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## PIERID (LEPIDOPTERA: PIERIDAE) PESTS AND THEIR NEW CRUCIFERS HOSTS IN POTHWAR REGION OF PAKISTAN

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**ABSTRACT:-** Field surveys were conducted in Pothwar region during January 2012-December 2013 to find out the pierids pests on cultivated and non-cultivated cruciferous plants, the known cultivated hosts such as *Raphanus sativus*, *Eruca sativa*, *Brassica napus*, *B. oleraceae*, *B. oleracea* var. *italica* and *B. campestris* were attacked by *Pieris brassicae*, *P. canidia* and *Pontia daplidice*. Among above reported Pieridae species *P. rapae* is reported for the first time however, *Pontia daplidice* is also a new record from districts Rawalpindi and Chakwal and *P. canidia* from Jhelum, Rawalpindi and Chakwal. However, the non-cultivated host plants in the region were *Caspsella bursa-postoris*, *Coronopus didymus*, *Lepidium pinnatifidum*, *Arabidopsis thaliana* and *B. officinalis*. Among non-cultivated hosts *L. pinnatifidum* was the new host for *P. daplidice*. *C. didymus* was found common host for *P. brassicae*, *P. canidia* and *P. daplidice* from the study area. Among non-cultivated host plants *A. thaliana* was found for *P. canidia* and *B. officinalis* for *P. brassicae* and *P. daplidice*. All the non-cultivated host plants were new records from Pakistan however, *L. pinnatifidum* was new host of *P. daplidice* from the world, which was not reported earlier.

*Key Words:* Crucifers; Host Plants; Lepidoptera; Pieridae; Pests; Pakistan.

### INTRODUCTION

Family Cruciferae is a large family comprising 400 genera and 3000 plant species, mostly herbaceous rarely woody (Vaughan et al., 1976). The cultivated crucifers are important vegetables; hence widely grown in all parts of the world. Among these cabbage, *B. oleracea* L., is rich with important nutrients and is good source of fibers, vitamins and minerals, low in caloric food containing high percentage of calcium, iron, iodine, potassium, sulphur, and phosphorus. The anti-cancer properties

in cabbage make it extraordinarily curative food for treating cancer (USDA, 2009).

Cruciferous plants are attacked by a number of insect pests which cause severe damage to cauliflower, cabbage and many other cruciferous plants. The most important pests from Order Lepidoptera belong to families such as Pieridae, Noctuidae, Putellidae and Pyralidae. Among these families, family Pieridae belongs to yellow and white butterflies, is a cosmopolitan family comprising 83 genera under four subfamilies (Ehrlich and Raven,

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1965; Vane-Wright, 1978; Courtney, 1986; Ackery, 1991; Janz and Nylin; 1998). Out of four subfamilies its two sub-families Coliadinae and Pierinae represent their taxon in Pakistan. Their caterpillars feed upon a number of plants belonging to families Compositae, Leguminosae, Rhamnaceae, Zygophylaceae and Cruciferae (Robert, 2001). For example Pierids species *Anaphaeis aurota* Cram., *A. mesentina* Cram., *P. brassicae*, *P. kruperi* Stdjr., *P. rapae* L., and *P. deplidice* L. feed on cauliflower, cabbage and other cruciferous plants (Alam, 1969) and cause severe damage. *P. brassicae* has been reported as major pest of cabbage and cauliflower (Ghoury, 1960; Mohyuddin, 1981) and in severe infestation plants often completely skeletonized to stalk and veins (Jones and Jones, 1974) because both cauliflower and cabbage are the most preferred host of *P. brassicae* (Mushtaque and Mohyuddin, 1984; Rizvi et al., 2009; Yadav and Barwal, 2008). From Pakistan reported cultivated cruciferous host plants of *Pieridae* species were *Brassica* sp., *B. oleraceae*, *B. napus*, *B. campestris* and *R. sativus* while non-cultivated were *Capsella bursa pastoris*, *Caronopus didymus*, *Sisymbrium mirio* and *Lepidium repens* (Alam, 1969).

