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SPECIES COMPOSITIONS AND RELATIVE ABUNDANCE OF INSECT PESTS ASSOCIATED WITH STORED MAIZE IN DERA ISMAIL KHAN AND ITS ADJACENT PUNJAB AREAS

Muhammad Mamoon-ur-Rashid, Khalid Abdullah, Wajhi-ul-Abbas, Asma Batool, Sajjad Hussain and Riaz-ud-din

Department of Entomology, Gomal University, Dera Ismail Khan 29220, Pakistan

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***Corresponding Author**:
Muhammad Mamoon-ur-Rashid
E-mail: mamoondik@yahoo.com

ABSTRACT

A vast survey of government and private godowns was conducted during December, 2014-2016 from Dera Ismail Khan and its adjacent Punjab areas to find out the species composition and infestation level of insect pests associated with stored maize. Maize weevil, *Sitophilus zeamais* (Motschulsky) followed by confused flour beetle (*Tribolium confusum*), lesser grain borer (*Rhiozopertha dominica*), grain moth (*Sitotroga cerealella*), rice weevil (*Sitophilus oryzae*) and maize weevil parasitoid (*Anisopteromalus calandrae*) were the major insect pests and beneficial of stored maize in the study area. The collected species belonged to three different orders *i.e.* Coleoptera, Lepidoptera and Hymenoptera. All the surveyed locations had infestation of *S. zeamais* during January to November, 2015 and 2016 and no infestation of the targeted insects during the month of December, 2014 and 2015. The infestation of the maize weevil started to build up during January and reached at peak during the month of May. During the extreme hot months of June and July the population of the pest was at decline. Among the visited locations, Dera Ismail Khan and its adjacent areas had higher population of *S. zeamais* as compared to its adjacent Punjab areas during the study period. The population of parasitoid, *A. calandrae* started to build up during the month of April and reached at peak during the month of June, whereas; it was minimum during July-August. Among the surveyed locations, comparatively higher percent parasitization was found in Dera Ismail Khan and lower in Paharpur and Darya Khan areas. Overall, Dera Ismail Khan (KPK) had highest, whereas; Notak and Bhakkar areas (Punjab) had lowest population of *A. calandrae* during the surveyed period. The maximum percentage grain damage (37.51%) and weight losses (33.23%) were recorded in Dera Ismail Khan whereas; minimum percent infestation and weight loss was recorded in Paroa area.

Keywords: Maize, Insects, *S. zeamais, A. calandrae,* Survey, Specie composition

INTRODUCTION

Maize *(Zea mays* L.) is a member of Poaceae family having annual life cycle. Based on the area and production, it is considered the 3rd most important crop after wheat and rice in Pakistan. Maize is a multipurpose crop and it is the only cereal grain that is eaten from flower to flour (Boutard, 2012). Maize can be used as food for livestock and poultry and is also a source of raw materials for a number of industries including textile, paper and corrugation industries, food products, pharmaceuticals, animal health and nutrition (Bibi *et al*., 2010). Pakistan is one of the important suppliers of maize starch in the world (Ali, 2004).

Maize crop is grown in all the provinces of Pakistan, but Punjab and Khyber Pakhtunkhwa are the main areas of its production. It is the 2nd most important crop after wheat in Khyber Pakhtunkhwa which contributes more than 50% of the total maize production in the country (Amir, 1986; Byerlee *et al*., 1986; 1988). It is used as a staple food in the country and particularly in Khyber Pakhtunkhwa province (Rahman *et al*., 2003; Guria, 2006; Aurangzeb *et al*., 2007). In Sub Saharan Africa, it is used as a staple food for 50% of the population and millions of people inhabiting in the tropical region around the globe (Anonymous, 2009). In Pakistan, maize crop was grown on 1116.6 thousand hectares with 4527.2 thousand tones production during 2013-14 (Anonymous, 2014).

