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Bionomics of tortoise beetle, *Cassida circumdata* Herbst : An emerging pest of water spinach in northern and eastern India

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ABSTRACT: The present study records the occurrence of tortoise beetle, *Cassida circumdata* Herbst on water spinach (*Ipomoea aquatica*) from the northern and eastern region of the country. Both the grubs and adults prefer to feed the chlorophyll of the leaf lamina and thereby creating shot holes on it. Affected leaves often failed to fetch the good market price. The seasonal incidence and biology of this pest were studied at Varanasi region, Uttar Pradesh during 2017-18. The pest occurred thorough out the year with peak during 34th and 48thstandard meteorological weeks (SMW) *i.e.,* third week of August and last week of November, respectively when almost 50% of leaves were severely damaged. With the onset of summer in the region the population was declined. *C. circumdata* had life-cycle of 38.5 – 70.25 days under laboratory conditions. The incubation period varied from 2.5 to 6 days with an average of 4.25±1.25 days. There were five larval instars. The first, second, third, fourth and fifth instar larval period ranged from 2.75 to 3.50, 2.75 to 4, 2.50 to 3.25, 2.50 to 3.50 and 4 to 5 days, respectively. The pre-pupal and pupal stages lasted for 1.5–4.75 and 5–7.25 days, respectively. Adults survived for 15 to 33 days with an average of 23.20±7.69 days.

Keywords: Tortoise beetle, water spinach, damage, biology, seasonal incidence

INTRODUCTION

Water spinach (*Ipomoea aquatica* Forsk), belonging to the family Convolvulaceae, is an aquatic/semi-aquatic vascular plant occurs both wild and commonly cultivated forms in many parts of India, Sri Lanka, Bangladesh and southern China. It is easily grown with little labor and grows rapidly up to 10 cm/day (Ruskin and Shipley, 1976). The growing tips and young, floating stems with petioles and leaves make a delicious vegetable which is much appreciated mainly in the northern and eastern parts of the country. It has a high food value and is rich in vitamin A, vitamin C and iron (Chughtai, 1995). In India it is mainly grown in the states of West Bengal, Bihar, Uttar Pradesh, Tripura, Odisha and Tamil Nadu (Basu *et al*., 1981). This aquatic, perennial creeper is often attacked by a number of insect pests throughout its growth period (Rangaswamy *et al*., 2012). Amongst them, a leaf feeder which devours the chlorophyll portion of the leaves by creating numerous shot-holes on the leaf lamina is very serious. The affected leaves often fail to fetch good market price. Maximum fifty percent leaves were recorded to be infested by this leaf feeder. Several local farmers from Varanasi and adjoining districts were also reported the same problem. This prompted to conduct a detailed study about the morpho-taxonomy, biology and seasonal incidence of this nefarious pest from the region.

MATERIALS AND METHODS

Detailed studies on morphology and biology of the pest were carried out in the Entomology laboratory of ICAR-Indian Institute of Vegetable Research, Varanasi (82°52' E longitude and 25°12' N latitude), Uttar Pradesh, India whereas the seasonal incidence was carried out during the April to March of 2017-18 at the villages Shahanshahpur and Kelabela, Uttar Pradesh, India.

Taxonomic identification

The insect specimens of (preserved in 80% alcohol) were sent to Department of Entomology, Kerala Agricultural University, Vellayani, Kerala, India for taxonomic identification.

Studies on seasonal incidence

To study the seasonal incidence, in terms of leaf damage on water spinach, randomly twenty apical twigs were selected form each ponds/marshy lands at weekly intervals from the first week of April (14th standard meteorological week (SMW)) to last week of March (13th SMW). Damaged leaves by this foliage feeder and total leaves in each twig were counted separately and per cent damage was calculated by the following formula:

$$\text{Leaf damage (\%)} = \frac{\text{Number of damaged leaves}}{\text{Total number of leaves}} \times 100$$

Studies on biology of the pest

Nucleus culture of the test insect (tortoise beetle) was maintained in Entomology laboratory starting with the initial culture obtained from the nearby villages. To determine the duration of the egg stage and their viability, newly emerged (up to 24 h old) tortoise beetle adult male and female (2:1 ratio) were placed on the twigs of water spinach. For the purpose, apical twigs were kept in upright position (with support of cotton swab) inside a reagent bottle (Schott Duran, 50 ml capacity) filled with water. The entire set was again put inside a cage (36 × 30 × 40 cm) under laboratory conditions at 28±2ºC, 70-80% relative humidity and a photoperiod of 13:11 (L:D) hour. Eggs were laid mostly on under surface of the leaves. The larvae hatched were counted daily and hatching (%) was computed. To access the different larval stages, newly hatched grubs were collected with a fine-tipped entomological brush and transferred in to fresh water spinach twigs placed inside a reagent bottle filled with water. Observations were made at regular intervals.

