



Seasonal incidence of cereal leaf beetle (*Oulema melanopus* L.) infesting oats in North Kashmir

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Abstract

Experiment was carried out at the farmers field near the Faculty of Agriculture, Wadura, Kashmir, India during 2021-22 under free choice conditions to study seasonal incidence of cereal leaf beetle (*Oulema melanopus*) infesting Rabi Oats (*Avena sativa* L.) in North Kashmir. The results obtained during investigation revealed that, both adults and grubs of *O. melanopus* appeared on oats from 10th standard week of 2021 and attained peak (21/m⁻²) in 12th standard week. During 2022 peak of the pest was observed in 11th standard week, while appearing from 9th standard week. However, the larval population commenced from 14th standard week with its peak (334/m⁻²) in 16th standard week. In year 2022, Adult population of *O. melanopus* appeared on oats from 9th standard week of 2022 and attained peak (23/m⁻²) in 11th standard week. While, the larval population commenced from 13th standard week with its peak (336/m⁻²) in 17th standard week. Later on, the pest population declined gradually towards the maturity of crop. Activity of pest has been observed in months of April-June where temperatures are congenial for multiplication of the pest, while the period before and after were low and high, respectively. The variation in degree of damage through this pest might be attributed because of change in weather factors responsible for overall climate change.

Keywords: *Oulema melanopus*, meteorological data, seasonal incidence

Introduction

The oats, *Avena sativa* Linnaeus occupies the 6th place among main crops, cropped throughout the world including wheat, maize, rice, barley and sorghum. The main purpose of its cultivation is to obtain source of food for livestock and also for seed because it is known to be nutritionally and medicinally valuable. The grain is now mostly preferred to use because of its rich source of nutrients and beneficial for health. The oats also occupy important place in the biochemical and cosmetic industry. Oats is being used as an important grain crop especially by the people of peripheral populations among the developing countries, and for specifically important uses in developed world. Oats are grown as a source of grain as well as for source of food for livestock, straw for bedding, hay, haylage, silage and chaff in many parts of the world. Oats are rated as rich source of protein, dietary soluble fibers and minerals. The oats are believed to contain protein content, equivalent to meat, milk and, egg protein. As food source oats are being most preferably used in breakfast, however it is being considered by consumers as healthiest food from natural source which adds to its global demand. Moreover, oats are preferred over other types of grain because it possess a distinctive nutritional composition and multifunctional benefits of select bioactive compounds, including protein, unsaturated fatty acids, soluble(beta-glucan) and insoluble fibre, micronutrients such as iron, potassium, copper and magnesium, thiamine, folate, zinc and phosphorus (Yu *et al.*, 2012). Oats is also provided with source of many compounds such as tocopherol, inositol hexaphosphate, phenolic compounds, avenanthramides and sterols that bears antioxidant activity. (Brindzova *et al.*,2012) [3]. The Consumption of oats helps to reduce weight, cholesterol-lowering, antidiabetic effects, improve postprandial

glycemic, insulinemic response and boost immunity. (Poulter *et al.*,1999 and Keenan, 2002) [17, 13].

The total world production of oats was reported to be 23 million tonnes with major contributions from Russia and Canada, with both producing approximately 20% of the total global production. Other remarkable producers were, Australia and Finland, the United Kingdom and Poland each with over 1 million tonnes (Anonymous a, 2019) [1]. In India, the total fodder cultivation constitutes approximately 4.9 (%). The total area under fodder cultivation is 8.6 million ha on individual crop basis. Whereas, oat cultivation occupies approximately about 1.0 million ha in the country with its production of 35-50 t/h (Anonymous, 2019) [1]. In India, it is cultivated in Punjab, Haryana, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Rajasthan, Maharashtra and West Bengal. Uttar Pradesh holds maximum share of oat production with - 34 per cent, followed by Punjab - 20 per cent, Bihar -16 per cent, Haryana - 9 per cent and Madhya Pradesh - 6 per cent (Panday and Roy, 2011) [16].

