Phosphorus	0.38	0.38	0.38	0.38	0.25	0.40
Av. Lysine	0.78	0.79	0.79	0.79	0.69	0.88
Methionine+						
Cystine	0.64	0.64	0.64	0.64	0.58	0.76
Ergot Alkaloid ($mgkg^{-1}$)	24	12	6	0		

fed experimental diets *ad libitum* from day 5 to 25. Artificial light was provided from 4.00 pm to 8.00 am (16 hrs).

Weekly feed intake was recorded. Egg were collected and recorded daily and laying percentage calculated. Eggs from one day's production were weighed each week to calculate egg mass and feed conversion ratio. Chickens were monitored daily for signs of sickness and mortality.

Statistical Analysis

The measurements were analysed using ANOVA (SAS Institute, Inc. 1990) and the results of each treatment were expressed as mean ± standard error (SEM). The significances between the means was estimated from least significant difference (LSD).

RESULTS

The egg laying percentage, average egg weight, egg mass, feed intake and feed conversion ratio (FRC) for the three weeks that the laying hens were fed the experimental diets are given in Table 3, 4 and 5.

In the first week of the trial, there was no significant effect of the level of sorghum ergot alkaloid or of the addition of Mycosorb® on the egg production, egg weight, egg mass, feed intake or FCR of the laying hens (Table 3). The level of production was normal for ISA Brown hens of this age, but feed intake was less than expected.

In the second week of the trial, there was no significant effect of the level of sorghum ergot alkaloid on egg production, egg weight, egg mass or FCR. However feed intake was significantly ($P<0.05$) affected by sorghum ergot and Mycosorb®. The feed intakes of hen fed the diets containing 24 and 6 $mgkg^{-1}$ were significantly greater ($P<0.05$) than the intake of hens fed control diet. The mean feed intake of hens fed Mycosorb® - supplemented diets was significantly greater than hens fed the unsupplemented diets (Table 4).

In the third week of the trial, the level of sorghum ergot had no significant effect on feed intake, FCR or egg weight. However, in week three, the level of sorghum ergot had a significant ($P<0.05$) effect on egg production and egg mass and there was a significant interaction between sorghum ergot and Mycosorb® on egg production and egg mass. The egg production of hens fed the ergot free diet was significantly ($P<0.05$) less than the egg production of hens fed the diets containing 24 and 12 $mgkg^{-1}$ sorghum ergot alkaloid. The egg production of hens fed the Mycosorb® supplemented ergot diets increased (significantly for the 6 $mgkg^{-1}$ SEA diets) but it decreased for the non ergot diet.

In week three, egg mass production of hens decreased as dietary protein level decreased. The lowest protein diet (CP 15.7%) (basal 4) produced significantly smaller egg mass than basal diets 1 and 2 (CP 19.6, 17.6% respectively).

Table 3. The performance of layer chickens fed SEA and Mycosorb® binding agent (week one).

Sorghum Ergot Alkaloid ($mgkg^{-1}$)	Mycosorb®	Egg Production (%)	Av. Egg Weight (g)	Egg Mass (g)	Av. Feed Intake (g/d)	FCR
24	+	80.9	59.3	48.2	82.8	1.71
	-	67.8	61.6	41.6	83.0	2.15
12	+	72.6	58.0	42.1	71.4	1.79
	-	71.4	60.3	42.6	71.3	1.74
6	+	82.1	58.9	48.5	86.2	1.80
	-	76.2	60.5	45.4	84.4	1.98
0	+	78.6	60.4	47.4	74.5	1.62
	-	73.8	58.4	43.3	73.2	1.75
SEM		± 8.3	± 1.7	± 5.0	± 7.8	± 0.23

Table 4. **The performance of layer chickens fed SEA and Mycosorb® binding agent (week two)**

Sorghum Ergot Alkaloid ($mgkg^{-1}$)	Mycosorb®	Egg Production (%)	Av. Egg Weight (g)	Egg Mass (g)	Av. Feed Intake (g/d)	FCR
24	+	82.1	57.6	47.4	86.2 ^{a}	1.91
	-	58.3	60.3	35.5	80.4 ^{ab}	3.06
12	+	75.0	58.5	44.4	95.1 ^{a}	2.86
	-	69.0	57.9	40.0	59.7 ^{c}	1.52
6	+	85.7	58.8	50.2	89.2 ^{b}	1.82
	-	69.0	59.7	41.2	83.0 ^{ab}	2.13
0	+	66.6	63.4	41.6	67.3 ^{bc}	1.69
	-	73.6	60.4	43.8	70.8 ^{bc}	1.70
SEM		± 9.1	± 1.7	± 5.6	± 5.8	± 0.48

a, b, c; means with different superscripts are significantly different (P<0.05).

Table 5. **The performance of layer chicken fed SEA and Mycosorb® binding agent (week three).**

Sorghum Ergot Alkaloid ($mgkg^{-1}$)	Mycosorb®	Egg Production (%)	Av. Egg Weight (g)	Egg Mass (g)	Av. Feed Intake (g/d)	FCR
24	+	82.1	57.6	47.4	86.2 ^{a}	1.91
	-	58.3	60.3	35.5	80.4 ^{ab}	3.06
12	+	75.0	58.5	44.4	95.1 ^{a}	2.86
	-	69.0	57.9	40.0	59.7 ^{c}	1.52
6	+	85.7	58.8	50.2	89.2 ^{b}	1.82
	-	69.0	59.7	41.2	83.0 ^{ab}	2.13
0	+	66.6	63.4	41.6	67.3 ^{bc}	1.69
	-	73.6	60.4	43.8	70.8 ^{bc}	1.70
SEM		± 9.1	± 1.7	± 5.6	± 5.8	± 0.48

a, b, c; means with different superscripts are significantly different (P<0.05).

When Mycosorb® was added to the ergot containing diets, egg mass increased, significantly (P<0.05) in the case of basal diet 3 (6 $mgkg^{-1}$ SEA) (Table 5).

