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Seasonal incidence of major insect-pest and their biocontrol agent of wheat crop

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Abstract
Field experiment on Seasonal incidence of major insect-pest and their biocontrol agent of wheat crop was conducted during *rabi* season of 2018-19 on wheat crop at Agricultural Research Station, Niphad, Dist. Nasik. To study the seasonal incidence of insect pest on wheat and their natural enemies and their correlation with the weather parameters.

During seasonal abundance study, aphid species *R. padi* was found predominant on wheat. Wheat aphid was noticed from December, 2018 to second week of February, 2019. The maximum population of wheat aphid was recorded in the month of January and reached the peak in the 4thweek of January (160.90 aphid/shoot/plant) thereafter declined. The incidence of aphid disappeared from 3rd week of February i.e. 8th MW. Aphid infestation showed significant negative correlation with minimum temperature and non-significant negative correlation with evening and morning humidity.

The maximum of 34.20 number of Jassid/plant were recorded in the first meteorological week when the maximum and minimum temperature was 29.0 and 5.5^{0}C, respectively.

The activity of natural enemies was noticed from 2nd week of December to 4th week of January coinciding with aphid population on the crop. It ranged from 1.10 to 6.50 natural enemies/m^2. Natural enemies/m^2 showed significant negative correlation with minimum temperature and non-significant negative correlation with maximum temperature.

Keywords: aphid, wheat, natural enemies, seasonal abundance, temperature

Introduction
Wheat is the leading grain of the world and is grown wherever climatic and soil conditions are favorable in the temperate zone, especially in North America, Europe, China, North west India, Argentina and Australia. Wheat belongs to family *Poaceae* (*Gramineae*). The chromosome number sets (genomes) for wheat are diploids 14 (n=7), tetraploids 28 (n=14) and the hexaploids 42 (n=21). There are 50 wild species of wheat, out of which four species *viz. Triticum aestivum, Triticum durum, Triticum diccocum* and *Triticum sphaerococcum* are under cultivation in India. *Triticum aestivum* is the most important species occupying more than 90 per cent of the total wheat area in country followed by *Triticum durum* (8-9 %) and *Triticum dicocum* (< 1%). *Triticum sphaerococcum* has now practically not cultivated because of its low productivity and high susceptibility to diseases. Nearly 344 wheat varieties (291 *T. aestivum*, 46 *T. durum*, 4 *T. dicoccum* and 3 *T. triticale*) have been released so far in India.

In India wheat is grown in almost all states. The important wheat growing states are Bihar, Jharkhand, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Uttar Pradesh, Uttrakhand and West Bengal. In India it occupies an area of 30.42 million hectare with a production and productivity of 98.38 million tonnes and 3172 kg/ha, respectively and accounts for about 38% of the country's total food grain production (Anonymous, 2018) [2]. Wheat is one of the important *rabi* crop of Maharashtra. In Maharashtra it is grown on area of 08.00 lakh hectare with a production and productivity of 12.07 lakh tonnes and 1508 kg/ha, respectively during *rabi* 2017-18 (Anonymous, 2018) [2].

Wheat is grown primarily as a food crop, its plant, seed, straw, and bran are used in industrial products as well as a feed of livestock. Wheat straw is used as fuel, animal bedding, and organic matter for soil (Wiese, 1987) [14]. In India, the largest cropped area is devoted to wheat and the quantity produced is more than that of any other crop. Globally, wheat occupied first position in production among cereals.

India is still struggling to become self-sufficient in wheat production. This is possible when the gap between the potential yield of this crop and the actual yield obtained by the growers in this country is filled. This gap is attributed to the lack of appropriate production technology and attack by a variety of insect pests species. The crop is infested by a number of insect pests, *viz.*, armyworm, *Mythimna separata* (Haworth); ghujhia weevil, *Tanymecus indicus* (Faust);

termite, *Odontotermes obesus* (Ramb.); cutworms, *Agrotis spp.;* shoot fly, *Atherigona naquii* (Styskal); pink borer, *Sesamia inferens* (Walker); Jassid, *Amrasca basalis* (Baly); and, aphid. Among these insect pests, the aphid is most serious and regular insect pest of this crop.