During this study both cultivated and non-cultivated cruciferous host plants and their pierids pests were explored from Pothwar region of Pakistan. Pothwar division of Pakistan is politically a part of the Punjab province of Pakistan, located at 32.5°N to 34.0°N latitude and about 72°E to 74°E longitude, covering 23161 km<sup>2</sup> and comprising five districts namely Attock, Chakwal, Jhelum, Rawalpindi and Islamabad (GoP, 1997). The nor-

thern and north-eastern parts of the Pothwar division are situated with Himalayan foothills with an average height of 450 to 900 m. Biogeographically the Pothwar region is Oriental and species those belonging to the Oriental occur primarily in the Indus plain, the Himalayan foothills and continuous with those of Indian Punjab and Rajasthan (Qadri, 1968).

### MATERIALS AND METHOD

To explore the cultivated and non-cultivated host plants and their pierids pests from Pothwar region, 75 surveys were conducted in different localities of five districts i.e., Jhelum, Rawalpindi, Chakwal, Attock and Islamabad during 2012-2013. From each district 15 localities of variable habitats were visited such as natural vegetation, cropped and urban areas. Each locality was visited fortnightly for collecting plant samples, egg, larvae, pupae, and adults butterflies starting from January 2012 till the end of December 2013.

### Larval Collection and Rearing

Larval host plant flora was reviewed, from published records (Bingham, 1905; Talbot, 1939; Robert, 2001; and Robinson et al., 2001).

Random search was made to observe and record data for the immature stages i.e., number of eggs and larvae (with their respective stages) on their host plants. Some eggs or larvae were collected with their host plants for rearing in laboratory for further confirmation of butterfly after emergence. All collection were initially placed in small plastic petri dishes of 55 mm × 30 mm diameter the base of the leaf or branch containing eggs was secured with moistened cotton to

reduce desiccation. Petri dishes were placed in small cages (6"×6"×6") for further rearing. All rearing cages were observed at least after 12 h daily to observe egg, and larval developments. The cages were regularly cleaned by removing frass. After emergence of adults, the butterflies were identified.

### Identification

The identification of the collected specimens of pierids and their host plants were made to possible taxonomic taxa by using literature of previous workers like Bingham (1905); Talbot (1939); Kitamura (1964); Stewart (1982); Haribal (1992); Gay et al. (1992); Gunathilagaraj et al. (1998); Naz et al. (2001); Feltwell (2001); Bhaskaran and Eswaran (2005); Jafri (2011); Robinson et al. (2012); Olive et al. (2012); Braby (2012); Kaneria et al. (2013).

### Relative Abundance and Percentage

The relative abundance and percentage of each species along with their host plants were calculated by using formula:

$$\text{Relative Abundance} = \frac{n_i}{N}$$

where,

$n_i$  = Number of individuals in  $i^{\text{th}}$  species and

$N$  = Total number of individuals in the sample.

% =  $R \times 100$

Through relative abundance and percentage the most common and the least common insect were determined.

## RESULTS AND DISCUSSION

Four species of subfamily Pierinae belonging to two genera were identified which were found in study areas. Among four reported pierids species three species belong to genus *Pieris*, *P. brassicae*, *P. canidia* and *P. rapae* while, one species *P. daplidice* was recorded from genus *Pontia*. Three species *P. brassicae*, *P. canidia* and *P. daplidice* were reported on six cultivated host plants such as *B. napus*, *B. oleraceae*, *B. oleraceae* var. *italica*, *B. campestris*, *R. sativus*, and *E. sativa* and, four on non-cultivated crucifers plants i.e., *C. didymus*, *B. officinalis*, *L. pinnatifidum* and *A. thaliana*. However, among non-cultivated host *L. pinnatifidum* was a new host for *P. daplidice*. While crucifers plant *C. didymus* was common host for *P. daplidice*, *P. canidia* and *P. brassicae*, plant *A. thaliana* was found host for *P. canidia* while *B. officinalis* for *P. brassicae* and *P. daplidice*. All the non-cultivated host plants were new records from Pakistan, however; *L. pinnatifidum* was new host of *P. daplidice* which was not earlier reported from any part of the globe as a host for pierid species. However, adults of *P. rapae* were collected from the study areas but its larvae were not found on any above reported host plant of the areas (Table 1).

