Article

The incidence of insect pests on potato crop in Hazara division, Khyber Pakhtunkhwa, Pakistan

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Abstract

The research was conducted on insect pests in Hazara division (Mansehra, Abbottabad, Battagram, Haripur, Kohistan, and Tor Ghar) on potato crops under the proposed project. From each district, five fields were selected and major and minor insect pests were collected on potato during the visit. The preserved insects were identified in NARC, and the reported species in 5-meter row were as follows: leafhopper, 0.53±0.40, 0.46±0.26, 0.40±0.17, 0.34±0.15 and 0.32±0.20; flea beetle, 0.58±0.39, 0.57±0.55, 0.33±0.16, 0.45±0.4 and 0.27±0.18; potato tuberworm, 0.68±0.44, 0.65±.60, 0.55±0.52, 0.40±0.28, and 0.28±0.18; black cutworm, 0.60±0.29, 0.58±0.54, 0.33±0.18, 0.32±0.20 and 0.47±0.34; wireworm, 0.62±0.35, 0.55±0.50, 0.53±0.31, 0.50±0.27 and 0.35±0.21; white grub, 0.55±0.33, 0.60±0.53, 0.38±0.26, 0.80±0.60 and 1.14±1.19. The seasonal average of each insect in each district was different in incidence. The difference in the pest population in different districts of the Hazara division is due to the climate conditions, temperature, and incidence of pests.

Keywords insect pests; potato crop; leafhopper; flea beetle; potato tuberworm.

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1 Introduction

Potato is an imperative yield worldwide; after maize (*Zea mayz*), wheat (*Triticum aesitvum*), and rice (*Oryza sativa*), its position is fourth (Ullah et al., 2020). Potatoes have numerous medical advantages, incorporating reductions in a few kinds of cancers and bringing down frequencies of coronary illness, macular degeneration, and cataracts because they are rich in cell reinforcements (Jansky et al., 2019; Khalid et al., 2020). Potato is the fourth most perilous yield in Pakistan by the measure of generation and has incomparable yields for

agriculturists. Harvest time (Sep-Oct), spring (Jan-Feb), and summer (March-May) are the three principal periods of potato in Pakistan (Majeed and Muhammad, 2018; Qasim et al., 2013). Pests obstruct potato yield and production, infections, and generational shifts are some of the factors that force breeders to rely on low-quality administration approaches (Khan et al., 2011). The cutworm, wireworms, aphids, and white grub are the most prominent creepy insect pests on potatoes. While for spring crops, peach aphid and cutworms in potatoes are two decimating pests that reduce potato production to a considerable measure per annum (Alyokhin et al., 2022; Kroschel et al., 2020; Nikoukar and Rashed, 2022). In the farming industry framework, insect pest irritations are the fundamental driver of harvest generation and its accretion (Sayyid et al., 2018). The above-mentioned irritations become virtually annihilated in tropical countries, which, as a consequence, leads to a deficit of 60 to 70% in missing objects. The control of pest invasion on a particular crop in a farming organization is a big challenge (Dangles et al., 2009; Khan et al., 2020; Khan et al., 2022; Khan et al., 2019).

The zones that are moist and cooler attract the green peach aphid (*M. persicae*) for immigration, infest potatoes and other crops, and cause serious foliage and tuber damage (Ali et al., 2023; Forghani et al., 2018). At the larval stage, the insect pests feed on petioles, leaves, and stems, resulting in asymmetrical tunnels and channels. They also dig more interconnected galleries over tubers. The outbreak of tuber leads to a decrease in tuber production up to 100%, specifically in areas where the condition is warm (Anderson et al., 2018; Andreadis et al., 2017; Ben-Issa et al., 2017).

Additionally, other pests, such as *Macrosiphum euphorbiae* (potato aphid) and *Myzus persicae* (green peach aphid), are the most important insects that attack and reduce potato crop production (Ali et al., 2023). *M. persicae* is a vector of the leafroll virus, which transmits the pathogen from plant to plant in the potato crop (Bethke, 2023; Bhoi et al., 2022; Liu et al., 2024; Lyngkhoi et al., 2024). However, *P. operculella* is another insect pest of this crop (Eltair et al., 2024; Lyngkhoi et al., 2024) that causes losses of about 100% as the pest destroys potato tuber storage in goddamn as well as in fields (Tsedaley, 2015; Ullah et al., 2020). In tubers or foliage, *P. operculella* passes its larval phase (Horgan et al., 2010; Sileshi and Teriessa, 2001). The pesticides needed are used to control the loss of potato crops in the field and at the time of storage from *P. operculella* (Anderson et al., 2018; Mammori, 2021; Zheng et al., 2020).

