# BANANA WEEVIL, *COSMOPOLITES SORDIDUS* (GERMAR), OVIPOSITIONAL PREFERENCES, TIMING OF ATTACK AND LARVAL SURVIVORSHIP IN A MIXED CULTIVAR TRIAL IN UGANDA

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Abstract

Host location, acceptance and larval success were studied in a mixed cultivar trial consisting of three East African cooking bananas, two East African beer banana and Kayinja (an exotic cultivar used for beer making). Weevil damage to the endemic cultivars was 5 to 25 times higher than that of Kayinja. Capture of weevils in pseudostem traps at the base of banana mats was highest for Kayinja, while egg density on Kayinja was similar to that of four endemic cultivars. Therefore, host location and acceptance do not appear to be factors in host plant resistance. In contrast, larval survivorship indices were 10 to 23 times higher in endemic cultivars than in Kayinja suggesting that larval success may be an important factor in resistance to banana weevils. Timing of attack was similar among cultivars. Oviposition occurred throughout the banana cycle with egg density increasing with plant age. These data provide a possible explanation of differences in weevil attack found among banana cultivars in Uganda.

## 1. Introduction

The banana weevil, *Cosmopolites sordidus* Germar, is an important pest of banana in Uganda. Weevil attack may prevent crop establishment and causes death of suckers, affects plant snapping and toppling, lengthens maturation rates and leads to reduced yields. On-station trials suggest that sustained attack over several cycles may result in up to 60% yield loss (Rukazambuga, 1996). Weevil damage is believed to have been a major factor in the decline and disappearance of highland cooking bananas (*Musa* spp. AAA) from traditional growing areas in central Uganda during the last two decades (Gold *et al*., 1993). Moreover, weevil outbreaks in the mid-1980s in Masaka and Rakai districts led to total crop failure and raised further alarm over the future of the bananas in Uganda (Sengooba, 1986).

The banana weevil displays a classical "k" selected life cycle (Pianka, 1970). Egg production is low with oviposition estimated from 1 to 4 eggs per week (Koppenhofer, 1993, Griesbach and Gold, *unpub.*), although dissections of field collected weevils revealed an average of 10 mature eggs (Gold and Abera, *unpub.*). These data suggest environmental factors may impede weevils from reaching their ovipositional potential.

Bananas (*sensu latu*) (*Musa* spp.) are comprised of a wide range of diploids, triploids and tetraploids and include dessert, cooking, roasting and brewing cultivars. According to diagnostic surveys of banana-based cropping systems, plantains (*Musa* spp. AAB) and highland bananas were more susceptible to banana weevil attack than other bananas (Gold *et al.*, 1994). Bogoya (a dessert banana) demonstrated peripheral damage similar to highland cultivars but penetration into the central cylinder was limited. Introduced beer types (with either the putative AB or ABB genomes) were relatively resistant with little peripheral damage and limited penetration into the corm (Gold *et al*., 1994).

Different levels of susceptibility to banana weevils may also exist among highland banana cultivars. In Ugandan diagnostic surveys, for example, the cultivars Nassaba and



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Kisansa displayed weevil damage scores two to three times higher than those recorded for Mbwazirume and Nakyetengu, while degree of penetration into the central cylinder was highest for Nakitembe, Namwezi and Musakala (Gold *et al.*, 1997). These data underscore the importance of making comparisons in mixed cultivar trials at the same site.

Host plant resistance studies in Africa and Latin America have provided inconsistent results (Haddad *et al*., 1979, Ittyeipe, 1986, Fogain and Price, 1993, Pavis and Minost, 1993, Seshu Reddy and Lubega, 1993, Ortiz *et al*., 1995). Moreover, it is unclear whether differential levels of damage among cultivars reflect differences in host plant location, timing of attack, acceptance (ovipositional rates) or larval survivorship.

Two were the objectives of this study. Firstly, we investigated the relative roles of host plant attraction, host plant acceptance and larval success in explaining differential damage across banana cultivars. Secondly, we studied the timing of attack relative to host plant phenology on selected banana cultivars.

## 2. Materials and Methods

### 2.1. Site description

Weevil ovipositional preferences, timing of attack and larval survivorship were studied in field and laboratory trials at the Kawanda Agriculture Research Institute, located 13 km N of Kampala, Uganda. Kawanda is at an elevation of 1300 masl. The site has two rainy seasons, March-May and September-November, with annual rainfall of 1250 mm. Average daily temperatures were 15 $^0$C minimum and 27 $^0$C maximum. Daylength was constant (12 h) throughout this study.

