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Seasonal Incidence of Insect Pests and Predatory Fauna on Toria (*Brassica rapa*) in West Central Tableland of Odisha, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present field investigation was conducted for two consecutive *Rabi* seasons of years 2021/22 and 2022/23 at the College of Horticulture, Odisha University of Agriculture and Technology, Chiplima, Odisha to record the seasonal incidence of major insect pests with the predatory fauna on toria (*Brassica rapa*) in relation to meteorological parameters. The occurring pest complex in both seasons constituted a total nine number of insects and three consistent predatory fauna.

The highest peak population of pests recorded for 2021/22 were: mustard aphid (3.7 A.I plant^{-1} at 50th SMW), whitefly (25.9 whiteflies plant^{-1} at 50th SMW), painted bug (13.37 nymphs+adults plant^{-1} at 50th SMW), mustard sawfly (12 larvae plant^{-1} at 48th SMW), flea beetle (12.45 grubs+adults plant^{-1} at 50th SMW), diamondback moth (1.3 larvae plant^{-1} at 52nd SMW), leaf Webber (6.45 larvae plant^{-1} at 51st SMW), Bihar hairy caterpillar (29.3 larvae plant^{-1} at 50th SMW) and tobacco caterpillar (8.9 larvae plant^{-1} at 49th SMW. Similarly, the highest peak population of pests recorded for 2022/23

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were: mustard aphid (3.82 A.I plant^{-1} at 51st SMW), whitefly (23.8 whiteflies plant^{-1} at 50th SMW), painted bug (13.7 nymphs+adults plant^{-1} at 51st SMW), mustard sawfly (15 larvae plant^{-1} at 48th SMW), flea beetle (13.45 grubs+adults plant^{-1} at 50th SMW), diamondback moth (1.2 larvae plant^{-1} at 47th SMW), leaf Webber (5.45 larvae plant^{-1} at 51st SMW) which coincided the abundance of natural enemies namely, coccinellid predators, syrphid fly and spider between 50th to 52nd SMW of the experimental year for both seasons.

The correlation of insect pest density with weather parameters (*Rabi*, 2021/22) showed negative correlations with T_{max} (mustard aphid, painted bug, flea beetle, leaf Webber, diamondback moth, Bihar hairy caterpillar), T_{min} (all pests), rainfall (mustard aphid, whitefly, mustard sawfly, flea beetle, tobacco caterpillar), RH% at 7 hours (all pests), and RH% at 14 hours (mustard aphid, whitefly, painted bug, leaf Webber, diamondback moth, Bihar hairy caterpillar).For natural enemies, T_{max}, T_{min}, RH% at 7 hours, RH% at 14 hours, and wind velocity had negative effects on their population, while rainfall had a positive influence. However, in *Rabi* 2022/23, $T_{max,}$ $T_{min,}$ and RH% at 14 hours negatively influenced the pest population mostly except for wind velocity and RH% at 7 hours. For predators, wind velocity showed positive correlation with its' population.

Keywords: Seasonal incidence; rapeseed-toria; insect pests; natural enemies; meteorological parameters.

1. INTRODUCTION

Toria (*Brassica rapa* Linnaeus, 2n (2x) = 20) is a significant oilseed crop in India grown during the *Rabi* season. Belonging to the Brassicaceae family. It is commonly known as sarson or lahi and has its origin in South-East Asia through the crossing of *Brassica nigra* and *B. campestris* [1,2]. Rapeseed-mustard, including toria, encompasses eight different species and is cultivated in 53 countries worldwide. The place of origin of rapeseed is Eastern Afghanistan and adjoining part of India and Pakistan [3]. In India, rapeseed-mustard contributes nearly 80% of the total *Rabi* oilseed production and is widely grown in various states.[4].

However, despite the availability of good production technology, the crop faces challenges due to various biotic and abiotic factors. Insect pests are a major constraint, causing significant yield losses. Mustard aphid, mustard sawfly, leaf miner, painted bug, flea beetle, diamondback moth, cabbage aphid and green peach aphid are the insects infesting the crop in India [5]. To manage these pests, the primary priority is to understand the pest ecology and pest cycle along with the susceptible crop growth stages. Predatory fauna like coccinellid beetles [6], etc play a vital role in crop ecosystem. In the context of Odisha's north-western plateau region, limited research has been conducted on insect-pest complex of toria. Therefore, an experiment was carried out to study the seasonal incidence of important insect pests and their natural enemies on toria with meteorological parameters like maximum and minimum temperature, morning and evening relative humidity, rainfall on development and survival of the insect pests and natural enemies was studied. By focusing on sustainable practices, farmers can improve toria production and reduce yield losses caused by insect pests.