### *Pontia daplidice* (Lannaues, 1758)

#### Distribution

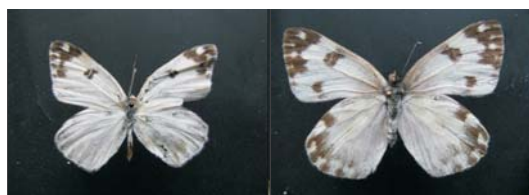
##### Pothwar

During current study *P. daplidice* was collected from Jhelum, Rawalpindi, Chakwal, Attock and Islamabad districts.

**Table 1. Number of different stages of pierids species on cultivated and non-cultivated Crucifer plants in 2012 and 2013**

Butterflies Name	<i>Pontia daplidice</i>				<i>Pieris brassicae</i>				<i>Pieris canidia</i>				<i>Pieris rapae</i>			
	E	L	P	A	E	L	P	A	E	L	P	A	E	L	P	A
<b>2012</b>																
<i>Coronopus didymus</i> *	5	3	2	20	60	12	4		5	2	2		-	-	-	
<i>Lepidium pinnatifidum</i> *	7	2	1		65	15	3		6	1	1		-	-	-	
<i>Arabidopsis thaliana</i> *	-	-	-		-	-	-	40	2	2	1	25	-	-	-	2
<i>Brassica officinalis</i> *	-	-	-		55	16	7		-	-	-		-	-	-	
<i>B.napus</i>	12	4	2	31	85	20	6	55	9	5	2	43	-	-	-	4
<i>Raphanus sativus</i>	15	5	1		57	17	8		11	4	3		-	-	-	
<i>Eruca sativa</i>	6	1	2		59	12	7		-	-	-		-	-	-	
<i>Brassica oleraceae</i>	-	-	-		49	15	5		-	-	-		-	-	-	
<i>B. oleracea</i> var. <i>italica</i>	-	-	-		55	21	8		-	-	-		-	-	-	
<i>B.campestris</i>	-	-	-		72	18	4		-	-	-		-	-	-	
<b>2013</b>																
<i>Coronopus didymus</i> *	10	5	4	50	75	6	2		2	4	1		-	-	-	
<i>Lepidium pinnatifidum</i> *	8	6	3		70	8	3	20	3	3	1	35	-	-	-	3
<i>Arabidopsis thaliana</i> *	-	-	-		-	-	-		2	6	0		-	-	-	
<i>Brassica officinalis</i> *	-	-	-		60	5	2		-	-	-		-	-	-	5
<i>B.napus</i>	15	9	6	87	80	6	4	42	5	5	2	42	-	-	-	
<i>Raphanus sativus</i>	18	8	4		75	7	2		6	7	1		-	-	-	
<i>Eruca sativa</i>	13	9	5		82	5	2		-	-	-		-	-	-	
<i>Brassica oleraceae</i>	-	-	-		62	7	3		-	-	-		-	-	-	
<i>B. oleracea</i> var. <i>italica</i>	-	-	-		90	7	3		-	-	-		-	-	-	
<i>B. campestris</i>	-	-	-		86	6	2		-	-	-		-	-	-	

E= Egg, L= Larva, P= Pupa, A=Adult, \*= non cultivated



Female  
*Pontia daplidice*

Male  
*Pontia daplidice*

**Remarks**

New for Pothwar districts Rawalpindi and Chakwal. However, earlier it is reported from Attock (Hasan Abdal) and Islamabad (Malik, 1970; Arshad et al., 1983; Hassan, 1997;

Roberts, 2001), and Jhelum River (Steven, 2001; Khan et al., 2007).

**Previously Reported Cruciferous Host Plants**

Crucifer cultivated plants such as mustard and *Brassica* spp., and non-cultivated plants are *Sysimbrium* sp. *S. altissimum*, *S. irio* (Alam, 1969; Hassan, 1994; Roberts, 2001).

**Newly Reported Cruciferous Host Plants**

During the current study re-

ported cultivated host plants are *B. napus*, *E. sativa*, *R. sativus* and non-cultivated host plants are *L. pinnatifidum*, *C. didymus*. Although *Sysimbrium* sp. were found in the region extensively but no egg, larva, pupa were found on these plants in two years study.