Besides diseases, A number of insect pests has been reported so far on oats which lead to considerable losses in green fodder and oat meal as well. Fifteen (15) insect pests, belonging to 5 different orders were recorded in the oats (*Avena sativa* L.) Kashmir agro-ecosystem. Soil borne insects *viz.* white grubs (*Holotrichia longipennis*, *Brahmina* spp, *Melolontha furcicauda* and *Oryctes* spp), wireworm (*Agriotes* spp) and cutworm (*Agrotis* spp); sucking pests including wheat aphid (*Schizaphis graminum*), green stink bug (*Carpocoris* spp), aster leafhoppers (*Macrostelus quadrilineatus*), broad-headed bug (*Camptopus lateralis*) and oat thrips (*Stenothrips graminum*) and foliage pests including cereal leaf beetle (*Oulema melanopus* L.), surface grasshopper (*Chrotogonus trachypterus* Blanchard),

armyworm (*Mythimna separata*) and gram pod borer (*Helicoverpa armigera*) appeared as pests in the oats field. Among these *M. separata*, *O. melanopus* and *H. armigera* were major pests (Kumar *et al.*, 2019) [14]. The initial appearance of cereal leaf beetle was recorded in Southern Michigan of the United States in the beginning of 1960s but now have occupied major area of North America. It is important pest of cereal crops, mentioned by Carl Linnaeus in 1778. This beetle is characterized to produce one generation in a year. The Adult members of this beetle feed before winter and stay much of over wintering time in protected areas such as wind rows, crop stubble and tree bark crevices. Adults perform matting once the temperature reaches optimum levels of above 9-10 degrees Celsius (or 44.6 degrees F) and females have a comparably long laying period of approximately 45-60 days. They eggs are laid on the undersurface of leaves. The larvae make appearance in 7-15 days, and begin feeding on leaves with marked stripes along the leaf. The larvae took 12-20 days to attain maturity. Larvae poses serious threat to crops, as they consume upper surface of the leaves and make them hindered and unable to photosynthesize. Pupation takes place inside soil and took 20-25 days for adults to emerge, to repeat the cycle once again. Keeping in view the above facts it becomes imperative to study the "Seasonal Incidence of *Oulema melanopus* Infesting Rabi Oats (*Avena sativa* L.) in North Kashmir".

Materials And Methods

Present study was conducted out at farmers field near FOA SKUAST-K Wadura campus during Rabi season (2020-21 and 2021-22). Sowing was done on 12th of November 2020 and 5th Nov. 21 for two consecutive years. A set of 4 oat genotypes with 3 check varieties were screened for their resistance against cereal leaf beetle. The cultivars were sown in Complete Randomized Block Design with genotype to genotype spacing of 50 cm and plant to plant spacing of 10 cm. The packages of practices were followed as per recommendations of SKUAST-K. However, no insecticidal treatment was given to experimental material. The genotypes were screened under natural infestation in the field

Grubs and adult of Cereal leaf beetle feed on the crop was observed by square meter method and the damage was worked out as under:

$$\text{Damage percentage} = \frac{\text{No. of damaged plants}}{\text{Total number of plants}} \times 100$$

Total number of plants

Larval activity was determined by counting the total number of larvae at weekly interval. To assess the larval populations at experimental sites, square meter/quadrant method was done within the experimental plots. Larvae registered in the experiment were correlated with the abiotic factors (temperature, relative humidity and rainfall).

Meteorological data

Data on temperature (Max. / Min. in 0C), relative humidity (%) and rainfall (mm) was collected from automatic weather station, Wadura. Multiple correlations were worked out to determine the cumulative and individual effects of weather

factors (temperature, rainfall and relative humidity) on population buildup of the insect pests.

Statistical analysis

Data collected from the experimental site was subjected to standard statistical procedure using standard statistical procedures (Gomez and Gomez, 1984) [6]