2. MATERIALS AND METHODS

The field experiment was conducted for two consecutive *Rabi* seasons of years 2021/22 and 2022/23 at the Experimental Farm, College of Horticulture, Odisha University of Agriculture and Technology, Chiplima, Odisha. "Sushree" variety was selected and sown in an area of 200 m^2 with a spacing of 30 cm row to row and 10 cm plant to plant. All recommended agronomical practices were followed to raise the crop. Observations on the incidence of major insect-pests and predators were counted from 10 plants randomly, recorded at weekly intervals starting from two weeks after sowing till the crop maturity.

Weekly weather data was obtained from the regional research and technology transfer station (RRTTS), Chiplima, Odisha. The correlation coefficients between the incidence of insect pests/ predators and weather factors *i.e.,* T_{max}, T_{min}, rainfall, RH% (7 hr.), RH%(14hr.), wind velocity was calculated.

2.1 Observations on Important Insect Pests

2.1.1 Mustard aphid

Ten plants were selected randomly and from each plant, aphid population was worked out in

terms of aphid index (0-4 scale) based on method suggested by Butani and Bharodia [7], which has been presented below in list 1.

2.1.2 Other important insect pests and natural enemies

Ten plants were selected randomly and from each plant average number of insects per plant *i.e.,* Whitefly (No. of adults plant^{-1}), Painted bug (No. of nymphs+adults plant^{-1}), Mustard sawfly (No. of larvae plant^{-1}), Flea beetle (No. of grubs+adults plant^{-1}), Leaf Webber (No. of larvae plant^{-1}), Diamondback moth (No. of larvae plant^{-1}), Tobacco caterpillar (No. of larvae plant^{-1}), Bihar hairy caterpillar (No. of larvae plant^{-1}), Coccinellid predators (No. of grubs+adults plant^{-1}), Syrphid fly (No. of maggots plant^{-1}) and Spider (No. of adults plant^{-1}) was calculated.

List 1. Aphid index infestation scale

Index scale	Aphid infestation
0	Plant free from aphid infection
1	Aphids present but colonies are not built up
2	Small colonies of aphid present
3	Large colonies of aphids present on tender plant parts (Counts are possible)
4	Entire plants covered by aphid and counts impossible

The average aphid index worked out by adopting the following formula:

Average Aphid Index (A.I) = 0N + 1N + 2N + 3N + 4N / Total no of plants observed.

Where;

0, 1, 2, 3, 4 are aphid index

N = Number of plants showing respective aphid index

3. RESULTS AND DISCUSSION

Nine insect pests namely mustard aphid (*Lipaphis erysimi* Kaltenbach), whitefly (*Bemisia tabaci* Gennadius), painted bug (*Bagrada hilaris* Kirkaldy), mustard sawfly (*Athalia lugens proxima* Kluger), flea beetle (*Phyllotreta cruciferae* Goeze, *Monolepta signata* Olivier), leaf Webber (*Crocidolomia binotalis* Zeller), diamondback moth (*Plutella xylostella* Linnaeus), tobacco caterpillar (*Spodoptera litura* Fabricius), Bihar hairy caterpillar (*Spilarctia obliqua* Walker) were detected at different stages of the crop growth. Among natural enemies of the pests observed were, coccinellid predators (*Coccinella transversalis, Menochilus sexmaculatus* Fabricius and *Coccinella californica* Mannerheim), syrphid fly (*Episyrphus balteatus)* and spider. There was significant difference in the occurrence of insect pests during the two observed seasons *i.e., Rabi* of 2021/22 and 2022/23.