No signs of any pathogenic effects or wet droppings were seen for laying hens fed 6 – 24 $mgkg^{-1}$ sorghum ergot.

DISCUSSION

The diets used contained only sorghum as the grain component to maximize the level of sorghum ergot in the diets. This may have reduced production from what may have been achieved for a mixed grain diet. The ergot contaminated sorghum had a higher crude protein content than the non contaminated sorghum,

resulting in decreasing content of protein in the diets as one sorghum was replaced by the other. This appears to have caused a decrease in production, even though the nutrient levels were adequate by National Research Council (1994) standards. Only the diets containing the highest level of contaminated sorghum were adequate for protein recommended by the ISA company (ISA 1996).

Even though the production of laying hens fed ergot contaminated sorghum was acceptable, nevertheless their production increased when Mycosorb® was added to their diet. It therefore appears that SEA did cause effect in egg production of layers, and that Mycosorb® combated this effect.

After three weeks feeding sorghum ergot, it was found that the effect of Mycosorb® supplement appeared to be greater in the diets containing the lower ergot alkaloid concentrations. Therefore high protein concentrations appeared to prevent the severe effects of sorghum ergot alkaloid on egg production and egg mass. Thus Mycosorb® appeared to be less effective in higher protein diets than in lower protein diets.

Thus Mycosorb® seems to be an effective agent to use to combat the effects of SEA and help in promoting laying performance of chickens fed with SE contaminated sorghum. These results are similar to the findings of Devegowda and co-workers (1998) and Deo (2000) that Mycosorb™ was an effective binding agent for several mycotoxins including ergot alkaloids.

CONCLUSION

In the absence of an effective binding agent, the feeding of sorghum contaminated with ergot tends to result in changes that reduce the production efficiency of laying hens. This study has shown that increased dietary protein level and Mycosorb® binding agent effectively combat such changes. Both appear to be efficient solutions to the problem of feeding sorghum contaminated by sorghum ergot. However it is not recommended that Mycosorb® be added to diets not containing sorghum ergot.

Within any sorghum/protein level, mycosorb appears to be beneficial and at higher protein levels, mycosorbs may not be so effective.

This report deals with the response of laying hens fed sorghum ergot diets for three weeks only. In view of the production changes seen in the first three weeks it is recommended that the response of layers fed the diets with level of nitrogen (Lysine) over a longer period be examined before more definite conclusions are drawn

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EARLY MATURING SWEET POTATO VARIETIES FOR THE HIGHLANDS OF PNG

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ABSTRACT

Following the drought of 1997, it became clear that rural people in PNG need early maturing crops, which would produce food sooner rather than later during the post drought period. This paper reports three trials on 30 varieties of sweet potato for earliness to mature. The first two trials were conducted between 2001 and 2002, and trial three was a follow-up of the top nine selected varieties from the previous trials. The trials were conducted in Aiyura, Eastern Highlands Province. The third trial was conducted in 2003. This activity was part of the World Bank funded Drought Response Project.

The trials were laid out as Split Plot Design with three blocks. In the first two trials, there were four harvests (4th, 5th, 6th and 7th month after planting), which served as main plots and 30 varieties as subplots. Those varieties that yielded at the fourth and fifth months were analysed for earliness. Of the 10 high yielding varieties in the two trials, six were common. Based on this, nine varieties that yielded over 4 tonnes per hectare were selected for earliness and recommended to farmers.

Following that, the third trial screened these nine top performing varieties to identify the earliest yielding varieties. The harvest dates were 3rd and 4th month after planting. Seven varieties (WHCK 007, SSYK 026, PRAP 469, PRAP 417, WHCK 005, SKK 010 and WBS 010) gave acceptable yields (4 – 7 tonnes per hectare) at three months and 10 - 14 tonnes / ha at four months and can therefore be recommended as very early maturing.

Keywords: *Early maturing, varieties, sweet potato, trials, split plot design.*

INTRODUCTION

The PNG Department of Agriculture & Livestock and the National Agricultural Research Institute (NARI) jointly proposed a project to improve PNG's ability to cope with future El Nino related weather fluctuations. This was a consequence of the severe drought, associated with frosts, experienced in Papua New Guinea in 1997 and 1998. Crop yields were reduced by as much as 80% in some areas, resulting in severe food shortages (AUSAid Report). Towards the end of 1997, 40% of the rural population (1.2 million) was starving (Allen & Bourke 2000).

When the rain did return, people planted early maturing vegetables such as bean, leafy vegetables, corn, sweet potato and other staples. However, sweet potato takes between four and nine months to mature, depending on altitude and variety. It meant people had to wait that long. It was a crucial point in time. People suffered from diahorrea due to lack of solid starch foods and there were reports of deaths. The objective of these three trials were to select early maturing varieties of sweet potato to recommend for cultivation during the post drought period so that farmers can secure their invaluable energy food as soon as possible after an event of drought, frost or other natural disasters.

MATERIALS AND METHODS

There were three trials conducted. The two earlier trials were laid out using the Split Plot Design with three blocks. Four harvest dates served as main plots and the varieties (30) as sub plots. The blocks were 75 m x 48 m each while each main plot measured 75 m x 12 m. The plant spacing was 0.5 m within rows and 1.0 m between rows. The gross plot measured 6 m x 4.5 m and a net plot of 4 m x 4.5 m. There were 36 plants in the net plot. The outer 1 m x 4.5 m on each side served as guard.

In the third trial, the same trial design was applied with four replicates. The two harvest dates (three [3] and four [4] months after planting) served as the main

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plots and the nine varieties as subplots. Plots consisted of six single row ridges four metres long and spaced at one metre apart. The actual size of the plot harvested was 4 m x 3 m with 24 plants. Plant spacing was same for all trials.

