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# Incidence and distribution of coleopteran insect pests on rainfed maize (*Zea mays* L.) in upper himalayas of Jammu and Kashmir, India

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**Abstract**
Experimental trail was conducted in free choice conditions at intermediate zone of Jammu and Kashmir, India during *kharif* season 2007. Various beetle populations *viz.* white grub (*Holotrichia consaguinea*), Blister beetle (*Mylabris pustulata*), flower eating beetle (*Protatia alboquattata* Vig.), wire worms (*Melanotus communis* Gyllenhal) and flea beetle **(***Phyllotera* sp.**)** were observed at the experimental site. Among these pests *H. consaguinea* populations were found to be the dominating one. Correlation studies depicted that, both *H. consaguinea* adults and grubs were positively correlated with maximum and minimum temperatures. *M. pustulata* and *P. alboquattata* were negatively correlated with maximum and minimum temperatures, other beetles were positively correlated. *H. consaguinea* grubs, *M. communis* adults, were negatively correlated with relative humidity. *M. pustulata* and *Phyllotreta* sp. were positively correlated with relative humidity. As infestation of these insects is concerned wire worm, white grub larvae, white grub adult and blister beetle, fed on germinating seedlings, roots, leaves and silk, respectively however, both *P. alboquattata* and grain feeding flea beetle were found to feed on cob grains. Thus these beetles led to varying degree of damage and their distribution on maize plant.

**Keywords:** Beetles, population, infestation and sampling

## INTRODUCTION

Maize (*Zea mays* L.) is an important crop grown all over India, and yield of this crop is severely affected by different insect pests right from seedling to maturity and global losses due to insect pests is about 9%, which is equivalent to 52 million MT and worth approximately $5.7 billion annually [1]. The most commonly occurring insect pests infesting maize are: lepidopterous pests (including borers, cutworms, armyworms, earworms, and grain moths) and coleopteran pests (root worms, wireworms, grubs, grain borers, and weevils). Apart from this a group of insects that serve as carriers (vectors) for disease causing agents or pathogens, are the sap-sucking bugs (leafhoppers and aphids) are of the greatest importance [2]. In India the crop is being attacked by about 130 species of insect pests with varying degree of damage [3]. Among these only about a dozen of these are quite serious. Out of 139 species, 26 insect species were reported from order coleoptera [4]. Fifteen beetle species has been reported in association of maize crop causing considerable damage [5]. Beetles such as seed feeders, foliage feeders, silk feeders and cob feeders cause considerable losses to the maize crop. Reports indicate that adult beetles belonging to the sub-family centonidae were found to feed on anthers of maize [6]. Hence, attempt has been made to study the incidence and distribution behavior of beetles infesting maize in *kharif* season at higher altitudes of Himalyas of Jammu and Kashmir as these studies, were undertaken for the first time. This type of study under natural conditions will provide clear information needed in formulating effective management strategies.

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## MATERIALS AND METHODS

Experiments were conducted in free choice conditions in the farmer's field at intermediate zone of Jammu and Kashmir, India during *kharif* season 2007 under rainfed conditions. Maize variety "Kanchan" was planted at 60 x 20 cm spacing in 3 x 4 m plot size. The experimental plot was maintained without application of any insecticides. Crop was raised in natural conditions (*i.e.* without any application of insecticides) to allow population build up of insect pests. The observation of various beetles infesting maize was taken at weekly intervals throughout the growing season.

### Sampling and incidence of beetles

To estimate the population of different beetles in maize agro-ecosystem, light trap was installed in the field to monitor the adult beetles (mostly of nocturnal habit). The observations of the insect pests were recorded in morning as well as in the dusk period to take the advantage of sedentary nature of the insects. Adult beetles feeding on foliage were quantified on plant basis while, beetles feeding on cobs were quantified on cob basis. Incidence of beetles on each plant / cob in the plot was keenly observed. 10 plants were selected from the experimental plots. Mean of three plots was calculated to make further statistical analysis.

**Quantification of soil arthropods**

Grubs hiding in the soil debris (soil arthropods *viz.* white grubs and wireworms) were quantified by taking three samples of larvae excavating in 8400 $cm^2$ area *i.e.* (20cm x 20cm) of 21cm deep in soil in the field. Mean number of larvae present per three samples was recorded [7].

## RESULTS AND DISCUSSION

During the course of study five beetles were found to be infesting maize starting from its germinating stage to physiological maturity and their populations were recorded at weekly intervals. Table-1 predicted that peak period in both adult and grub populations of white grub *H. consaguinea* were found to be maximum in the month of June and this pest was found to be the dominating species among beetles associated with maize crop. Wireworm adults populations / trap was varying from sowing (*i.e.* 2nd fortnight of May) till the end of August, however larval populations / 8400 $cm^3$ was found from sowing to 1st week of July.