Therefore, the current research study was considered to explore the invasion of insect pests on potato crop at Hazara region.

2 Materials and Methods

2.1 Survey methodology

This research study was arranged at Hazara Division, Khyber Pakhtunkhwa, Pakistan. The insects' collection was supported through the (Ruby et al., 2010) and (Butt et al., 2008) procedures. In 2017, the study started to record different pests that attack and destroy potatoes in Mansehra, Haripur, Abbottabad, Battagram, and Kohistan. In a visit, five fields were selected in each district. The average pest incidence was counted randomly for ten days.

2.2 Specimen sampling and observations

During the visit, we selected a 5-meter row of plants from each field and designated 5 fields per village in a district for the observation of pest collection from crop leaves, branches, and roots using the (Bodlah et al., 2013) method.

2.3 Identification of specimens

All the collected insect species were taxonomically identified with the help of keys and the literature of Noronha et al. (2010), Medvedev (1997), Powell et al. (1992), and (Blackman, 2013), previously recognized insect species at the National Insect Museum, Islamabad.

2.4 Statistical analysis

The EXCEL and GraphPad Prism-5 softwares were used for statistical analysis of collected insect species to find the average number of pests taken in each visit of five rows and 12 visits of each district.

3 Results

The present study was conducted at the Hazara division, Khyber Pakhtunkhwa, Pakistan, during 2013. From (Mansehra, Haripur, Abbottabad, Battagram, and Kohistan) five fields were selected and pests were collected from potato crops. The preserved insects were identified in NARC; the reported species are leafhopper, flea beetle, potato tuberworm, black cutworm, wireworm, and white grub, respectively, from the study area. The seasonal average of each insect in each district was different in incidence.

3.1 Statistical analysis of potato insect pests of district Mansehra

The average number of arthropod pests collected from the 5-meter row of potato crop per field at Mansehra district during 2017, was Potato leafhopper 0.95±0.62, Potato tuberworm 0.68±0.44, Wireworm 0.62±0.35, Field cricket 0.60±0.52, Black cutworm 0.60±0.29, potato flea beetle 0.58±0.39, white grub 0.55±0.33, red pumpkin 0.54±0.25, and beet armyworm 0.46±0.26. The results of the present survey show that there were the highest number of potato leafhoppers and the lowest number of beet armyworms (Table 1, Fig. 1).

Table 1 Average no. of insect pests per 5-meter row of potato in Mansehra.

District	Dates	Pest names								
		WG	FC	PT	BC	BA	PLH	PFB	WW	RP
Mansehra	1-7-17	0	0	0	0.2	0	0.2	0	0	0
	10-7-17	0.2	0.2	0.4	0.6	0.8	0.8	0.8	0.6	1
	20-7-17	0.6	0.8	1	1	0.2	0.6	1	0.2	0.8
	2-8-17	0.8	0.4	0.4	1	0.6	0.4	0.4	0.4	0.4
	12-8-17	0.2	1	0.6	0.6	0.8	0.8	0.4	0.8	0.6
	22-8-17	1	0.4	0.4	0.8	0.4	0.8	0.6	0.4	0.6
	1-9-17	0.4	0.4	0.8	0.4	0.4	1	0.2	0.6	0.6
	11-9-17	0.6	0.2	0.6	0.4	0.4	0.6	0.4	0.4	0.6
	21-9-17	0.6	0.4	0.6	0.4	0.6	1.2	0.8	1.2	0.4
	2-10-17	0.6	0.6	0.4	1	0	0.6	0	0.6	0.4
	12-10-17	0.4	1	1.4	0.6	0.6	1.6	1	0.8	0.4
	22-10-17	1.2	2	1.6	0.4	0.6	2.6	1.2	0.8	0.8

WG White grub, **FC** Field cricket, **PT** Potato tuber worm, BC Black cutworm, **BA** Beet armyworm, **PLH** Potato leafhopper, **PFB** Potato flea beetle, **WW** Wireworm, **RP** Red pumpkin.