The first trial was planted in March 2001, second in January 2002 and third in April 2003 in Aiyura, EHP at 1,680 metres above sea level. In the first two trials, the four main treatments were harvesting times; very early maturing at four months after planting, early maturing at five months, maturing at six months and late maturity at seven months. The harvesting dates formed main blocks, with the varieties as sub plots. The same 30 varieties were used in both trials. In the third trial, there were two main treatments as harvesting times, very earliest maturing (3 months) and very early maturing (4 months). The first harvest was carried out on July 28th, 2003, after three months, and the second harvest on August 28th, 2003.

The data collected were the same for all three trials; immature tuber number per plant, immature tuber weight per plant, mature tuber weight per plant, marketable tuber number per plant, marketable tuber weight per plant, non-marketable tuber number per plant, non-marketable tuber yield per plant, total yield per plot and vigor assessment.

The two earlier trials assessed 18 varieties, which farmers had selected as being drought tolerant (Humphrey, *et al.* 2002) and 12 high yielding varieties from the Pacific Regional Agricultural Project (PRAP) selection (Guaf *et al.* 1998). Listed below are the varieties evaluated: Farmer SSYK 023, Farmer SGG 008, Farmer SSYK 018, Farmer WHCK 005, Farmer SGG 001, Farmer SGG 006, Farmer SSYK 019, Farmer WJW 001, Farmer EDK 003, Farmer SKK 010, Farmer WBS 010, Farmer WMK 008, Farmer WJW 002, Farmer SSYK 002, Farmer WHCK 007, Farmer WJW 003, Farmer SSYK 026, Farmer SKK 009, PRAP 469, PRAP 91, PRAP 559, PRAP 714, PRAP 1443, PRAP 123, PRAP 107, PRAP 2, PRAP 219, PRAP SUGAR, PRAP 1170 and PRAP GOIFE.

The third trial assessed nine top performing varieties identified from the two earlier trials; they were WHCK 007, WHCK 005, WBS 010, SKK 010, PRAP 123, PRAP 714, PRAP 469, PRAP 559 and SSYK 026.

The trials were manually weeded using spades during the growing period. No fertilisers or chemicals was applied in all the trials.

RESULTS

The results of the first two trials are presented in Tables 1, 2 and 3 below and results of trial 3 are presented on Table 4 under the combined results.

First Sweet Potato Early Maturing Variety Trial Planted in Aiyura

Yield at four months was low for all varieties, though nine varieties yielded 4 tonnes per hectare or more (Table 1). At five months, seven varieties yielded 8 t/ha or more.

Second Sweet Potato Early Maturing Variety Trial Planted in Aiyura

At four months, 12 varieties yielded over 4 tonnes per hectare (Table 2). Eight of these varieties also yielded over 4 tonnes at four months in the first Trial. At five months, 14 varieties yielded more than 10 t/ha. Eleven varieties had mean yields of 8 t/ha or more (Table 2).

COMBINED TRIAL RESULTS

Based on harvest at four months of Trials 1 and 2, nine varieties were selected as early maturing. They yielded between 4 and 8 tonnes per hectare (Table 3).

Trial 3 assessed nine selected varieties from the two earlier trials, to identify earliest varieties that can mature as early as three to four months after planting with acceptable yield.

The fourth column in table 4 gives an indication of possible yields if farmers chose to harvest their crop between three and four months. Overall, the available data shows seven superior varieties.

DISCUSSION

The objective of these trials is to select early maturing varieties of sweet potato to recommend for cultivation during the post drought period; so that farmers can secure this important energy food sooner rather than later.

Yield at four months was low for all varieties in trial 1, though nine varieties yielded 4 tonnes per hectare or more and could be considered as early maturing. At five months, seven varieties yielded 8 t/ha or more

(Table 1). Four of these were among the nine, which yielded best at the first harvest. If mean yields from the first two harvests are considered, six varieties yielded over 6 t/ha.

For the purpose of selecting for early maturity, total yield of varieties when harvested at four and five months is important (Table 1). Yields were low in two of the three blocks in Trial 1 due to waterlogged conditions and death of some plants. Therefore there were significant differences between varieties in the number of plants harvested. The high CV reflects this. Despite that, one variety (714) produced the highest yield at five months.

Similarly in trial 2, selection for early maturity was done for harvests at the fourth and fifth months and analysed separately (Table 2).

If the top 10 varieties in Trial 1 and Trial 2 are compared, six varieties are common to both lists, suggesting that they consistently produce good

Table 1. **Total Yield (t/ha) of 30 Varieties of Sweet Potato after harvesting at 4 and 5 Months in Trial One**

Variety	4 Months	5 Months	Mean
PRAP 714	4.20	20.36	12.28
PRAP 123	6.84	13.70	10.27
WHCK 007	4.18	14.26	9.22
PRAP 91	3.68	12.96	8.32
PRAP 469	8.34	7.96	8.15
WBS 010	6.39	8.41	7.40
GOIFE	0.51	10.58	5.55
SSYK 022	3.20	7.68	5.44
WHCK 005	2.07	8.19	5.13
PRAP 559	6.19	4.02	5.11
PRAP 1170	5.09	4.90	5.00
SKK 009	3.93	5.57	4.75
SSYK 026	5.05	3.40	4.22
SKK 010	4.95	3.37	4.16
SGG 008	2.70	5.52	4.11
WJW 003	2.09	5.81	3.95
WJW 002	3.48	4.36	3.92
PRAP 219	3.52	3.78	3.65
WMK 008	2.86	4.35	3.61
EDK 010	1.21	5.71	3.46
SSYK 019	0.80	5.09	2.95
PRAP 2	1.42	4.21	2.81
WJW 001	0.85	4.17	2.51
SGG 006	1.51	3.46	2.49
SSYK 018	2.64	2.28	2.46
PRAP SUGAR	1.60	2.64	2.12
PRAP 1443	1.62	2.38	2.00
SSYK 023	0.47	2.26	1.36
PRAP 107	0.69	1.29	0.99
SGG 001	0.13	0.49	0.31
Mean	**3.07**	**6.11**	
LSD (P<0.05) CV (%)	7.7 17.2	8 80	

