VIIth Symposium of the International Society for Tropical Root Crops,
Gosier (Guadeloupe), 1-6 July 1985, Ed. INRA, Paris, 1988.

CYRTOMENUS BERGI FROESCHNER, A NEW PEST OF CASSAVA : BIOLOGY, ECOLOGY AND CONTROL

(Cyrtomenus Bergi Froeschner ravageur de manioc : Biologie, Ecologie et Lutte)

Anthony C. BELLOTTI
Octavio VARGAS H.
Bernado ARIAS
Oscar CASTANO
Cesar GARCIA

CIAT
Apartado Aero 6713
Cali, COLOMBIA

SUMMARY

Nymphs and adults of this subterranean sucking insect, *Cyrtomenus bergi Froeschner*, feed on cassava roots by means of a thin, strong stylet. Insect feeding combined with soil pathogens induce the appearance of brown to black spots on the white fleshy root, rendering it commercialy unacceptable. In recent years severe attacks of this pest have caused severe crop losses in several cassava growing areas of Colombia. Life cycle studies indicate an egg stage of 13.6 days, five nymphal stages totalling 111.2 days, and an adult stage of 293.4 days. Field studies show that *C. bergi* populations are present in the soil throughout the crop cycle and root damage is iniciated during the first or second month. Studies, show that there is a definite preference for feeding on low HCN varieties. Studies of control of *C. bergi* show that foliar applications of a systemic pesticide will reduce damage but intercropping with repellent varieties is more promisory.

RESUME

Les larves et les adultes de C. bergi se nourrissent sur les tubercules de manioc au moyen d'un fin et solide stylet. L'alimentation de l'insecte combinée avec les pathogènes du sol provoque l'apparition de taches brunes à noires sur les parties charnues blanches des tubercules les rendant inacceptables sur le plan commercial. Dans les années récentes des attaques importantes de ce ravageur ont causé de sévères pertes dans plusieurs régions de culture du manioc en Colombie. Les études sur le cycle de cet insecte ont montré en moyenne que l'incubation des oeufs était de 13,6 jours, que la durée des 5 stades larvaires était de 11,2 jours et que le stade adulte était de 293,4 jours. Les études en champs ont montré que les populations de C. Bergi étaient présentes dans le sol pendant toute la période de cul-

ture et que les dégâts intervenaient pendant le premier ou le second mois de végétation. Les études ont montré qu'il y avait également une très nette préférence pour les variétés à basse teneur en HCN. Les études concernant la lutte contre C. bergi ont montré que l'application foliaire d'insecticide systémique réduisait les dégâts mais l'utilisation de rotation avec des variétés non attractives paraissait plus prometteuse.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is attacked by a wide range of insects and mites (BELLOTI and SCHOONHOVEN, 1978). The great majority of these pests are leaf and stem feeders and their subsequent damage, therefore is indirect in that the commercial part of the plant, the swollen root is not directly fed upon by these pests. Few pests directly feed upon the roots ; termites, grubs and certain species of borers are reported as occasional root feeders.

In recent years, beginning about 1980, damage to cassava roots caused by a subterranean sucking insect, *Cyrtomenus bergi* Froeschner, has been observed in several important cassava growing regions of Colombia. Damaged roots are rendered commercially unacceptable for the fresh root market and often are also rejected by the processing market. Since root damage cannot be detected until roots are harvested and peeled, a 20 to 30 per cent infestation (percentage of roots damaged) will often result in complete rejection by middlemen who purchase roots by the truck-load or while still in the field.

The potential damage of this insect is, therefore, extremely serious for the fresh market. Consequently the CIAT Cassava Entomology Program initiated studies into the biology, ecology and control of this pest.

PEST DESCRIPTION AND DAMAGE

Nymphs and adults of *C. bergi* feed on the swollen roots of cassava by injecting their strong thin stylets through the root peel into the parenchyma. Insect feeding combined with soil pathogens induce the appearance of brown to black spots on the White fleshy root, rendering it commercially unacceptable. This feeding habit results in the transmission of several fungal pathogens and their development causes a "smallpox" effect on the edible pottion of the root. These pathogens include species from the genera *Aspergillus, Diplodia, Fusarium, Genicularia, Phytophthora* and *Pythium*. These micro-organisms degrade the infected root tissues causing initial localized rots which can invade the entire root along the vascular system. Lesions are pale to dark brown spots which show tissue degradations (CIAT, 1981). Laboratory observations show that these spots begin to appear at 12 to 24 hours after feeding is initiated.

Adults are black in color, with short legs, provided with strong spines, which help then more in the soil. Nymphs are dark brown to almost black in color with white to cream colored abdomens. When disturbed these insects become immobile and appear dead, making them difficult to find. At harvest they can be found adherring to roots by their stylets.