### 2.2. Experimental design and trial management

Research on oviposition and larval survivorship was undertaken in an on-going mixed cultivar trial consisting of six cultivars. The cultivars included three East African (AAA) cooking landraces (Mbwazirume, Atwalira, Nakabululu), two East African brewing landraces (Nsowe and Kabula) and one exotic (ABB) brewing cultivar (Kayinja). The field was arranged in a randomized complete block design with each block consisting of a single row of six plants (one plant per accession). There were 50 replicates.

Planting was in December 1991 with plants spaced in a 3 x 3 m arrangement. Planting material was pared to remove weevil eggs and expose weevil damaged suckers that were then rejected. Weevils were further controlled by dipping the suckers in carbofuran (5%). Mats for all East African landraces were desuckered bimonthly, leaving four different aged plants per mat at any time. In contrast, following standard Ugandan farmer practices, Kayinja was not desuckered. Ten weevils (five males and five females) were released at the base of each mat in October 1993.

### 2.3. Weevil damage assessment

Following plant harvest, weevil damage was assessed by paring 10 cm of corm periphery from the collar (junction of corm and pseudostem) and estimating the percentage of tissue consumed by weevil galleries (Gold *et al.*, 1994). Additionally, cross sections were made at 0 and 5 cm below the collar and percentage of tissue consumed by weevil galleries was estimated (Gold *et al.*, 1994).

### 2.4. Weevil adult density

In December 1995, weevil density was estimated within the trial by mark and recapture methods and marking techniques employed for banana weevils by Gold and Bagabe (1997). Weevils were trapped on 24 December, marked by scratching the elytra, released and then retrapped again on 2 January 1996. Population estimates were then made using a Lincoln index (Southwood, 1976).

### 2.5. Host plant attraction

Attraction to the different cultivars was estimated by comparing numbers of adult weevils aggregating in split pseudostem traps (Mitchell, 1978) at the base of banana mats of each cultivar. On a monthly basis, starting in November 1993, one trap (30 cm long) was placed 5 cm from the base of each mat. Three days after trap placement, the traps were removed and weevils found in these traps were counted and released.

### 2.6. Weevil oviposition

Weevil oviposition on different cultivars and on plants of different phenological stages was assessed over a three week period in December 1995. Twenty blocks, including 1 mat per cultivar, were entirely uprooted. In each mat, the plants were gently separated by splitting the shared rhizome. These plants were then grouped into four phenological stages: 1) peeper, (1-3 months old), 2) maiden sucker (4-6 months), 3) preflowered plant, (usually 7-10 months), 4) flowered plant (usually > 10 months). One plant from each phenological stage was sampled per mat. The number of eggs per mat were obtained by multiplying eggs per plant stage by the number of plants in that stage for each mat.

For each plant, the root system was first inspected for eggs. Then the surfaces of the corm and pseudostem (up to 20 cm above the corm) were gently pared with a sharp knife to expose weevil eggs and recently hatched larvae. The number and location (relative to the collar) of eggs and first instar larvae were recorded. Corms were then dissected to extract mid-sized (head capsule width 1-2.5 mm) and large-sized larvae (head capsule width > 2.5 mm). Based on head capsule studies for larvae extracted from field plants (Gold and Nemeye, *unpub.)*, mid-sized larvae (ML) probably represented instars 2 and 3, while large larvae (LL) were in instars 4 to 6.

Most eggs were found in the first 10 cm of the pseudostem. To account for differential plant size, pseudostem surface area was estimated by multiplying plant girth at the collar X 10 cm. Egg number per $cm^2$ was then determined for eggs oviposited in this part of the plant.

### 2.7. Survivorship

Larval success in different cultivars was estimated through a simple survivorship index (SI) using numbers of eggs and large larvae collected in plant dissections as follows: SI = ((ML+LL)/E) X 100, where ML = mid-sized larvae, LL = large larvae and E = eggs. We observed that the individuals in the egg and larval stages represent different cohorts but we were unable to know what level of earlier recruitment into the egg stage was for insects that were large larvae at the time of sampling. Nevertheless, it was likely that seasonal peaks and valleys in oviposition affected all cultivars equally. Thus, our survivorship index provided a relative rather than absolute index which was used for comparing cultivars (van Driesche, *pers. comm.*).

