Biolife
AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE
4(2):295-299
ISSN (online): 2320-4257
www.biolifejournals.com
BIOLIFE RESEARCH ARTICLE

Diversity and Bio-Control Potential Of The Genus *Cotesia Cameron* (Hymenoptera : Braconidae) From Kolhapur Region, India

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ABSTRACT

The genus *Cotesia* Cameron (Hymenoptera: Braconidae) is widely scattered in the world containing about 2000 species and act as insect pest biocontrol agents. Biological pest control is ecofriendly and good alternative for chemical control for avoiding pollution, pest resistance, pest resurgence, secondary pest out break etc. Hence, biodiversity and biocontrol potential of the genus *Cotesia* have been studied from Kolhapur region, India. A total of 25 species of this genus have been reported causing mortalities in pest insects of economically important crops both from agro and forest ecosystems. *C. flavipes, C. parnari, C. mangiferae, C. chilonis, C. orientalis, C. anari* and *C. sesamae* showed 32.00%, 34.00%, 38.50%, 27.00%, 21.00 %, 20.50% and 18.50% biocontrol potential against lepidopterous pests, *Chilo partellus, Parnara mathias, Inderbella tetraonis, C. partellus, Exelastis atomosa* and *Sesamia. inferens* respectively.

Key words: Genus *Cotesia,* diversity, biocontrol potential, Insect pests, Kolhapur region.

INTRODUCTION

The genus *Cotesia* (Hymenoptera: Braconidae) was erected by Cameron in 1891. However, Mason (1981) reclassified the subfamily Microgastrinae of the family Braconidae and he included all new combinations of the genus *Apanteles* including the species *Cotesia flavipes* under the genus *Cotesia*. In temperate region, this is the largest segregate of the old *Apanteles* including 30-40 per cent of species. In the tropics, *Cotesia* is partly displaced, ecologically by the genus *Glyptapanteles* and comprise only 10-20 per cent of the *Apanteles* fauna. At any rate *Cotesia* is commonest and ubiquitous genus of subfamily Microgastrinae comprising 1500 - 2000 species from the world which attacks macrolepidopterous pests of forest and agro-ecosystems and suppress the populations (Sathe, *et al*. 2003).

Most of the species of the genus *Cotesia* are gregarious parasitoids of pest insects. About 25 per cent of *Cotesia* are solitary parasitoids on insect pests. The form and location of cocoon mass varies greatly inter specifically (Mason, 1981). From India about 100 species of *Cotesia* have been reported (Sathe, 2014). In past, Ayyar (1924), Wilkinson (1928 a,b), Bhatnagar (1948), Rao (1961), Chalikwar *et al*., (1981), Mason (1981), Nixon (1981), Sathe (1984 a,b, 1987, 1988, 1991, 1992, 2000), Dawale *et al*. (1993), Sathe *et al*. (1994), Sathe & Bhoje (2000), Sathe 2003 a,b; 2004, 2005), Sathe *et al*. (2003), Rokade & Sathe (2008), Sathe (2014), Sathe & Chougale (2014), Sathe & Shendage (2014), Sutar and Sathe (2016), etc. worked on diversity and bicontrol potential of the genus *Cotesia*. Species of *Cotesia* are bio-pesticides with high insect pest biocontrol potential found in the environment of Kolhapur region. Therefore, they are very good alternative for pesticides in pest management.

How to Site This Article:
Ambi Ashutosh A, T.V. Sathe and S.S. Patil (2016). Diversity and Bio-Control Potential Of The Genus *Cotesia Cameron* (Hymenoptera : Braconidae) From Kolhapur Region, India. *Biolife*, 4(2), pp 295-299. *DOI: https://dx.doi.org/10.5281/zenodo.7317801*

Received: 4 April 2016;
Accepted; 21 May 2016;
Available online : 4 June 2016

Pesticides cause many serious problems such as pollutions, pest resistance, pest resurgence, secondary pest outbreak, etc. Therefore, the present study has great relevance in eco-friendly insect pest management.

