THE EFFECT OF BANANA WEEVIL DAMAGE ON GROWTH AND YIELD OF BANANAS

D. Ocan[1], L.F. Turyagyenda[2], H.H. Mukasa[2], P.R. Rubaihayo[3], W. Tinzaara[2] and G. Blomme[2]

[1]Agronomy Department, Gulu University, P.O.Box 166, Gulu, Uganda; [2]Bioversity International, P.O. Box 24384, Kampala, Uganda; [3]Department of Crop Science, Makerere University, P.O.Box 7062, Kampala, Uganda. Author for correspondence: G. Blomme (G.blomme@cgiar.org)

Introduction

Bananas are of great economic importance in most regions of tropical and subtropical Africa. Their all year-round production ensures a continuous supply of food and income to the farmer, making bananas a major food security crop in the region. However, banana productivity has declined over recent years as a result of declining soil fertility and a high incidence of pests and diseases. The major pests of banana affecting the corm and root system development are the banana weevil (Figure 1), *Cosmopolites sordidus* (Germar) (Coleoptera: Curculionidae) and nematodes. The banana weevil has been implicated in the decline and disappearance of highland banana from traditional production zones in East Africa. The weevil lays its eggs at the base of the plant and the larvae which tunnel through the corm as they feed are the most destructive stage of the banana weevil. It was hypothesized that root initiation could be affected by severe weevil infestation. Internal weevil damage (Figure 2) has also been hypothesized to affect nutrient transport and stem growth, while peripheral damage may detach roots or adversely affect root development. It has also been postulated that a weevil infestation could prolong the bunch maturation period and shorten plantation life. This study aimed at investigating the effects of weevil infestation on root, shoot and bunch characteristics of East African *Musa* spp. genotypes.

Figure 1: Adult weevils

Figure 2: Cross sectional weevil corm damage in a farm in central Uganda

Materials and Methods

The study was carried out at the Makerere University Agricultural Research Institute Kabanyolo (MUARIK) in Wakiso district. Five East African highland bananas (*Musa* AAA-EA group); *'Mpologoma'*, *'Lwadungu'*, *'Nakitembe'*, *'Mbwazirume'* and *'Kibuzi'*; the dessert banana *'Sukali Ndiizi'* (AAB); the plantain *'Gonja'* (AAB) and the beer banana *'Kayinja'* (AABB) were used. Planting using in vitro-derived plantlets was done at a spacing of 4 x 4 m. Plants in the control plots were protected against weevil and nematode infestation by using Furadan. A split-plot within a randomized complete block design was used, with three replications of four plants per genotype. Forty adult weevils (20 males and 20 females) were released per mat at 18 weeks after planting in the infested plots. Twelve banana mats per genotype and per treatment were assessed for weevil damage at harvest of the plant crop. The following data was collected: bunch fresh weight (BW, kg), days to flowering (DF), days for fruit filling (FF) and total days to maturity/harvest (DM), leaf area (LA, m^2), dry weight of the leaves (LW, kg), height of the mother plant (PH, cm), height of the tallest sucker (HS, cm), pseudostem circumference of the mother plant at soil level (PC, cm), pseudostem circumference of the tallest sucker at soil level (CS, cm), pseudostem dry weight (PW, kg) and corm dry weight (CW, kg), number of cord roots (RN), root dry weight (RW, kg), cord root diameter (RD, cm) and cord root length (RL, m). Statistical analysis of data was performed using the Genstat statistical package.

Results and Discussion

A significant (P < 0.001) effect of genotype was observed on all growth and yield traits (Table 1). The lowest corm damage was recorded for *'Sukali Ndiizi'* and *'Kayinja'*, while the East African highland bananas, especially *'Lwadungu'* had the highest damage level (Figure 3). The plantain *'Gonja'* on the other hand recorded a moderate damage.

There was a strong genotypic effect on weevil damage. Genotypes with a 'B' genome such as *'Sukali Ndiizi'* and *'Kayinja'* are more tolerant to banana weevils than genotypes with only 'A' genomes.

The effect of weevil corm damage on growth characteristics is presented in Table 2. Time to flowering and days to harvest of *'Lwadungu'*, *'Mbwazirume'* and *'Kibuzi'* were significantly (P<0.05) reduced. *'Gonja'* was observed to take longer to flower and to produce a ripe bunch in the weevil infested plots.

Weevil damage to the banana corms during the first crop cycle was low, with a mean damage of 1.2 percent. Although the weevil infestation reduced bunch weight for most genotypes no significant effects were observed. The results suggest that several ratoon cycles may be required in order to have a significant yield loss caused by weevils in newly established fields.

Table 1. Mean squares and significance for different growth and yield traits of *Musa* spp. genotypes assessed at bunch maturity/harvest of the mother plant.

