

## Quiescence behaviour in *Ceuthorhynchus portulacae* Marshall, a potential biocontrol agent of the purslane weed, *Portulaca oleracea* L.

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**ABSTRACT:** *Portulaca oleracea* L. is considered as a serious problematic weed of vegetables, vineyards and banana orchards in many parts of India. *Ceuthorhynchus portulacae* Marshall (Coleoptera: Curculionidae) was identified as a potential indigenous biocontrol agent, which could be utilised for the effective suppression of the purslane weed. Field and laboratory studies in Bangalore revealed that the adults cease to feed and multiply during the cold winter months of November- January, indicating the possibility of diapause in the adult stage. A study was carried out to determine whether adults undergo diapause and the factors governing it. Behavioural and physiological observations showed that the adults were not capable of undergoing any diapause. But, they remain inactive during the cold winter period and become active with the advent of favourable environmental conditions.

**KEY WORDS:** Biocontrol agent, *Ceuthorhynchus portulacae*, diapause, *Portulaca oleracea*

*Portulaca oleracea* L., a plant of South American origin, considered as the ninth world's worst weed infests about 85 crops in 45 countries of the world (Holm *et al.*, 1977). In India, it is a serious weed of vegetables, vineyards and banana orchards, especially during the rainy seasons (Chadha *et al.*, 1995). The weed also acts as alternate host to varied pests and diseases and has allelopathic effects to many crops (Waterhouse, 1994). *Ceuthorhynchus portulacae* Marshall was identified as a potential indigenous biocontrol agent that could be utilised for the biological suppression of the weed (Ganga Visalakshy and Jayanth, 1997). Field and laboratory observations

in Bangalore indicated that the adults of *C. portulacae* cease to feed and reproduce during the cold months of winter which indicated the possibility of adult diapause. Diapause in many insects has been reported to bring varied behavioural and physiological adaptations like burrowing into soil, aggregation, flight muscle degeneration, fat body accumulation and re-absorption of the reproductive organelles (Delinger, 1986). A study was made to determine whether *C. portulacae* adults exhibit any such physiological or behavioural adaptations whereby the possibility of diapause and the factors governing it could be identified.

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## MATERIALS AND METHODS

Physiological adaptations that could take place in relation to diapause were studied based on the structural changes in flight muscles, fat body accumulation and reproductive organelles. Newly emerged adults were maintained on purslane plants in wooden cages under field conditions. The cages were 2m height x 1m width, with nylon mesh on top and three sides, with a sliding glass front and wooden base. From these cages, 10 – 15 adults of about a month old were hand picked at monthly interval and preserved in alcohol (70%), for a minimum period of 24 hours. These insects were later fixed in paraffin wax, with their dorsal surface facing upwards and dissected using stereo binocular microscope. Observations on the physiological status of flight muscles (MDL), indirect median dorso- longitudinal muscles, reproductive organelles and fat body accumulation were made. The experiment was carried out during March, 1998 to February, 1999.

## RESULTS AND DISCUSSION

### Flight muscles

The MDL in *C. portulacae* was formed of two muscle bundles, each bundle having 4-5 muscle fibers. Well developed MDL in normal, active adults were found occupying the entire width of thoracic region.

The details of the physiological status of the MDL during different months of the study are presented in Table 1. The adults were found to have well developed MDL revealing no changes in the flight muscles, throughout the year. Traces of fat body accounting for only 20 per cent of their body cavity were found in adults dissected during the study period.

Diapause has been reported to cause degeneration of indirect flight muscles-median dorso-longitudinal (MDL) and accumulation of fat bodies, in many coleopterans. For example, in the rice water weevil, based on the degeneration and development of indirect flight muscles, diapause

induction and termination has been estimated for pest management strategy (Muda *et al.*, 1981). Similarly in *Zygogramma bicolorata*, diapausing adults were reported to have degenerated flight muscles, and the entire body cavity filled up with orange coloured fat globules (Ganga Visalakshy and Jayanth, 1999). In *C. portulacae*, such changes in the structure of indirect flight muscle (MDL) or fat bodies, were not observed during the present study.

### Reproductive organelles

The ovarian follicles were divided into two phases, the pre-vitellogenesis and vitellogenesis. The pre-vitellogenesis follicles were found to have no signs of developing ovum. The vitellogenesis follicles had ova. That was in developing and developed stages. Similarly, immature testes were small and diffused while matured ones were well formed with the bilobed nature clearly demarcated.

It could be seen from Table 1 that adults of March to September had well developed reproductive organelles (follicles and testes) indicating that they were reproductively active. About 20-30 per cent of the adults dissected in October-November were found to have follicles in the previtellogenesis phase that increased to 100 per cent during December. These adults on exposure to 25 °C and above started ovipositing within 1-2 days, indicating that the prevailing low temperature could have reduced their reproductive activity. However, by January, 60 per cent of the adults had follicles with different stages of ovarioles that reached 100 per cent in February.

In many tropical insects, diapause initiation caused behavioral changes in adults like congregation on host plants and burrowing into the soil (Woldha and Delinger, 1984). During our study *C. portulacae* adults were found to exhibit no such specialized behavioural adaptations. The adults during favourable conditions were found to actively feed and multiply. During the cold months of winter, adults were found resting on the twigs of *P. oleracea*. When twigs were not provided, majority of the adults was found among the leaf

litter. However, these adults even on slightest disturbance became active and started moving. Further, on warmer periods of sunny days of winter, *C. portulacae* adults were found to come out of the soil cover and move actively on the sides of the cage. Few feeding marks were also observed

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Table 1. Anatomical status of flight muscles (MDL) and reproductive organelles of *C. portulacae*

Month	Adults with well developed MDL (%)	Adults with matured reproductive system (%)
March	100	100
April	100	100
May	100	100
June	100	100
July	100	100
August	100	100
Sept.	100	100
October	100	70
November	100	80
December	100	0
January	100	70
February	100	100

CD (P=0.01) =1.78

CD (P=0.05) =1.00

on the purslane twigs provided.

Based on the above observations, it could be concluded that *C. portulacae* adults may not undergo diapause, but remain quiescent during the cold seasons of the winter.

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