

**INVESTIGATING THE POTENTIAL OF CULTIVAR
DIFFERENCES IN SUSCEPTIBILITY TO THE SWEET POTATO
WEEVIL *CYLAS PUNCTICOLLIS* AS A MEANS OF CONTROL**

Experimental design and methodology, 1998

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List of cultivars

Ukiriguru		Kibaha
Cultivar name	Code No.:	Cultivar name
SPN/O	1	SPN/O
Mwanamonde	2	Mwanamonde
Sinia	3	Sinia
Budagala	4	Budagala
SP/93/2	5	Elias
SP/93/23	6	H/Mtumwa
SP/93/34	7	Iboja
SP/93/5	8	Kibaha10
SP/93/30	9	Ukerewe
Bagazanentukuru	10	Maria
Simbeichumu	11	
Ipembe	12	
Mwananjemu	13	
SP/93/17	14	
Polista	15	
SP/93/13	16	

Field trials

Planting materials, sites and experimental design

At Ukiriguru the above mentioned 16 cultivars were grown for field evaluation, an additional plot containing the 16 cultivars were grown to provide clean roots for use in the laboratory experiments.

At Kibaha the above mentioned 10 cultivars will be grown for field infestation evaluation and the same 10 cultivars will be planted in a separate area to obtain clean roots for use in the laboratory experiments.

Frequent hilling up will be carried out on the clean root plots to try and minimise weevil infestation

- Planting sites were chosen which had not recently been planted to sweet potato.
- Planting material produced on station was used, apical cuttings were used to reduce risk of prior infection.
- Five reps of each cultivar were planted in a randomised complete block design a map of the field layout at each site can be found in Appendix 1. Each plot consisted of three ridges one metre apart, ten apical cuttings were planted per ridge, giving a total of 30 plants per plot. A timetable of activities at both Ukiriguru and Kibaha sites is recorded in Appendix 2.

Artificial infestation

Artificial releases of *Cylas puncticollis* in the field were made at intervals in order to guarantee high weevil population levels. 30 weevils were released in the centre of each plot. If too few weevils are available to allow the release of 30 per plot, reduced numbers can be released but equal numbers must be released per plot. It is not necessary to sex the weevils. Approximately 2400 weevils per release at Ukiriguru and 1500 at Kibaha. Weevils were released 4, 6 and 20 weeks after planting at Ukiriguru, and 8, 12, 16 and 20 weeks after planting at Kibaha (see App. 2 for dates). (Note: it was decided to release weevils later at Kibaha in order to allow sweet potato roots to form prior to release).

Weevil rearing

Rearing should begin five weeks before the first artificial infestation date, a new set of jars can be set up every two weeks. For example: 8 - 10 two litre jars could be set up each time, with 3 roots in each jar and at least one male and one female weevil for each root.

Observations during growth of the field trial

The following observations should be made and recorded on form 1:

- Leaf shape (using the CIP description of leaf lobe types) at 3 months
- Plant type/ growth habit at 3 months
- Extent of insect caused foliage damage - at 2 and 3 months after planting, to be assessed using the central 1 metre section of the middle ridge of each plot, assessment date should be recorded (Note: too difficult to differentiate between *Cylas* and other insects damage)
- Crown diameter at 3 months (measure 3 plants per plot using a calliper)

Observations to be made the day before harvest

- Number of plants per plot (form 2)
- Number of plants with soil cracks per plot
- Number of plants with roots protruding from soil
- Number of tubers exposed per plot

Observations to be made in the field at harvest (~6 MAP at Ukiriguru and 5 MAP at Kibaha)

- Mark the crown position (at soil level) with a marker pen on five randomly chosen plants per plot
- Record root arrangement on a variety basis, categories are: compact; semi-compact and spreading
- Record any plants which have no roots (form 2)
- Measure and record neck length (per plant) and internode length (per tuber) for the five randomly chosen plants (form 3) (see Appendix 3 for diagram)
- Collect the crown section (3 cm above and 3 cm below marker pen line = 6 cm length of total section) for each of the five plants per plot and keep carefully for laboratory examination
- Collect all vegetation and weigh so we have kg/plot (form 5)
- Collect all tubers per plot into a well labelled sack (one plot per sack e.g. 80 sacks at Ukiriguru and 50 sacks at Kibaha).

