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Effects of botanical extracts and entomopathogens on natural enemies in rapeseed–mustard

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Abstract

The present investigation was conducted during the *rabi* season of 2022–2023 at Tirhut College of Agriculture, Dholi, Bihar, to assess the effects of selected botanical extracts, entomopathogenic fungi, and a chemical insecticide on coccinellid beetles, important predators of mustard aphid (*Lipaphis erysimi* Kalt.). The experiment was laid out in a randomized block design with eight treatments and three replications. Treatments comprised *Beauveria bassiana*, *Metarhizium anisopliae*, *Verticillium lecanii*, ginger rhizome extract, onion bulb extract, garlic bulb extract, dimethoate 30 EC, and an untreated control. Coccinellid populations were recorded before spraying and at 3, 7, and 10 days after treatment application. The results indicated that entomopathogenic fungi and botanical extracts were comparatively safer to coccinellid beetles than the chemical insecticide. Among the tested treatments, *Verticillium lecanii* and ginger rhizome extract maintained the highest mean coccinellid population (5.75 beetles per plant), followed by onion bulb extract (5.71 beetles per plant), whereas dimethoate 30 EC recorded the lowest population (3.40 beetles per plant). The untreated control had the highest population of natural enemies, with 6.02 beetles per plant. These findings suggest that entomopathogens and botanicals extracts are compatible with the conservation of natural enemies and can be effectively integrated into environmentally sustainable pest management strategies for rapeseed and mustard cultivation.

Keywords: Botanical extracts, coccinellids, entomopathogens, *Lipaphis erysimi*, rapeseed–mustard

Introduction

Rapeseed and Mustard (*Brassica* spp.) is a major oilseed crop used for edible oil, vegetables, condiments, medicinal, and bio-industrial reasons, ranking third in the world behind soybean (*Glycine max*) and palm (*Elaeis guineensis*) (Anonymous 2020) [2]. India is holding 4th position among the major rapeseed and mustard growing countries and contributes about 19.8% and 9.8% of total world area and production, respectively. While Canada, China and European Union are on top three positions, respectively. It is the 2nd most important edible oilseed crop in India after groundnut which alone having 27.8% contribution in the oilseed economy. The overall production of rapeseed and mustard is 11.75 million tons, while its productivity is 1458 kg/ha. (Bhanu *et al.*, 2019; Anonymous 2022) [4, 3].

Rapeseed and Mustard is a broad term which contain several genera of the family Crucifereae (syn. Brassicaceae), called by different names in India viz., Indian Mustard (*Brassica juncea*), Yellow mustard (*Brassica rapa* L. var. yellow sarson), Brown sarson (*Brassica rapa* L. var. brown sarson) and Toria (*Brassica rapa* L. var. toria). These all genera are cultivated in different agroecological zones in different states of India. Rajasthan, Uttar Pradesh, Bihar, Madhya Pradesh, Assam, Gujrat, Maharashtra, and West Bengal are the major mustard growing states in India.

Despite all the nutritional factors and its adaptability in different agro-ecological zones, this crop is affected by several biotic and abiotic stresses. Among the biotic stresses, insect pests are of much importance. Nearly 50 species of insect pests damage to rapeseed and mustard crop. Dozens of species such as Mustard aphid (*Lipaphis erysimi* Kalt), Mustard saw fly (*Athalia lugens proxima* Klug), Leaf miner (*Chromatomyia horticola* Gour) and Painted bug (*Bagrada hilaris* Burmeister) are considered as major pest in India (Sharma and Singh, 2011) [11]. Among all these

species, Mustard aphid (*Lipaphis erysimi* Kalt.) is the key pest, causing maximum infestation and damage to the crop. The pest is known to be responsible for up to 96% yield losses and 5-6% in oil quantity reduction (Sahoo, 2012) ^[10].