RESULTS AND DISCUSSION

The leaf feeder infesting water spinach was taxonomically identified as *Cassida circumdata* Herbst, 1799 (Coleoptera: Chrysomelidae: Cassidinae).

Nature of damage

Early instar grubs scrap the chlorophyll part of the leaves resulting skelotilization of the leaves. Later instars make small irregular shot holes and notches on the leaves. Numerous (2 to 39 with an average 11.37) such small holes occurred on a single leaf. Black excreta were often visible on the upper surface of the leaves. Affected leaves had lower photosynthetic activity and also fetch lower market values.

Seasonal incidence

The incidence of *C. circumdata* on water spinach was persisted almost throughout the year from first week of April (14th standard meteorological week (SMW)) to last week of March (13th SMW) with a peak during 34th and 48th standard meteorological weeks (SMW) *i.e.,* third week of August and last week of November, respectively when almost 50% leaves were severely affected by this beetle. Form the figure 1 it is also evident that population was minimum during the period of February to May coinciding with summer in the region. Form June onwards, with onset of monsoon in the Varanasi and the adjoining districts, the population of *C. circumdata* was gradually increased. Apart from eastern part of Uttar Pradesh, its incidence was also observed in serious proportion in the districts of North and South 24 Parganas, Nadia, Howrah, Hooghly, Burdwan, Birbhum and Paschim Medinipur of West Bengal where water spinach is considered as a popular aquatic leafy vegetable. During the rainy season, in the month of July – August, about 35-50% leaves were infested by this beetle in this region.

Biology

From the table 1 it is evident that tortoise beetle, *C. circumdata* had life-cycle of 38.5 – 70.25 days under laboratory conditions. Gravid females laid eggs up to 241 eggs during her life-time with an average of 210 ± 20.02 eggs. The egg was elongated. The light green egg is covered by translucent parchment-like membrane. Egg viability ranged from 83–95 per cent. The incubation period varied from 2.5 to 6 days with an average of 4.25±1.25 days. There are five larval instars. The first, second, third, fourth and fifth in star larval period ranged from 2.75 to 3.50, 2.75 to 4, 2.50 to 3.25, 2.50 to 3.50 and 4 to 5 days, respectively. The larvae (grubs) were

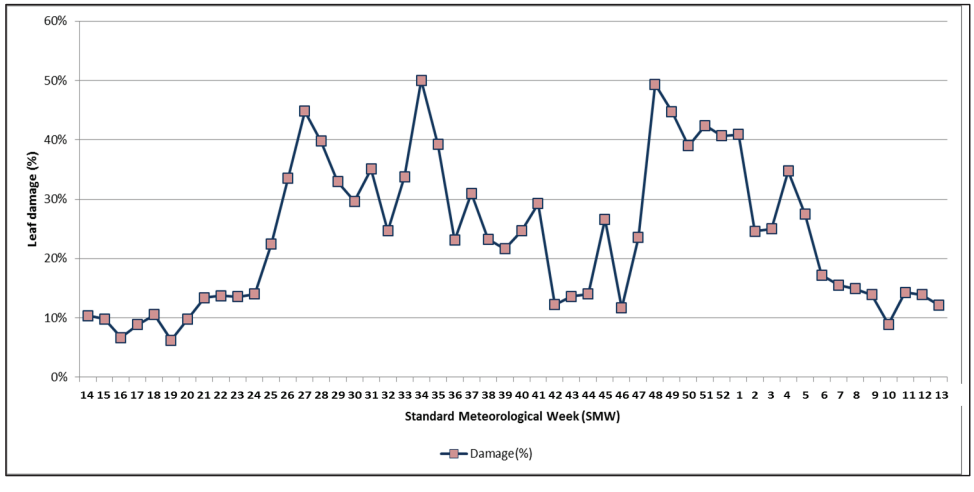

Fig.1. Seasonal incidence of tortoise beetle, *C. circumdata* on water spinach

Table 1.Biological events in life-cycle of *C. circumdata* on water spinach under laboratory conditions