Observations to be made in the laboratory just after harvest

Vegetation

- Record external and internal crown damage using the 1-6 scale (1=0% damage; 2=1-10%; 3=11-25%; 4=26-50%; 5=51-75%; 6=>75%) for each of the five randomly chosen plants per plot (form 4)

Roots

1. Grade the roots for each plot into four size categories:
 - small roots (up to 25 mm in diameter at the widest part of the root)
 - medium roots (26-40 mm in diameter at the widest part of the root)
 - large roots (41-80 mm in diameter at the widest part of the root)
 - extra large (>80 mm in diameter at the widest part of the root)
2. Record the number of roots in each category (form 5)
3. Weigh each root category
4. Put the small roots (non marketable) to one side
5. Mix together the medium, large and extra large roots (the marketable roots) and grade the roots by external weevil damage using a 1-6 scale (1=0%; 2=1-10%; 3=11-25%; 4=26-50%; 5=51-75%; 6=>75%), record the number of roots and weight of roots in each category
6. Cut off the weevil damaged portion and weigh the undamaged root portion in each of the 6 damage categories (weigh categories separately to obtain weight loss for each category)
7. Grade the small roots for external weevil damage using the 1-6 scale (as above), record the number of roots and weight of roots in each category (form 6)

Dry matter content assessment

- Select 3 clean roots of each variety
- Slice off both ends of each root and cut the rest of the root into small pieces, mix the pieces of all three roots (they will be the same variety) together
- Weigh and record the weight of a piece of aluminium foil shaped into a boat to safely hold the pieces of sweet potato, label the bag clearly with the variety name or number and the rep number (1-3) (form 7)
- Place approximately 150 - 200 g of the chopped up root inside the aluminium foil boat, weigh the aluminium foil boat and the root and record the exact amount
- 3 reps of each variety should be set up
- Place the aluminium foil boats containing the chopped up roots into an oven set at 60C for 3 days
- Remove the aluminium foil boats and samples from the oven and weigh and record the exact weight of the bag and its dry chopped up root
- Calculate the percentage dry matter (see recording sheet for details)

Laboratory trials

Rearing known age insects

Place 100 - 200 adults of *C. puncticollis* in a plastic jar with several fresh, clean roots of a susceptible cultivar such as SPN/O. Cover with netting to prevent insects escaping. Remove adults from jar after two weeks. After a further week (3 weeks from inoculation) check for emergence daily. Record the date of the first adult emergence. After two weeks, remove the newly emerged adults and place in jars with fresh clean roots (SPN/O). After a further two weeks, the adults will be between 2 - 4 weeks and the experiment can be started.

No - choice experiment

- Place 10 female weevils of known age (2-4 weeks) in a plastic jar with a single root of one variety. Care must be taken to ensure that each root is clean (wash with water and dry in sun for 3 hours), free of infestation, of a similar size and has been freshly harvested.
- Record the weight of each root, and label the jar clearly (form 8).
- Record the temperature in the laboratory at the same time each day throughout the experiment (form 9)
- Remove the adult female weevils after five days and record mortality (form 10)
- 3 weeks (21 days) after the start of the experiment, check the jars **daily** for adult emergence. Record the number of adults emerging daily for four weeks after the first emergence, discard adults after recording (form 10)
- After the 4 week recording period, weigh each root and assess the percentage of external and internal weevil damage using the 1-6 scale (1=0%; 2=1-10%; 3=11-25%; 4=26-50%; 5=51-75%; 6=>75%)
- Record the number of insects, larvae and pupae inside the roots, note any dead insects, larvae or pupae if present (form 8).

Preference experiment

- Place 10 female weevils of known age in a plastic jar with a single root of SPN/O and another variety. Care must be taken to ensure that each root is clean (wash with water and dry in sun for 3 hours), free of infestation, of a similar medium size and has been freshly harvested.
- Record the weight of each root, and label each root clearly using marker pen (form 8).
- Record the temperature in the laboratory at the same time each day throughout the experiment (form 9)
- Remove the adult female weevils after five days and place the roots in separate jars
- 3 weeks (21 days) after the start of the experiment, check the jars **daily** for adult emergence. Record the number of adults emerging daily for four weeks after the first emergence, discard adults after recording (form 11)
- After the 4 week recording period, weigh each root and assess the percentage of external and internal weevil damage using the 1-6 scale (1=0%; 2=1-10%; 3=11-25%; 4=26-50%; 5=51-75%; 6=>75%) (form 8)
- Record the number of insects, larvae and pupae inside the roots, note any dead insects, larvae or pupae if present (form 8)

Note:

10 replicates of each variety need to be undertaken for each experiment. It is unlikely that the weevil culture will produce a sufficient number of insects to undertake all 10 replicates at one time. Concentrate on testing the five most important cultivars first and spread replicates over several experiments. For example, if there are only 200 females, set up four replicates of each of the five varieties and complete the remaining six replicates in a separate experiment. Investigation of the other local varieties must include a susceptible control such as SPN/O to allow comparisons to be drawn among the separate experiments.