Table 2. **Total Yield (t/ha) of 30 sweet potato varieties after harvesting at 4 and 5 Months in Trial 2.**

Variety	4 Months	5 Months	Average
WHCK 005	8.59	16.04	12.32
WBS 010	6.99	16.93	11.96
PRAP 714	5.51	18.03	11.77
WHCK 007	7.34	14.92	11.13
SSYK 026	7.79	13.74	10.77
PRAP 469	5.62	15.68	10.65
SKK 010	6.44	13.71	10.08
SGG 006	4.08	14.06	9.07
PRAP 219	3.15	14.74	8.95
PRAP 559	4.82	12.65	8.74
PRAP 123	4.61	11.56	8.09
SKK 009	3.41	12.10	7.76
WJW 003	3.19	12.16	7.68
SSYK 019	4.23	9.92	7.08
PRAP 2	4.33	9.27	6.80
Goife	1.92	11.60	6.76
PRAP 1170	3.89	9.27	6.58
WJW 002	1.60	10.01	5.81
PRAP 91	3.22	8.36	5.79
EDK 010 (003)	2.99	7.54	5.27
SSYK 022	2.70	8.57	5.64
WMK 008	3.66	6.85	5.26
PRAP 1443	2.50	6.36	4.43
WJW 001	1.76	6.56	4.16
SSYK 023	2.48	5.75	4.12
PRAP 107	2.55	4.95	3.75
SSYK 018	2.47	4.68	3.58
PRAP Sugar	2.00	3.93	2.97
SGG 008	0.48	4.10	2.29
SGG 001	0.30	3.89	2.10
Mean	**3.82**	**11.04**	
LSD (P<0.05)	2.51	NS	
CV (%)	40	80	

yields when harvested early. These six are included in Table 3, which consists of high yielding and early maturing varieties at four months after planting.

Based on the results, all nine varieties on Table 3 and 4 are recommended as giving reasonable yield (more than 4 tonnes per hectare) at four months. Given that yield in traditional PNG gardens is between 5-20 tonnes per hectare (Bourke 1985), the yields of these varieties at 4 months are acceptable.

It should be noted that five of the nine varieties are also tolerant to drought conditions. It means farmers can add these varieties to their collection to be grown for long- term drought preparedness and for enhancing post drought recovery.

Further more, the results of Trial 3 confirmed earlier selections for early maturing sweet potato varieties and drought tolerance (Bang *et al.* 2002). The varieties found to be high yielding continue to out-

Table 3. **Total yield (t/ha) of common Early Maturing Sweet Potato Varieties at 4 months from Trials 1 and 2.**

Variety	Trial 1	Trial 2	Mean	Remarks
PRAP 469	8.34	5.62	6.98	Also drought tolerant
WBS 010	6.39	6.99	6.69	Also drought tolerant
SSYK 026	5.05	7.79	6.42	Popular in Simbu
WHCK 007	4.18	7.34	5.77	Very early Maturing
PRAP 123	6.84	4.61	5.73	
SKK 010	4.95	6.44	5.70	Also drought tolerant
PRAP 559	6.19	4.82	5.51	
PRAP 714	4.20	5.51	4.86	Also drought tolerant.
WHCK 005	2.07	8.59	5.33	Also drought tolerant

Table 4. **Total Weight of Edible Sweet Potato Tubers in tonnes per hectare (t/ha) and yield ratios at 3 and 4 months harvests from date of planting in trial 3.**

Sweet Potato Variety	Three Months	Yields (t/ha)		Average Yields
		Four Months	Ratios 3:4	
PRAP 559	2.83 a	7.96 a	0.36 abc	5.39 a
PRAP 123	2.85 a	8.96 a	0.33 ab	5.90 ab
PRAP 714	3.87 a	10.83 a	0.35 abc	7.35 abc
WHCK 007	3.96 a	13.80 a	0.28 a	8.88 bcd
SSYK 026	4.04 a	10.45 a	0.40 abcd	7.24 abc
PRAP 469	4.33 ab	13.92 a	0.32 ab	9.13 cd
WHCK 005	6.41 bc	13.56 a	0.46 bcd	9.99 cd
SKK 010	6.75 c	13.79 a	0.51 cd	10.27 cd
WBS 010	7.46 c	14.01 a	0.57 d	10.74 d
LSD (5%)	2.08	Ns		3.15
C.V. (%)	30.2	28.2	29.6	26.0

perform the others. Five varieties (WBS 010, SKK 010, WHCK 005, PRAP 469 and WHCK 007) produced tubers in excess of 13 tonnes/ha during the fourth month harvest. The highest yielding variety WBS 010 was particularly recommended for its ability to tolerate drought and early maturing characteristics.

It can be recommended for farmers to not only cultivate the top seven selected early maturing sweet potato varieties (WHCK 007, SSYK 026, PRAP 469, PRAP 417, WHCK 005, SKK 010 and WBS 010) post drought, but add these permanently into their gardening system as a strategy for long–term preparedness. All three trials at Aiyura have shown that acceptable yields can be obtained at three and four months, though tubers will continue to bulk up after this. They will be able to provide edible and good tuber sizes sooner than most varieties.