MATERIALS AND METHODS

The species diversity of the genus *Cotesia* was studied by collecting lepidopterous pest larvae from various agro and forest ecosystems of Kolhapur district at evening and morning during the years 2012-2015. Kolhapur district of India is situated between 15^{o}-17^{o} North Latitude and 73^{o}-74^{o} East Longitude with rainfall range 500 mm - 6000 mm. The field collected larvae of various pest species have been reared on their natural host plants for screening the parasitic wasps of the genus *Cotesia.* The adult wasps emerged in the laboratory were pinned and kept in the insect boxes. Later, they have been identified by consulting appropriate literature (Wilkinson, 1928 a,b; Rao 1961; Mason 1981; Sathe *et al*. 2003; Sathe & Bhoje 2002 etc.) The biocontrol potential of *Cotesia* species have been studied by noting per cent parasitism/mortality from the infested pest larvae out of hundred which were collected from the crop fields at 15 days interval.

RESULTS

Results are recorded in table-1 and figs. 1 to 5. During the course of studies, 2012 - 2015, a total of 25 species of the genus *Cotesia* have been reported from Kolhapur region of Maharashtra. The species *C. flavipes, C. chilonis, C. sesamae, C. orientalis, C. diurnii, C. ruficrus, C. glomeratus* and *C. anari* were common from this region (Table-1). *C. flavipes, C. parnari, C. chilonis, C. orientalis, C. anari* and *C. sesamae* have showed great biocontrol potential by causing 32.00%, 34.00%, 38.50%, 27.00%, 21.00%, 20.50% and 18.50% mortalities in lepidopteran pests *C. partellus, P. malthias, I. tetraonis, C. partellus, E.atomosa* and *S. inferens* respectively. Out of 25 species of *Cotesia* listed from Kolhapur region of Maharashtra, *C. flavipes, C. parnari* and *C. chilonis* were dominant over others by bio-control potential (causing mortalities in pests) while, *C. meghrangini, C. shri, C. tuski, C. hansdwani, C. parijati, C. lepidopteri* and *C. karviri* showed less bio-control potential by causing mortalities in pests. Most of the species listed

Table-1. Diversity and biocontrol potential of the genus *Cotesia* From Western Maharashtra

Sr. No.	Species	Host Record	Eco-system	Occurrence	Host Per cent mortality/ parasitism
1.	*Cotesia flavipes*	*Chilo partellus*	A	July to February	32.00
2.	*C. chilonis*	*C. partellus*	A	July to February	27.00
3.	*C. sesamae*	*Sesamia inferens*	A	July to February	18.50
4.	*C. ruficrus*	*Helicoverpa armigera*	A, F	Sept. to January	12.00
5.	*C. glomeratus*	*Peiris brassicae*	A	Except March-June	16.50
6.	*C. orientalis*	*Exelastis atomosa*	A	Aug. to Feb.	21.00
7.	*C. diurnii*	*E. atomosa*	A	Aug. to Feb.	12.00
8.	*C. meghrangini*	*E.atomosa*	A	Sept. to Feb.	5.00
9.	*C. shri*	*Erias fabia*	A	Oct. to Dec.	7.00
10.	*C. suvarni*	*S. inferens*	A	Aug. to Dec.	11.00
11.	*C. anari*	*Viracola isocrates*	A	Aug. to Nov.	20.50
12.	*C. parnari*	*Parnara mathias*	A	Aug. to Dec.	34.50
13.	*C. tuski*	*Euproctis lunata*	A,F	Aug. to Nov.	9.00
14.	*C. hansdwani*	*C. partellus*	A	Aug. to Nov.	4.00
15.	*C. parijati*	*Eupterote mollifera*	A, F	Aug. to Nov.	8.50
16.	*C. arachi*	Ground nut semilooper	A	July to Oct.	11.00
17.	*C. bajari*	*Latoia lepida*	A	Aug. to Nov.	2.00
18.	*C. chiloi*	*Chilo suppressalis*	A	Aug. to March	6.00
19.	*C. janati*	*Achea janata*	A	Aug. to April	16.00
20.	*C. mangiferi*	*Inderbella tetraonis*	A, F	July to Oct.	38.50
21.	*C. sunfloweri*	*Spilosoma obliqua*	A, F	July to Nov.	14.00
22.	*C. karviri*	Lepidopteran larva	A	Sept. to Nov.	1.00
23.	*C. lepidopteri*	Lepidopteran larva	A	Aug. to Sept.	0.50
24.	*C. gramini*	Lepidopteran larva	A, F	Aug. to Sept.	1.00
25.	*C. indica*	Lepidopteran larva	A	July to Oct.	1.50