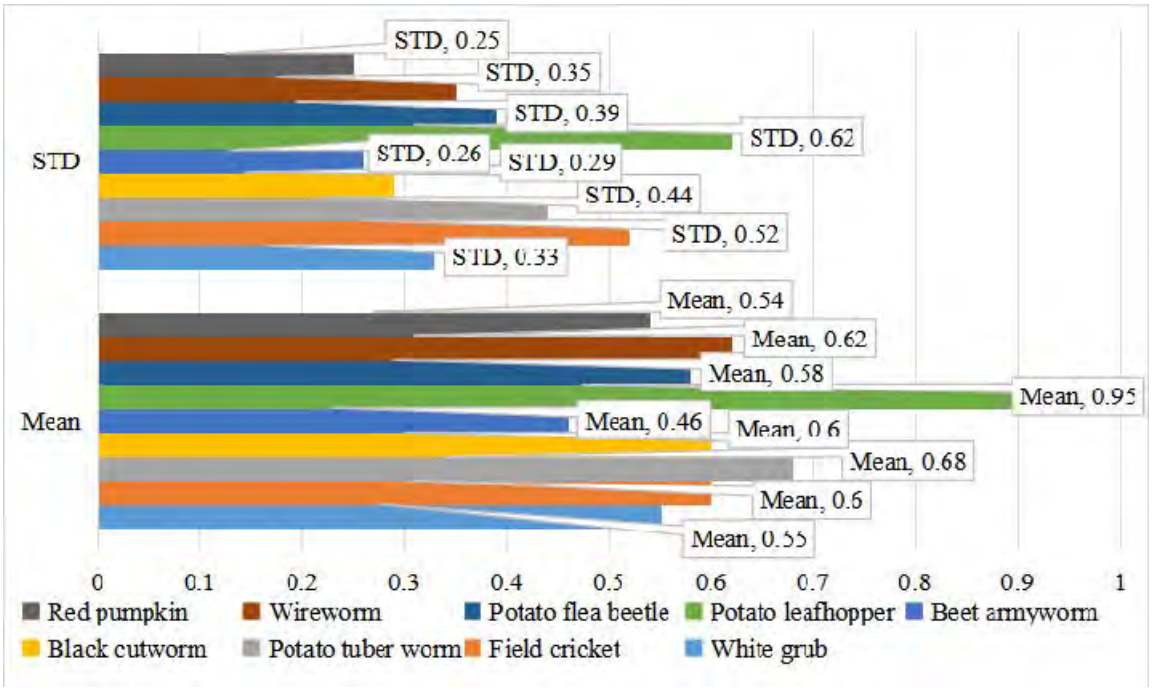

Fig. 1 Average of mean and standard deviation (STD) of insect pests per 5-meter row of the potato crop in district Mansehra.

3.2 Potato pests of district Haripur statistical analysis

The average number of harmful pest species from the potato 5-meter row sampled at Haripur district during the year 2013 was field cricket 0.67±0.67, red pumpkin 0.65±0.67, white grub 0.60±0.53, black cutworm 0.58±0.54, potato flea beetle 0.57±0.55, wireworm 0.55±0.50, potato tuberworm 0.55±0.52, beet armyworm 0.53±0.40, and potato leafhopper 0.52±0.55. This survey displays that there were the highest number of field crickets and the lowest number of potato leafhoppers (Table 2, Fig. 2).

Table 2 Average no. of insect pests per 5-meter row of potato in Haripur.