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JAVANESE ZEBU CATTLE OF PAPUA NEW GUINEA EXTINCTION BY NEGLECT

Alan R. Quartermain

ABSTRACT

Cattle of South-east Asian origin were introduced and became widespread in New Guinea during German colonial times. The predominant type was a small, distinctive zebu-type animal which became known as the Javanese Zebu. These cattle were used for vegetation control under coconuts as well as for beef. The herds were decimated and dispersed during the Japanese occupation but a number were re-established post-war and, in the mid 1970s, government officers accumulated such cattle to establish breeding herds at Erap in Morobe and Urimo in East Sepik. A limited amount of comparative production data were obtained before these herds too were dispersed in the 1980s. There are now no known purebreeding herds in existence but there may be a number of these cattle still owned by smallholders in the Sepik Plains area. The FAO – UN lists the breed as endangered and, short of a major salvage operation, it may well be regarded as extinct. The available data and publications all come from the work of Dr John Holmes and his colleagues, but there are only three research papers. Compared to typical lowland Brahman crossbred commercial cattle, Javanese cattle are smaller and grow more slowly when on good pasture. They are more fertile but the margin is small under good conditions. However, the Javanese cattle are clearly superior in all aspects of productivity in the harsh environment of the Sepik Plains. If indeed the breed has been lost due to over 20 years of neglect by government agencies and the cattle industry, it will be difficult to replace for beef production in the harsh, humid, poor fertility lowland grasslands. The conservation of domestic animal biodiversity at the sub-species level is crucial as production industries face uncertain futures.

Keywords: *Cattle, Javanese Zebu, Brahman crossbreed, Dressing percentage, grasslands.*

INTRODUCTION

Cattle of Southeast Asian origin were variously introduced into the then New Guinea colony by the German Administration, planters and missionaries from the 1880s up until the change in administration as a result of the First World War (Holmes 1977, Holmes *et al.* 1977). Cattle of a variety of types and origins became widespread throughout the colony or protectorate where coconut plantations were established. While there are various references to the introductions in records such as those of the New Guinea Kompagnie, it was rarely clear what kinds of animals came from where, most having been loaded on route. Indications are that most came from the Dutch colony of Batavia or Java but cattle were also introduced from Thailand. A distinct type of zebu cattle became widespread and known as the Javanese Zebu. These cattle were ideally suited to the control of grass growth under coconuts.

The regions of the New Guinea north coast mainland and islands where most plantations were concentrated were also the areas occupied by the Japanese army during the Second World War. As a result of slaughter for food supply and intense fighting, the cattle herds were decimated and many cattle became feral. Post-war, a number of plantations and Catholic missions, particularly in the Sepik, Madang and New Ireland Provinces of what is now Papua New Guinea (PNG), re-developed herds of Javanese cattle. It is believed that few if any of these herds retain these animals in pure-breed form today.

These Javanese Zebu (JZ) cattle of PNG have featured in publicity releases by FAO as an example of a threatened domestic animal resource. The FAO World Watch List for Domestic Animal Diversity (Scherf 2000) lists the breed type as endangered with a decreasing population trend. They state that the total number of breeding females may be as low as 400 and there are no banked germplasm materials. Endangered is defined for breeds as having between 100 and 1000 breeding females or 5-20 breeding males.

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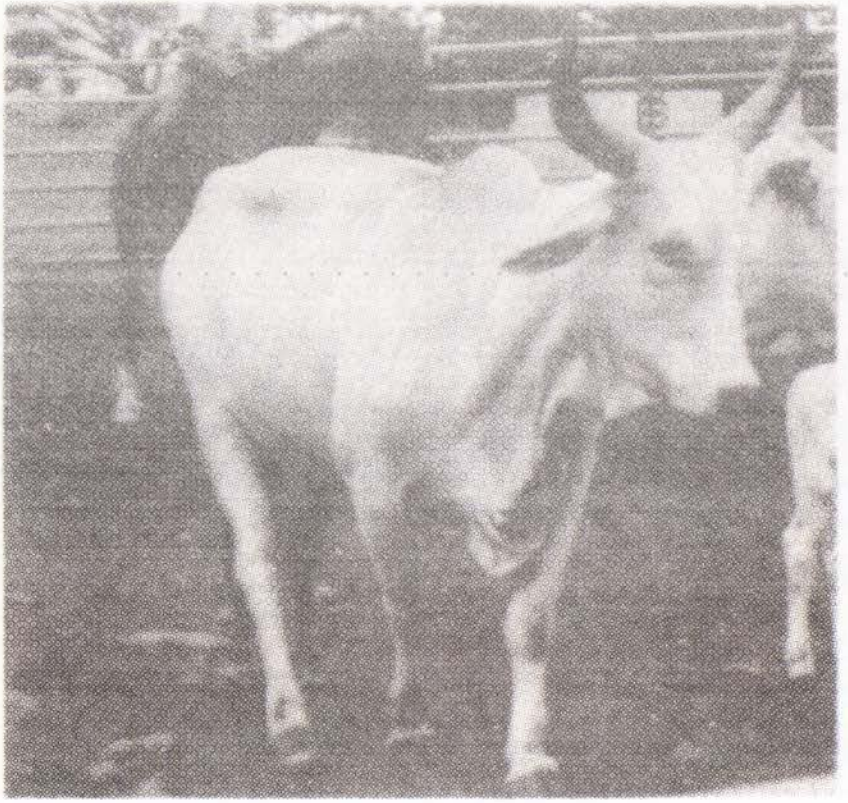
No survey of the status of this breed has been carried out since 1979. The two government herds with these cattle were dispersed and many of the existing cattle are presumed feral. Anecdotal evidence suggests that there may be a reasonable number of animals of the type with smallholders in the Sepik Plains area and Holmes (1980) estimated that there might be 2000 animals total. Another major salvage operation as was undertaken in the mid 1970s to establish the government herds would probably be necessary to save the breed from extinction, if not already too late. It is thought worthwhile to aggregate and summarise the limited amount of data in the small number of publications concerning these cattle for ease of reference. A systematic description of the breed is given by Holmes (1980) and the only available photograph is given in Figure1 from Holmes (19811b).

THE TWO GOVERNMENT HERDS

From 1974, officers of the PNG government Department of Agriculture, Stock and Fisheries (now Department of Agriculture and Livestock) accumulated JZ cattle to establish herds on the government ranches of Erap and Urimo. Holmes *et al.* (1992) state that the department purchased one bull and 24 females of a range of ages from Catholic missions in the Lower Sepik, 33 heifers and four bulls from coconut plantations near Madang, and 25 heifers and two bulls from plantations in New Ireland. The available data were only begun to be collected after the formation of these government herds and there are only seven publications altogether, all authored or co-authored by Dr Holmes. Of these, only three papers contain experimental results with estimates of precision attached to production statistics. All data come from purebred or crossbred cattle on the two stations.