Results and Discussion

Oat's crop was monitored throughout the growing season in both years 2021 and 2022 to record the infestation and population of the cereal leaf beetle of both larvae and adult. It was observed that the adult population of (*O. melanopus*) appeared oats in 10th standard week of 2021 and attained peak (21/m²) in 12th standard week. Similarly, the larval population was found in the 14th standard week with peak attained (334/m²) in 16th standard week. The infestation was recorded in 10th week with highest infestation in 16th week of 2021. Similarly, the same procedure was repeated in the year 2022 and was found that the adult population appear on oats crop in 9th standard week and attained peak (23/m²) in 11th standard week. In the same manner the larval population was found in the 13th standard week and attained peak (336/m²) in 17th week. The first visual of infestation was recorded in the 9th standard week and with highest infestation in 18th standard week of the year 2022. Our results are in close conformity with Mc Pearson (1983) who described seasonal abundance of *O. melanopus* in soft red winter wheat, winter barley, and spring oats and observed highest Population in wheat and barley during mid-May and attained beetle density of 31.7 and 14.7 per 0.3 m of row, respectively. In spring oats, the population had attained a peak of 196.7/ 0.3 m of row at the ending of May. Egg laying with higher presence of frequent clusters of egg was observed during mid-April instead of May. First adults before prolonged dormancy were seen in corn field early in the month of June. Population reached peak densities of over 24/0.5 m of row between 10 and 15 June, followed by rapid decline in population. *O. melanopus* were notably in frequent numbers on the edges of corn field as compared to the interior. Importantly ample beetles were seen on margins of field corn nearer to small grain than were reported close to wooded areas. (Francis *et al.*, 2012) [5] conducted a study in wheat, *Triticum aestivum* L., in South Carolina through sampling on week basis of cereal leaf beetle, *O. melanopus* (L.). Spatial Analysis indicated that Peak densities of adults were found directly dependent on peak densities of eggs and larvae. Results also revealed that all stages of cereal leaf beetle were found directly proportional to spike counts and the spike numbers were found higher in internal vicinity of the field as compared with field edges.

The effect of antibiotics on pest biology could be observed at the time of oviposition. Study also revealed that arthropod pests may experience resistance from host plant by strongly inhibiting the progression of eggs by processes such as exaggerated reactions, development of abnormal lumps, or by biochemical defensive mechanisms. (Hilker and Meiners, 2002) [10]. Although, (Laznik *et al.*, 2010) described the activity of entomopathogenic nematodes (*Rhabditida*) against cereal leaf beetle (*O. melanopus* L.), Coleoptera, Chrysomelidae) adults under laboratory conditions. In this course of study, the three Slovenian strains of entomopathogenic nematodes) and commercial product Entonem (active ingredient of *S. feltiae*), were brought in use to measure their activity against cereal leaf beetle. The

most effective strain and good substitute to chemical insecticides with greater tendency to control overwintered cereal leaf beetles was *S. carpocapsae* C101. The efficiency of entomopathogenic nematode was found greatly dependent on temperature.

Suppositions of the investigation must be look into first. It was supposed that bulkiness of insect was estimated correctly. Inaccuracy of unexpected extent is related to the day-to-day calculations of density, combination of these into seasonal totals, and, with respect to eggs, the assumed stage time scale. (Sawyer and Haynes, 1984). There was seen notable difference in CLB appearance within small grains fields in northern Utah, with few fields reported heavy infestation of eggs and larvae whereas, rest of many fields were seen to exhibit light or moderate infestation. There had also been reported large variation during years as to which fields and areas of Cache Valley were massively crowded by CLB, due to various grounds: adults frequently spent winter away from grain fields (Haynes and Gage, 1981^[8] and

Honek, 1991)^[12], many fields under crop rotation directly effects the population density of the beetle, especially when fields planted with crops other than grains. This shows significant variability in when separate fields are cropped with grains. Although not studied here, geographical variability of CLB density found also at finer resolution among separate locations within fields of small grains (Reay-Jones, 2010 and 2012)^[18]. Geographical variability in the density of *Oulema melanopus* among and within fields may depend on oviposition directly influenced by the host plant characteristics, like tiller and spike density (Honek 1991; Reay-Jones 2010 and 2012)^[12, 18] and foliage age and development (Ruppel, 1972, Dysart *et al.*, 1973)^[4]. The density of *O. melanopus* was measured on a square meter basis, rather than on the basis of individual plants, tillers, or flag leaves, as is widely recommended to growers for scouting (e.g., Herbert and Van Duyn 1999^[9], Blodgett *et al.*, 2004^[2], Hammon and Peairs, 2004^[7], Hodgson and Evans, 2007^[11] and Roberts and Walenta, 2012)^[12]

Table 1: Effect of weather parameters on population and infestation of cereal leaf beetle during 2020-21