A = Agro F = Forest

Figure-1. *C. flavipes* – female

Figure-2. *C. flavipes* – male

Figure-3. *C. partellus* larva

Figure-4. *P. mathias* larva with parasitoid larvae

Figure-5. *H. armigera* larva (host of *C.ruficrus)*

in table-1 are prevent in plain and agro ecosystems of Kolhapur.

The prominent gregarious parasitoids of pest insects were *C. flavipes, C. chilonis, C. sesamae* and prominent solitary parasitoids of the region were *C. orientalis*, *C. diurni* and *C. janati*. Newly reported and described species of Kolhapur region refer to *C. meghrangini, C. shri, C. suvarni, C. anari, C. parnari, C. tuski, C. hansdwani, C. parijati, C. arachi, C. bajari, C. chiloi, C. janati, C. sunfloweri, C. mangiferi, C. karviri, C. lepidopteri, C. indica* and *C. gramini* which were found controlling various lepidopterous pests both from agro and forest ecosystems (Table-1).

DISCUSSIONS

The genus *Cotesia* Cameron (Hymenoptera : Braconidae) is characterized by propodeum mostly rugose and without areola, usually with median carina or none and short transverse carina running sesad from the spiracle, hypopygium short, ovipositor short and stout basally, ovipositor sheath with hairs concentrated apically, tergite II atleast half as long as III and usually

sub-rectangular. In the present study, 25 species of the genus *Cotesia* have been reported from Kolhapur region. Sathe (1987) recorded natural enemies of *Spodoptera litura* from Kolhapur. He reported 5 braconids parasitizing the larvae of *S. litura.* Sathe (2003a) studied biodiversity of braconid pest biocontrol agents from Western Maharashtra. He reported 53 species of braconids causing mortalities in several agricultural and forest insect pests. Out of 53 parasitoids, 13 species were from the genus *Cotesia*. The *Cotesia* species attacked the insect pests such as *Chilo* spp., *Helicoverpa armigera, Pieris brassicae, Exelastis atomosa, Erias* spp., *Parnara mathias, Spilosoma obliqua, Spodoptera litura, Achea janata,* etc.

Biodiversity of braconid pest biocontrol agents has been studied by Sathe (2004) from Southern Maharashtra, India. He reported 37 species of braconids. Out of which 10 species were from the genus *Cotesia.*

Sathe (1992) surveyed the natural enemies of 29 insect pests of economic importance from various agro-ecosystems of Maharashtra. The prominent *Cotesia* species he reported were *C. orientalis, C. diurnii, C. flavipes, C. chilonis, C. sesamae* and *C. glomeratus* while, in the present study, 25 species of the genus *Cotesia* have been reported as good bicontrol agents of forest as well as agricultural insect pests. From the genus *Cotesia* 14 species, from *Apanteles* 13 from *Bracon* 3, from *Glyptapanteles* 2, and from *Meteorus* 2 species have been reported while, the genera *Rhigoplitis,* and *Microplitis* have been represented by single species. The more abundant species of the region refer to *C. flavipes, C. chilonis, C. orientalis, C. ruficrus, C. glomeratus, A. prodeniae, A. angaleti, A. plutellae, Meteorus dichomeridis, Bracon* spp. and *Stenobracon* sp. etc. From Western Ghats *A. balteatae, A. baoris, A. papilionis, A. angaleti, C. meghrangini, C. blackburni, A. schoenobi, G. melantis* and *Stenobracon nicevillei* were common (Sathe, 2003a).