The former Beef Cattle Research Station at Erap in the Markham Valley of Morobe Province is situated at 100 m above sea level, has an average annual rainfall of 1250 mm and has a temperature range of 18o-35o C with little annual variation. The recently deposited alluvial silt and sandy loam soils support pastures of *Dichanthium annulatum*, *Imperata cylindrica* and *Cenchrus ciliaris*. The former Sepik Plains Livestock Station, now mainly reverted to traditional land ownership, has a considerably harsher environment. While the climate is similar to

Figure 1. Javanese Zebu Cow.



that of Erap, except for a higher annual rainfall averaging 1700 mm, the podsolic soils have multiple mineral deficiencies for cattle production, the major limitation being phosphorus as shown clearly by Holmes (1981a). The vegetation of these rolling grass plains is an association of *Imperata cylindrica, Themeda australis, Lochaemum barbatum* and sedges.

DESCRIPTION AND PRODUCTION DATA

According to Holmes (1980), the animals come in a variety of coat colours, the commonest being fawn with a black stripe along the spine. The coat is short, ears small (15 cm) and held horizontal, hump overhanging or pyramidal, horns variable in colour and direction but not twisted, and the udder small, neat and closely attached. Bulls weigh 500-580 kg while cows weigh 320-410 kg. The cattle are quiet but alert in the field. In yards they can become very excitable and nervous. They are good mothers and are very aggressive when the calves are young. They are the most resistant of all the PNG cattle to ticks which have a limited distribution in PNG and screw worm.

The most comprehensive set of comparative reproduction and calf growth data comes from assessment with continuous mating over five years of Brahman crossbred (BX) and JZ cattle and their reciprocal crosses at Erap (Holmes *et al.* 1992). The BX cows were typical lowland commercial cattle and there were 20 heifers (later reduced to 14 cows) in each mating group. Three bulls of each breed were used sequentially.

Tables 1 and 2 are reproduced directly from the Holmes *et al.* (1992) paper and give the relevant data on cow weights and calving intervals by cow breed and on calf weights and pre-weaning growth rates by breed of dam and sire. Initial heifer mating time was determined by weight rather than age, based on earlier experience, and hence the JZ heifers were mated some 134 days earlier and 100 kg lighter than the BX heifers. Nevertheless, JZ cow weights never approached those of the BX and JZ cows were 62-73 percent of the weight of the BX. Calving intervals for the JZ were 19 days shorter.

Purebred BX calves were 10 kg heavier at birth than JZ calves and grew 48 percent faster to weaning at 7.5 months. Pre-weaning average daily gains were 0.68 kg and 0.46 kg respectively. The effect of the breed of sire in the reciprocal crosses was quite small.

Holmes (1981b) reported average calving intervals and pre-weaning growth rates for both types of cattle at Erap and at Urimo. Intervals were 14 months for BX cows at Erap, 22 for BX at Urimo, 12 for JZ at Erap and 13 months for JZ at Urimo. These intervals are probably closer to what might be expected in a smallholder herd than the least-square means in Table 1. Corresponding pre-weaning growth rates were 0.72 and 0.35 kg per day for BX at the two

Table 1. **Least squares breed and parity means of weights and intervals during calving cycles in BX and JZ cows and calf pre-weaning weights**

Trait	Breed	Parity				
		1	2	3	4	5
Cow Traits						
Weight (kg) at:						
Conception	BX	333	368	404	448	428
	JZ	217	262	276	279	292
Pre-calving	BX	424	455	471	487	486
	JZ	293	306	309	333	322
Minimum during lactation	BX	363	392	396	406	375
	JZ	241	270	274	284	253
Weaning of calf	BX	380	413	424	431	397
	JZ	277	294	273	312	278
Calving Interval (days)	BX	1078 *	389	357	365	370
	JZ	944 *	370	338	346	351
Calf Traits						
Birth Weight (kg)		31.3	31.9	31.3	28.4	27.4
Birth weight/Cow pre-calving weight (%)		8.7	9.0	8.8	8.0	6.6
Average Daily Gain (kg/day)		0.58	0.64	0.60	0.52	0.50
Weaning weight/Cow weight at weaning (%)		50	52	49	40	45

* Time between birth of cow and birth of first calf

Table 2. **Least squares means for birth weight, birth weight as a proportion of cow pre-calving weight, average daily gain to weaning and adjusted weaning weight as a proportion of dam weight at weaning for BX – BX, JZ – JZ, BX – JZ and JZ – BX**

Trait	Mean	Breed of Dam	Breed of Sire		
	(SE)		BX	JZ	Both
Birth Weight (kg)	30.1	BX	35.1	30.8	33.0
	(0.7)	JZ	29.3	25.0	27.2
		Both	32.2	27.9	
Calf birth wt/Cow pre-calving wt (%)	8.0	BX	7.8	6.7	7.3
	(0.3)	JZ	9.3	8.3	8.8
		Both	8.6	7.5	
Pre-weaning Average Daily Gain (kg)	0.57	BX	0.68	0.61	0.65
	(0.01)	JZ	0.53	0.46	0.50
		Both	0.61	0.54	
Calf weaning wt/Cow wt at weaning (%)	47	BX	47	43	45
	(1.0)	JZ	52	47	50
		Both	50	45	

sites and 0.50 and 0.52 kg for JZ. Weaner production per cow in kg per year were 162 and 61 for BX at the two sites and 122 for JZ at both sites. BX cows at Urimo lose 30 percent of their body weight during lactation (Holmes 1977) compared to five percent and 11 percent for JZ and BX heifers at Erap. The environmental effect of the conditions at Urimo on performance of the BX cows is clear.