Standard Week	Damage (%)	Max. Temp. C ⁰	Min. Temp C ⁰	Rainfall (mm)	RH Morning	RH Evening	Adult	Grub	Infestation
44 th	0.00	19.75	0.50	0.00	74.50	50.50	0.00	0.00	0.00
45	0.00	19.25	-2.15	0.00	77.50	37.50	0.00	0.00	0.00
46	0.00	12.75	0.75	3.30	84.50	76.50	0.00	0.00	0.00
47	0.00	7.00	-1.50	8.00	86.00	81.50	0.00	0.00	0.00
48	0.00	12.5	-1.00	2.90	90.50	74.00	0.00	0.00	0.00
49	0.00	8.75	-1.00	11.00	92.00	80.50	0.00	0.00	0.00
50	0.00	8.75	-1.60	14.60	91.00	72.00	0.00	0.00	0.00
51	0.00	9.50	1.75	0.00	85.50	58.00	0.00	0.00	0.00
52	0.00	7.75	-4.30	0.75	89.50	73.50	0.00	0.00	0.00
1	0.00	5.25	-4.75	42.50	89.50	74.50	0.00	0.00	0.00
2	0.00	6.30	-5.50	3.50	90.00	62.00	0.00	0.00	0.00
3	0.00	10.50	-6.00	0.00	91.00	60.00	0.00	0.00	0.00
4	0.00	5.00	-5.00	9.00	94.00	73.50	0.00	0.00	0.00
5	0.00	4.25	-6.00	-0.75	90.00	89.00	0.00	0.00	0.00
6	0.00	10.50	-3.00	0.00	94.00	68.00	0.00	0.00	0.00
7	0.00	15.30	-2.00	0.00	70.50	46.00	0.00	0.00	0.00
8	5.92	16.75	3.00	1.20	82.50	43.50	0.00	0.00	0.00
9	7.87	11.85	3.75	4.50	79.50	67.00	0.00	0.00	0.00
10	10.35	13.75	3.00	4.60	79.00	59.50	3.00	0.00	31.00
11	13.29	13.00	3.00	29.00	81.00	66.50	6.00	0.00	42.00
12	13.01	13.00	4.45	30.00	65.50	62.50	16.0	0.00	59.00
13	14.55	17.75	6.25	3.70	83.00	58.00	11.0	0.00	71.00
14	16.69	19.25	5.25	17.90	68.50	56.00	9.00	37.00	89.00
15	13.02	16.00	5.00	10.80	80.00	53.50	6.00	165.00	189.00
16	19.81	15.25	6.75	12.80	80.50	64.00	2.00	306.00	329.00
17	18.63	21.00	5.50	17.60	65.00	46.50	0.00	115.00	332.00
18	21.82	24.75	9.25	1.40	66.50	60.50	0.00	34.00	257.00
19	26.51	22.25	10.25	5.70	80.50	69.50	0.00	13.00	249.00
20	36.93	24.00	9.00	2.25	84.50	46.00	0.00	9.00	211.00
21	19.32	23.75	8.00	4.00	76.50	54.50	2.00	0.00	162.00
22	14.24	28.75	11.75	1.10	77.50	61.50	5.00	0.00	153.00
23	8.62	31.75	15.00	0.00	73.50	38.50	6.00	0.00	126.00
24	3.23	29.00	14.25	3.45	74.00	46.50	8.00	0.00	114.00

Table 2: Effect of weather parameters on population and infestation of cereal leaf beetle during 2021-22

Standard Week	Damage (%)	Max. Temp. C ⁰	Min. Temp. C ⁰	Rainfall (mm)	RH Morning	RH Evening	Adult	Grub	Infestation
44	0.00	19.25	1.00	0.00	91.50	65.50	0.00	0.00	0.00
45	0.00	12.50	2.25	1.50	90.50	69.50	0.00	0.00	0.00
46	0.00	14.00	-1.50	0.00	89.00	61.00	0.00	0.00	0.00
47	0.00	13.75	-2.05	0.00	89.00	65.50	0.00	0.00	0.00
48	0.00	12.50	-2.25	0.00	88.50	64.50	0.00	0.00	0.00

