Monitoring studies of Arthropod Complex fauna associated with Rapeseed- mustard crop grown in Kashmir Himalayas

Abstract

Kashmir has quietly undergone a yellow revolution as thousands of hectares of land have been brought under mustard cultivation to double the farmers' income. Earlier, most of the land in Kashmir was used only for growing a single crop -- paddy in most areas but now farmers are rotating crops in Kharif and Rabi seasons just like in other parts of the country.There is still many challlanges which are hurdle in high production goal.Insect biodiversity is associated with the quantity and type of host plants available, environmental factors, and their physiological state. Arthropod complex of mustard was studied and about eight species of insects-pests at Mountain Research centre for field crops(MRCFC) during Rabi 2020 -21 was recorded. It has been observed that the mustard aphid, *Lipaphiserysimi*Kalt., persists constantly in a sizable population and causes substantial crop damage from the blossoming to the maturity stage. *Phyllotretacruciferae*Goeze (flea beetle) occurred at the seedling stage, and *Carpocoris* sp. (shield bug) caused little harm to the crop from the seedling to the maturity stage. Leaves have been only infested by cabbage aphid, *Brevicorynebrassicae*, mustard aphid, *Lipaphiserysimi*(Kalt.), and mustard leaf miner, *Chromatomyiahorticola*, and they been detected in sporadic, low-population occurrences. Among them,*Brevicorynebrassicae*is found at flowering stage. *Pierisbrassicae*, the cabbage butterfly, occurs sporadically and with high abundance. The status of all eight insect-pests on *Brassica* species was observed as minor with irregular occurrence while *L. erysimi*as a regular key pest.Six Insect pollinators were recorded during the bloom period of the crop.

Key words;-Arthropod,Rapseed,Mustard,insects,Kashmir,Crop

INTRODUCTION

"Amid a slew of initiatives by the government to double farmer's income, mustard oilseed farming is gaining popularity in Kashmir as the farmers brought more land under its cultivation during 2020-21.The variety and availability of host plants, environmental variables, and physiological status are all related to insect biodiversity. As host plants serve as both acceptable oviposition sites for adult females and prospective food sources for the young ones, their availability and an insect's capacity to locate them are crucial for the survival of a species" (Patel and Singh, 2017a). "The information that the olfactory and gustatory systems transmit to the central nervous system (CNS) about the chemical composition of the plant plays a significant role in the choice and recognition of a host plant.Insects in particular exhibit a high degree of peripheral plasticity that enables them to adapt to their surroundings. In terms of production, rapeseed-mustard is the second most important oilseed crop farmed in India after soybean, and it has the highest oil yield among oilseed crops. It is produced on a 6.4 million hectare (ha) area with a productivity of 1262 kg/ha"(Patel and Singh, 2017a)."It has an oil content ranging from 35 to 45%. India produces 10% of the world's edible oils and holds the fourth-largest edible oil economy in the world, behind the US, China, and Brazil. The primary oilseed crop cultivated in India during rabi is rapeseed-mustard. The top states for mustard cultivation, accounting for more than 70% of the nation's total mustard area, are Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana, and Gujarat. *Brassica juncea*, one of the *Brassica* species, makes up roughly 90% of the total area in India.Even with the use of good production technologies, the nation's mustard crop is unable to produce its full potential output. This is owing to the fact that different biotic and

abiotic variables severely reduce the production of *Brassica* crops. Insect pests are one of the most significant biotic factors affecting crop productivity among biotic restrictions" (Patel and Singh, 2017a). In India, rapeseed-mustard has been discovered to be infested by about 50 different insect species. The Kashmir valley, where we have a moderate type of environment that is different from the rest of the country, offers significant potential for research on insect-pests of rapeseed and mustard.

Material and Methods

The study was conducted first time in kashmir during rabi 2020-21 and 2021-22 in the Field and Laboratory of the Section of Entomology, Mountain research centre for field crops (MRCFC) KhudwaniKulgamSKUAST-K. The mustard *Brassica juncea,* variety Shalimar sarson -1 was collected from BreedingCentre and seeds were sown on 30 October in rows. The row to row distance was 45 cm. Intercultural operations such as weeding etc were done whenever necessary but no pest management practices were done in the field. Fertilizers were applied according as SKUAST-K Package and practices.Monitoring of the incidence of insect pests and their natural enemies was carried out along with collection of adult arthropods through sweep net method, and adopting the methods suggested by Reissig*et al*., (1986) and Bayot*et al*., (1990).The relative abundance were calculated by Relative abundance of dominant species of pollinator was worked out by using the following formula given by Nath and Virakthamath (2010) after pooling all the data.