3.1 Seasonal Incidence of Insect Pests and Predators on Toria during *Rabi* of 2021/22 and 2022/23

3.1.1 Mustard aphid

The data (Tables 1 and 2) clearly indicated that the overall population of mustard aphid persisted throughout the growing season of toria specifically during vegetative maturity stage and it lasted up to the siliqua harvest stage *i.e.,*45th SMW to 2nd SMW (of next year) for both the seasons. The peak population of the pest was 3.7 A. I plant-1 (50th SMW) and 3.82 A. I plant-1 (51st SMW) during *Rabi*, 2021/22 and 2022/23 respectively. Earlier to this, Nayak [8] and other workers (Mandawi *et al.* [9], Pradhan *et al.* [10], Yadav *et al.* [11]) reported similar observations in their experiments.

3.1.2 Whitefly

It was evident from the recorded data (Tables 1 and 2) that pest density of whitefly in the growing period of toria persisted throughout the vegetative maturity stage and continued up to siliqua harvest stage *i.e.,* 45th SMW to 1st SMW (of next year) for the *Rabi* seasons. The pest density peaked at 25.9 adults plant^{-1} (50th SMW) and 23.8 adults plant^{-1} (50th SMW) during *Rabi* of 2021/22 and 2022/23 respectively. Syed *et al.* [12], in his experiment found almost similar results.

3.1.3 Painted bug

The pest infestation initiated at the flowering stage of the crop *i.e.,* 46th SMW. The peak painted bug population in toria was observed with 13.37 nymphs+adults plant^{-1} (50th SMW) in *Rabi* of 2021/22 and 13.7 nymphs+adults plant^{-1} (51st SMW) in *Rabi* of 2022/23. However, varied but similar results were also observed in the field studies undertaken by Divya *et al.* [13], where the data revealed that incidence of painted bug started in 3rd week of December in both years and attained first peak during the 1st week of January.

3.1.4 Mustard Sawfly

The occurrence of mustard sawfly on toria during *Rabi* of 2021/22, was observed initially at 45th SMW, which coincided the vegetative maturity stage. The population attained peak (12.0 larvae plant^{-1}) at 48th SMW. Similar pest density results were also confirmed in an experiment conducted by Pradhan *et al.* [14] as data revealed occurrence of sawfly during 51st SMW *i.e.,* 3rd week of December.

Conversely, the population density of the said pest during *Rabi* of 2022/23, was surprisingly different from the previous season observation (Tables 1 and 2). The pest began its' infestations quite earlier *i.e.,* 44th SMW (almost 2 weeks after sowing). The peak population was 15.00 larvae plant^{-1} at 48th SMW and the infestation lasted up to siliqua harvest stage of the crop. These results confirmed to the findings of Pal *et al.* [15] where, incidence of mustard sawfly on varieties *Urvashi,* GSC6, BSH1, YST151, T27, DRMR IJ-31 were recorded in a range of 0 to 2.6 larvae plant^{-1} in 45th standard meteorological week (SMW) and found till 48th SMW.

3.1.5 Flea beetle

The results on flea beetle population were apparent on infestation (Tables 1 and 2) that started with 8.34 grubs+adults plant^{-1} from 46th SMW (flowering stage) and continued up to 2 SMW (2nd week of January). The peak level of population was observed at 50th SMW (12.45 grubs+adults plant^{-1} in *Rabi* of 2021/22 and 13.45 grubs+adults plant^{-1} in *Rabi* of 2022/23. Our finding are much similar with that of Pradhan *et al.* [10], where flea beetle was observed during 51st SMW *i.e.,* 3rd week of December 2018 and active till 9th SMW *i.e.,* 1st week of March 2019 and maximum population (1.60 plant^{-1}) was observed during the 6th SMW.

3.1.6 Leaf webber

Current findings (Tables 1 and 2) revealed that the leaf Webber incidence was observed first at 48th SMW *i.e.,* siliqua development of the crop. Its peak level was seen as 6.45 larvae plant^{-1} at 50th SMW in 2021-22. However, in *Rabi* of 2022-23, the larval population was highest and consistent throughout the 51st-52nd SMW (5.44-5.45 larva plant^{-1}). Thereafter, the pest population decreased and disappeared at the time of harvesting. Similar results of pest density had been reported by Pawar *et al.* [16], where larval population of leaf Webber on mustard started to build up after 2nd week of sowing *i.e.,* 3rd week of November (1.60 larvae plant^{-1}) and ranged between 1.10 to 9.20 larvae plant^{-1}.