### 2.8. Data analysis

Data on weevil damage and trap catches are presented for the entire trial following weevil release. Additionally, data are presented separately for the six month period (June-November 1995) prior to oviposition studies. These data were analyzed disregarding date of sample. Damage data were pooled over time while analysis of variance was based on the mean number of weevils trapped per mat. Number of eggs, egg data per unit area and number of larvae were analyzed using a two factor analysis of variance for cultivar and plant age. Means were separated using Tukey's test.

## 3. Results

In response to differential management, the exotic cultivar Kayinja had 2 to 3.5 times as many plants per mat than other cultivars including greater plant number for all phenological stages (Table 1).

### 3.1. Weevil damage

All five East African highland cultivars displayed 5 to 25 times as much weevil damage as the cultivar Kayinja (Table 2). Such differences were manifested throughout the trial as well as in the period immediately preceding sampling of eggs and larvae. Differences within the highland group were also present with Nsowe, Nakabululu and Atwalire displaying higher levels of internal damage than Mbwazirume and Kabula. Damage was increasing towards the end of the trial (Table 2) and in comparison to field studies (e.g. Gold *et al.*, 1994), damage levels for highland cultivars were very high while that for Kayinja was low.

### 3.2. Weevil adult density

A total of 1,656 weevils were trapped, marked and released on 24 December 1995. The following week, 1,626 weevils, including 268 marked weevils were recaptured. Using the Lincoln index, the estimated population was 10,047 weevils or 37 weevils per mat for the 272 mats remaining in the trial. Within the 20 blocks employed in quantification of egg and larval numbers, the weevil population was estimated at 25 weevils per mat.

### 3.3. Host plant attraction

Catches of banana weevils were greatest for traps placed at the base of Kayinja mats and lowest at the base of Atwalira (Table 3). Catches at the base of other highland cultivars were similar and slightly lower than that of Kayinja. Weevil populations were increasing during the latter part of the trial as evidenced by increases in trap catches.

### 3.4. Weevil oviposition

Oviposition per mat was highest in Kayinja while among East African highland cultivars Nsowe received most eggs (Table 4). Higher levels of oviposition in Kayinja reflected larger mat size. Egg density per unit surface area was greatest in Nsowe while that in Kayinja was similar to the other highland cultivars. Highest levels of oviposition could occur on post harvest residues. Although not systematically quantified within this study, up to 200 eggs were observed on a single harvested corm.

Fifty seven percent of the eggs were found in the pseudostem (majority in first 10 cm), 36% in the corm and 7% on the roots while 65% of the eggs were observed below the soil surface (Table 4). Unlike other cultivars which had the corm buried beneath the soil surface, Nakabululu suffered high mat and supported the highest percentage of eggs (50%) on the corm and above the soil surface (81%). Similarly, in Nsowe, the corm was at the soil surface and high percentage of eggs (65%) was above the soil.

### 3.5. Timing of attack

Banana weevil attack increased with age of plant. Preflowered and flowered plants supported 2 to 6 times as many eggs as did peepers and maiden suckers (Table 5). Moreover, egg density per unit surface area was also greatest on flowered plants. Weevil preference for older plants existed for all six cultivars and was most strongly exhibited in Mbwazirume, Kayinja and Nakabululu (Table 5).

3.6. Survivorship

Although oviposition was predominantly in the pseudostem, in excess of 80% of banana weevil larvae were located within the corm. More larvae were extracted from highland cultivars than from Kayinja. Moreover, survivorship indices suggest that larval success was 10 to 23 times higher in highland bananas than in Kayinja (Table 6). For example, the survivorship index for Nsowe was 16.4 while it was 0.7 for Kayinja. A two-fold difference in survivorship also appeared to exist within the East African highland bananas.

## 4. Discussion

Decline and disappearance of highland cooking bananas from central Uganda have been, in part, attributed to high levels of banana weevil damage (Gold *et al.*, this volume). At these same sites, the importance of the brewing bananas Kayinja and Kisubi has increased 13-fold. Farmers report that these two cultivars are resistant to banana weevil.

In an on-going mixed cultivar trial, weevil damage levels in Kayinja were only 5 to 20% than that observed in three East African highland cooking bananas and two East African highland brewing bananas. Host plant resistance has been broadly classified as either antixenosis (reduced host plant location or attraction, and reduced host plant acceptance) or antibiosis (reduced insect success). This study was to determine if lower banana weevil damage levels in Kayinja could be attributed to differential host plant location or attraction, host plant acceptance, or larval survivorship.