District	Dates	Pest names								
		WG	FC	PT	BC	BA	PLH	PFB	WW	RP
Haripur	2-7-17	0	0	0	0	0	0	0	0	0
	12-7-17	0	0	0.2	0	0	0	0	0	0
	22-7-17	1.2	1.4	0.6	1.6	0.8	0.6	1.2	0.6	1.8
	1-8-17	0.4	1.8	0.4	0.8	1	1.2	0.4	1	1.4
	13-8-17	1.2	0.6	0.6	0.4	1.2	0.6	1.6	1.6	1.2
	23-8-17	1.6	1.8	2	1	0.8	1.2	1.4	1.2	1.4
	2-9-17	0.6	0.4	0.6	1.2	0.4	0	0.6	0.4	0
	12-9-17	0.4	1	0.6	0.8	0	0.4	0	0.4	0
	22-9-17	1	0	0.8	0.8	0.8	1.6	0.6	0	1
	3-10-17	0.2	0.2	0.4	0.4	0.4	0.4	0.4	0.6	0.2
	13-10-17	0.4	0.4	0	0	0.6	0.2	0.2	0.4	0.4
	23-10-17	0.2	0.4	0.4	0	0.4	0	0.4	0.4	0.4

WG White grub, **FC** Field cricket, **PT** Potato tuber worm, **BC** Black cutworm, **BA** Beet armyworm, **PLH** Potato leafhopper, **PFB** Potato flea beetle, **WW** Wireworm, **RP** Red pumpkin.

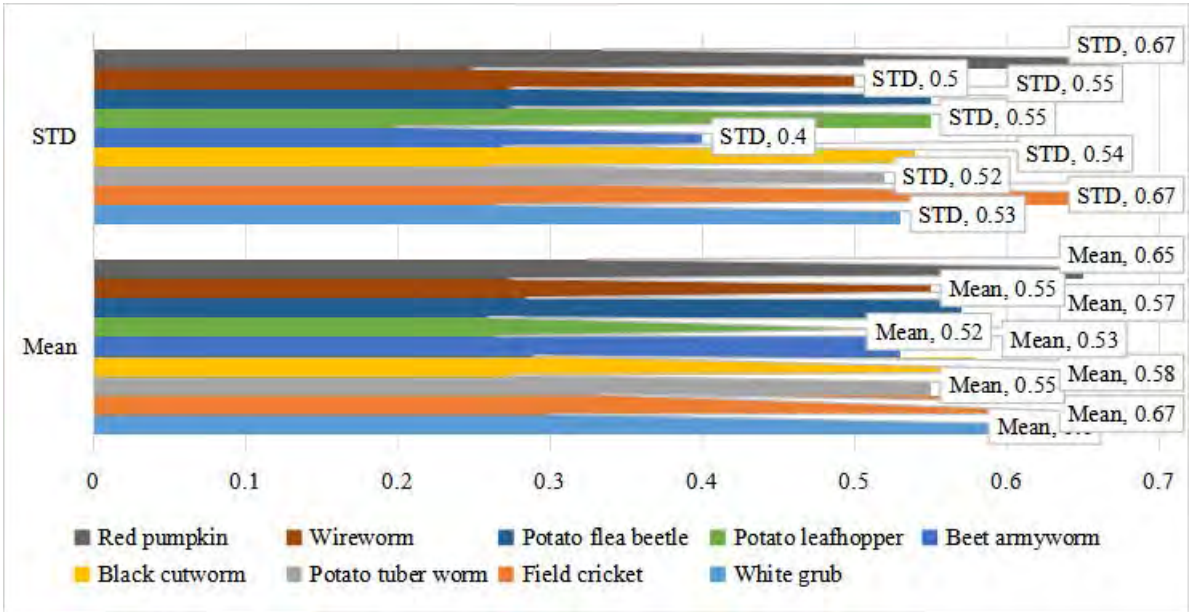

Fig. 2 Average mean and standard deviation (STD) of insect pests per 5-meter row of potato in Haripu**r.**

3.3 Potato pests of Abbottabad district statistically analysed

The mean potato pests per 5-meter row sampled from Abbottabad district during 2017 were: wireworm 0.53±0.31, red pumpkin 0.40±0.27, potato tuberworm 0.40±0.28, beet armyworm 0.40±0.17, white grub 0.38±0.26, potato leafhopper 0.37±0.19, black cutworm 0.33±0.18, potato flea beetle 0.33±0.16, and field cricket 0.32±0.23. This confirmation of our research study reveals that beet armyworm, red pumpkin, and potato tuberworm were in a similar statistical number and the maximum of wireworm, while the tropical armyworm was in the lowermost numbers in Table 3 (Fig. 3).

Table 3 Average no. of insect pests per 5-meter row of potato in Abbottabad.