Two reports on feeding experiments give data on the post-weaning growth of steers and on carcass characteristics. Holmes (1979) grazed steers of the two breeds at Erap on three feeds with three steers per group. The feeds were Nunbank buffel grass pasture and two cultivars of the tree legume *Leucaena*. The experiment ran for one year. Initial weights of the 14-17 month BX steers averaged 215 kg while the 12-18 month JZ steers averaged 177 kg. Since there were no differences in steer growth between the feeds, the data in Table 3 are given as breed means.

BX steers grew significantly faster than JZ steers with a greater total weight gain. However, the breeds had similar dressing percentages since the JZ steers had smaller but fatter carcasses.

In the second experiment, Gwaiseuk and Holmes (1985) fed steers for 18 weeks on treatments to evaluate the use of wheat millrun as a supplement to grazing of buffel grass pasture. Breed differences were not analysed as such and only data relevant to the breed comparison are given here. There were two 20-24 month JZ steers and two 16-24 month BX steers on each treatment. Relevant data from the grazing and four hours of millrun feeding as a supplement to grazing treatments are given in Table 4. JZ steers did not respond at all well to higher levels of millrun supplementation. The only significant breed difference was that for average daily gain on full grazing when the BX out performed the JZ steers.

Table 3. **Growth and carcass characteristics of JZ and BX steers at Erap**

Breed	Javanese Zebu	Brahman Cross
Average daily gain	0.3 kg	0.4 kg
Total liveweight gain	105 kg	143 kg
Final weight	282 kg	358 kg
Carcass weight	170 kg	212 kg
Dressing percentage	60.3 %	59.2 %
Backfat thickness	6.4 mm	3.8 mm

Table 4. **Growth and carcass characteristics of JZ and BX steers on grazing and limited millrun supplementation**

Treatment	Grazing only	Millrun 4 hours	Grazing only	Millrun 4 hours
Breed	JZ	JZ	BX	BX
Growth rate per day	0.61 kg	0.97 kg	0.83 kg	1.07 kg
Final liveweight	345 kg	386 kg	358 kg	391 kg
Carcass weight	192 kg	215 kg	194 kg	215 kg
Dressing percentage	55.6 %	57.4 %	54.2 %	54.9 %
Backfat thickness	6 mm	9 mm	4 mm	8 mm

CONCLUSIONS

In summary it seems appropriate to quote the conclusion and recommendation of Holmes *et al.* (1992). They "conclude that crossbreeding BX and JZ to produce F1 cattle is unlikely to be advantageous in PNG unless greater advantages are shown than found here. The BX cattle at Erap have high fertility and good growth rates. JZ cattle are smaller and more fertile than BX, but this advantage is smaller under good conditions and their energetic efficiency is unlikely to be significantly greater. Under harsh, humid equatorial lowlands conditions JZ are superior and their contribution to beef production in Papua New Guinea probably lies in these areas."

If indeed the breed has been lost due to over 20 years of neglect by government agencies and the cattle industry, it will be difficult to replace for beef production in the harsh, humid, poor soil fertility, lowland grasslands. The conservation of domestic animal biodiversity at the sub-species level is becoming of increasing concern worldwide and is crucial if production industries are to have the flexibility to adapt to uncertain futures. If it is not already too late to act, the JZ cattle of PNG should not be allowed to vanish through neglect or ignorance of their actual or potential contribution to beef production from the nation's grassiands.

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DRY MATTER PRODUCTION OF FIVE VALANGUR (POLYSCIAS SP.) VARIETIES

Joachim A.R. Pitala

ABSTRACT

Five Valangur varieties namely Tuna, Kiau, Ene, Molo and Ravalian were collected and established at the University of Vudal farm in the East New Britain Province.

As part of a series of studies planned for the Valangur Varieties Collection Project, a dry matter production study was conducted from March to June 2008 to find out which of the five varieties produces consistent higher dry matter yields (DMY).

The study shows that the Valangur variety Ene gave higher dry matter yields throughout the 4 months period. This result is consistent with the physical leaf characteristics of this particular variety. The DMY for the other four varieties (Tuna, Kiau, Molo and Ravalian) were similar and not significantly different.

Keywords: *Five Valangur varieties, studies, Collectiion Project, matter yields, leaf, characteristics.*

INTRODUCTION

Papua New Guinea (PNG) is blessed with extensive renewable and non-renewable natural resources, a generally favorable climate, and a relatively small population of about 5.4 million. The forests in particular have provided Papua New Guineans with building and clothing materials, spiritual purposes and food resources since time immemorial. There is a plethora of diverse plant species which are used for medicinal purposes and as green vegetables that continue to play a major role in the nutrition and health, and livelihood of many communities.

In spite of this floral diversity, there is unfortunately scant information about their biological characteristics, nutritional and other uses as well as information on their negative aspects. This lack of information and documentation has led to a situation where some of these plant species especially the green leafy vegetables have been "neglected" and sadly to say have been given less priority in terms of research and their cultivation compared to many introduced vegetable plant species.

One of these plant species which continue to contribute to the nutrition and well-being of the people of East New Britain Province is a shrub called "Valangur" in the Kuanua language of the Tolai people of East New Britain Province (ENBP). Valangur (Polyscias spp.) is used extensively in the Gazelle Peninsula as a live fence, as an erosion control plant and as a vegetable crop. A survey conducted by Lolo (1982), indicated that Valangur (Polyscias verticillata) is one of the most frequently consumed green vegetables among the Tolai people of ENBP.

Conn (1995), indicated that there are about 100 species of Polyscias throughout the tropics including the Pacific Islands and 20 of them are found in Papuasia region. Moreover, 9 of the species are considered endemic and only 3 of them are known to be in cultivation. In PNG, Conn (1995) documented the characteristics of 19 Polyscias species. However, there is very little information available on the nutritional and other social beneficial attributes of these species.