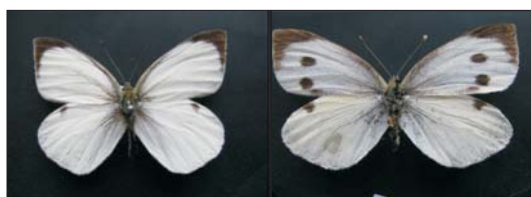
**Pest Status**

It was observed as most common pest of crucifer in the study area, feeds on leaves, flowers and fruits. Slowly progressed and destroy whole plant. Initially feeds upon leaves and in later stages shifted to inflorescences. Rarely found in fruits. Highest percentage recorded on cultivated hosts i.e., 73.4% and 71.8% as compared to non-cultivated host plants i.e., 26.7% and 28.1% (Table 2).

**Pieris brassicae (Linnaeus, 1857)  
Large White**

**Distribution  
Pothwar**

Common in all districts of study area.



Female  
*Pieris brassica*

Male  
*Pieris brassicae*

**Remarks**

Earlier this species was reported throughout the Pothwar region (Malik, 1970; Ahsan and Iqbal, 1975; Roberts, 2001; Tshikolovets, 2001).

**Previously Reported Cruciferous Host Plants**

Cultivated crucifer like *R. sativus*, *Brassica* sp., *Brassica juncea*, *B. napus*, *B. nigra*, *B. oleracea*, *B. rapa*, *B. oleraceae* var. *botrytis*, *B. oleracea* var. *capitata*, *B. oleraceae* var. *gongylods*, while non-cultivated crucifers are *Arabis allionii*, *Armoracia rusticana*, *Barbarea stricta*, *Berberoa incana*, *Bunias orientalis*, *Cakile maritime*, *Capsella bursa-pastoris*, *Crambe maritime*, *Draba incana*, *Erysimum cheiri*, *E. hieraciifolium*, *E. scoparium*, *Hesperis matronalis*, *Arabis* spp., *Lepidium repens*, *L. draba*, *Lunaria*, *Rorripa*, *Sysimbrium austriacum*, *S. irio*. (Alam, 1969; Mohyuddin, 1981; Hassan, 1994; Roberts, 2001; Robinson et al., 2001).

**Newly Reported Cruciferous Host Plants**

During the current study cultivated reported host plants are *Brassica napus*, *B. oleraceae*, *B. oleracea* var. *italica*, *R. sativus*, *B. campestris* and *E. sativa* and non-cultivated host plants are *B. officinalis*, *C. didymus*, and *L. pinatifidum*.

**Table 2. Percentage abundance of pierids on crucifer plants during 2012 and 2013**

Host Plants	<i>Pontia daplidice</i>		<i>Pieris brassicae</i>		<i>Pieris canidia</i>		<i>Pieris rapae</i>	
Years	2012	2013	2012	2013	2012	2013	2012	2013
Non-cultivated	26.7	28.1	32.3	30.1	39.4	38.9	-	-
Cultivated	73.4	71.8	67.7	69.8	60.6	61.1	-	-



**Pest Status**

*P. brassicae* is a major pest; feed on leaves, particularly cabbage and broccoli. Mostly whole plant is skelitized. Eggs are laid in bunches so attack is severe and rapid. In present study unusual behaviour of host trend of this butterfly has been observed i.e., laying a single egg on non-cultivated host plant *C. didymus* the egg successfully reared and male butterfly was emerged. Similar high percentage was observed in cultivated plants i.e., 67.7% and 69.8% as compare to non-cultivated host plants which is 32.3% and 30.1% (Table 2).

***Pieris canidia* (Sparrman, 1768)**

**Distribution**

**Pothwar**

During current study *P. canidia* was collected from all districts of study area.



Female  
*Pieris canidia*

Male  
*Pieris canidia*

**Remarks**

New to Jhelum, Rawalpindi and Chakwal districts of Pothwar. Earlier it has been reported from districts Islamabad and Attock (Campbellpur) (Hassan, 1994; 1997; Iqbal, 1978; Roberts, 2001).