49	0.00	10.50	-0.25	12.20	80.00	69.50	0.00	0.00	0.00
50	0.00	9.10	-3.60	0.00	89.00	73.50	0.00	0.00	0.00
51	0.00	9.05	-2.50	0.00	83.50	50.50	0.00	0.00	0.00
52	0.00	7.50	-1.30	1.10	90.00	61.00	0.00	0.00	0.00
1	0.00	5.05	0.10	9.15	93.00	82.50	0.00	0.00	0.00
2	0.00	5.70	-2.35	6.20	92.50	80.50	0.00	0.00	0.00
3	0.00	6.25	-1.90	4.60	92.00	82.50	0.00	0.00	0.00
4	0.00	8.55	-1.60	1.05	90.50	65.00	0.00	0.00	0.00
5	0.00	9.75	-1.00	1.90	88.50	68.00	0.00	0.00	0.00
6	0.00	10.50	-1.20	3.45	91.50	59.50	0.00	0.00	0.00
7	0.00	15.35	-1.20	0.10	87.00	44.00	0.00	0.00	0.00
8	4.92	10.75	-0.40	7.90	90.50	67.50	0.00	0.00	0.00
9	7.81	10.85	1.35	5.00	93.00	66.00	4.00	0.00	34.0
10	10.78	15.10	3.95	5.85	90.50	63.00	8.00	0.00	45.0
11	13.56	25.65	5.85	0.50	82.00	40.50	21.0	0.00	65.0
12	14.52	22.90	6.40	5.80	80.00	43.00	11.0	0.00	77.0
13	15.37	27.15	7.15	0.00	70.00	34.50	10.0	24.0	83.0
14	16.59	27.80	7.70	0.00	67.50	28.50	8.00	33.0	88.0
15	14.25	25.30	7.90	3.70	79.50	43.00	5.00	114	103.
16	20.61	21.70	8.20	8.90	83.00	54.50	0.00	169	192
17	26.73	24.25	8.60	0.70	85.00	58.00	0.00	313	336
18	24.32	24.35	11.60	2.50	86.00	69.00	0.00	118	341
19	31.54	28.80	10.55	0.00	79.50	40.00	0.00	30.0	329
20	35.62	22.85	11.25	2.60	79.00	62.00	0.00	10.0	314
21	22.45	25.85	10.60	9.60	83.50	60.00	0.00	0.00	215
22	13.67	26.80	11.20	2.80	74.50	51.50	6.00	0.00	199
23	8.33	29.80	10.85	0.30	71.00	57.50	4.00	0.00	169
24	3.26	29.55	12.25	2.50	70.50	52.00	0.00	0.00	153

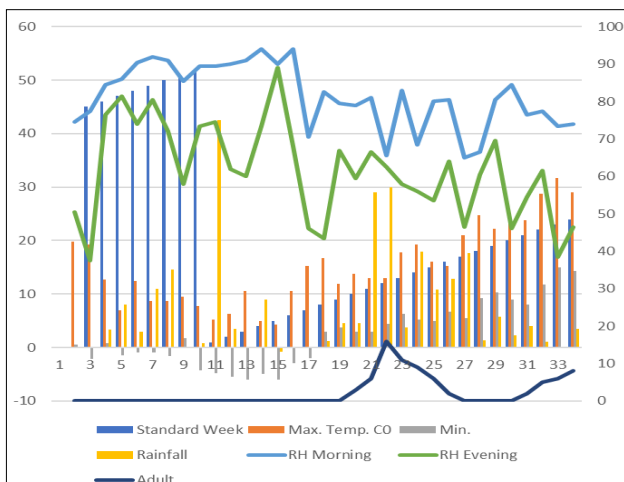


Fig 1: Population fluctuations of adults of cereal leaf beetle along with weather parameters of 2021

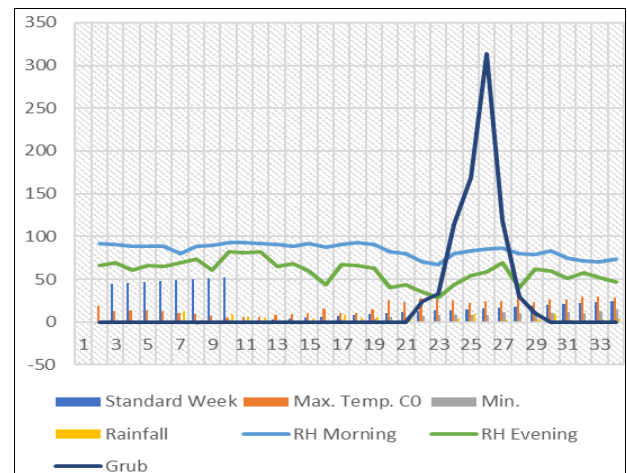


Fig 3: Population fluctuations of grubs of cereal leaf beetle along with weather parameters of 2022

