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Ecology and Natural Limiting Factors of Taro Corm-Borer (*Aplosonyx chalybaeus* Hope) in North Eastern India

Taro (*Colocasia esculenta*) is grown extensively in the plains and hill slopes as a rainfed crop during April to September in the North Eastern Hill Region (NEH) of India. Several insect pests damage taro, while the corm-borer (*Aplosonyx chalybaeus* Hope) (Coleoptera: Chrysomelidae) is a regular and endemic pest causing 20-30% damage to the foliage and 80-90% to the corms, resulting in severe losses to the tribal farmers of the region. In India, *A. chalybaeus* was reported only from the North Eastern states for the first time. Barwal (1988) first identified *A. chalybaeus* on taro as a new record in Meghalaya. Later, the pest was also reported from several South Asian countries (Maddison, 1993). Infestations of *A. chalybaeus* were recorded in Darjeeling, Kalimpong (ZSI, 2010). Some species of *Aplosonyx* were reported from Sikkim and Himalayas (Kimoto, 1967), Malaysia (Mohamedsaid, 1999), China (Chen, 2007), Indonesia (Mohamedsaid, 2007) and Vietnam (Darling, 2007). The origin of *A. chalybaeus* is not known but its specimens collected from Nepal and Myanmar (Burma) were preserved and kept in the Entomological Museum of Lund University, Lund, Sweden. Medvedev (2000) briefly described *A. chalybaeus* and *A. scutellaris* (Baly) collected at altitudes ranging from 1500-1900 m above MSL in Nepal. A mention of corm-borer on taro was reported earlier from Meghalaya (Swamy et al., 2002) but the pest was not identified. In an attempt to promote tuber crops in the North Eastern Region by the Regional Centre, Central Tuber Crops Research Institute, Odisha, India, and to focus on the development of North Eastern Region of India, a study was conducted in Meghalaya and Sikkim to understand the bioecology of corm-borer *A. chalybaeus* and its natural limiting factors.

Present studies were conducted during the period 2005-2009 in July and September. The adults were collected from taro fields and reared in the Division of Entomology, ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya. Duration of different life stages of the taro corm-borer (*A. chalybaeus*) was recorded by maintaining their population in laboratory under incubation at 26°C and 80-85% RH. The adults and grubs collected from the field were incubated for the isolation of indigenous strains of *Beauveria bassiana*.

Adults, both male and female of *A. chalybaeus,* are shiny with bright metallic blue, blue-green and purple-pink colours on the elytra (Fig. 1). Fifth to eighth segment of antenna and apices of tibia and tarsi are black with a metallic sheen, underside not shiny as that of upper surface. Eight irregular double rows of punctures counting the rows from the suture are present on each elytron. The punctures are deeply impressed holes, becoming very fine and confused on the apical area. Out of the total beetles collected (n=500), approximately 90% of the beetles exhibited metallic pink colour and the rest were of metallic blue colour. *Aplosonyx* species associated with aroids are brightly coloured and exhibit aposematic or warning colouration (Darling, 2007). Sexual dimorphism is present.

The head and thorax of *A. chalybaeus* are orange coloured and the elytra is deep pink to purple in colour. However, the ventral side is yellowish to orange in colour. A leaf sheath harboured 3-4 young beetles, thus making their number 9-12 per plant. The adults were found surviving in the water accumulated between the leaf sheaths at the base of the plant (Fig. 2). The young ones were found hiding one on the other. Adult beetles also hide in the cracks and crevices of the soil around the taro plant. The taro plant whose diameter is less than one inch was

not preferred for hiding by the corm-borer and they preferred ~2 inch diameter, indicating that mature plants were more susceptible than the younger ones. Females were the first to reach the dorsal surface of the top leaves and sent chemical signals by raising their abdomen, which attracted the males leading to an increase in male beetle population in the nearby plants. The cues were perceived by males within 5-10 minutes. Identification of the chemical compounds that orient the beetle population is required for effective corm-borer management. Copulation was noticed during dusk and nights. The adults fell on to the ground by a slight touch to the leaf and flew up to 60-70 m at a stretch horizontally as well as in steep slopes in search of the host plant. The beetles were very active in the day time and much of the mating was observed during the dusk.

Beetles emerged with the start of the first summer showers in the region during middle of May. However, peak adult activity was noticed from the month of June till August with peak population during July first week (5-6 per plant). The female laid eggs in groups of 80-100 in leaf sheath above the ground. The eggs hatched in 3-5 days, a fully grown larva is white to wheatish in colour measuring 5 cm in length and 5-7 mm in width (Fig. 3). Soon after hatching, the tiny grubs bored into the shoot and consumed the developing corm resulting in the death of the plant (Fig. 4). The grubs hibernated in the corms as the temperatures during winter in the region ranges between 0°C to 3°C. The damaged plants became yellow, wilted and withered. The dead plants emitted foul smell. The local cultivars with purple or pink colouration on the leaves were less preferred by *A. chalybaeus*. A maximum of 70-80 grubs were found per plant. One generation per year was recorded. The adults consume the leaves by damaging up to 20-30%. The adults make circular holes (trenches) of different sizes ranging between 2-3 cm on the leaf and the damaged leaf exuded milky and waxy latex (Fig.5). More number of holes was seen on the edges of the leaf than inside. The corms were damaged up to 80-90% in the improved varieties and the local genotypes were found moderately resistant to *A. chalybaeus*. Among the 25 taro varieties screened for *A. chalybaeus* resistance, var. Surya Mukhi and var. Bk-Col-1 were found promising with less than 20% infestation.