3.1.7 Diamondback moth

The initial population of the pest (Tables 1 and 2) started at 46th SMW *i.e.,* flowering stage. The highest peak of incidence was 1.3 larvae plant^{-1} at 52nd SMW (siliqua development stage) during *Rabi* of 2021/22. Conversely the following season (*Rabi* of 2022/23), insect's peak population (1.2 larvae plant^{-1}) was observed at 47th SMW *i.e.,* flowering stage. This corroborates with the findings of Shaila *et al.* [17], who reported first appearance of diamondback moth was during vegetative stage of the crop and the peak incidence of *Plutella xylostella* (12.31 larvae plant^{-1}) was observed at 49th SMW *i.e.,* during 1st week of December, later the population declined gradually.

3.1.8 Bihar hairy caterpillar

The first appearance of the pest during *Rabi* 2021/22 (Tables 1 and 2) on toria was at 48th SMW *i.e.,* flowering stage. Its peak population was 29.3 larvae plant^{-1} at 50th SMW. Kashyap *et al*. [18], concluded the similar results on the incidence of Bihar hairy caterpillar that started from 2nd week of December (50th SMW) with 0.02 larvae per plant and population ranged from 0.02 to 0.12 larvae plant^{-1}. However, during *Rabi* of 2022/23, there was no incidence of the said pest throughout the crop season.

3.1.9 Tobacco caterpillar

The polyphagous pest, tobacco caterpillar (Tables 1 and 2) during *Rabi* of 2021/22 appeared at the vegetative maturity stage *i.e.,* 45th SMW (5.6 larvae plant^{-1}) and attained its' peak population (8.9 larvae plant^{-1}) at 49th SMW, *i.e.,* siliqua development stage. Likewise, resembling outcomes were reported by Kumar *et al*. [19]. In *Rabi* of 2022/23, there was no incidence of pests throughout the cropping season.

3.1.10 Coccinellid predators

The aphid appeared at a very early stage of the crop, which was synchronized with the activities of predatory coccinellid beetles (Tables 1 and 2) *i.e.,* 44th SMW. The peak population of the

Table 1. Seasonal incidence of insect pests and predators on toria under field conditions during *Rabi*, 2021/22

WAS	SMW	Aphid Index (0-4 Scale)	Mean No. of insect pests (adults/nymphs/grubs/larvae/plant)								Mean No. of predators (adults/maggots/grubs/plant)		
		Mustard aphid	White fly	Painted bug	Mustard sawfly	Flea beetle	Diamond Back moth	Leaf Webber	BHC	TC	Coccinellid	Syrphid fly	Spider
2	44	0	0	0	0	0	0	0	0	0	0.09	0	0
3	45	0.01	0.05	0	0.02	0	0	0	0	5.6	2.09	0	0.08
4	46	2.01	18.53	5.77	8.3	8.34	0.35	0	0	5.78	4.2	1.01	0.09
5	47	3.34	23.3	8.61	9.71	10.0	0.90	0	0	6.77	4.38	1.03	0.09
6	48	2.94	21.8	8.92	12.0	11.03	0.91	3.24	10.3	6.9	4.78	1.02	0.13
7	49	2.9	24.4	9.11	11.37	11.24	0.89	5.26	24.9	8.9	4.56	1.01	0.19
8	50	3.7	25.9	13.37	10.5	12.45	0.98	6.33	29.3	7.96	4.77	1.02	0.14
9	51	3.5	24.53	12.81	8.45	11.23	1.0	6.45	28.5	7.56	4.67	1.24	0.09
10	52	2.4	10.10	10.5	3.05	7.56	1.3	5.7	24.9	5.23	4.75	1.58	0.18
11	1	1.5	5.3	6.3	0	3.2	0.5	4.3	10.0	1.22	5.11	1.19	0.12
12	2	1.01	0	2.21	0	2.45	0	0	0	0	5.21	2.09	0.25
13	3	0	0	0	0	0	0	0	0	0	5.34	1.95	0.37

** WAS – Weeks after sowing, SMW- Standard meteorological weeks, BHC -Bihar hairy caterpillar and TC- Tobacco caterpillar.*

Table 2. Seasonal incidence of insect pests and predators on toria under field conditions during *Rabi*, 2022/23