		Traits#											
Source	**df**	**DF**	**FF**	**DM**	**BW**	**LW**	**PH**	**PW**	**CW**	**NR**	**RL**	**RW**	**WD**
Replication	11	6,026***	363	4,235**	9.3	0.9	850	28	18.9	132,698	59,007	0.1	1.5
Genotype (Gen.)	7	45,893***	5,390**	48,680***	245.4***	33.6***	4,057***	9,570***	464.7***	1,855,794***	889,721***	11.0***	6.3***
Infestation (Inf.)	1	3,355	143	4,882	9.8	0.5	7,684***	18	0.1	77,226	220	0.5	282.1****
Gen*Inf	7	5,314**	816**	3,686*	25.5	1.1	436	22	1.2	45,561	64,481	1.1	5.8***
Residual	129	249	1517	4.0	12.8	1.6	504	39	5.6	91,454	758,626	0.3	0.9

*#: DF: days to flowering, FF: days of fruit filling, DM: days to maturity/harvest, BW: bunch fresh weight (kg), LW: dry weight of leaves of the mat (kg), PH: height of the mother plant (cm), PW: pseudostem dry weight of the mat (kg), CW: corms dry weight of the mat (kg), NR: number of cord roots of the mat, RL: cord root length of the mat (m), RW: root dry weight (kg) and WD: weevil corm damage (%). *, **, *** significant at P<0.05, 0.01 and 0.001, respectively*

Table 2. Growth parameters and percentage difference between non-infested (NI) and weevil infested (I) plants for eight *Musa* spp. genotypes assessed at bunch maturity/harvest of the mother plant.

	Mpologoma			*Lwadungu*			*Nakitembe*			*Mbwazirume*		
Traits	NI	I	%	NI	I	%	NI	I	%	NI	I	%
DF	333±12	341	2	450±11	380	-16***	375±20	378	1	413±16	339	-18**
FF	131±9.4	114	-13*	110±5.5	120	9	119±8.3	128	8	111±7.4	130	17
DM	464±11	455	-2	560±11	500	-12**	494±15	506	2	524±3.4	469	-10*
BW	17.8±2.4	18.3	3	13.9±0.7	13.6	-2	14±1.7	12.3	-12	12.7±0.82	12.6	-1
LW	3.1±0.2	3.4	8	3.6±0.7	4	11	3.2±0.2	2.8	-15	3.6±0.4	3.1	-14
PH	270±12	262	-3	320±12	287*	-10	288±8.3	269	-7	314±9.2	291	-7
PC	66±7.5	66	0	53±7.5	62	17	70±1.8	65	-7	61±1.2	58.0	-3
PW	7.2±0.7	7.4	3	9.94±1.9	8.8	-12	7.6±1.4	6.7	-12	14±1.2	15	6
CW	3.16±0.32	2.85	-10	4.3±0.4	3.8	-12	4.32±0.43	4.0	-7	2.6±0.34	2.6	0
RN	1,252±119	1,299	4	1,854±131	1,631	-12	1,275±90	1,279	0	1,863±117	1,720	-8
CS	70±2.6	75	7	82.4±2.6	78.4	-5	77±2.14	73	-5	72±5.5	70	-2
RL	205±29	189	-8	283±36	291	3	246±18	260	6	287±29	274	-5
RW	1.4±0.24	1.5	8	2.1±0.2	2.0	-5	1.4±0.2	1.5	3	1.4±0.22	1.5	4
	Kibuzi			*Sukali Ndiizi*			*Gonja*			*Kayinja*		
Traits	NI	I	%	NI	I	%	NI	I	%	NI	I	%
DF	429±4	406	-6***	327±12	326	-0.3	451±8	514	14**	383±19	386	1
FF	106±3.3	117	11*	158±8	139	-12*	148±3	138	-7*	160±3	149	-7
DM	535±4	523	-2	485±14	464	-5	599±10	652	9***	543±16	535	-2
BW	12.7±0.7	11.2	-12	6.4±0.6	6.03	-6	15.5±0.9	13.9	-11	14.8±1.0	13	-12
LW	2.3±0.5	2.5	-9	5.8±0.7	5.0	-14	2.1±0.4	1.8	-14	5.3±0.5	4.9	-8
PH	313±9.2	290	-7	271±14.8	266	-2	299±8	294	0	308±10	291	-6
PC	60.5±1.2	58	-4	62.7±1.7	62.9	-1	71±3.8	69	-3	71±1.4	68	-5
PW	14±1.8	15	10	14±1.9	13	-10	5.05±0.28	4.49	-11	69.3±5.2	65.7	-5
CW	7.5±0.43	9.9	-6	8.9±0.7	8.4	-5	2.06±0.34	1.89	-8	14.7±0.96	14.7	0
RN	1,863±90	1,835	-2	1,757±169	1,723	- 2	1,337±133	1,300	-3	2,003±66	2,015	1
CS	71.7±2.7	70	-2	77±3.8	71	-8	65±3.1	70	7	92±2.5	86	-7
RL	330±54	379	2	308±31	275	- 11	308±13	275	-12	328±20	289	-12
RW	1.8±0.15	2.0	11	3.5±0.2	3.5	1	1.0±0.08	0.9	-10	3.0±0.3	2.7	-10

%: percentage difference between infested and non-infested plots;
, **, * significant at P<0.05, 0.01 and 0.001, respectively.*

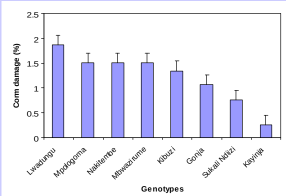

Figure 3. Weevil corm damage levels (%) according to genotype.

Conclusions

Genotypes with a 'B' genome such as *'Sukali Ndiizi'* and *'Kayinja'* are less affected by banana weevils compared to the genotypes with only 'A' genomes. Several ratoon cycles are required in order to have a substantial yield loss caused by weevils in newly established fields.