PARASITISM OF *PIERIS BRASSICAE* (L.) (LEP.: PIERIDAE) ON CABBAGE FARMS IN COMPARISON WITH WILD HOSTS AND STUDY ON USE OF *PTEROMALUS PUPARUM* (L.) (HYM. PTEROMALIDAE), AS A BIOLOGICAL CONTROL AGENT VERSUS THIS PEST

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ABSTRACT: During the recent decade, the high risks and detrimental consequences associated with the use of chemical and even microbial pesticides have been a recurring theme in pest control, and researchers have been trying to pursue low-risk and environmentally sound tactics. However, biological control is a non-chemical method that utilizes natural enemies for suppression and regulation of insect pest populations. This study was performed in order to assess parasitism rate and parasitoid diversity of Cabbage Large White Butterfly, *Pieris brassicae* (L.) (Lep.: Pieridae), on cabbage fields in comparison with wild hosts in Urmia. Also In this study some biological and behavioral characteristics of *Pteromalus puparum* (L.) (Hym.: Pteromalidae), predominant endoparasitoid wasp of *P. brassicae*, was studied. For this purpose, samples were taken from various cabbage farms and wild hosts of this pest outside the farm. The specimens have been collected from all stages of *P. brassicae*. In order to parasitoids emerge, samples incubated separately in laboratory conditions at 23 ± 1°C, 40 ± 5 % r.h. and 16:8 h (L:D) photoperiod. The other main purpose of this study was to evaluate the efficacy of *P. puparum* in the biological control of Cabbage Large White Butterfly.

KEY WORDS: *Pieris brassicae*, *Pteromalus puparum*, Biological control, Parasitism, Cabbage .

Pieris brassicae and *Pieris rapae* (Pieridae) are some of the most frequent pests of cabbage crops alongside *Mamestra brassicae*, and *Plutella xylostella* (Patriche et al., 2005). The Large White Butterfly (LWB), *Pieris brassicae* L., is a cosmopolitan insect and is found wherever cruciferous plants are grown (Hill, 1987). Sometimes massive outbreaks of LWB may occur and injury on cabbage cultures may be extensive.

Parasitic wasps which lay their eggs either in or on their hosts are important regulators of insect populations and comprise a large proportion of hymenopteran species (Quicke, 1997).The role of beneficial organisms (such as parasitoids) as natural enemies of insect pests on cabbage is of great consequence (Balevski et al., 2007). Insect parasitoids have been introduced into a variety of ecosystems as bioregulators and there have been many successful cases of their being used to control harmful native arthropods (DeBach & Schlinger 1964; DeBach, 1974). Studies on the fauna of parasitic insect of different regions are of great significance for effective pest control (Aliyev, 1999). Moreover, eggs and larvae of *P. brassicae* are preyed on by generalist predators such as Spiders, Chrysopids, Staphylinids and Carabids (Pfiffner et al., 2009).

Numerous experiments have shown that pest populations often flourish in absence of predators and parasitoids, often killed by the pesticide applications used to control the pest. Chemical pesticides affect more the beneficial insects than the pests themselves, because they are more sensitive (Costea et al., 2002). The goal of our research was to observe how the parasitoids limit *P. brassicae* populations on the cabbage crops in comparison with wild hosts of this pest outside the farms.

MATERIALS AND METHODS

The experiments were conducted in north-west of Iran (Urmia). In 2008 & 2009, during a survey on this pest LWB, sufficient specimens including egg, larvae (in all stages) and pupae have been collected from different collecting dates. Also, we monitored pupal and larval parasitism as well as parasitism rates in some cabbage fields and regions with wild hosts of this pest like *Capparis spinosa* (Capparaceae) and *Raphanus raphanistrum* (Cruciferae). All insects used in the experiments originated from cabbage fields in the Urmia.

In laboratory, egg clusters, larvae and pupae in order to prevent infecting with pathogens (fungi, virus or bacteria), placed in a clean Petri dish separated one by one and each of which with a part of fresh host leaf as an alimentary material. Once a day, Petri dishes were cleaned and larvae were fed fresh leaves of *Brassica oleracea* or *C. spinosa* or *R. raphanistrum*. Food plants were not changed during the experiment. Host larvae were fed until they pupated. Also, egg clusters with up to 150 eggs were kept on moist tissue paper in Petri dishes under 16L : 8D and 23 ± 1°C in an incubator.

Parasitized butterfly pupae were maintained in large Petri dishes (10-cm diameter) and were monitored until adult parasitoid emergence. Then, emerged adult wasps were placed in separate Petri dishes and were provided with water and honey and pollen. The parasitoids are identified and the percentage of parasitism by each parasitoid is estimated too.

To evaluate the efficacy of *P. puparum* in the biological control of LWB, host stage preference, number of progeny laid by the female, number of parasitoid adults emerged from each pupa, immature period from egg hatch to adult emergence of this parasitoid was estimated. For parasitism, we used females that were 1- to 3-d old after adult emergence.

For experiments, newly pupated hosts (within 24 h after pupation) were exposed to female wasps, which had no pervious contacted with hosts. To avoid super parasitization, a pupa was held together with one mated female wasp in Petri dishe. Furthermore, the parasitioid was removed immediately after the oviposition was observed. Then, the parasitized pupae were cultured at 23 ± 1°C and a photoperiod of 16:8h (L:D).