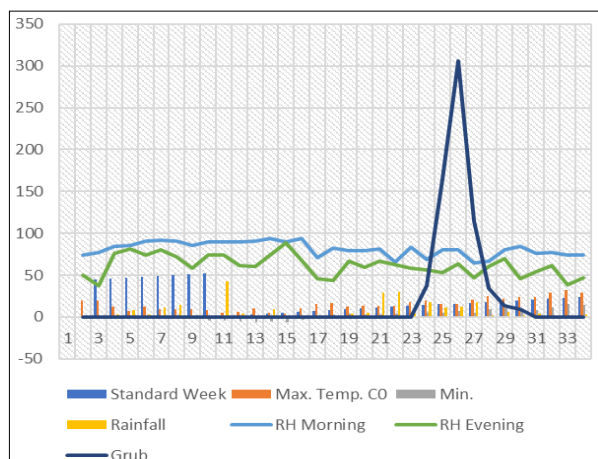


Fig 2: Population fluctuations of grubs of cereal leaf beetle along with weather parameters of 2021

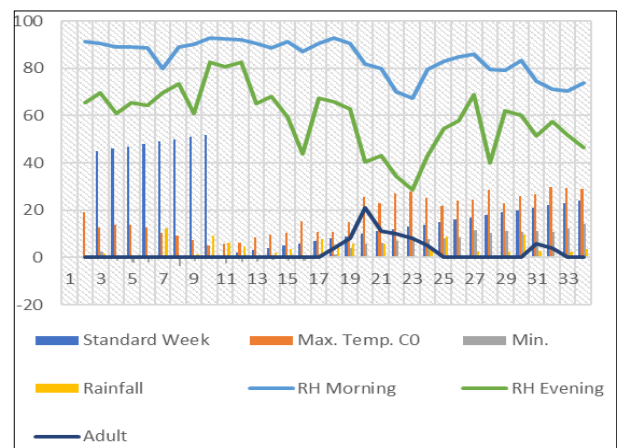


Fig 4: Population fluctuations of adults of cereal leaf beetle along with weather parameters of 2022

Correlation of per cent damage of cereal leaf beetle with abiotic factors

Table-3&4 revealed that correlation between abiotic factors and per cent damage of *O. melanopus* in the year 2021 exhibited highly significant positive correlation with maximum, minimum temperature ($r=0.593^{**}, 0.703^{**}$), while as highly significant negative correlation with relative humidity of morning as well as non-significant negative

correlation with relative humidity of evening. However, this pest exhibited non-significant positive correlation with rainfall. Similarly, the correlation results in the year 2022 revealed highly significant positive correlation with maximum, minimum temperature (0.723^{**} and 0.822^{**}), although highly significant negative correlation with relative humidity of morning as well as evening. Though this pest showed significant positive correlation with rainfall.

Table 3: Correlation of cereal leaf beetle with weather parameters 2021.

Factors	<i>Oulema melanopus</i>	
	Correlation coefficient (r)	Regression Equation
Temperature (°C)		
Max.	0.593**	Y = 0.781+ (-3.96) X
Min.	0.703**	Y = 0.767+ (-5.81) X
Relative humidity (%)		
Morning	-0.47**	Y = -0.550+ 52.858 X
Evening	-0.31 NS	Y = -0.237 + 22.623 X
Rainfall/week (mm)	0.11	Y = 0.107 + 7.1971 X

Table 4: Correlation of cereal leaf beetle with weather parameters 2022.

Factors	<i>Oulema melanopus</i>	
	Correlation coefficient (r)	Regression Equation
Temperature (°C)		
Max.	0.723**	Y = 0.548 + 12.615 X
Min.	0.822**	Y = 0.411 + 0.038 X
Relative humidity (%)		
Morning	-0.47**	Y = -0.3375 + 87.608 X
Evening	-0.43**	Y = -0.5824 + 64.628 X
Rainfall/week (mm)	0.03	Y = 0.5123 + (- 4.7606) X

Conclusion

It was concluded that insect pests of oats are changing year after year and most of the insect pests are changing their host range due to climate change all over the world. Adult population of *O. melanopus* appeared on oats from 10th standard week of 2021 and attained peak (21/m²) in 12th standard week and during 2022 peak of the pest was observed in 11th standard week, while appearing from 9th standard week. Furthermore, the larval population commenced from 14th standard week with its peak (334/m²) in 16th standard week. In year 2022, Adult population of *O. melanopus* appeared on oats from 9th standard week of 2022 and attained peak (23/m²) in 11th standard week. Furthermore, the larval population commenced from 13th standard week with its peak (336/m²) in 17th standard week. Later on, the pest population declined gradually towards the maturity of crop.

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