The population of blister beetle, grain feeding flea beetle and *P. alboquattata* were recorded in the month of July and onwards. Further reports depicted that localized populations of white grubs annually shrink and swell because of variations in rainfall and soil moisture [8].

**Correlation with abiotic factors**

Among the beetles studied all populations were positively correlated with temperature except blister beetle and *P. alboquattata* which were negatively correlated with temperature. *M. pustulata* and *P. alboquattata* were negatively correlated with maximum and minimum temperatures, other beetles were positively correlated. *H. consaguinea* grubs, *M. communis* adults, were negatively correlated with relative humidity. *M. pustulata* and *Phyllotreta* sp. were significantly positively correlated with relative humidity (Table 2).

**Infestation and feeding habit of beetles**

It is evident from table-3 that white grub (larvae) was reported to be feeding on maize roots and peak period of this pest was found to be in the 1st fort night of July. However, adults of this pest fed on maize leaves and peak period was in the 2nd fort night of July. Wire worm larva fed on germinated seedling while, blister beetle adults fed on silk and peak infestation was recorded in mid of August. On the other hand *P. alboquattata* and grain feeding flea beetle were recognized to feed on cob grains from miliking stage to physiological maturity and peak period of these pests was recorded in the 2nd fort night of august and first week of September. *P. alboquattata* changed its feeding habit as it fed the grains of the cob. Although, reports indicated, feeding behavior of flea beetle, *Macrodactylus* spp as pest consume the pollen in the tassels, thereby

Table 1. Population of different beetles associated with maize crop.

| Standard week | Weather parameters | | | Name of the pest | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Temperature | | RH | White grub | | Wire worm | | Blister beetle | *P. alboquattata* | Flea beetle |
| | Max. in ˚C | Min. in ˚C | Per cent | Adult/trap | Grub/ 8400 $cm^3$ | Adult/trap | Grub/ 8400 $cm^3$ | Adult /trap | Adult /trap | Adult /trap |
| 21 | 25.70 | 15.00 | 60.00 | 6 | 3.00 | 7 | 5.33 | 0 | 0 | 0 |
| 22 | 25.90 | 15.90 | 62.30 | 10 | 3.33 | 6 | 3.66 | 0 | 0 | 0 |
| 23 | 27.20 | 16.10 | 63.00 | 13 | 4.66 | 8 | 4.00 | 0 | 0 | 0 |
| 24 | 29.80 | 17.80 | 67.50 | 17 | 6.00 | 5 | 2.66 | 0 | 0 | 0 |
| 25 | 31.30 | 17.80 | 65.00 | 23 | 3.66 | 3 | 2.66 | 0 | 0 | 0 |
| 26 | 32.60 | 18.90 | 63.00 | 24 | 3.33 | 5 | 2.33 | 0 | 0 | 3 |
| 27 | 27.70 | 16.40 | 71.00 | 19 | 3.00 | 6 | 2.33 | 0 | 0 | 2 |
| 28 | 30.90 | 17.00 | 73.00 | 17 | 2.66 | 4 | 1.66 | 0 | 0 | 8 |
| 29 | 29.90 | 16.30 | 83.50 | 17 | 2.33 | 7 | 0.66 | 2 | 1 | 7 |
| 30 | 33.30 | 19.30 | 78.00 | 14 | 2.00 | 5 | 0.00 | 1 | 3 | 7 |
| 31 | 31.70 | 16.50 | 77.00 | 14 | 1.00 | 3 | 0.00 | 1 | 2 | 9 |
| 32 | 28.30 | 16.70 | 79.00 | 9 | 1.00 | 9 | 0.00 | 4 | 2 | 6 |
| 33 | 26.50 | 15.30 | 82.00 | 6 | 0.00 | 4 | 0.00 | 5 | 5 | 5 |
| 34 | 25.30 | 15.50 | 72.00 | 2 | 0.00 | 2 | 0.00 | 3 | 5 | 2 |
| 35 | 27.00 | 15.90 | 71.50 | 0 | 0.00 | 2 | 0.00 | 3 | 7 | 2 |
| 36 | 26.50 | 15.00 | 70.50 | 0 | 0.00 | 0 | 0.00 | 2 | 9 | 3 |
| 37 | 26.30 | 14.70 | 65.50 | 0 | 0.00 | 0 | 0.00 | 1 | 6 | 1 |
| 38 | 25.30 | 13.30 | 63.50 | 0 | 0.00 | 0 | 0.00 | 0 | 2 | 0 |
| 39 | 25.00 | 13.20 | 67.00 | 0 | 0.00 | 0 | 0.00 | 0 | 1 | 0 |
| 40 | 23.67 | 13.00 | 64.37 | 0 | 0.00 | 0 | 0.00 | 0 | 1 | 0 |
| 41 | 23.34 | 12.45 | 67.65 | 0 | 0.00 | 0 | 0.00 | 0 | 0 | 0 |

Max. = maximum, Min. = minimum, ˚C= Centigrade and RH= relative humidity.