$$\text{Relative abundance of species A} = \frac{\text{Number of particular species}}{\text{Total no. of Insect species}} \times 100$$

Observation, collection and identification of free living arthropods

Free-living insects were collectedfrom Germination/seedling to siliqua maturation stages using a sweep net having a diameter of 30 cm, mesh size of 1.5 mm and attachedwith a 1.5 m long rod. Sweeping was done weekly inbetween 09.00 to 11.00 h of the day, and each sample was consisted of 30 sweeps encompassing an area from ground level to the top of the plants.The pollinators were collected during bloom of the crop. The collected insects werebrought to the Entomology Laboratory of MRCFC Khudwani for identification and counting. "They were killed by storing in a freezer for a few hours, mounted on points, dried and morphotyped. Insects were identified up to species or genus level and also separated as pest, predator, pollinator and unknown categories"[Patel et al. 2019].

Results & Discussion:-

Six insect- pests were recorded during the cropping season at different stages of *Brassica* species of which 3 belonged to Hemiptera, 1 to Lepidoptera, one each to the order Coleoptera and Dipterain kashmir valley (Table 1). It was observed that the insect- pest species infested different parts *viz.*, leaves, shoot, flower and pod. Major pest which caused significant damage was *Cabbage butterfly,Leaf miner and Mustard aphid*. During the course of investigation, three natural enemies' *viz.*, *Coccinellaseptempunctata*, *Apantelesglomeratus*and *Diaeretiellarapae*were found to be associated with insect-pest of rapeseed-mustard irrespective to the insect pest (Table 3). The abundance of insect pollinators recorded from mustard field during bloom of same experiment revealed 6 insect pollinators (Table-2) belonged to 3 orders.The highest mean relative abundance of *Apiscerana*(11.71%) followed by *Apismellifera* (7.04%) and least 3.74% of

*Erstalisarbustorum.*The Photographs of insect pests pollinators are listed in Table 2 and fig-1. Table 4 showed that the abundance, richness and diversityof pest, predator, pollinator and other category of insects varied from 0.8 ± 0.1 to 7.0 ± 1.6,0.3±0.1 to 0.5 ± 0.2 and 0.5 ± 0.3 to 6.4 ± 1.6 per 30 sweeps, respectively andthe results differed significantly.The richness and abundance of pollinatorswere significantly higher compared to pests, predators andother category. The pests revealed the highest diversitycompared to predators, pollinators and other category.Several studied have shown that different insectpests infest rapeseed-mustard at different locations in India. Rai (1976) reported "a total of 24 insect pests from India, out of which *L. erysimi, A. lugensproxima*and*B. Cruciferarum*were referred as the major pests while flea beetles, *P. Cruciferae*Goeze and cabbage butterfly, *P. Brassicae*L., *M. Persicae*Sulzer and *P. Xylostella*Lin. were considered as minor pest". "The total number of insect pests on rapeseed-mustard increased and stood at 38, of which 15 are considered economically important" (Bakhetia and Sekhon, 1984). "In 1991, the number of insect pests increased to 40" (Bakhetia and Arora, 1993)."Present, more than 43 species of insect pests have been reported to infest rapeseed mustard in India, in which about a dozen species are considered as major pests" (Purwar*et al*., 2004). Choudhury and Pal (2006) reported "fourteen insect including natural enemies on rapeseed-mustard. Out of which, *L. erysimi*was categorized as major pest". Singh *et al*. (2007) reported "21 insect species during
the various crop stages". "Nowadays, mustard aphid is observed as a national insect-pest" (AICRP, 2015).

Conclusion

In conclusion from the present investigation it can be concluded that the mustard aphid, flea beetle and cabbage butterfly were key pests of mustard found abundantly at different developing stages of the crop. Fortunately a number of natural enemies of these pests also present along with them. These beneficial bio control agents are useful for pest suppression in an ecologically viable and sustainable pest management programmre.

