NEW RECORDS OF *CARDIOCHILES* (BRACONIDAE: HYMENOPTERA) ON *HELIOTHIS ARMIGERA* (Hb.) AND *RAGHUVA ALBIPUNCTELLA* DE JOANNIS IN THE SAHEL

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THE Sahelian zone extends between the Sahara in the North and the Sudanic zone in the South[1]. Rainfall has been the crucial element throughout the Sahel. Entomological surveys under the Integrated Pest Management project were concluded in December 1986 in Senegal where the average annual rainfall is on a continuous decline. For example, at Nioro-du-Rip in the district of Kaolack (latitude: 13° 45 N) in Senegal, where most surveys were concentrated, the average annual rainfall was 916 mm during 1945–67, 680 mm during 1968–82 and only 571 mm during 1983–86. While the drought has remained a principal enemy in the Sahel, damage to cowpea *Vigna unguiculata* (L.) Walp and

Table 1 *Cardiochiles* complex recovered in the entomological surveys, Senegal 1981–86

Species of *Cardiochiles*	Association: Flora	Association: Insect pest	Remarks
Identified up to species level by taxonomists			
C. coelofrons sp. n.	Pearl millet	—	From malaise trap in August; rare
C. punctatus Szepligeti	Pearl millet	—	From malaise trap in July–August, females predominant
	Maize	—	From malaise trap in September–October; Females predominant
C. sahelensis sp. n.	Pearl millet	*R. albipunctella*	Up to 30% larvae successfully parasitized in addition to equal proportions directly killed by the parasite larvae; August–October, predominant in malaise trap collections
	Wild millets	*R. albipunctella*	Rare; October
C. testaceus Kriechbaumer	Pearl millet	—	From malaise trap collections; rare
C. variegatus Szepligeti	*Acanthospermum hispidum* DC.	*H. armigera*	Up to 7% parasitization; June–August
	Cow pea and Sorghum	*H. armigera*	July–September, surveys inadequate to reveal economic importance.
	Maize	*H. armigera*	Up to 30% larvae parasitized; August–September.
	Pearl millet	*H. armigera*	Up to 40% larvae parasitized, August–October
		R. albipunctella	Up to 9% larvae successfully parasitized, August–October
Unidentified species			
Cardiochiles sp. C	Maize, sorghum and pearl millet	*Marasmia* sp	Up to 5% larvae successfully parasitized, July–Aug
Cardiochiles sp. D	Maize, sorghum and pearl millet	*Mythimna loreyi* Dup	August–September, surveys inadequate to reveal economic importance

maize *Zea mays* L. by noctuid pod borer *Heliothis armigera* (Hb.) and on pearl millet *Pennisetum americanum* (L.) by *H. armigera* and noctuid millet spike worm *Raghuva albipunctella* de Joannis further accentuated production deficiencies. One of the main causes of these pest problems is the rapid depletion of natural enemies as a result of prolonged drought and an alarming increase in the use of subsidised pesticides in Senegal[2].

Entomological surveys on noctuid and pyralid pests on food crops in Senegal resulted in the recovery of seven species of *Cardiochiles* (table 1). Of these two new records are *Cardiochiles variegatus* Szepligeti attacking early instar larvae of both *H. armigera* and *R. albipunctella* and *Cardiochiles sahelensis* sp.n. attacking early instar larvae of only *R. albipunctella*. In view of the high level of natural control of *H. armigera* larvae by *C. variegatus* in the drought hit Sahel, an efficient searching capability of early instar host larvae by the parasite adults in dry land cereals and grain legumes[3] and with the absence of any species of *Cardiochiles* on *H. armigera* in the Indian sub-continent, *C. variegatus* becomes a highly potential biological control candidate for import against *H. armigera* on grain legumes in India.

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MANAGEMENT OF RESISTANCE IN *PYTHIUM APHANIDERMATUM* TO ALUMINIUM ETHYL PHOSPHITE

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CONTINUOUS use of fungicides in spray programmes may develop resistance in the pathogens under selection pressure and a fungal strain may develop which is simultaneously resistant to two site-specific inhibitors with different modes of action[1]. If, under the selection pressure of one such substance, specifically resistant strains accumulate in a fungal population, their further reproduction may be prevented by the simultaneous use of another chemical. Hence, alternate and combined use of conventional fungicides such as copper oxychloride, ziram and mancozeb was made in order to see the development of resistance to aluminium ethyl phosphite in *Pythium aphanidermatum*.

Poisoned food technique was used to study the effect of continuous and alternate treatments with two fungicides and a mixture of both on the development of fungicide resistance in *P. aphanidermatum*. The resistant strain of *P. aphanidermatum* (UVPA) was cultured for five successive passages on glucose nitrate agar plates containing 2X MIC of aluminium ethyl phosphite (3000 μg/ml), aluminium ethyl phosphite alternating with copper oxychloride (1500 μg/ml), ziram (10 μg/ml) and mancozeb (1500 μg/ml) and a mixture of aluminium ethyl phosphite and the above mentioned fungicides one at a time. All concentrations were used on active ingradient basis[2]. The resistant strain of the pathogen was developed through UV irradiation of wild sensitive isolates. MIC of wild sensitive isolates was 1500 μg/ml. The mycelial suspension exposed to UV (for 30 min at 10 cm distance) was plated onto the agar medium containing 2X MIC of aluminium ethyl phosphite. Colony growing on this 2X medium was considered to be that of the resistant mutant. Concentrations (a.i.) of the conventional fungicides used are generally recommended for the management of diseases of various crop plants[3]. In each passage, linear mycelial growth was measured after 12 days. The increase in the mycelial growth from passage to passage was employed as the criterion for the development of resistance.

When *P. aphanidermatum* was treated continuously with aluminium ethyl phosphite, the resis-