WAS	SMW	Aphid Index (0-4 Scale)	Mean No. of insect pests (adults/nymphs/grubs/larvae/plant)						Mean No. of predators (adults/maggots/grubs/plant)		
		Mustard aphid	White fly	Painted bug	Mustard sawfly	Flea beetle	Diamond Back moth	Leaf Webber	Coccinellid	Syrphid fly	Spider
2	44	0	0	0	0.9	0	0	0	0.5	0	0
3	45	0.09	0.05	0	2.8	0	0	0	2.0	0	0.09
4	46	2.50	15.5	4.9	5.2	6.64	0.45	0	4.35	1.01	0.08
5	47	3.39	20.3	7.91	8.41	10.5	1.2	0	4.42	1.5	0.09
6	48	3.57	21.0	8.05	15.0	11.03	0.93	3.54	4.54	1.92	0.5
7	49	3.01	20.4	9.2	12.07	11.5	0.89	4.29	4.66	1.88	0.29
8	50	2.9	23.8	12.57	11.5	13.45	0.97	5.44	4.89	1.56	0.24
9	51	3.82	21.57	13.7	6.47	11.23	1.0	5.45	4.63	1.24	0.19
10	52	2.9	12.13	11.5	2.35	9.56	1.0	3.43	4.75	1.28	0.18
11	1	1.5	8.3	7.5	0.8	5.6	0	0	5.01	1.19	0.22
12	2	1.0	0	3.01	0.2	3.45	0	0	5.11	2.08	0.30
13	3	0	0	0	0	0	0	0	5.0	1.87	0.35

** WAS – Weeks after sowing, SMW- Standard meteorological weeks,*
BHC -Bihar hairy caterpillar and TC- Tobacco caterpillar

Table 3. Correlation coefficient (r) of different weather parameters with insect pests/predators on toria during *Rabi*, 2021/22

Insect pests/ predators	Temperature (^{0}C)		Rainfall	Relative Humidity (%) after (hours)		Wind velocity
	Maximum	Minimum		7	14	
Mustard aphid	-0.16289	-0.31019	-0.01596	-0.14107	-0.04429	0.34454
Whitefly	0.05017	-0.17701	-0.21794	-0.19144	-0.00796	0.41522
Painted bug	-0.25794	-0.46406	0.05909	-0.15568	-0.13125	0.24994
Mustard sawfly	0.08214	-0.05556	-0.22966	-0.15782	0.06633	0.52870
Flea beetle	-0.12572	-0.23720	-0.03698	-0.12362	0.02535	0.45989
Leaf Webber	-0.40514	-0.66241*	0.04751	-0.17188	-0.25636	0.00891
Bihar hairy caterpillar	-0.40034	-0.60401*	0.07344	-0.21424	-0.27809	0.10778
Diamondback moth	-0.22520	-0.35913	0.16574	-0.01969	-0.07002	0.31657
Tobacco caterpillar	0.12108	-0.02447	-0.16841	-0.12467	0.02186	0.57265*
Coccinellid	-0.69326*	-0.58913*	0.244511	-0.05138	0.031869	-0.20009
Syrphid fly	-0.83003**	-0.52899	0.490033	-0.02627	-0.00883	-0.28531
Spider	-0.66928*	-0.4096	0.258023	-0.07714	-0.07401	-0.37037

**Significant at 5% level of significance ** Highly significant at 1% level of significance*

Table 4. Correlation coefficient (r) of different weather parameters with insect pests/predators on toria during *Rabi*, 2022/23

Insect pests/ predators	Temperature (^{0}C)		Rainfall	Relative Humidity (%) after (hours)		Wind velocity
	Maximum	Minimum		7	14	
Mustard aphid	-0.19528	-0.63327*	0	-0.09928	-0.12771	0.573889
Whitefly	-0.21876	-0.42298	0	0.050827	-0.08357	0.629266*
Painted bug	-0.29252	-0.64774*	0	0.044286	-0.13405	0.630329*
Mustard sawfly	-0.11928	-0.16236	0	0.053038	-0.0842	0.37711
Flea beetle	-0.24274	-0.5584	0	-0.05518	-0.12525	0.655065*
Leaf Webber	-0.20311	-0.45288	0	0.208612	-0.2246	0.325065
Diamondback moth	0.033427	-0.42052	0	0.002097	0.086534	0.481738
Coccinellid	-0.56536	-0.66065*	0	-0.21439	-0.29433	0.45103
Syrphid fly	-0.53901	-0.58786	0	-0.39273	-0.41366	0.42477
Spider	-0.51916	-0.35057	0	-0.08579	-0.34291	0.053812