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Table.1 Insect pest complex associated with mustard in MRCFC Khudwani Kashmir during rabi 2020-21

Common name	Scientific name	Order	Family	Feeding site	% Incidence		Mean	Status
					2020	2021		
Mustard aphid	*Lipaphiserysimi(Kalt.)*	Aphididae	Hemiptera	Leaf/Flowering stage	7.69	8.69	8.19	+++
Cabbage butterfly	*Periesbrassicae*	Lepidoptera	Pieridae	Leaf	11.53	10.54	11.03	+++
Flea beetle	*Phyllotretacruciferae (Goeze)*	Coleoptera	Chrysomelidae	Leaf	5.76	6.22	5.99	+ +
Pea leaf miner	*Phytomyzahorticola*	Diptera	Agromyzidae	Leaf	9.61	10.69	10.15	++
Cabbage aphid	*Brevicorynebrassicae (Linn.)*	Hemiptera	Aphididae	Leaf/Flowering stage	7.22	8.12	7.67	+++
Shield Bug	*Carpocoris sp.*	Pentatomidae	Hemiptera	leaf	0.34	0.24	0.29	+
C.D.(P=0.05)					2.34	2.67		

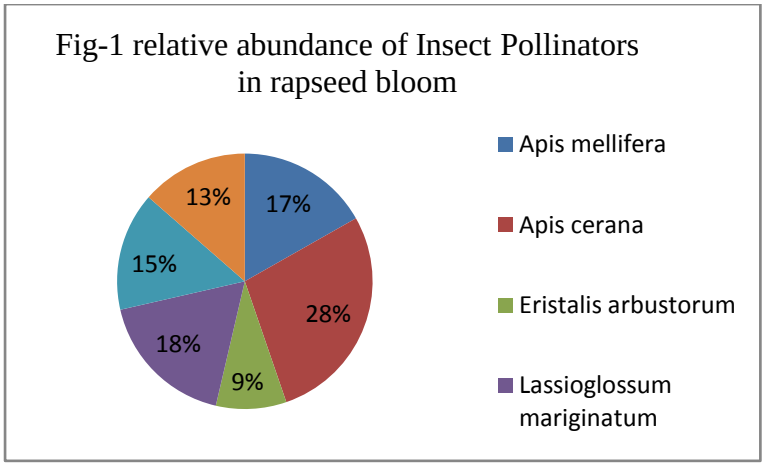

Table-2 Insect Pollinator complex of Mustard in MRCFC Khudwani Kashmir during rabi 2020-21

Scientific Name	**Order**	**Family**	**Relative abundance (%)**		**Mean**
			2020	**2021**	
Apismellifera	Hymenoptera	Apidae	6.54	7.55	7.04
Apiscerana	Hymenoptera	Apidae	11.21	12.21	11.71
Eristalisarbustorum	Diptera	Syrphidae	3.73	3.76	3.74
Lassioglossummariginatum	Hymenoptera	Halictidae	7.47	7.44	7.45
Adrena spp.	Hymenoptera	Andrenidae	6.54	6.04	6.29
Eristalistenax	Diptera	Syrphidae	5.60	5.78	5.69
C.D.(P=0.05)			2.97	1.89	

Table 3. Natural enemies associated with insect-pests of rapeseed-mustard in MRCFC Khudwaniduring *rabi*2020-21

Scientific name	**Order and family**	**Host**	**Relative abundance**	**Economic status**
Coccinellaseptempunctata	Coleoptera Coccinellidae	*Lipaphiserysimi, Myzuspersicae, Brevicorynebrassicae*	+++++	Major
Apantelesglomeratus	Hymenoptera Braconidae	*Pierisbrassicae*	++	Low
Diaeretiellarapae	Hymenoptera Braconidae	*Lipaphiserysimi, Myzuspersicae, Brevicorynebrassicae*	++	Low

Table-4 Average richness, abundance and diversity of arthropod fauna of mustard

	Pests	**Natural Enemie (Parasitoids/predators)**	**Pollinators**
Abundance	7.0 ± 1.6	1.0 ± 0.5	3.0 ± 8.5
Richness	1.8 ± 0.43	0.5 ± 0.2	6.4 ± 1.6
Diversity	0.8 ± 0.1	0.3 ± 0.1	0.5 ± 0.3

Fig 2- Some insect pests of rape seed mustard In Kashmir Valley.1,Shield bug,2,*Lipaphiserysimi 3, Pierisbrassicae 4,Phytomyzahorticola*

References:-

Patel, S. and Singh, C. 2017a. Development of weather based forewarning model for mustard aphid, *Lipaphiserysimi*(Kalt.) in Tarai region of Uttarakhand. *J. Agrometeorol.*, **19**: 382.