Sathe (1988) studied the intrinsic rates of increase and inter-specific relationships between *C. orientalis, C. diurnii* (Braconidae) and *Diadegma trichophilus* (Cameron) (Ichneumonidae). Above three species are internal larval parasitoids of Turplume moth *Exelastis atomosa* Wals. The intrinsic rates of increase in the species were 0.188, 0.158 and 0.149 and population multiplied to 41.93, 25.99 and 25.63 times in mean generation time of 19.87, 20.61 and 21.77 days respectively. The maximum parasitism was noted at the host age 3-4 days in *C. orientalis* and 2-3 days in *C. diurnii.* C. *orientalis* avoided the host which were already parasitized but, *C. diurnii* was not able to discriminate the hosts previously parasitized by other species. His laboratory experiments showed that *C. orientalis* was dominant over other two parasitoids viz., *C. diurnii* and *D. trichoptilus*.

Sathe (1984a) studied seasonal mortality of *C. orientalis* due to hyperparasitoids. He noted 3 hyperparasitoids on *C. orientalis* namely, *Brachymeria* sp., *Eurytoma* sp. and *Diagepletidia* sp.

Sathe (1984b) studied the reproductive potential of *C. diurnii* in relation to host density. He exposed early second instars of *E. atomosa* in 10, 20, 30, 40 and 50 host densities to parasitoid for parasitism. The number of parasitoids obtained from host density 40 was highest. The host densities 10, 20, 30 and 50 showed 16.12%, 17.85%, 19.44% and 16.33% parasitism respectively.

Sathe (2000) studied the impact of hymenopterous parasitoids including *Cotesia* spp. on population of *E. atomosa* from India. *C. orientalis* and *C. diurnii* caused 20% and 8% mortalities in second instars larvae of *E. atomosa*. Mostly, 3-4 day old caterpillars were preferred by the parasitoids for parasitism. *C. orientalis* developed relatively faster than other parasitoids viz. *C. diurnii* and *D. trichoptilus*. He also studied hyper parasitism in cocoon stage of parasitoids and found hyper parasitism peak in January.

Nikam and Sathe (1983) studied life tables and intrinsic rate of natural increase of *C. flavipes* (Hymenoptera: Braconidae) population on *C. partellus* (Lepidoptera : Pyralidae). The innate capacity of increase of *C. flavipes* they found was 0.176 per female per day and population multiplied to 30.72 times in mean generation time of 19.45 days. Sathe (1991) studied the developmental interactions between the sorghum stem borer *C. partellus* and its gregarious braconid parasitoid *C. flavipes.* The maximum egression of parasitic larvae was noted with 5^{th} instars, followed by 6^{th}, diapausing, 4^{th} and 3^{rd} instars. Parasitized larvae showed a decline of food consumption with increasing size/age. Under high parasitoid load *C. flavipes* emerged high where as with high load emergence was reduced.

Sathe (1986) studied the biology of *C. diurnii* under laboratory conditions wherein eclosion occurred within 3 days after oviposition. There were 3 instars, the first two were vesiculate and last hymenopteriform. Total developmental time from egg to adult was 18 days in *C. diurnii.* In general, *Cotesia* spp. develops from egg to adult within 14-20 days. Third instar matured larvae came out of the host by breaking body wall and thus, killing the host larva.

Since the genus *Cotesia* is very economical as biocontrol agents of insect pests their knowledge on diversity, biology, ecology, mass rearing and their use in pest control plays important role in eco-friendly pest control.

Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

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