**Previously Reported Cruciferous Host Plants**

Cultivated are *B. oleracea*, how-

ever non-cultivated are *L. virginicum*, *Rorippa indica*, *Cardam inflexuosa*, *C. escutata* (Robinson et al., 2001).

**Newly Reported Cruciferous Host Plants**

During the current study reported cultivated host plants are *Brassica napus* and *R. sativus* and non-cultivated host plants are *A. thaliana*, *Coronopus didymus* and *L. pinatifidum*.

**Pest Status**

It was observed comparatively as minor pest of crucifer cultivated plants i.e., 60.9% and 61.1%, non cultivated 39.4% and 38.9% (Table 2) mainly attack on leaves and inflorescence. Mostly remained unnoticeable so a type of hidden pest. Least observed and has highly selective host range.

***Pieris rapae* (Linnaeus, 1758) - Small White**

**Distribution**

**Pothwar**

During current study *P. rapae* was collected from district Rawalpindi and Islamabad.



Female  
*Pieris rapae*

Male  
*Pieris rapae*

**Remarks**

*P. rapae* is new for Pothwar districts like Rawalpindi and Islamabad.

### Earlier Reported Cruciferous Host Plants

Cultivated host plants are *Brassica caulorapa*, *B. alboglabra*, *B. juncea*, *B. napus*, *B. oleracea*, *B. oleracea* var. *botrytis*, *B. oleracea* var. *capitata*, *B. oleracea* var. *gongylods*, *Raphanus raphanistrum*, *R. sativus*, and non-cultivated are *Alliaria petiolata*, *Arabis alpine*, *Armoracia rusticana*, *Aurinia axatilis*, *Barbarea orthoceras*, *B. verna*, *B. vulgaris*, *Biscutella auriculata*, *B. parachi-nensis*, *B. rapa*, *B. chinensis*, *B. nigra*, *Cakile edentula*, *Capsella bursa pastoris*, *Cardamine diphylla*, *C. pratensis*, *Caulanthu scooperi*, *Descura iniasophia*, *Diplotaxis virgate*, *Eruc avesicaria*, *Erysimum capitatum*, *Hesperis matronalis*, *Hirschfeldia aincana*, *Lepidium densiflorum*, *L.campestre*, *L. virginicum*, *Lobularia maritime*, *Lunaria annua*, *Matthiola incana*, *Rorippa aquatic*, *R. curvisiliqua*, *R. indica*, *R. microphylla*, *R. nasturtium aquaticum*, *R. sylvestris*, *Sinapis alba*, *S. arvensis*, *Sisymbrii maltissimum*, *S. irio*, *S.officinale*, *Streptanthus tortuosus* and *Thlaspi arvense* (Mohyuddin, 1981; Robinson et al., 2012).

### Expected Future Threat of Crucifer Plants

During the current study although no egg, larvae and pupae were found over cultivated and noncultivated host plants however, adults were reported hovering around the fields of host plants like cauliflower, *B. napus* and *R. sativus* (Table 2).

### Pest Status

Reported as major pest of crucifer specially cauliflower. No pest status

was observed during the study. However, Jogar et al., (2005) described this species as a major pest of crucifer crops. A single female lays 400 eggs; on average 300 which may approaches up to 1,000 young larvae feed upon outer leaf of cabbage. When larvae become old they move into inner leaves of cabbage and finally into cabbage head and eating outer leaves of the cabbage head.

The study is significant because it provides detail regarding new crucifer cultivated and non-cultivated host plants of pierid pests from Pothwar region of Pakistan. The non cultivated host plants provide opportunities to the former to manage pest status of these butterflies by shifting their host trends from cultivated to non-cultivated host.

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### **AUTHORSHIP AND CONTRIBUTION DECLARATION**

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S.No	Author Name	Contribution to the paper
1.	Mr. Syed Waqar Shah	Conceived the idea, Wrote abstract, Methodology, Conclusion, Technical input at every step, Data collection, Data entry in SPSS and analysis, Results and Discussion, Introduction, References.
2.	Dr. Muhammad Ather Rafi	Conceived the idea, Wrote abstract, Methodology, Technical input at every step, Overall management of the article, Results and Discussion, Introduction, References.

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