Biological parameter	Minimum	Maximum	Mean* ± SD
Fecundity (No.)	197	241	210±20.02
Egg viability (%)	83	95	88±4.69
Incubation period (days)	2.5	6	4.25±1.25
Larval duration (days)			
First instar	2.75	3.50	3.05±0.23
Second instar	2.75	4.00	3.40±0.52
Third instar	2.50	3.25	3.00±0.41
Fourth instar	2.50	3.50	2.95±.037
Fifth instar	4.00	5.00	4.30±0.28
Total larval period	14.5	19.25	16.50±1.25
Pre-pupal period (days)	1.50	4.75	3.80±1.39
Pupal period (days)	5.00	7.25	6.40±1.15
Adult longevity (days)	15	33	23.20±7.69

SD = Standard Deviation; *Means are based on ten replications

light green in colour, flattened and slug-like. The skin from the last moult was attached to the last abdominal segment and held upright. Duration of the total larval period ranged from 14.50 to 19.25 days. Late instars changed colour from green to yellowish green, becoming more yellow near pupation. Pupae were oval, flattened with prominent prothoracic shield. Critical observation revealed that during pupation the final instar full grown grub stopped its feeding and became sedentary by settling itself on leaf surface. The larval skins were attached to the posterior end appearing as an irregular black mass. The pre-pupal stage lasted for 1.5 – 4.75 days. The pupal period ranged from 5 to 7.25 days with an average of 6.40 days ranging (table 1). The adult was a small tortoise beetle with metallic greenish yellow body. The wings have 3 irregular longitudinal black bands. The middle black band on inner margin of wing shares with opposite wing. Adults were survived for 15 to 33 days with an average of 23.20±7.69 days.

Liu and Wenfeng (2005) recorded about five larval instars of *C. circumdata* when fed up on sweet potato leaves under laboratory conditions and the stadium durations were 2.86, 2.82, 2.65, 2.92 and 4.21 days, respectively, whereas survival rates of larvae were 100%. George and Ipe (2000) from Keoladeo National Park, Bharatpur, Rajasthan, India observed that there were also five instars *C. circumdata* when they feed on *Ipomea reptans* (Linn.). They recorded that maximum leaf area was consumed on the eighth day by 5thinstar larvae. Maximum food intake was during last instar larval stage on 7thand 8thday. GreSSitt(1952) reported that *C. circumdata* fed on a number of Convolvulaceae plants including *Ipomoea palmata*, *I. batatas*, *I. aquatica*, *I. cairica*, *I. digitata* in China. In another study, Sultan (2008) from Pakistan documented that adults and larvae of *C. circumdata* were found feeding on the foliage of *I. aquatica* and *I. cairica* (Convolvulaceae). *C.circumdata* is an oligophagous pest recorded to occur in India, Philippines, Indonesia, Nepal, Malaysia, Thailand, Vietnam, China, Japan and Taiwan (Rangaswamy *et al*., 2012).

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REFERENCES

Basu, C.R., Bhaumik, A.R. and Sengupta, T. 1981. Chrysomelidae (Coleoptera) of Tripura (India). *Records of Zoological Survey of India*, **78:** 41-61.

Chughtai, M.A. 1995. Effects of water spinach (*Ipomoea aquatica*) on nutrient regime and fish growth. AIT Thesis AE-95-38. Asian Institute of Technology, Bangkok, Thailand.

George, M.J. and Ipe, M.I. 2000. Feeding Potential of *Cassida circumdata* Herbst (Chrysomelidae: Coleoptera) on *Ipomea reptens* (Linn.) (Convolvulaceae). *Bombay Journal of Natural History Society*, **97**(3):370-374.

Gres Sitt,J.L. 1952. The tortoise beetles of China (Chrysomelidae: Cassidinae). *Proceedings of California Academy of Science*, **27**: 433-592.

Liu, K. and Wenfeng, H. 2005. Preliminary study of the life cycle of *Cassida circumdata* Herbst (Coleoptera: Chrysomelidae). *Formosan Entomologist,* **25**(4): 303-308.

Rangaswamy, M., Shepard,B. M., Carner, G. R. and Peter, A.C.O. 2012. Arthropod pests of horticultural crops in tropical Asia, CABI, pp:54.

Ruskin, F.R. and Shipley, D.W. 1976. Making aquatic weeds useful: Some perspectives for developing countries. *National Academy of Sciences*, Washington DC.PP:65-182.

Sultan, A., Borowiec, I., Rafi, M.A., Ilyas, M., Naz, F.and Shehzad, A. 2008. Tortoise beetles of Rawalpindi-Islamabad, Pakistan and their host preferences (Coleoptera: Chrysomelidae: Cassidinae). *Genus,* **19**(1):93-102.

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