District	Dates	Pest names								
		WG	FC	PT	BC	BA	PLH	PFB	WW	RP
Abbottabad	6-7-17	0	0	0	0	0	0.2	0.4	0.4	0
	17-7-17	0	0	0.2	0.4	0.2	0.2	0.4	0	0
	28-7-17	0.4	0.4	0.4	0.4	0.4	0.6	0.4	0.4	0.4
	5-8-17	1	0.2	0.4	0.4	0.6	0.6	0	0.6	0.6
	14-8-17	0.4	0.6	0.6	0.6	0.6	0	0.4	1.2	1
	24-10-17	0.6	0.6	0.2	0.4	0.6	0.4	0.4	0.4	0.6
	3-9-17	0.4	0.4	0.4	0.4	0.4	0.2	0.4	0.6	0.4
	13-9-17	0.4	0	1	0	0.4	0.6	0.4	1	0.4
	23-9-17	0.2	0.4	0.2	0.4	0.4	0.4	0	0.6	0.2
	4-10-17	0.4	0.2	0.2	0.4	0.4	0.4	0.4	0.4	0.4
	14-10-17	0.4	0.4	0.4	0.2	0.4	0.4	0.4	0.4	0.4
	24-10-17	0.4	0.6	0.8	0.4	0.4	0.4	0.4	0.4	0.4

WG White grub, **FC** Field cricket, **PT** Potato tuber worm, **BC** Black cutworm, **BA** Beet armyworm, **PLH** Potato leafhopper, **PFB** Potato flea beetle, **WW** Wireworm, **RP** Red pumpkin

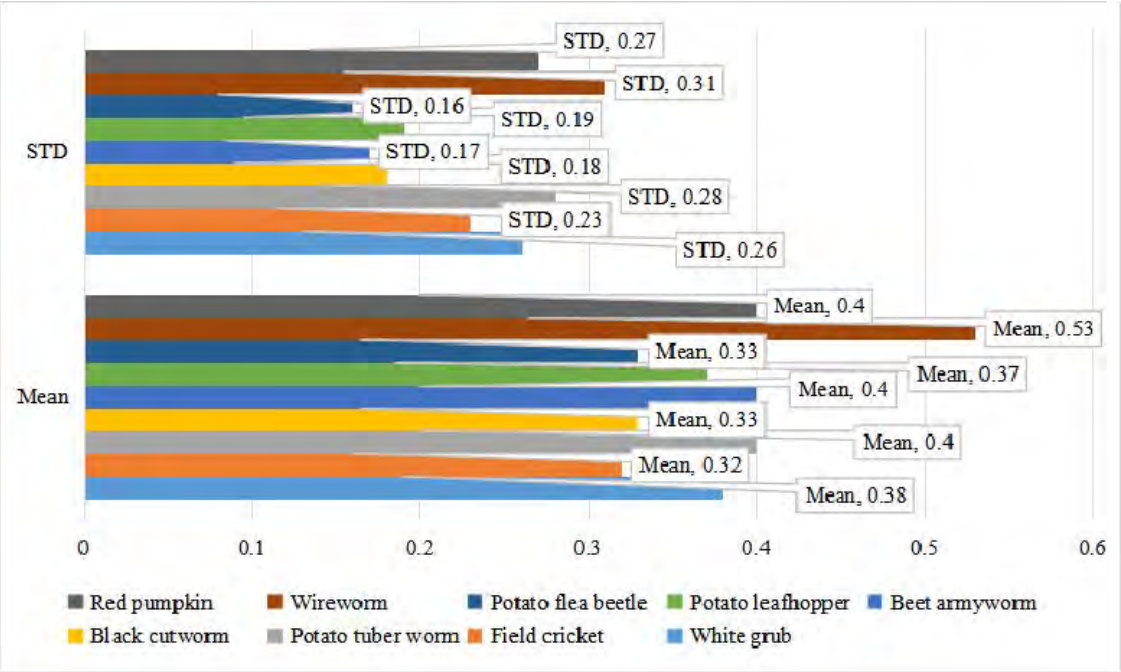

Fig. 3 Average mean and standard deviation (STD) of insect pests per 5-meter row of potato in Abbottabad.