BIOLOGY AND ECOLOGY OF *C. BERGI*

Studies on the duration and dimension of the life stages were undertaken in the laboratory on cassava roots (Var CMC-40). One to two cm piece of cassava roots were wrapped in parafilm and placed on the soil surface in a deep plastic tray. A *C. bergi* colony could be maintained for 8 to 10 days before roots pieces needed to be replaced. Life cycle studies were done by individually maintaining nymphs on root pieces on soil in 5 cm diameter petri dishes (average temperature 23°C and 65 per cent relative humidity) (GARCIA and BELLOTTI, 1980).

Eggs are translucent, cream-colored, oval, with a smooth shining surface. The incubation period is an average of 13.6 days (Table 1). The nymphal stage has five instars with a total average duration of 111.15 days. The first pair of legs are the escavating type with spined tibia, which facilitate movement in the soil (CIAT, 1981).

The recently emerged adults are cream colored, gradually changing to their characteristic dark brown to black color. Adult longevity was measured at an average of 293.4 days (CIAT, 1982).

The resulting life cycle is therefore more than one year, during which time *C. bergi* can survive feeding only on cassava roots. This means that this pest can maintain and increase its populations in cassava fields without feeding on an alternate host.

FIELD INCIDENCE AND ECONOMIC DAMAGE

The field incidence of *C. bergi* in cassava was measured at the CIAT-Quilichao experiment station on two varieties CMC 40, low HCN, and M Mex 59. intermediate HCN. Since feeding by *C. bergi* is underground, populations were determined by escavating around cassava roots on a monthly basis and nymphs and adults were recorded. An experiment was also designed to determine the stage in the crop growth cycle when *C. bergi* attacks are initiated and to monitor the damage done to roots throughout the crop cycle. To do this, 20 plants were uprooted each month and roots examined beginning at the second month of plant growth.

Table 1. Dimensions and duration of the life stages of *Cyrtomenus bergi* feeding on cassava root (var. CMC-40) under laboratory conditons (22° and 65% relative humidity).

Life stage	N° observation	Dimensions average (mm)		Duration (days)		Standard deviation
		Length	Width	Range	Average	
Egg	89	1.32	0.92	11-18	13.60	1.79
Nymph						
Instar						
I	85	1.70	1.18	12-18	13.76	1.31
II	86	2.76	1.64	15-22	17.80	1.83
III	75	3.45	2.13	19-26	21.09	1.73
IV	98	4.60	2.92	19-30	24.95	2.20
V	103	6.15	3.88	26-38	33.55	2.61
Total				91-134	111.15	
Adult						
Female		7.30	4.44		293.4	
Male		7.00	4.06			

Results show that *C. bergi* populations are present in the soil throughout the crop cycle (Fig. 1). Nymphs and adults were found around the roots of both varieties beginning at the second month of crop growth. Populations were about three times higher around the roots of CMC 40 as compared to M mex 59. In general, population increased with the age of the plant for CMC 40 but remained more constant with M Mex 59.

By measuring root damage it was determined that root attack began by the second month of plant growth (Fig. 2). At this point 25 per cent and 35 per cent of the roots of M Mex 59 and CMC 40 respectively show damage from the feeding of *C. bergi*. By eight months, 85 per cent of the roots of CMC 40 and 65 per cent of M Mex 59 were damaged by *C. bergi* attack. There was a definite upward trend in damage with increased plant age. These high levels of damage translate into a complete crop loss and indicate that any control measures must be undertaken very early in the crop growth cycle, most probably at planting.

FEEDING PREFERENCE-STUDIES

Laboratory studies have indicated that there is a strong preference for *C. bergi* to feed on sweet or low HCN varieties vs. bitter or high HCN varieties. Field studies at CIAT-Quilichao compared two varieties, CMC 40, low HCN content and M Col 1684, high HCN content. Ten blocks of nine plants each were randomly planted for each variety were evaluated.

Results showed a definite preference for *C. bergi* feeding on low HCN varieties (Table 2). Only 0.3 per cent of the roots of M col 1684 (high HCN) were damaged while 27.3 per cent of those of CMC 40 (low HCN) were damaged.

CONTROL OF *C. BERGI*

Chemical control

Chemical control studies of *C. bergi* were undertaken due to the severity of the pest. An experiment was designed to evaluate three insecticides and two methods of application. The pesticides Sistemin (48 per cent) and Furandan PF were foliar-applied and Furadan 3 per cent and Aldrex 2 per cent were applied to the soil. All pesticides were applied at monthly intervals but Sistemin was also applied every two months as a separate treatment. The control plots received no insecticide application. Two varieties were compared, CMC 40 and M Col 1684 and plants were harvested at 10 months.

