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Population density of aphid (*Myzus persicae* Sulzer) and lady bird beetle (*Coccinella septempunctata)* on spring potato cultivars, Gilgit, Pakistan

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Abstract
Potato is an important cash crop of Gilgit Baltistan, an ecologically fragile region of Pakistan. The present study was carried out to find out the population density of Green peach aphid (*Myzus persicae*) and its associated natural enemy, lady bird beetle (*Coccinella septempunctata*) on three cultivars of spring potato crop at Nomal valley, Gilgit Baltistan during 2013. Field experiment was carried out in randomized complete block design with three replications. Three potato cultivars namely Desiree, Diamont and Cardinal were tested in the experiment. Population of aphid (*M. persicae*) and lady bird beetle (*Coccinella septepunctata*) was recorded at weekly intervals throughout the growing season and it was observed that density of *M. Persicae* was highest on Cardinal (5.48 aphid per leaf) and lowest on Diamont (3.97 aphid per leaf). Similarly the population of lady bird beetle (*Coccinella septempunctata*) was recorded highest on Cardinal (4.3 per plant) and lowest population was recorded on the Diamont (3.53 per plant). Population of *M. persicae* and *Coccinella septempunctata* was found to intermediate on Desiree (4.6 aphids per leaf and 3.91 lady bird beetles per plant) as compared to Cardinal and Diamont varieties of potato crop. Based upon our observation under the prevailing agro climatic condition of Nomal valley Gilgit Baltistan, it was concluded that Diamont variety was ideal for cultivation due to low aphid (*M.Persicae*) infestation as compared with Cardinal and Desiree variety of potato crop.

Keywords: Potato, Population density, *Myzus persicae, Coccinella septempunctata*

1. Introduction
Potato (*Solanum tuberosum* L) is herbaceous annual plant belonging to family Solanaceae. It contains about 70% water, 18% starch, 2% protein while 1% is constituted by vitamins, minerals and trace elements [1]. It is grown in 140 countries [2]. Potato is an important cash and vegetable crop of Pakistan. It is grown over an area of 159.4 thousand hectares with a total production of 3491.70 thousand tons and average yield of 21.90 tons per hectares [3]. Three crops of potato are grown in Pakistan i.e. autumn and spring crops in the plains and summer crop in the hills [4]. In Gilgit Baltistan after the cereals such as wheat, rice and maize, vegetables particularly potato has prime importance [5]. Potato crop is one of the most irrigated crops grown during dry season [6]. Due to major contribution to the overall economy of the poor families, potato has become an increasingly significant cash crop in Gilgit Baltistan and contributes highly to food security, nutrition, employment and improvement in the socio-economic status of the poor families of Gilgit Baltistan [7]. Potato is attacked by a number of aphid species, of these; Green peach aphid (*Myzus persicae*) is causing substantial loss to potato crop [8]. *M. persicae* is considered to be a major pest of potatoes worldwide [9]. Infestation by this pest causes dwarfism and curling of leaves of potato crop. It causes reduction in growth rate of the plant. Severe aphid infestation also causes reduction in the yield of potato crop. Aphids are also responsible for causing viral diseases. The most prevalent and common plant viruses are Potato virus Y (PVY) and potato leaf roll virus (PLRV). Yield losses of potatoes caused by the transmission of viruses can reach to 85% depending on cultivar, infestation and environmental conditions [10]. Under severe infestation, whole plant may be killed. In the dry temperate regions most of the life cycle of aphid has an annual sexual stage having two alternate hosts. Eggs are laid in the primary host which is peach (*Prunus persica*) and its secondary host belongs to family *Solanacea* [8]. There are a number of natural enemies of aphids principally the lady bird beetle (*Coccinella septempunctata* (L) belonging to order Coleoptera and family Coccinellidae is found predating *M. persicae* in potato crop. Natural enemies are influenced by the varieties of host plant, cultural practices and

environmental condition of a specific region [11]. Knowing the importance of potato crop in Gilgit baltistan and the damage caused by the *M. Persicae,* this research was carried out to determine the population of *M. persicae* and the population of lady bird beetle (*C. septempunctata*) in the three varieties of potato crop i.e. Diamont, Desiree and Cardinal commonly grown in Gilgit Baltistan.