The beetle made trenches from underside of the leaf. Similar infestation pattern has been observed in *A. ancora* on aroids in Vietnam (Darling, 2007). Circular feeding holes occur only in Araceae in which latex is contained in cells or vessels with cells bridging adjacent files (anastomosing laticifers). The phylogeny of Araceae and the restricted host records suggest a coevolution and parallel phylogensis between *Aplosonyx* and its aroid hosts (Darling, 2007). *Aplosonyx* species make circular trenches in order to avoid the poisonous latex that contains cyanogenic glucoside triglochinin (Bradbury et al., 1995) and hydrogen cyanide is a defensive allomone in some species of leaf beetles (Moore, 1967; Pasteels et al., 1994). In Indonesia, another species of chrysomelidae i.e. *Aplosonyx amorphophallus* infest *Amorphophallus muelleri* Blume, which feeds from the leaf margin resulting in semicircular cuts (Mohamedsaid, 2008), not as round holes made by *A. chalybaeus* on taro leaf. In both the states of Sikkim and Meghalaya in India, *A. chalybaeus* was found infesting foliage and corms.

Extensive cultivation of taro in Meghalaya as a pure crop and availability of several wild species of taro, as weeds, are responsible for the build-up of taro corm-borer irrespective of the altitude (up to 2000 m above MSL). Taro is grown in Meghalaya as a pure and a mixed and/or intercrop. Taro is a weed in Sikkim and the plants were found in vacant places on the hills and backyards. Several wild species of taro, namely, *Colocasia esculenta* var. *antiquorum, C. esculenta* var. *esculenta*, *C. esculenta* var. *sylvestris*, *C. affinis*, *C. fallax* were infested by *A. chalybaeus* in the state of Sikkim, up to 3000 m altitude (Fig. 6). Similarly, Chen (2007) reported herbivory by *Aplosonyx* sp. on *Alocasia macrorrhiza* in China, pointing out the possibility for using the insect to contain *A. macrorrhiza* spread and dispersal. Build-up of several chrysomelids in the cultivated lands was because of existence of adjoining forests, which were the main source of the phytophagous chrysomelids (Irwin et al., 2000). The adults and grubs of corm-borer may be found probably only in humid temperate climate as evident from their occurrence in higher altitudes of India. The corm-borer has not

been recorded and/or reported from other parts of tropical regions in India.

The population of corm-borer is kept under control by several natural and human interventions. Many tribes of Meghalaya consume the adults and grubs of *A. chalybaeus* as diet. The adults and grubs may be rich in proteins. Pathak and Rajasekhara Rao (2000) reported that the tribals of the North Eastern Region consume insects belonging to several orders. *A. chalybaeus* is a seasonal diet of indigenous tribes of Arunachal Pradesh in India (Chakravorty, 2009). Since the states of Meghalaya and Sikkim are declared organic and chemical pesticides are not being applied in these states over a half decade, *A. chalybaeus* including other insect species may also be part of the diet seasonally and occasionally, as the crop and pest are free from pesticide residues. In the light of such food habits of tribes of the North Eastern Region, insect outbreaks may be beneficial for local and indigenous human population. Although entomophagy can be seen as a response to famine, in some tribal cultures, it represents an important seasonal source of protein and is a normal part of the diet of ethnic tribes. In some ethnic groups, insects provide 5–10% of annual protein input as well as fats, calories, vitamins and minerals (MacEvilly, 2000). Farmers in Meghalaya were also found collecting the corm-borer adults from the fields thus keeping a check on the rise of the population of *A. chalybaeus*. Predatory insects were also found attacking the *A. chalybaeus*. An unidentified earwig (Dermaptera) was found predating on the eggs and young ones of *A. chalybaeus* hiding in the leaf sheath. Natural populations of *A. chalybaeus* were found infected with entomopathogenic fungus *B. bassiana* during June to August. Effective management strategies are required to contain and limit the spread and dispersal of taro corm-borer into or from the adjoining states and countries.

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Fig. 1. Corm-borer adult

Fig. 2. Corm-borer beetle hiding in the leaf sheath

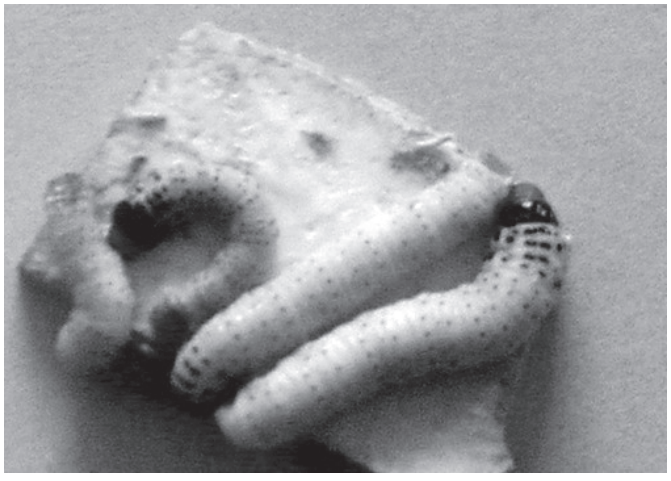

Fig. 3. Corm-borer larvae

Fig. 4. Corm-borer infested plant

Fig. 5. Circular trenches and the latex

Fig. 6. Wild hosts of corm-borer

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