3.4 Battagram district potato insects statistical analysed

The average number of different potato pest species found in Battagram district per 5-meter row in 2017 was 0.80±0.60 for the white grub, 0.68±0.76 for the field cricket, 0.45±0.24 for the potato flea beetle, 0.35±0.21 for the wireworm, 0.32±0.20 for the black cutworm, 0.32±0.20 for the beet armyworm, 0.30±0.23 for the potato leafhopper, 0.28±0.18 for the potato tuberworm, and 0.17±0.22 for the red pumpkin. This was the results of an increased number of white grubs and a decrease in red pumpkins (Table 4; Fig. 4).

Table 4 Average no. of insect pests per 5-meter row of potato in Battagram.

District	Dates	Pest names								
		WG	FC	PT	BC	BA	PLH	PFB	WW	RP
Batagram	7-7-17	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.2
	18-7-17	0.6	0.4	0.2	0.4	0.6	0	0	0.6	0.6
	29-7-17	0.4	1	0.4	0	0.4	0.4	0.4	0.2	0
	10-8-17	0.4	0.6	0.4	0.2	0.2	0.4	0.4	0.4	0
	20-8-17	0.4	0.4	0.4	0.4	0.4	0.2	0.4	0.6	0.4
	29-8-17	0.8	0.2	0.4	0.2	0.2	0.2	0.2	0	0
	6-9-17	1	0.4	0.2	0.4	0	0.4	0.6	0.4	0.4
	16-9-17	0.2	0.4	0.2	0	0.6	0	0.4	0.4	0
	29-10-17	0.8	0.8	0.2	0.6	0.4	0.8	0.6	0.2	0
	5-10-17	0.6	0.2	0.6	0.4	0	0.4	0.6	0.6	0
	15-10-17	2.8	3	0	0.2	0.2	0	1	0	0
	25-10-17	1	0.4	0	0.6	0.4	0.4	0.4	0.4	0.4

WG White grub, **FC** Field cricket, **PT** Potato tuber worm, **BC** Black cutworm, **BA** Beet armyworm, **PLH** Potato leafhopper, **PFB** Potato flea beetle, **WW** Wireworm, **RP** Red pumpkin.