Table 2. Correlation of different beetle populations with abiotic factors.

| Sr. No. | Pest | Max. temp. | Min. temp. | RH |
|---|---|---|---|---|
| 1 | White grub adult | 0.922 | 0.920 | 0.044 |
| | White grub larva | 0.677 | 0.641 | □□ 0.312 |
| 2 | Blister beetle | □□ 0.123 | □□ 0.081 | 0.790 |
| 3 | Wireworm larva | 0.152 | 0.564 | 0.312 |
| | Wireworm adult | 0.306 | 0.317 | □□ 0.446 |
| 4 | *P. alboquattata* | □□ 0.327 | □□ 0.272 | 0.328 |
| 5 | Flea beetle | 0.461 | 0.492 | 0.802 |

Table 3. Percent damage of beetles associated with maize crop.

| Standard week | White grub | | Blister beetle | Wire worm | *P. alboquattata* | Flea beetle |
|---|---|---|---|---|---|---|
| | Grub /100 plants | Adult /100 plants | / 100 cobs | /100 plants | / 100 cobs | / 100 cobs |
| 21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | 1.33 | 0.00 | 0.00 | 2.66 | 0.00 | 0.00 |
| 23 | 2.33 | 0.00 | 0.00 | 2.00 | 0.00 | 0.00 |
| 24 | 3.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 3.66 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 2.00 | 0.66 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 5.33 | 0.66 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 4.33 | 1.33 | 0.00 | 0.00 | 0.00 | 0.00 |
| 29 | 3.00 | 3.66 | 0.00 | 0.00 | 0.00 | 0.00 |
| 30 | 3.66 | 3.66 | 0.00 | 0.00 | 2.00 | 0.00 |
| 31 | 1.33 | 3.66 | 2.33 | 0.00 | 2.33 | 3.00 |
| 32 | 0.00 | 3.00 | 3.00 | 0.00 | 0.00 | 2.00 |
| 33 | 0.00 | 2.00 | 4.66 | 0.00 | 1.00 | 3.33 |
| 34 | 0.00 | 2.33 | 5.33 | 0.00 | 3.66 | 2.66 |
| 35 | 0.00 | 1.66 | 3.00 | 0.00 | 2.66 | 4.33 |
| 36 | 0.00 | 1.33 | 0.00. | 0.00 | 1.66 | 2.00 |
| 37 | 0.00 | 1.66 | 0.00 | 0.00 | 2.00 | 1.66 |
| 38 | 0.00 | 0.33 | 0.00 | 0.00 | 3.00 | 1.33 |
| 39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 |
| 40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mean | 1.57 | 1.23 | 0.91 | 0.095 | 0.88 | 0.96 |
| S.D | 1.72 | 1.32 | 1.68 | 0.69 | 1.19 | 1.35 |

reducing pollination. When the infestation is heavy, the beetles also consume the silks (styles), checking pollination, and thus prohibiting the formation of grain [9]. However, leaf beetle *Diabrotica virgifera virgifera* (Coleoptera: Chrysomelidae), distribution was found to be endemic to the New World and ranks among the top ten insect pests in worldwide in grain production [10-11]. Similarly, incidence and distribution of four flower eating beetles *Oxycentonia versicolor* (W.), *Cetoninae gen. sp.* Indct. and *Protaetia alboquattata* feeding on maize crop have been reported [12]. In addition to this, different beetles attacking roots (rootworms, wireworms, white grubs); ears and tassels (adult rootworms) and grain during storage (grain weevils, grain borers) also reported damage can occur at any stage of maize [13]. Moreover, female beetles of *D. speciosa* were detected from 30 to 45 days after maize emergence (latter season planting). Greatest peak of larvae were found on latter season maize (recently introduced in the farm system) and this explains adult's peak in seasons that were not recorded before. Larvae were found developing on black oats roots [14].

Blister beetle

White grub (Adult)

Grain feeding beetle

Leaf eating beetle

Wire worm

## CONCLUSIONS

Experimental studies presented scenario of the coleopteran insect pests infesting maize. These studies were carried out first time in the higher reaches of Udhampur district (Panchari). This study will ensure the further management strategies of various pests attacking the maize crop in a specified area. Weekly populations are in fact a source for various practices to be carried out to get rid of these insect pests.

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