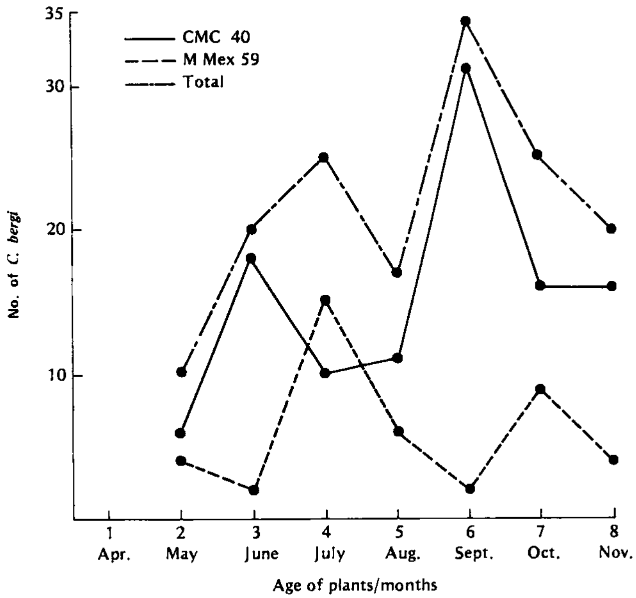

FIGURE 1. Populations of *Cyrtomenus bergi* associated with cassava roots over an eight month period at Santander de Quilichao, Valle, Colombia.

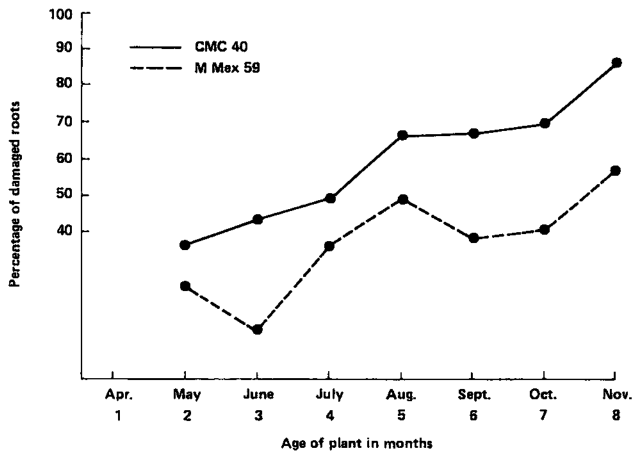

FIGURE 2. Percentage of cassava roots damaged by an attack of the subterranean sucking insect *Cyrtomenus bergi* (Froschener).

Table 2. Feeding preference of the subterranean sucking insect *Cyrtomenus bergi* (Froeschner) in two cassava varieties, CMC 40 (low HCN content) and M Col 1684 (high HCN content) under field conditions (CIAT- Quilichao).

Varieties [a]	N° Damaged Roots [b]	% Damaged Roots
CMC 40	8.2	27.3
M Col 1684	0.1	0.3

[a] Ten blocks of nine plants each for each variety.

[b] Thirty roots evaluated in each block.

Results show that all pesticide applications reduced the incidence of *C. bergi* attack on CMC 40 resulting in fewer damaged roots (Table 3). Sistemin was the most effective product and there was no significant difference with application at one and two month intervals. An average of about 9 per cent of the roots of the Sistemin-applied plots were damaged. Furadan applied to the soil was more effective than the foliar application (18.5 vs. 31.7 per cent). Aldrex was also effective in reducing damage (23.5 per cent) of roots damaged) but not as effective as Sistemin. Damage levels in the control plots with CMC-40 were very high with 85 per cent of the roots damaged. M Col 1684 ; a bitter variety suffered only minor damage, again showing the strong preference of *C. bergi* for feeding or low HCN varieties.

Cultural, Botanical control of *C. bergi*

Numerous plant species possess insecticidal qualities ; i.e. they can detrimentally affect the development of insects or may act as a repellent to certain insect species or affect insect development or presence in various ways. *Crotolaria* sp. (SUNNE HEMP) is known to have insecticidal qualities.

Preliminary laboratory studies tested the ability of *C. bergi* to feed on the roots of several crops including cassava, corn, sorghum and *Crotalaria* sp. Results showed a no-preference for feeding on Crotalaria and a preference for

Table 3. Chemical control of the subterranean sucking insect, <u>Cyrtomenus bergi</u> (Froeschner) attacking cassava (Santander de Quilichao, Colombia).