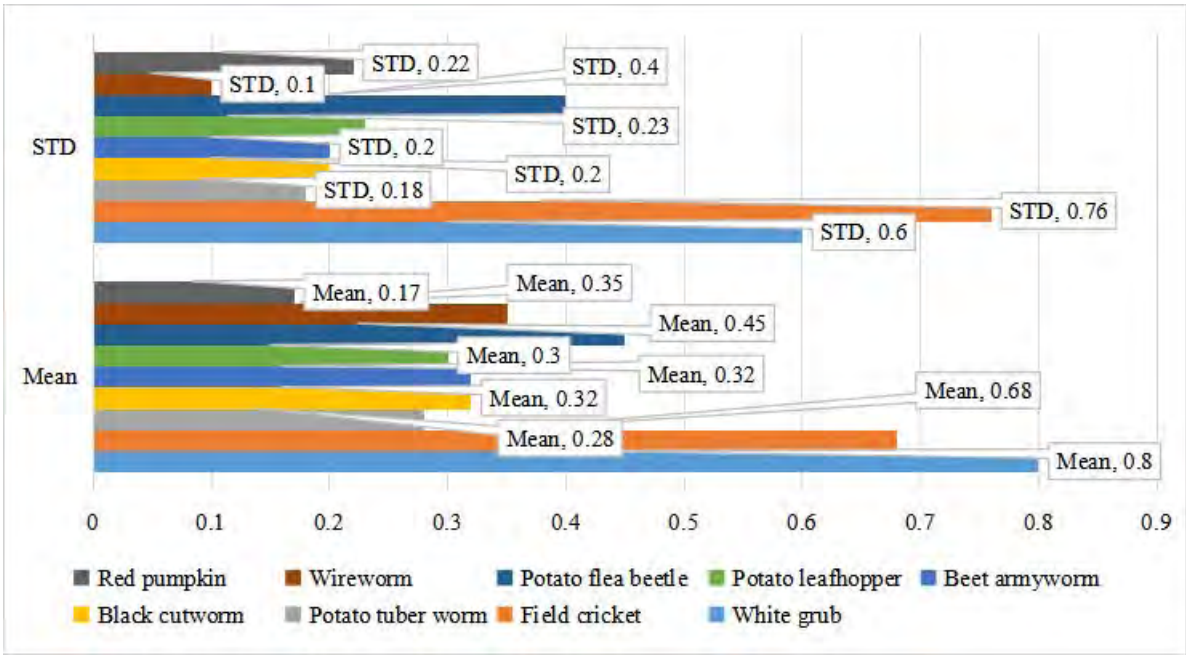

Fig. 4 Average mean and standard deviation (STD) of insect pests per 5-meter row of potato in Battagram.

3.5 Kohistan district potato insect pests statistical analysed

The average number of pests per 5-meter row of potato sampled from Kohistan district during 2017 were: field cricket 1.18±1.46, white grub 1.14±1.19, potato tuberworm 0.65±0.6, wireworm 0.50±0.27, black cutworm 0.47±0.34, potato leafhopper 0.41±0.26, beet armyworm 0.34±0.15, potato flea beetle 0.27±0.18, and red pumpkin 0.4±0.25. This shows the peak number of field crickets and the lowest number of potato flea beetles (Table 5; Fig. 5).

Table 5 Average no. of insect pests per 5-meter row of potato in Kohistan.

District	Dates	Pests names								
		WG	FC	PT	BC	BA	PLH	PFB	WW	RP
Kohistan	8-7-17	0	0	0	0	0	0	0	0	0
	19-7-17	0	0	0.2	0	0.2	0	0	0.6	0
	30-7-17	0.6	0.2	0.4	0.6	0.4	0.4	0.4	0.2	0.2
	11-8-17	0.4	0	0.6	0.4	0.4	0.6	0	0.4	0.4
	21-8-17	0.4	0.4	0.4	0.2	0.4	0.2	0.4	0.6	0.4
	30-8-17	0.6	0.6	0.2	0.4	0.6	0.4	0.4	0.4	0.6
	8-9-17	0.4	0.4	0.4	0.4	0.4	0.2	0.4	0.6	0.4
	17-9-17	0.4	0.8	0.4	1	0.2	0.6	0.2	0.2	1
	25-9-17	0.2	0.4	0.2	0.4	0.4	0.4	0	0.6	0.2
	6-10-17	1.8	3.6	1.6	1.2	0	1	0.4	1.2	0.4
	16-10-17	4.4	2.8	2	0.2	0.4	0.4	0.4	0.4	0.4
	4-11-17	3.4	3.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4

WG White grub, **FC** Field cricket, **PT** Potato tuber worm, **BC** Black cutworm, **BA** Beet armyworm, **PLH** Potato leafhopper, **PFB** Potato flea beetle, **WW** Wireworm, **RP** Red pumpkin.