Budenberg *et al*. (1993) have suggested that kairomones emitted from host plant tissue are important attractants involved in host location by banana weevils. Thus, the level or quality of kairomones emitted from susceptible plants might be stronger than that from resistant plants. In this study, however, trap catches of banana weevils were greatest at the base of cultivar, Kayinja, with the least damage, suggesting that differences in host plant location could not explain differences in damage. Moreover, ovipositing weevils showed little discrimination among corm or pseudostem pieces of the same six cultivars in laboratory choice experiments (Abera *et al*., *unpub.*).

Similarly, oviposition appeared to be greater on Kayinja than on the highland cultivars. When corrected for surface area, however, Nsowe had higher levels of egg recruitment than any other cultivar while egg density on Kayinja was similar to the other highland cultivars. Thus, oviposition levels might, in part, explain high damage levels in Nsowe but did not contribute to lower damage levels in Kayinja.

In contrast, survivorship indices suggest that larval success does play an important role in host plant susceptibility or resistance to banana weevil. Survivorship indices were 10 to 23 times greater for highland bananas than for Kayinja. At the same time, highest survivorship indices occurred on Nsowe and Atwalira. These two cultivars had the highest level of internal weevil damage within the corm during the period of study.

Most oviposition occurred in the pseudostem while 80% of the larvae were extracted from the rhizome suggesting larval migration to the corm or larval mortality in the pseudostem. This suggests that the pseudostem is more readily accessible to ovipositing adults but not favored by developing larvae. Larval death in the pseudostem was suspected when small tunnels of recently emerged larvae were observed to end suddenly (blind tunnels). Such blind tunnels were more frequently observed in Kayinja than in the cooking banana landraces suggesting that important antibiosis factors may be located in the pseudostem.

The data suggest antibiosis mechanisms as the primary mechanism that may provide resistance to banana weevil in Kayinja. Banana weevils appear to locate and oviposit on Kayinja and highland bananas with equal facility while differential levels of



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larval success appear to explain reduced damage in Kayinja. The factors influencing survivorship in Kayinja remain unclear. In a related study, it was noted that larval damage in Kisubi was very low in standing plants while attack of residues was quite severe (Gold and Bagabe, 1994). This suggests, perhaps, the presence of secondary plant substances which break down following plant death (i.e., at harvest).

The second part of this study concerned timing and location of attack. Banana weevil damage is most commonly assessed through scoring of cumulative damage at the time of harvest (Gold *et al.*, 1994). In this study, weevil oviposition occurred on all banana phenological stages although egg density increased with plant age. Such data suggest that a relatively high proportion of this damage occurs in the bunch filling period. Further studies will be necessary to determine critical periods when weevil attack may have the most detrimental effects on yields. Finally, 65% of the weevil eggs were placed beneath the soil level suggesting that egg location may impede searching capacity of egg parasites or predators in a biological control program.

References

Budernberg, W.J, Ndeije, I.O, Karago, W.F and Hansson, B.S., (1993). Behavioural and electrophysiological responses of the banana weevil (*Cosmopolites sordidus* Germar) to the host plant volatiles. J. Chem. Ecol. 19:267-277.

Fogain, R. and Price, N.S., 1993. Varietal screening of some *Musa* cultivars for susceptibility to the banana weevil, *Cosmopolites sordidus* (Coleoptera: Curculionidae). In C.S. Gold and B. Gemmill (eds.), Biological and integrated control of highland banana and plantain pests and diseases. IITA, Cotonou, Benin Republic, pp. 49-56.

Gold, C.S., Ogenga-Latigo, M.W., Tushemereirwe, W., Kashaija, I. and Nankinga, C., 1993. Farmer perceptions of banana pest constraints in Uganda: Results from a rapid rural appraisal. In C.S. Gold and B. Gemmill (eds.), Biological and integrated control of highland banana and plantain pests and diseases. IITA, Cotonou, Benin Republic, pp. 3-24.

Gold, C.S and Bagabe, M., 1994. Banana weevil (*Cosmopolites sordidus*) infection of cooking and beer banana in adjecent stands in East in Uganda. Afric. Crop Sci. Conf. Proc. 1:296-299.

Gold, C.S., Speijer, P.R., Karamura, E.B. and Rukazambuga, N.D., 1994. Assessment of banana weevils in East African highland banana systems and strategies for control. In R.V. Valmayor *et al.* (eds.), Banana nematodes and borers in Asia and the Pacific. INIBAP/ASPNET, Montpellier, France, pp. 170-190.