Patel, S. and Singh, C. 2017b. Seasonal dynamics of *Lipaphiserysimi*(Kalt.): Arrival, peak and migration pattern in tarai region of Uttarakhand. *J. Exp. Zool.India.*, **20**: 1573-75.

Patel, S., Singh, C.P. and Yadav, S.K. 2017a.Seasonal incidence of mustard flea beetle, *Phyllotretacruciferae* on Brassica species in relation to weather parameters at different dates of sowing.*J. Ent. Zool. Stud.*, **5**: 673-77.

Patel, S., Yadav, S.K. and Singh, C.P. 2017b.The incidence of painted bug, *Bagradahilaris* (Burmeister) on *Brassica* spp. and Erucasativa with respect to the date of sowing.*J.Ent.Zool. Stud.*, **5**: 774-76.

Patel, S., Yadav, S.K. and Singh, C.P. 2017c.Bio-efficacy of insecticides against *Lipaphiserysimi* (Kalt.) in mustard ecosystem.*J.Ent. Zool. Stud.*, **5**: 1247-50.

Patel, S., Yadav, S.K. and Singh, C.P. 2018.Foraging behaviour of mustard sawfly, *Athalialugensproxima*Klug.on rapeseed-mustard.*J. Experim. Zool.*, **21**:379-81.

AICRP. 2015. Annual Progress Report. National Research Centre on Rapeseed-Mustard, Bharatpur - 321303, Rajasthan, India.

Bakhetia, D.R.C. and Arora, R. 1993. Changing scenario of insect pests and pest management in rapeseedmustard.***In***: *Pests and Pest Management in India - The Changing Scenario*. Sharma, H.C. and Rao,

M.V. (Eds). *National Seminar in Changing Scenario in Pest and Pest Management in India* held during31 Jan - 1 Feb. at Hyderabad, pp. 56-59.

Patel, S., Yadav, S.K. and Singh, C.P. 2018.Foraging behaviour of mustard sawfly, *Athalialugensproxima*Klug.on rapeseed-mustard.*J. Experim. Zool.*, **21**: 379-81.

Purwar, J.P., Singh, R.K. and Mall, P. 2004. Eco-friendly management of insect pests in rapeseed-mustard.*Indian Farmers Digest.*,**37**: 34-35.

Rai, B.K. 1976. Pests of oilseed crops in India and their control. ICAR, New Delhi, p. 121.
Singh, R., Singh, D. and Rao, V.U.M. 2007.Effect of abiotic factors on mustard aphid (*Lipaphiserysimi*Kalt.) on Indian Brassica.*Indian J. Agric. Res.*, **41**: 67-70.

Yadav, S.K. and Patel, S. 2017. Insecticidal and repellent activity of some plant extracts against *Myzuspersicae* (Sulzer) and *Brevicorynebrassicae* (Linnaeus). *J. Ent.Zool. Stud.*, **5**: 1434-39.

Sollai, G.; Biolchini, M.; Crnjar, R. Taste sensitivity and divergence in host plant acceptance between adult females and larvae of Papiliohospiton. *Insect Sci.* **2018**, *25*, 809–822

Feeny, P.; Städler, E.; Åhman, I.; Carter, M. Effects of plant odor on oviposition by the black swallowtail butterfly, *Papiliopolyxenes* (Lepidoptera: Papilionidae). *J. Insect Behav.* **1989**, *2*, 803–827.

Reissig WH, Heinrichs EA, Litsinger JK, Moody K, Fielder L, Mew TW, et al. Illustrated guide to Integrated Pest Management in Rice in Tropical Asia, International Rice Research Institute, Los Banos, The Philippines. 1986, 411

Bayot RG, Cayabyab BF, Benigno EA, Ebuenga MD, Penalba FE. Monitoring populations of the brown plant hopper, *Nilaparvatalugens* (Stal), the green leafhopper, *Nephotettixvirescens* (Distant) and spiders in rice at Maquiapo, Guagua, Pampanga. Philippines Entomologist. 1990; 8(2):779-786.

Nath, S. and Virathamath, S. 2010.Pollinator fauna of sunflower and their relative abundance.*Karnataka Journal of Agriculture Science***23**(3): 517-518.

Patel S, Singh CP, Yadav SK. Monitoring of insect-pest complex on rapeseed-mustard at Pantnagar.Journal of Entomological Research. 2019;43(1):73-6.