This report highlights the dry matter production of five Valangur varieties as part of a series of studies planned for the Valangur Varieties Collection Project (Project No: 10107) established at the University of Vudal (UOV) in East New Britain Province.

MATERIALS AND METHODS

Location

The Valangur Varieties Collection Project was established at the UOV's agriculture farm located

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within the university campus. The university is situated approximately 45 km away from Rabaul town in ENBP. The geographical coordinates are 155° east and 10° south of the equator. The annual rainfall is about 3000 mm and the mean monthly minimum and maximum temperatures range from 22-25°C and 30-33°C, respectively.

Varieties and spacing

Five Valangur varieties were used and are known locally as Valangur Tuna, Valangur Kiau, Valangur Ene, Valangur Molo and Valangur Ravalian. The total area used for the project was 529 m^2 and the spacing within and between rows, within a variety, were 200 cm and 150 cm, respectively. The spacing between varieties was 200 cm. Therefore, there were 3 rows per variety.

Stem cuttings (with variable lengths and sizes) were used as planting materials and the number of cuttings per variety was 33 which required a total of 165 cuttings.

Leaf sampling procedure for dry matter determination

The first leaf sampling for DMY was conducted in March 2008 and continued at monthly intervals for 4 months. Leaf samples were collected from 5 random selected plants from each variety and this was done by harvesting the 3rd and 4th imparipinnate leaves from the top. Subsequent leaf samplings were done on the same plants within the 4 months period. Immediately, after the leaves were harvested, their fresh weights (FW) were taken and then dried in an oven at 80°C for 24 hours and after cooling, their dry weights were taken.

RESULTS AND DISCUSSION

The dry matter yield data indicate that there were significant ($P<0.05$) differences in dry matter yields between varieties Ene and Tuna, between Ene and Kiau, between Ene and Molo, and between Ene and Ravalian (Figure 1). No significant ($P<0.05$) differences in dry matter yields were observed among varieties Tuna, Kiau, Molo and Ravalian.

It is apparent from the results that in terms of dry matter production, variety Ene consistently produced higher dry matter yields compared to the other four varieties. This result is consistent with the physical characteristics of this variety particularly in relation to its leaf characteristics. For example, the number of leaflets and petiole lengths of variety Ene are 13 and 52.5 cm, respectively. Also, the width range of leaflets and the average length of leaflets of variety Ene are slightly higher compared to the other four varieties (Table 1 and Plate 3) which have less number of leaflets and shorter petiole lengths (Table 3 and Plates 1, 2, 4 and 5). However, it is quite evident that the higher number of leaflets, the longer

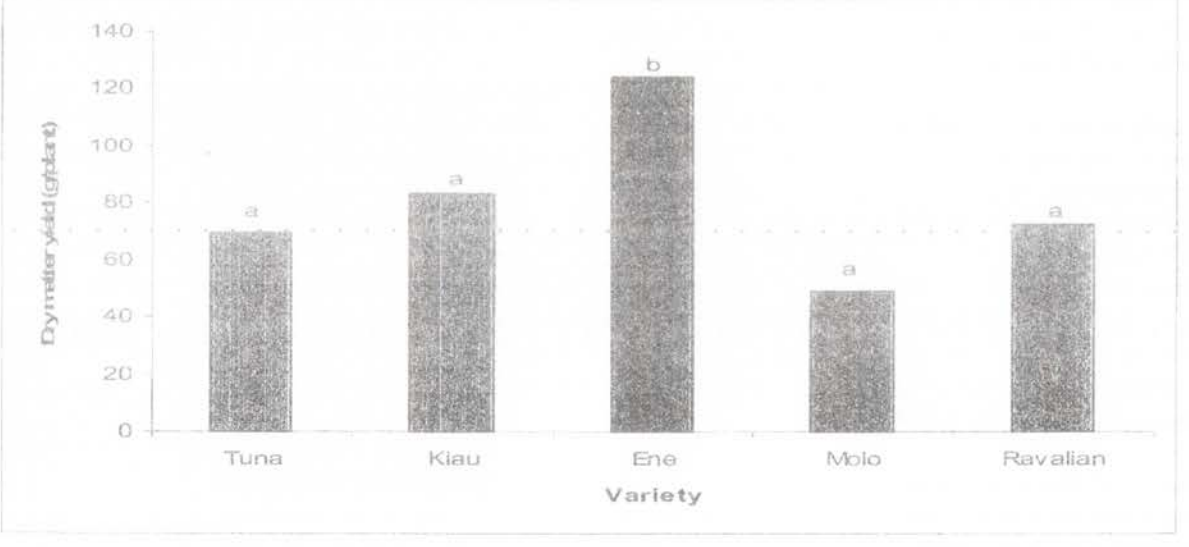

Figure 1. **Dry matter yields of the five varieties of Valangur. Columns headed by the same letter do not differ significantly at the 5% level by DMRT.**

Table 1. Some leaf characteristics of the different Valangur varieties

Characteristic	Variety				
	Tuna	Kiau	Ene	Molo	Ravalian
Number of leaflets	11	9	13	11	11
Average length of leaflets (cm)	15 cm (range: 11-16.5 cm)	17.8 cm (range: 12.9-19.4 cm)	23.3 cm (range. 17-26.5 cm)	22.3 cm (range: 17-27 cm)	17.4 cm (range: 14-21 cm)
Width range of leaflets (cm)	7-10 cm	7-9.5 cm	7.5-12 cm	7.5-10 cm	6.5-10 cm
Petiole length (cm)	36 cm	33.5 cm	52.5 cm	46 cm	38.5 cm
Color	Yellowish at top & green at lower leaves	Yellowish top leaves and green at lower leaves	Glossy dark green	Glossy dark green	Dark green

Plate 1. Valangur Tuna

Plate 2. Valangur Kiau

Plate 3. Valangur Ene

Plate 4. Valangur Molo

Plate 5. Valangur Ravalian

leaflets and the petiole length appear to be the major contributing factors to the higher dry matter yields observed in variety Valangur Ene.

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