Coccinellids, *Coccinella septempunctata* Linnaeus, syrphid flies, *Ischiodon scutellaris* Fabricius, and *Diaeretiella rapae* MacIntosh are among the many entomophagous predators and parasitoids that feed on aphids and are crucial to natural pest management (Farhan *et al.*, 2019) ^[7].

The seven-spotted ladybird beetle, *Coccinella septempunctata* (L.), is a natural predator of *Lipaphis erysimi* (Kalt.) that can control it in fields (Mathur, 1983) ^[8].

Syrphid flies (Diptera: Syrphidae) have a significant impact on aphid populations and other insect pests. Hover flies may efficiently exploit aphid colonies due to their high reproduction rates and voracity, consuming approximately 400 aphids each larva throughout maturation (Dixon, 2000) ^[5].

Lady bird beetle (Coccinellidae: Coleoptera) and syrphid fly (Diptera: Syrphidae) are frequently found predators associated with aphid colonies. The present study was conducted to evaluate eight different botanical extracts, entomopathogens and insecticide against the natural enemies under field conditions.

Materials and Methods

The study was conducted at the research farm, T.C.A. Dholi, during *rabi* 2022-2023 cropping season. The experiment was laid out in a Randomized Block Design (RBD) with eight treatments in three replications, with plot sizes of 3×3.5 m. The details of treatments used in the experiment are presented in Table 1.

Table 1: details of experiment

	Treatments Name
Treatments	1. <i>Beauveria bassiana</i> @ 5 g/liter of water.
	2. <i>Metarhizium anisopliae</i> @ 5 g/liter of water.
	3. <i>Verticillium lecanii</i> @ 5 g/liter of water.
	4. Ginger rhizome extract @5%.
	5. Onion bulb extract @5%.
	6. Garlic bulb extract @5%.
	7. Dimethoate 30EC @ 1ml/liter of water.
	8. Untreated control.
Time of spray	at Vegetative stage

Table 2: Effects of Botanicals and Entomopathogens on population of natural enemies

Treatments	Mean Population of Coccinellids per plant				
	1 DBS	3 DAS	7 DAS	10 DAS	MEAN
T ₁ - <i>Beauveria bassiana</i> 5 g/liter of water	5.39	5.34	5.09	5.78	5.4
T ₂ - <i>Metarhizium anisopliae</i> 5 g/liter of water	5.24	4.82	5.07	5.63	5.19
T ₃ - <i>Verticillium lecanii</i> 5 g/liter of water	5.67	5.34	5.78	6.23	5.75
T ₄ - Ginger rhizome extract @5%	6.18	5.24	5.61	5.98	5.75
T ₅ - Onion bulb extract @5%	5.97	5.18	5.67	6.03	5.71
T ₆ - Garlic bulb extract @5%	5.82	4.71	5.23	5.12	5.22
T ₇ - Dimethoate 30EC @ 1ml/liter	5.34	3.12	2.11	3.06	3.4
T ₈ - untreated control	5.02	6.12	6.97	6	6.02
CD (P=0.005)	0.76	0.7	0.71	0.76	0.73
SEm(±)	0.25	0.23	0.23	0.25	0.24
CV%	7.8	8	7.8	7.9	7.8

DBS – Day Before Spray, DAS – Days After Spray

Crude onion, garlic and ginger bought from the local market and after peeling they were dried in shade to dry out all amount of extra amount of water then grounded by the help of a grinder mixer, all the material kept in 500 ml of water overnight to mix the extract well in the water. Extract with water then separated through the tea Stainer. Whereas, natural enemies (coccinellids) count was taken from whole plant basis of ten randomly tagged plants with direct visual observation for at least 5 to 10 minutes.

Statistical Analysis

The data was subjected to an analysis of variance (ANOVA) as well as the Tukey's HSD test for significantly comparing means at the 5% level (SPSS 19 software).