Post-harvest storage insect pests inflict heavy losses to cereals in both quality and quantity and in most cases pre-dispose the stored grains to secondary attack by disease causing

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pathogens (Evans, 1987; Tefera *et al*., 2010). In storage, maize crop is attacked by various insect pests majorly by maize weevil (*Sitophilus zeamais*). The maize weevil, *S. zeamais* is one of the most destructive cosmopolitan pests of stored cereal grains, in tropical and sub-tropical regions of the world. The maize weevil is a primary field to store pest that starts to infest the ripening maize crop during field conditions when the moisture content has decreased to 18-20% and cause heavy weight losses ranging from 30–40% of produce (CABI, 2005). There are up to 80-90% losses have been reported in untreated maize grains stored in traditional structures (Boxall, 2002; Parugrug and Roxas, 2008). Damage to grains caused by maize weevil includes reduction in nutritional value, germination, weight and commercial value (Yuya *et al*., 2009). It is also a secondary storage pest of several other crops including rice, sorghum and cassava flour (Nwana, 1993). The infested grains become unfit for human consumption.

The information on the insect pests' spectrum of stored maize crop, their seasonal distribution and abundance is lacking in Pakistan and is of prime importance in devising an Integrated Pest Management (IPM) strategy. This study was aimed to elaborate the information on the biodiversity, distribution and relative abundance of major insect pests infesting stored maize in Dera Ismail Khan and its adjacent Punjab areas.

MATERIALS AND METHODS

Population dynamics of maize weevil and its parasitoid *Anisopteromalus calandrae*

A vast survey of government and private godowns was conducted during December, 2014-2016 to find out the infestation level of maize weevil and parasitization potential of its parasitoid, *A. calandrae* during January to December. The samples were collected from Dera Ismail Khan and its surroundings (KP) and adjacent areas of Punjab province. Each sample of 500 g was collected from each location at 30 days interval. The samples were collected from the bags by using a spear sampler at the middle, top and bottom portion of the bags as described by Hangstrum and Subramanyam (2000). All samples were placed in plastic jars and labeled appropriately to avoid contamination and were incubated for 30 days. At the end of incubation period, the samples were sieved to remove dead and live insects and the data was recorded on the infestation of maize weevil, species composition and emergence of its parasitoid. Live and dead insects were collected, preserved in 75 ml capacity glass bottles filled with 90% alcohol and kept for further identification. Identification was made using standard identification keys.

Laboratory study

In the laboratory of Entomology Department, Gomal University, Dera Ismail Khan, 20 gram maize seed was separated from each collected specimen and was incubated for two months to calculate the percent infestation and weight loss of collected specimens. After an incubation period of two months each sample was sieved through a 2mm mesh sieve. The sampled grains were separated into damaged and undamaged grains to calculate the percent infestation and weight loss following Adams and Schulter (1978) as follows:

$$\% \text{ weight loss} = ((Und - DNu) / U (Nd + Nu) \times 100$$

Where "U" is weight of undamaged grains, "Nd" is number of damaged grains, "D" is weight of damaged grains, and "Nu" is number of undamaged grains.

$$\text{Percent infestation} = \frac{\text{Damaged grains in a jar}}{\text{Total grains in a jar}} \times 100$$

RESULTS AND DISCUSSION

Population dynamics of maize weevil (*S. zeamais)*

The data presented in Fig-1 and Fig-3 show that all the surveyed locations had infestation of *S. zeamais* during January to November, 2015 and 2016. All the locations had no infestation of maize weevil during the month of December, 2014 and December, 2015. The infestation of the test insect started to build up during the month of January and reached at peak in during May during the both study years. During the extreme hot months of June and July the population of the maize weevil was at decline, whereas; it again started to build up after the month of August. Among the visited locations, Dera Ismail Khan and its adjacent areas had higher population of *S. zeamais* as compared to its adjacent Punjab areas during the both study years.