2. Materials and methods

2.1 Location of experiment

The present investigation was conducted at Nomal valley of Gilgit Baltistan during 2013 cropping season.

2.2 Field experiment

Three cultivars namely, Diamont, Desiree and Cardinal were sown in first week of April in Randomized Complete Block Design (RCBD) with three replications and each replication consisted of three rows of each cultivar and each row consisted of ten plants. Row to row distance was maintained as 70 cm and plant to plant distance was kept 30 cm as described by Ahmad *et al.,* (2011) [1]. Plant emergence was completed in 20 to 25 days after sowing. Two months before planting farm yard manure at the rate of 32 t /hac was incorporated into the field. At the time of sowing, di-ammonium phosphate (DAP) was applied at recommended rates and urea was applied at the rate of 170kg per hac after sowing of potato cultivars. Standard agronomic practices were fully applied and the field was left open for natural infestation of insect pests.

2.3 Data collection

The weekly data of *M.persicae* and its natural enemy lady bird beetle (*C. septempunctata*) was obtained from the beginning of their initial colonization up to harvest of the potato crop. Aphids were counted on the top, middle and lower parts of potato crop of four randomly selected potato plants. Average aphid population per leaf was obtained at the harvesting time whereas population of lady bird beetle was calculated per potato plant, by selecting four plants from each replication. The experimental field was surveyed regularly for incidence of insect and the data was collected on weekly basis. The insects were collected through hands, hand net and aspirator and placed in glass Vials. Collected insects were brought into the research laboratory of the Department of Entomology, The University of Agriculture, Peshawar for proper identification with the help of existing laboratory collection and entomological keys.

2.4 Analysis of Data

Collected Data were subjected to statistical analysis by using a computer program statistix 8.0. Least Significant Difference test (LSD) at 5% probability level was applied to compare the differences among population means of *M. persicae* and *C. septempunctata* on three cultivars of potato crop.

3. Results and discussion

3.1 Population of *M. persicae on* three varieties of potato crop

Population of *M. persicae* was found to be significantly different among the varieties of potato crop at ($P< 0.05$) over weekly intervals (Table 1). *M. persicae* remained a regular pest with different densities throughout the growing season. It was found that population density was highest on 24th day (3rd observation) and 31st day (4th observation) of May. The data obtained further revealed that the highest average number of aphid per leaf was recorded on cultivars Cardinal (5.48) followed by Desiree (4.6). The lowest number (3.97) was recorded on cultivar Diamont. *M. persicae* infestation was first recorded on the 10th day (1st observation) of May when its population per leaf was 2.6 and 1.6 for Cardinal and Desiree whereas for Diamont the population of *M. persicae* was recorded 1.1 aphids/leaf. Pest density consistently increased till the 1st week of June and its population was 7.1, 5.2 and 4.9 aphids/leaf on Cardinal, Desiree and Diamont respectively. It was observed that after 1st week of June aphid population started to decline. *M. persicae* infestations reached at the peak on 31st day of May (4th observation) with 11.3, 10.6 and 9.7 per leaf of Cardinal, Desiree and Diamont respectively. Overall population of *M. persicae* revealed that cardinal was heavily infested with 5.48 aphids per leaf followed by Desiree (4.6 aphids per leaf) while minimum *M. persicae* was observed in the cultivar Diamont with 3.97 aphids /leaf. Lowest infestation of *M. persicae* on Diamont as compared to Desiree and Cardinal indicated that Diamont is highly resistant against aphids as compared to Desiree and Cardinal. Similar difference of aphid infestation among potato cultivars was obtained earlier by many coworkers [12, 13, 14]. Numerous factors have been reported for the resistance of potato varieties against *M. persicae* including trichomes, visual cues and factors located on the plant surfaces and in subcutaneous tissues of potato cultivars [15]. Our findings are also in agreement with the findings of Naeem (1996) [16] who reported that both biological and physical factors could be responsible for the variation in aphid's population. They also stated that environmental factors (temperature, rain fall and humidity) and food availability greatly affect the population of aphids. These results are in consonance with the findings of Tobias and Olson (2006) [14] who reported that aphid population was highest in early Rabi and lowest in kharif season. Environmental conditions especially rainfall and high temperature had adverse effects on the population of *M. persicae.* These results agree with the findings of Salijoqi and Van emden (2003) [8] and Salijoqi (2009) [10] who reported that with the aging the plants become unsuitable and thus reproductive capacity declines. Watt and Dixon. (1981) [17] reported that sudden changes in the weather conditions and food quality could result in very poor survival of aphids.