Results and Discussion

From the table no 2 it is evident that population of coccinellids is significantly greater in all the ecofriendly treatments and untreated control except for chemical treatment. The minimum population recorded was 3.06 which was in T₇ (Dimethoate 30EC @ 1ml/liter) of water that is a chemical treatment, whereas maximum population was found on 6.23 in T₃ (*Verticillium lecanii* @ 5 g/liter of water) was is an ecofriendly treatment. Moreover, the overall mean population of coccinellids in all the ecofriendly treatments fluctuated from 5.19 to 5.75 which was significantly higher in comparison to chemical treatment that is 3.40. Based on table no 2 the maximum number of aphids was recorded in untreated control and found statistically at par with all the ecofriendly treatments.

Based on the above findings, botanical extracts and entomopathogens do not have adverse effects on coccinellid populations. However, in chemical treatments, the population of natural enemies decreased by more than 50%. Dwivedi and Singh (2022) ^[6] also reported that botanical extracts and entomopathogens are safer for natural enemies, whereas chemical insecticides were found to be toxic to natural enemies. These findings are also confirmed by Pawar *et al.*, (2023) ^[9], who reported that entomopathogens were less toxic to natural enemies. Amin *et al.*, (2014) ^[1] also found that Dimethoate was toxic to natural enemies.

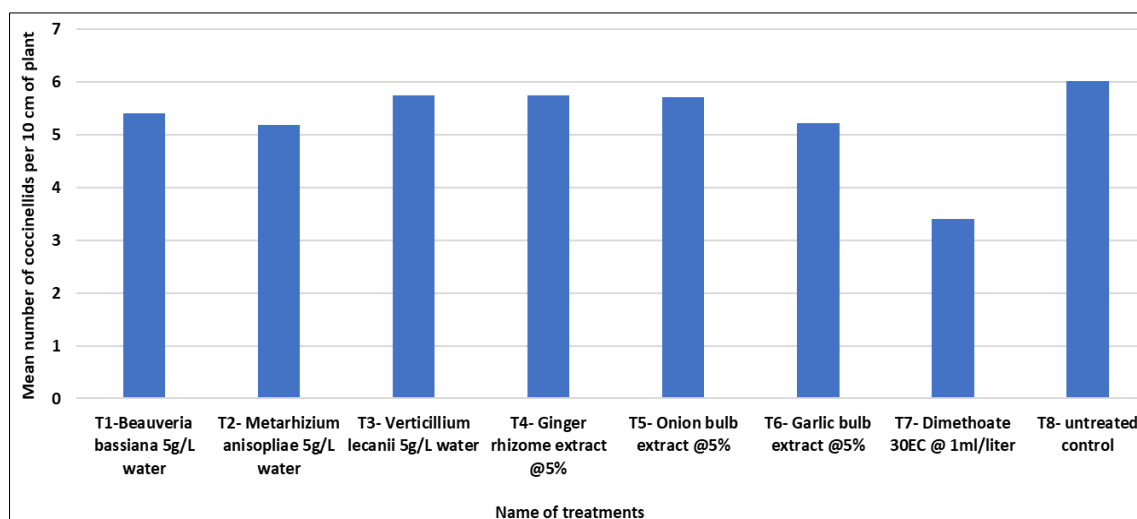


Fig 1: Mean population of natural enemies in different treatments before and after spray

Conclusion

The present investigation demonstrated that eco-friendly pest management practices are considerably safer for the conservation of coccinellid beetles than the conventional chemical insecticide used in rapeseed and mustard. Among the evaluated treatments, *Verticillium lecanii* and ginger rhizome extract maintained the highest mean coccinellid population (5.75 beetles per plant), followed by onion bulb extract (5.71 beetles per plant) and *Beauveria bassiana* (5.40 beetles per plant). In chemical treatment, dimethoate 30 EC recorded the lowest mean population (3.40 beetles per plant), showed a pronounced negative effect on natural enemies, while the untreated control supported the highest predator abundance (6.02 beetles per plant). These findings confirm that entomopathogens and botanical extracts are more compatible with the conservation of natural enemies and can be effectively incorporated into integrated pest management (IPM) programmes.

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