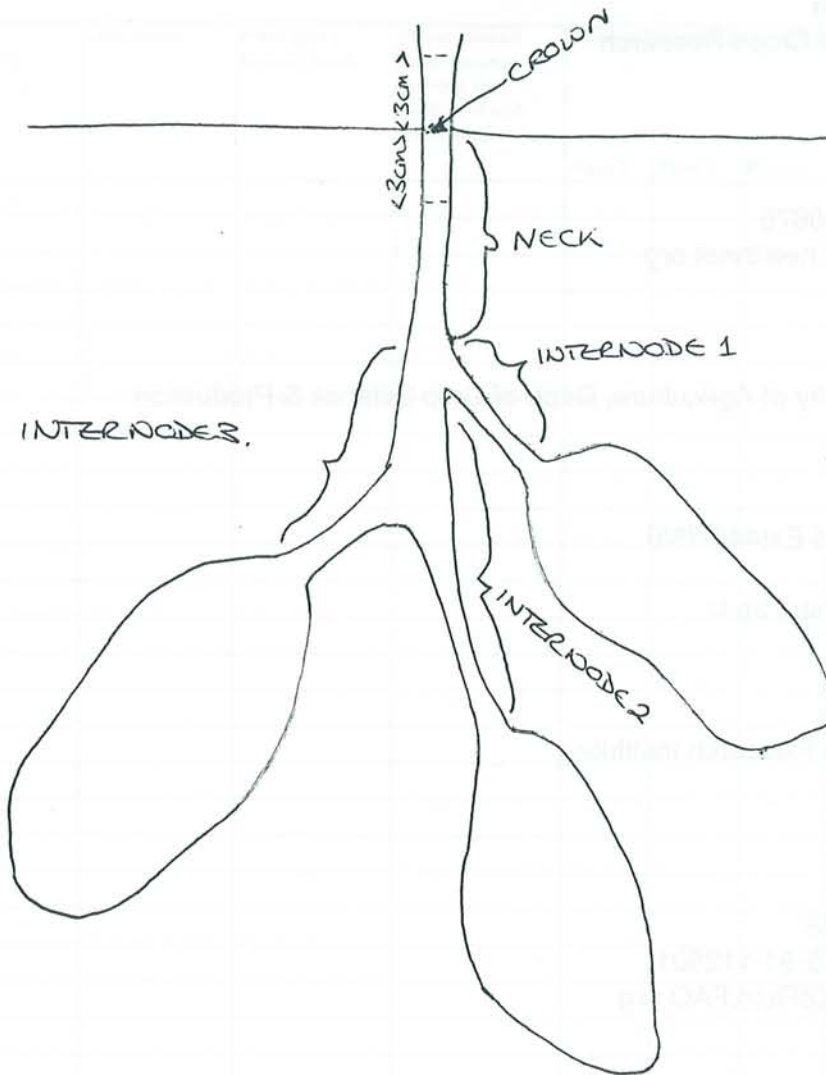
Natural root weight loss over time

- Weigh 5 roots of each variety used in the no-choice and preference laboratory tests at the time of setting up the above experiments. Care must be taken to ensure that each root is clean (wash in water and dry in sun for 3 hours), free of infestation, of a similar size and has been freshly harvested.
- Store the clean roots in the same place as the experimental roots.
- After 7 weeks (end of weevil emergence observations) weigh and record the final weight of each root. This will enable us to compare the natural weight loss of the roots over time with that of weevil infested roots.

Appendix 2
Dates of activities at Ukiriguru and Kibaha

Date	Ukiriguru	Date	Kibaha
24/12/97	Planting	20/4/98	Planting
		19/6/98	1st Artificial weevil release
		20/7/98	2nd Artificial weevil release
		17/8/98	3rd Artificial weevil release
		24/8/98	Clean root harvest 1
		25/8/98	Wash and cure clean roots 1
		26/8/98	Set up reps 1-5 of no choice and preference lab expts
		31/8/98	Remove adult weevils from lab expts reps 1-5 and place preference roots in separate jars
22/6/98	Harvest	7/9/98	4th Artificial weevil release
		8/9/98	Clean root harvest 2
		9/9/98	Wash and cure clean roots 2
		10/9/98	Set up reps 6-10 of no choice and preference lab expts
		11/9/97	Start checking daily and recording emergence of weevils from reps 1-5 of preference and no choice jars
		15/9/97	Remove adult weevils from lab expts reps 6-10 and place preference roots in separate jars
		21/9/97	Field trial harvest
		28/9/97	Start checking daily and recording emergence of weevils from reps 6 - 10 of preference and no choice jars

Appendix 3:
Diagram giving an example of rooting depth measurements and calculations



Appendix 4

Contact addresses for everyone involved in the weevil infestation trials

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Crown damage evaluation of various sweet potato varieties

Date: ____ / ____ / ____ Site: _____

Recorders names: _____

Plot number	Variety	Crown number	Crown damage		Cause of damage	Comments
			External	Internal		
		1				
		2				
		3				
		4				
		5				
		1				
		2				
		3				
		4				
		5				
		1				
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		3				
		4				
		5				
		1				
		2				
		3				
		4				
		5				

Natural Root weight loss over time

Site: _____

Variety	Root No.	Initial weigh date	Initial weight (g)	Final weigh date	Final Weight (g)	No. of days storage	% weight loss	Comments
	1							
	2							
	3							
	4							
	5							
	1							
	2							
	3							
	4							
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