Population of *A. calandrae*

The population dynamics data of *A. calandrae* revealed that the population of *A. calandrae* started to build up after the population buildup of *S. zeamais* at all the surveyed locations of Dera Ismail Khan and its adjacent Punjab areas (Fig 2 and 4). The population of *S. zeamais* started to build up during the month of January whereas; the population of its parasitoid, *A. calandrae* started to build up during the month of April during 2015 whereas, it started to build up in the month of March during 2nd year. The population was at peak during the month of June, whereas; it was minimum during July-August, another peak of *A. calandrae* population was noted during the month of October.

Among the surveyed locations, comparatively higher percent parasitization was found in Dera Ismail Khan and lower in Paharpur and Darya Khan areas. Overall, Dera Ismail Khan (KPK) had highest, whereas; Notak and Bhakkar areas (Punjab) had lowest population of *A. calandrae* during the surveyed period.

Insect pests recorded, their status and abundance

Studies conducted on the infestation of major insect pests infesting stored maize in Dera Ismail Khan and its adjacent Punjab province areas revealed a total of six species belonging to three different orders *i.e.* Coleoptera, Lepidoptera and Hymenoptera (Table 1). The Coleopteran insect pests belonged to three different families *i.e.* Curculionidae, Tenebrionidae and Bostrychidae. The Lepidopteran insect pests belonged to family Gelechiidae. From Hymenoptera, the insect pests belonged to family Pteromalidae. Among the recorded insect pests, the maize weevil (*Sitophilus zeamais)* was the most abundant species followed by confused flour beetle (*Tribolium confusum),* Angoumois grain moth (*Sitotroga cerealella),* (*Rhizopertha*

dominica) and rice weevil (*S. oryzae)* (Table-1). Similar results were also documented by Chimoya and Abdullahi (2011). They reported that *Tribolium castaneum*, *Sitophilus* spp, *Rhizopertha dominica*, *Trogoderma granarium* and *Cryptolestes* spp were the major species infesting stored grains in Nigeria. Sori and Ayana (2012) reported seventeen arthropod, thirteen Coleopteran, three Lepidopteran and one Acarina species infesting stored maize in Ethiopia. They reported that *S. zeamais* was the most prominent pest followed by *S. cerealella*, *S. oryzae* and *Tribolium confusum* in Jimma Zone, Ethiopia.

Percent infestation and weight loss of maize grains

There was a significant grain damage and weight loss caused by the different pests to stored maize (Table-2). The maximum (37.51%) percentage grain damage and weight losses (33.23%) caused by the pests under traditional farmers practices was recorded in Dera Ismail Khan followed by Paharpur (23.61% and 31.42%), Bhakkar (21.12% and 26.65%), Darya Khan (20.67% and 24.71%) and Notak (11.32% and 15.69%), whereas; minimum percent infestation and weight loss (10.82% and 13.85%) was recorded in Paroa area. Sori and Ayana (2012) reported grain damage and weight losses of 64.50% and 41 to 80% respectively caused by maize weevil after three to six months storage.

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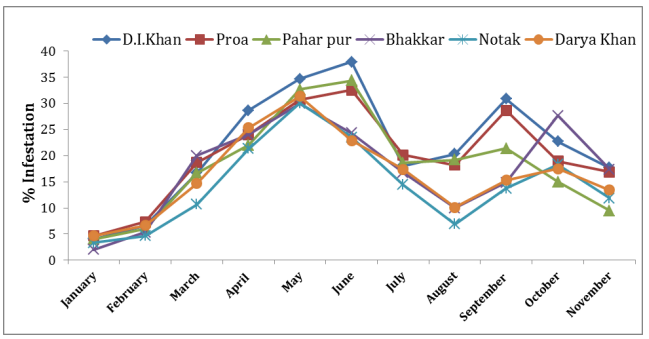

Fig1.

Percent infestation of *S. zeamais* in agro-climatic conditions of Dera Ismail Khan and its adjacent Punjab areas during 2015.