Gold, C.S., Karamura, E.B., Kiggundu, A., Abera, A.M.K., Bagamba, F., Wejuli, M., Karamura, D., Ssendege R. and Kalyebara, R., 1998. Geographic shifts in highland banana production in Uganda. Acta Horticulturae, this volume.

Gold, C.S. and Bagabe, M.I., 1997. Banana weevil, *Cosmopolites sordidus* Germar (Coleoptera, Curculionidae), infestation of cooking and beer bananas in adjacent stands in Uganda. J. Afric. Entomol. 5: 103-108.

Haddad, O., Surga J. and Wagner M., 1979. Relación de la composición genómica de las musáceas con el grado de atracción de adultos y daños de larvas de *Cosmopolites sordidus* G. (Coleoptera: Curculionidae). Agron. Trop. 29:429-438.

Ittyeipe, K., 1986. Studies on the host preference of banana weevil borer *Cosmopolites sordidus* GERM. (Curculionidae-Coleoptera). Fruits 41:375-379.

Koppenhofer, A.M., 1993. Observations on egg-laying behaviour of the banana weevil, *Cosmopolites sordidus* (Germar). Entomol. Exp. Appl. 68:87-192.

Mitchell, G.A., 1978. The estimation of banana borer population and resistance levels. Winsban Res. & Dev., Tech. Bull. 2.

Ortiz, R., Vuylsteke, D., Dumpe, B. and Ferris, R.S.B., 1995. Banana weevil resistance and corm hardness in *Musa* germplasm. Euphytica 86:95-102.

Pavis, C. and Minost, C., 1993. Banana resistance to the banana weevil borer

*Cosmopolites sordidus*: role of pseudostem attractivity and physical properties of the rhizome. In: J. Ganry (ed.), Breeding banana and plantain for resistance to diseases and pests. CIRAD, Montpellier, France, pp. 129-142.
Pianka, E.R., 1970. On r- and K-selection. Amer. Nat. 104: 592-597.
Rukazambuga, N.D.T.M., 1996. The effects of banana weevil (*Cosmopolites sordidus* Germar) on the growth and productivity of bananas and the influence of host vigor on weevil attack. Ph.D. thesis, Reading University, UK.
Sengooba, T., 1986. Survey of banana pest problem complex in Rakai and Masaka districts, August 1986: preliminary trip report. Uganda Ministry of Agriculture, Kawanda Research Station, Uganda, 10 pp.
Seshu Reddy, K.V. and Lubega, M.C., 1993. Evaluation of banana cultivars for resistance/tolerance of the weevil *Cosmopolites sordidus* Germar. In: J. Ganry (ed.), Breeding banana and plantain for resistance to diseases and pests. CIRAD, Montpellier, France, pp 143-148.
Southwood, T.R.E., 1978. Ecological methods, 2nd ed. Chapman and Hall, London, 524 pp.

Table 1. Plants per mat by phenological stages in mixed cultivar 48 months after planting at Kawanda (Uganda, December 1995).

| Cultivar | Peeper | Maiden | Preflowering | Flowering | Total |
|---|---|---|---|---|---|
| Mbwazirume | 2 | 1 | 2 | 1 | 6 |
| Atwalira | 1 | 1 | 1 | 1 | 4 |
| Nakabululu | 2 | 2 | 2 | 1 | 7 |
| Kabula | 2 | 2 | 1 | 1 | 6 |
| Nsowe | 2 | 1 | 2 | 1 | 6 |
| Kayinja | 4 | 4 | 3 | 3 | 14 |

Table 2. Weevil damage for entire trial and period prior to egg assessment in a mixed banana cultivar trial, Kampala, Uganda, 1995. (n = 20 plants per cultivar).

| | 20 to 42 months after planting | | 43 to 48 months after planting | |
|---|---|---|---|---|
| Cultivar | Peripheral | Inner | Peripheral | Inner |
| Mbwazirume | 13.7 b | 6.2 c | 22.7 ab | 13.5 b |
| Atwalira | 16.7 ab | 10.6 abc | 25.2 a | 22.3 a |
| Nakabululu | 16.0 ab | 11.4 ab | 21.7 ab | 17.5 ab |
| Kabula | 15.1 ab | 8.5 c | 15.7 b | 10.2 b |
| Nsowe | 18.1 a | 12.9 a | 25.7 a | 22.4 a |
| Kayinja | 2.4 c | 0.6 d | 3.4 c | 1.2 c |
| F value | 50.6** | 38.9** | 14.97** | 14.16** |

** means that F-test was significant at $P < 0.01$. Values within a column with same letter were not significantly different according to Tukey's multiple range test.