Treatment	N°. Damage Roots		% Damaged Roots	
	CMC 40	M Col 1684	CMC 40	M Col 1684
Sistemin 48% 2 cc/L. H_2O Every 2 months Folliage application	1.7	0	8.3	0
Sistemin 48% 2 cc/L. H_2O Every month Folliage application	2.0	0	10.0	0
Furadan 3% - 1 gr/plant Every month Soil application	3.7	0.7	18.5	3.5
Aldrex 2% - 2 cc/L. H_2O Every month Soil application	4.7	0	23.5	0
Furadan 4F - 1 cc/L. H_2O Every month Folliage application	6.3	0	31.7	0
Control (no treatment)	17.0	0	85.0	0

the other species. Therefore several experiments were designed to study the effectiveness of intercropping and rotation of Crotalaria and Cassava, and to compare this to chemical control and varietal preference. These experiments were carried out in farmers fields with Chiroza Gallinaza a low HCN, high yielding, commercially preferred variety, and compared to M Col 1684 a high HCN variety but not commercially acceptable for the fresh market.

The pesticide treatment, Dimethoate 2 cc/lt water, applied every 15 days, did not effectively control *C. bergi* on the low HCN variety (Table 4). Chiroza had 30.0 and 61.2 per cent root attack for the treated and non-treated plots of M Col 1684 (high HCN) were completely free of *C. bergi* attack.

Results with cassava intercropped with Crotalaria were impressive ; only 3.7 per cent of the roots of Chiroza were damage when intercropped with Crotalaria vs. the 62.2 per cent root damage when grown in monoculture (Table 4). Intercropping with *Crotalaria* is considerably more effective than the pesticide treatment. However, it reduced yield by 22 per cent.

Nevertheless, a 61 per cent root damage in commercial terms is a 100 per cent loss as the crop would not be harvested since damage roots cannot be determined until they are peeled. Therefore, the 22 per cent yield reduction is monetarily acceptable.

DISCUSSION

Although *C. bergi* may not reduce the yield of cassava roots it can greatly reduce the commercial value of the crop for both the fresh and processing market. This soil-borne insect is presently causing severe losses in localized cassava growing regions and potentially can spread to other regions. Its geographic range has not been determined ; however, several additional hosts have been reported, including peanut, onion, pastures, potatoes, coffee and corn.

The long life cycle of the insect, more than one year, and its ability to survive, complete its cycle and reproduce, feeding only on cassava indicates that this is a durable pest able to survive and infest succeeding crops of cassava. This greatly influences what control measures might be successful and economically feasible.

The use of chemical pesticides is generally not recommended in cassava fields especially when repeated applications are needed. Repeated pesticide applications are not only costly, especially for traditional farmers, but they also destroy the natural enemies that control or reduce populations of several other cassava pests. In addition, as seen from the previous cited results, chemical control is not

Table 4 A comparison of cassava root damaged caused by *Cyrtomenus bergi* when cassava is planted in monoculture, intercropped with crotalaria, treated with a pesticide and the use of a high HCN variety.

Treatment	Yield t/ha	% Root damage	Damage level (0-5 scale)
Cassava (Chiroza) Monoculture	38.4 b*	61.2 a	3.5
Cassava (Chiroza) + Crotalaria	29.9 c	3.7 c	0.5
Cassava (Chiroza) + Pesticide[a]	40.6 b	30.0 b	2.5
Cassava (M Col 1684) + Pesticide	56.1 a	0 d	0
Cassava (M Col 1684) without pesticide	57.0 a	0 d	0

[a] Dimethoate 2 cc/lt water.

* Numbers in the same column are not significantly differente at the 0.05 % level of the Duncan Multiple Range Test.

always effective, especially where there are high populations of the pest. Since it is the cassava root that is damaged by this pest the quality of the root is directly affected and its commercial value reduced. Therefore even a light infestation in a cassava field can result in severe losses. This is in contrast to light infestations of pest on cassava leaves or stems which usually result in little or no economic losses. Therefore one or two pesticide applications would probably not be enough to prevent root damage and a more permanent type of control is needed.

The use of intercropping with *Crotalaria* or other similar crops that deter or repell *C. bergi* development offers the most promising potential for control of the pest. In addition there is the added benefit that Crotalaria, a legume, acts as a green manure and enhances soil nutrition. It is also possible that the crop association can be manipulated so that there is no reduction in cassava yields due to competition with Croatalaria. Further research could determine alternative crops with a commercial value which would also deter *C. bergi* populations. This type of research is presently being carried out.

LITERATURE CITED

BELLOTTIA., and A. VAN SCHOONHOVEN, 1978. Mite and Insect pests of cassava. Ann. Rev. Entomology. 23:39-67.

Centro International de Agricultura Tropical. 1981. Cassava Annual Report 1980, Cali, Colombia, 93 pp.

Centro International de Agriclutura Tropical, 1982. Cassava Annual Report 1981. Cali, Colombia.

GARCIA C.A., and A.C. BELLOTTI, 1980. Estudio preliminar de la biologia y morphologia de *Cystomenus bergi* Froeschner, Nueva plaga de la yuca. Rev. Col. de Entomol. 6:3&4, 55-61.