**Significant at 5% level of significance ** Highly significant at 1% level of significance*

predator during *Rabi* of 2021/22 was 5.34 grubs+adults plant^{-1} at 3rd SMW (siliqua harvest stage). In *Rabi* of 2022/23, the predator population was highest at 1st SMW (5.11 grubs+adults plant^{-1}). The observation was much identical to Shaila *et al.* [17], who reported that the activity of coccinellids initiated from 1st week of January (0.22 beetle plant^{-1}) and reached its peak (1.20 beetle plant^{-1}) in 2nd SMW.

3.1.11 Syrphid fly

The syrphid fly appeared during 45th SMW (1.01 maggots plant^{-1}), *i.e.,* flowering stage and population was higher (2.09 maggots plant^{-1}) at 2nd SMW of *Rabi* of 2021/22. Similarly, peak population of maggots in the next observed season (*Rabi* of 2022/23) was 2.08 per plant. These results are supported by Mishra *et al.* [20], who stated that the predator appeared in the 2nd week of January and its peak population was (13 larvae 5 plants^{-1}) during the 4th week of January.

3.1.12 Spider

In *Rabi* of 2021/22, the spider appeared during 45th SMW (0.08 spider plant^{-1}), and population was highest (0.37 spider plant^{-1}) at 3rd SMW *i.e.,*

siliqua harvest stage. In successive session (*Rabi* of 2022/23) same trend of pest population was observed.

3.2 Correlation of Insect-pest and Predator Population with Weather Parameters during *Rabi* of 2021/22 and 2022/23

The results from the correlation of insect pest density with various weather parameters in *Rabi* of 2021/22 (Table 3) concluded that positive correlation was established by maximum temperature (for whitefly, mustard sawfly, and tobacco caterpillar), rainfall (for painted bug, leaf Webber, diamondback moth, Bihar hairy caterpillar), wind velocity (for all insect pest), RH% at 14 hours (for mustard sawfly, flea beetle and tobacco caterpillar).However, there was a negative effect on the abundance of various insect pests by maximum temperature (for mustard aphid, painted bug, flea beetle, leaf Webber, diamondback moth, Bihar hairy caterpillar), minimum temperature (for all insect pests), rainfall (for mustard aphid, whitefly, mustard sawfly, flea beetle and tobacco caterpillar), RH% at 7 hours (for all insect pests) and RH% at 14 hours (mustard aphid, whitefly, painted bug, mustard sawfly, leaf Webber, diamondback moth and Bihar hairy caterpillar).

The correlation of natural enemies with various weather parameters concluded that maximum temperature, minimum temperature, RH% at 7 hours, RH% at 14 hours and wind velocity negatively influenced the mean population however, rainfall had a positive effect on the natural enemies' population.

The relations between insect pest population and weather parameters in *Rabi* of 2022/23 (Table 4) showed positive correlation with maximum temperature (diamondback moth), wind velocity (all pests), and RH% at 7 hours (whitefly, painted bug, mustard sawfly, leaf Webber, diamondback moth). Conversely, negative correlations were found with maximum temperature (mustard aphid, whitefly, painted bug, mustard, flea beetle, leaf Webber), minimum temperature (all pests), rainfall, RH% at 14 hours (mustard aphid, whitefly, painted bug, mustard sawfly, flea beetle, leaf Webber) and no significant relationship with rainfall.

For natural enemies, maximum temperature, minimum temperature, RH% at 7 hours, RH% at 14 hours, and wind velocity had negative effects on their population, while rainfall had a positive influence on the same. These results are in agreement with the findings of Patel *et al*. [21], Divya *et al.* [13], Lal *et al.* [22], Patel *et al*. [23]. Kashyap *et al*. [18], and Mishra *et al.* [20].

4. CONCLUSION

From the present study it can be concluded that the period between the 3rd week of November to last week of December of 2021 and 2022 of the cropping seasons, was the most suitable period for abundance of almost all the major insect pests of toria. Whereas, in the prevailing condition of weather parameters *viz.,* maximum temperature, minimum temperature and RH at 7 hours and 14 hours, the pest density can be declined to much extent.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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