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Table 3. Weevil trap catches for entire trial and period prior to egg assessment in a mixed banana cultivar trial, Kampala, Uganda, 1995.

| Cultivar | 20 to 42 months after planting | 43 to 48 months after planting |
|---|---|---|
| Mbwazirume | 4.1 bc | 8.1 a |
| Atwalira | 3.4 c | 5.3 b |
| Nakabululu | 4.7 ab | 8.1 a |
| Kabula | 4.4 b | 7.1 ab |
| Nsowe | 4.3 b | 7.2 ab |
| Kayinja | 5.4 a | 9.2 a |
| F value | 10.0** | 5.1* |

* and ** mean that F-test were significant at $P < 0.05$ or $P < 0.01$, respectively. Values within a column with same letter were not significantly different according to Tukey's multiple range test.

Table 4. Banana weevil egg distribution by cultivar and by location in a mixed cultivar trial at Kawanda in December 1995.

a. Cultivar

| Cultivar | Eggs per mat | Eggs per 100 $cm^2$ |
|---|---|---|
| Mbwazirume | 10.7 c | 3.1 b |
| Atwalira | 7.5 c | 3.0 b |
| Nakabululu | 9.7 c | 2.2 b |
| Kabula | 9.8 c | 3.0 b |
| Nsowe | 17.1 b | 5.5 a |
| Kayinja | 23.4 a | 2.3 b |
| Fvalue | 6.5** | 10.8** |

** means that F-test was significant at $P < 0.01$. Values within a column with same letter were not significantly different according to Tukey's multiple range test.

b. Location

| | Plant location | | | Soil surface | |
|---|---|---|---|---|---|
| | Pseudostem (%) | Corm (%) | Root (%) | Above (%) | Below (%) |
| Mbwazirume | 59 | 34 | 7 | 15 | 85 |
| Atwalira | 57 | 37 | 6 | 13 | 87 |
| Nakabululu | 37 | 50 | 13 | 81 | 19 |
| Kabula | 59 | 36 | 5 | 15 | 86 |
| Nsowe | 65 | 32 | 3 | 65 | 35 |
| Kayinja | 58 | 34 | 8 | 11 | 89 |
| Trial | 57 | 36 | 7 | 35 | 65 |

Table 5. Banana weevil oviposition by host plant phenological stage at Kawanda in December 1995. (n = 20 mats per cultivar).

a. Field wise comparisons

| | Eggs | Eggs per 100cm$^2$ |
|---|---|---|
| Peeper | 2.4 c | 1.9 c |
| Maiden Sucker | 5.1 bc | 2.6 bc |
| Preflowered | 9.5 b | 3.6 b |
| Flowered | 15.6 a | 4.7 a |
| F value | 83.7** | 17.2** |

b. Cultivar comparisons (eggs/mat)

| | Mbwaz | Atwal | Nakab | Kabul | Nsowe | Kayinja |
|---|---|---|---|---|---|---|
| Peeper | 2.0 c | 1.6 c | 1.3 c | 2.9 c | 4.7 c | 2.1b |
| Sucker | 5.7 bc | 4.9 bc | 3.5 bc | 5.8 bc | 6.8 c | 3.9 b |
| Preflow. | 8.0 b | 10.6 ab | 7.6 ab | 9.2 b | 14.6 b | 7.0 ab |
| Flowered | 16.5 a | 3.1 a | 13.3 a | 12.4 a | 21.4 a | 16.2 a |
| F value | 17.1** | 8.0** | 11.3** | 10.7** | 19.1** | 4.3** |

** means that F-test was significant at $P < 0.01$. Values within a column with same letter were not significantly different according to Tukey's multiple range test.

Table 6. Weevil immatures and estimated survivorship index in six cultivars in the third ratoon of a mixed cultivar trial at Kawanda.

| Cultivar | Eggs | Larvae | Survivorship Index |
|---|---|---|---|
| Mbwazirume | 8.0 b | 1.7 ab | 9.9 |
| Atwalira | 7.2 b | 1.9 ab | 11.9 |
| Nakabululu | 6.4 b | 1.1 b | 8.2 |
| Kabula | 7.6 b | 1.2 b | 7.4 |
| Nsowe | 11.9 a | 4.3 a | 16.4 |
| Kayinja | 7.3 b | 0.14 c | 0.7 |
| F value | 3.1** | 6.9** | |

** means that F-test was significant at $P < 0.01$. Values within a column with same letter were not significantly different according to Tukey's multiple range test.



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