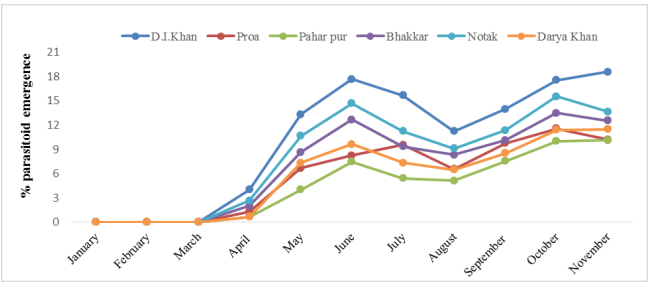

Fig 2.

Percent parasitization potential of *A. calandrae* in agro-climatic conditions of D.I. Khan and its adjacent Punjab areas during 2015.

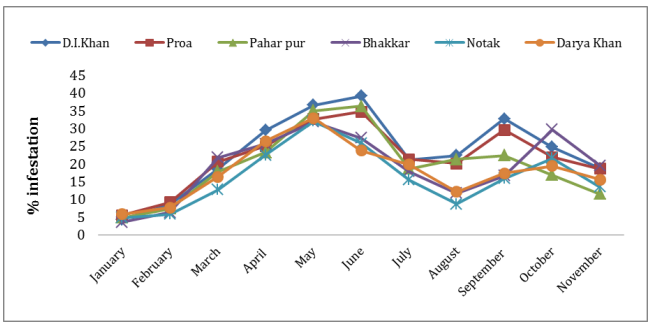

Fig 3.

Percent infestation of maize weevil, *S. zeamais* in agro-climatic conditions of Dera Ismail Khan and its adjacent Punjab areas during 2016.

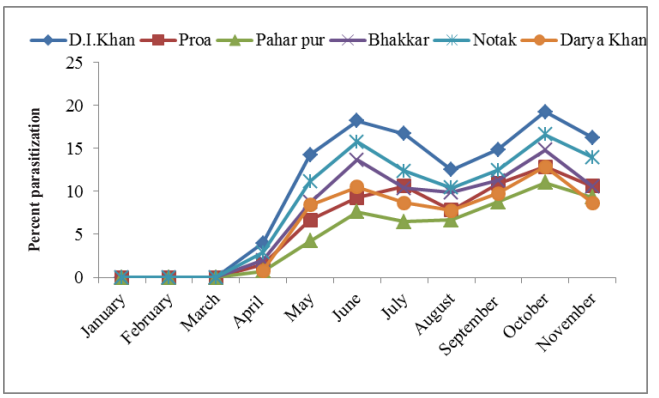

Fig 4.

Percent parasitization potential of *A. calandrae* in agro-climatic conditions of D.I.Khan and its adjacent Punjab areas during 2016.

Table 1.

List of insect and parasitoid species and their relative percent abundance in Dera Ismail Khan and its adjacent Punjab areas

Insect specie	Scientific Name	Family	Relative abundance
Maize weevil	*Sitophilus zeamais*	Curculionidae	31.59%
Confused flour beetle	*Tribolium confusum*	Tenebrionidae	27.51%
Lesser grain borer	*Rhiozopertha dominica*	Bostrychidae	10.49%
Angoumois grain moth	*Sitotroga cerealella*	Gelechiidae	4.91%
Rice weevil	*Sitophilus oryzae*	Curculionidae	3.52%
Maize weevil parasitoid	*Anisopteromalus calandrae*	Pteromalidae	21.98%

Table 2.

Percentage grain damage and weight losses of stored maize grain in Dera Ismail Khan and its adjacent Punjab areas

Insect specie	Total weight of sample	Percent infestation	Percent weight loss of sample
D.I.Khan	125gm	37.51	33.23
Pharpur	125gm	23.61	31.42
Darya khan	125gm	20.67	24.71
Bhakkar	125gm	21.12	26.65
Notak	125gm	11.32	15.69
Paroa	125gm	10.82	13.95

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