Table 1: Average number of Aphids *(M. persicae*) leaf^{-1} on three Potato cultivars in the spring season, at Nomal valley, Gilgit Baltistan.

	Weekly intervals							
Varieties	**10th May**	**17th May**	**24th May**	**31st May**	**7th June**	**14th June**	**21st June**	**Means**
Cardinal	2.61a	3.4a	8.8a	11.3a	7.1a	2.8a	2.4a	5.48a
Desiree	1.6b	3.2b	8.3b	10.6b	5.2b	1.8b	1.5b	4.6b
Diamont	1.1c	2.7c	6.8c	9.7c	4.9c	1.3c	1.3b	3.97c
LSD	0.07	0.13	0.12	0.06	0.32	0.17	0.15	0.03

Mean within a column followed by different letters are significantly different at 5% level of significance ($P<0.05$)

*Sowing: 1st week of April

*Emergence: 4rth week of April

*Harvesting: 4rth week of June

3.2 Population of *Coccinella septempunctata* on three varieties of potato crop

Data presented in Table 2 reveals that population of lady bird beetle (*C. septempunctata*) which was found a principal natural enemy of *M. Persicae* was significantly different among the varieties of potato crop at P< 0.05 level of probability. Lady bird beetle (*C. septempunctata*) was first recorded on 10th May (1st observation) with a mean number of 3.2, 2.8 and 2.69 per plant on Cardinal, Desiree and Diamont respectively. After first observation it was found that its population steadily increases and reached at the peak on 23rd May (4th observation) with 6.43, 5.63 and 5.4 per plant of Cardinal, Desiree and Diamont respectively. Afterward its population declined till the last observation (20th June). Overall population structure of lady bird beetle showed that highest lady bird beetle population was recorded in the Cardinal (4.3/plant) followed by Desiree (3.9/plant) whereas the lowest lady bird beetle population was recorded in Diamont (3.53/plant).

Gupta *et al.,* (1997) [18] stated that the Lady Bird beetle (*C. septempunctata*) is one of the most dominant enemies to reduce aphid population in the field. Rafi *et al.,* (2005) [19] reported that lady bird beetle (*C. septempunctata*) was found as the effective predator species against *M. persicae.* Nakata (1994) [20] reported population of lady bird beetle (*C. septempunctata*) was closely related to population fluctuation of *M. persicae.* Colonization of lady bird beetle adversely affected the population of *M. persicae* in the field depending on temperature and rainfall of the respective area where the experiment was carried out. Our findings are in agreement with the Saljoki [10], 2009 who reported population dynamics of lady bird beetle (*C. septempunctata*), the natural enemy of *M. persicae.*

Table 2: Average number of lady bird beetle *(C. septempunctata*) plant^{-1} on three Potato cultivars in the spring season, at Nomal valley, Gilgit Baltistan.

	Weekly intervals								
Varieties	**2nd May**	**9th may**	**16th May**	**23rd may**	**30th June**	**6th June**	**13th June**	**20th June**	**Means**
Cardinal	3.2a	4.1a	4.99a	6.43a	4.68a	4.5a	3.5a	3.3a	4.3a
Desiree	2.8b	3.6b	4.82b	5.63b	4.35b	4.2b	3.42b	3b	3.9b
Diamont	2.69c	3.33c	3.1c	5.4c	4.06c	4c	3c	2.7c	3.53c
LSD	0.3	0.27	0.3	0.2	0.4	0.5	0.3	0.24	0.13

*Mean within a column followed by different letters are significantly different at 5% level of significance (P<0.05)
*Sowing: 1st week of April
*Emergence: 4rth week of April
*Harvesting: 4rth week of June

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