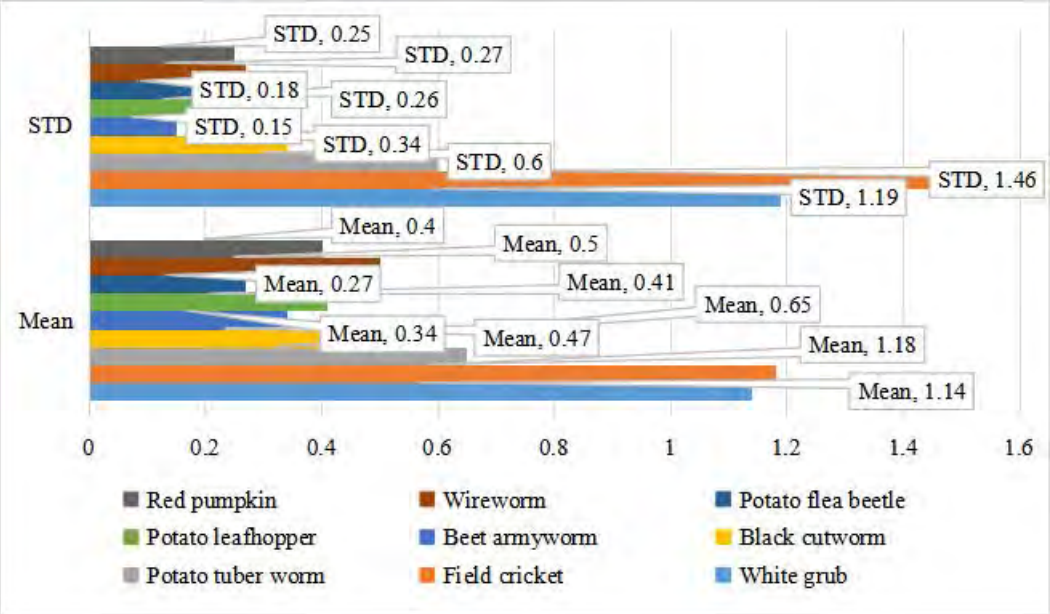

Fig. 5 Average mean and standard deviation (STD) of insect pests per 5-meter row of potato in Kohistan.

4 Discussion

The present study was conducted in the district of Hazara division, Khyber Pakhtunkhwa, Pakistan, during 2017. Each district was randomly exposed to pest diversity on potato crops. However, according to the present study, the average number of potato leafhoppers per 5-meter row was 0.53±0.40, 0.46±0.26, 0.40±0.17, 0.34±0.15, and 0.32±0.20. While such several flea beetles (0.58±0.39, 0.57±0.55, 0.33±0.16, 0.45±0.4, and 0.27±0.18) were found in Haripur, Mansehra, Abbottabad, Battagram, and Kohistan, respectively.

It is reported by Kaplan et al. (2008), Chasen et al. (2014), Orlova-Bienkowskaja and Bieńkowski (2015) that the potato leafhopper and flea beetle may also infrequently cause severe yield loss due to potato plants, leaves, and tuber damages. According to researchers, the insect pests of the potato crop were observed anywhere, which are the thread to the corresponding crop as well. The average number of field crickets per 5 meters in Mansehra, Haripur, Abbottabad, Battagram, and Kohistan was 0.60±0.52, 0.67±0.67, 0.32±0.23, 0.68±0.76, and 1.18±1.46, respectively. Analogous examinations were achieved by Shah et al. (2015); they collected an average number of field crickets per 5-meter row of 0.52 in Peshawar.

In districts Mansehra, Haripur, Abbottabad, Battagram, and Kohistan, the potato tuberworms with an average number per 5 meters were 0.68±0.44, 0.65±.60, 0.55±0.52, 0.40±0.28, and 0.28±0.18, respectively, while Rondon (2010), Bethke (2023) and Degebasa (2019) observed that the potato tuberworms had the maximum number. The Andes region, responsible for significant potato losses in many regions, is the origin of the potato tubeworm (PTW). Furthermore, the study area found some species at high altitudes and latitudes, indicating the presence of pests everywhere except the Arctic and Antarctic regions.

The average numbers of black cutworms in Mansehra, Haripur, Abbottabad, Battagram, and Kohistan were 0.60±0.29, 0.58±0.54, 0.33±0.18, 0.32±0.20, and 0.47±0.34. According to Popov et al. (2022) and Taylor et al. (2018), the black cutworm was causing damage to plants and grazing on tubers in Minnesota and the American Midwest.

Every spring, adult black cutworms migrated from southern states to fields with greenery that was actively growing. Compared to later-planted potato fields, early-planted potato fields are more exposed to a black cutworm infestation. The average number of wireworms per 5 meters of potato in Mansehra, Haripur,

Abbottabad, Battagram, and Kohistan was 0.62±0.35, 0.55±0.50, 0.53±0.31, 0.50±0.27, and 0.35±0.21, respectively. Olle et al. (2015) regarded it as a significant and serious pest, and the risk of the total crop being reduced due to the increasing numbers of wireworm damage in all-arable rotations is a concern for some growers. In Mansehra, Haripur, Abbottabad, Battagram, and Kohistan, the average number of white grubs per 5 meters was 0.55±0.33, 0.60±0.53, 0.38±0.26, 0.80±0.60, and 1.14±1.19, respectively.

While Noronha et al. (2010), Nenotek et al. (2022), and Khanal et al. (2013) discovered it in soil, it feeds on the roots of potatoes, while adults consume foliage. In addition, the study area, was characterized by identical environmental and climatic conditions, and yielded the same species.

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