RESULTS

Laboratory assays made an evidence of the parasitism percentage in samples collected from farms and wild hosts were 16.93 and 43.25, respectively. The diversity of parasitoids in the samples collected from the wild hosts outside the cabbage fields was higher than the specimens collected from farms. Results showed that 0.56, 1.41, 1.97, 3.66, 44.51 and 47.89 percent of extracted parasitoids belonged to the families: Eulophidae, Ichneumonidae, Chalcididae, Tachinidae, Braconidae and

Pteromalidae respectively. The summary of parasitoids Family recorded during the present investigation is provided in Table and figure 1. The other main purpose of this study was to evaluate the efficacy of *P. puparum* in the biological control of LWB. Initially, host stage preference of this parasitoid to different instars and developmental stages was determined. Other experiments pointed out that number of progeny laid by the female was 270.6 ± 4.62. Number of parasitoid adults emerged from each pupa was 42.36 ± 2.42, but more than 200 parasitoids can be produced within each host pupae, when more than one female attacked a single host. Total immature period from egg hatch to adult emergence required 17.56 ± 0.33 days. Mating starts soon after eclosion. Longevity was evaluated in two diets including honey mixed with pollen and without feeding that were 16.28 ± 0.38 and 3.04 ± 0.12 days, respectively. The parasitoid wasp, *P. puparum,* significantly preferred to attack the pupae and pre-pupal stage of *P. brassicae*.

DISCUSSION

Some *P. brassicae* larvae in Hokkaido have been parasitized by *Cotesia glomerata*, but the parasitism rate of *P. brassicae* larvae tends to be lower than that of *P. rapae* (Sato & Ohsaki, 2004). During this study we observed that considerable numbers of *P. brassicae* larvae are efficiently controlled by *C. glomerata*. This difference in results perhaps because all of the wasps used via Sato and Ohsaki were obtained from *P. rapae* larvae. However, several of the *P. brassicae* larvae collected in the field and on wild hosts in our region had been parasitized by *C. glomerata*.

Also, considerable numbers of *P. brassicae* pupae are efficiently parasitized by *P. puparum* and use of this parasitoid in same time with *C. glomerata* may play an important role in the biological control of *P. brassicae* on cabbage farms. *P. puparum* (Linnaeus) is a gregarious pupal parasitoid with a wide host range, including species of the Nympahlidae and Pieridae. This parasitoid contributes to regulation of a population of *Papilio xuthus* Linnaeus at low density in a suburban area of Fukuoka, Japan (Takag, 1985). This wasp is a predominant pupal endoparasitoid of Pieris rapae (Zhu et al., 2008) and considered to be an important biological control agent of this pest (Harvey et al., 2007).

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Table 1: Parasitoids of *P. brassicae*, recorded during 2008-2009 survey in Urmia (Iran).

Parasitoid Family	Order	Host pest/Stage	Host-crop/s	percentage of parasitism
Ichneumonidae	Hymenoptera	Pupa/*P. brassicae*	*Raphanus/ Capparis*	1.41
			Brassica oleracea	0.00
Chalcididae	Hymenoptera	Pupa/*P. brassicae*	*Raphanus/ Capparis*	1.97
			Brassica oleracea	0.00
Braconidae	Hymenoptera	Larva/*P. brassicae*	*Raphanus/ Capparis*	6.76
			Brassica oleracea	37.75
Pteromalidae	Hymenoptera	Pupa/*P. brassicae*	*Raphanus/ Capparis*	47.89
			Brassica oleracea	0.00
Eulophidae	Hymenoptera	Pupa/*P. brassicae*	*Raphanus/ Capparis*	0.56
			Brassica oleracea	0.00
Tachinidae	Diptera	Larva/*P. brassicae*	*Raphanus/ Capparis*	2.82
			Brassica oleracea	0.84

Specimens reared from *Raphanus/Capparis* and Cabbage in Urmia has been deposited in the University of Urmia at Department of Entomology collection.

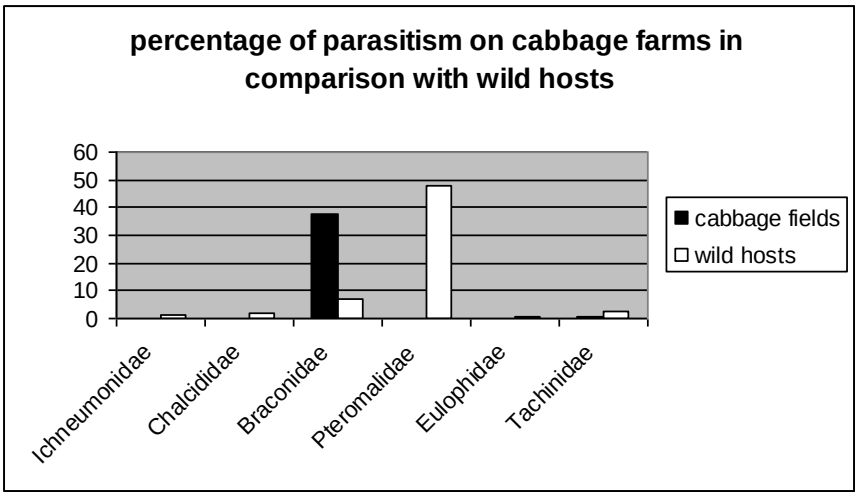

Figure 1. Percentage distribution of *P. brassicae* parasitoids on cabbage farms in comparision with wild hosts.