Aphid (Homoptera: Aphididae) are sucking insect pests of various field crops. These are important and economic pests of about 60 plant species including wheat, barley, sorghum and corn. Three species of cereal aphid were recorded on wheat varieties including Bird cherry oat aphid, *Rhopalosiphum padi* (Linnaeus), Corn leaf Aphid, *Rhopalosiphum maidis* (Fitch) and green bug, *Schizaphis graminum* (Rondani). The population of *R. padi* was the most abundant and it was the most important aphid species on wheat whose occurrence interfered with grain formation and grain filling (Kannan, 1997) [5]. Aphid are major pests of the crops causing wheat yield loss in many parts of the world. Most of them because of parthenogenesis, viviparation and polymorphism have very high reproduction rate in the absence of natural enemies. These insects become mature in a short time, so they can significantly increase its population in less time (Carver, 1989) [3].

Aphid pierce and suck sap from leaves, stems, and less frequently the developing kernels of wheat. Some inject toxic substances that destroy plant tissue while some are vectors of viruses that may cause widespread losses exceeding those attributed to the direct feeding damage (Gair *et al.*, 1983) [4]. One of the important aphid species is wheat aphid, *Rhopalosiphum padi* Although many insect pests in India attack wheat crop but aphid is the most damaging agent. The damage due to aphid is reported in many field is now known as a regular pest of wheat due to a dramatic increase in its population on wheat crop and is found responsible for as high as 50 % reduction in grain weight per earhead. Their incidence is increasing day by day and had attained the status of a regular pest. On average, about 72 % losses due to aphid attack were attributed to their direct sap sucking and remaining 28 % were due to fungal growth favored by their honeydew secretions. Aphids have been found affecting wheat production adversely causing 35-40 % direct and 20-80 % indirect yield losses by transmission of viral and fungal diseases. The decline in grain yield in various genotypes, ranging from 7.9 to 34.2% has also been reported by (Lal *et al*., 2010) [7]. Aphid incidence is reported variable among different wheat cultivars and also depends on crop stage. It is better to utilize varietal resistance of wheat cultivars along with judicial use of appropriate insecticides application against aphid.

Material and Methods

The present investigation entitled, Efficacy of microbial and chemical pesticides against wheat aphid (*Rhopalosiphum padi* L.) was carried out during *rabi* season of 2018-19 under field condition at the research farm of Agricultural Research Station, Niphad Dist. Nashik, Maharashtra to study the seasonal incidence of insect pest on wheat and their natural enemies and their correlation with the weather parameters.

Seeds: Seed of wheat variety NIDW 295 (Godavari) were obtained from Wheat specialist, Agricultural Research Station, Niphad, Dist. Nashik

Seasonal abundance of wheat aphid and natural enemies:

Five shoots of five plants from each plot were selected randomly and tagged with label. Number of aphid/shoot/plant was recorded.

Aphid populations were recorded from the unsprayed plot for seasonal incidence study at weekly interval after sowing. The observations on natural enemies were also recorded. One m^2 area was selected at five different locations in plot and natural enemies (parasites as well as predators) were recorded and converted it into population per m^2

Observations:

Seasonal incidence: Weekly observations on seasonal incidence of wheat pest were recorded from sowing to till maturity

- **Aphid:** No. of aphid from five shoots of five randomly selected tagged plants were recorded.
- **Jassid:** No. of Jassid from five tagged plants were recorded.
- **Natural enemies:** One m^2 area was selected at five different locations in plot and natural enemies (parasites as well as predators) were recorded and converted it into population per m^2 area.

Meteorological data

The data on weather parameters viz., maximum temperature, minimum temperature, relative humidity and rainfall was obtained from the observatory of Agricultural Research Station, Niphad for statistical analysis.

Statistical analysis

Collected data of wheat aphid and natural enemies with weather parameters were analysed to find out the influence of various weather parameters on seasonal abundance of wheat aphid and natural enemies.

Results and Discussion

The results of present studies on Seasonal incidence of major insect-pest and their biocontrol agent of wheat crop with an objectives to study the seasonal incidence of insect pest on wheat and their natural enemies and their correlation with the weather parameters are presented and discussed here under

It is desirable to understand the entire details of abiotic factors of the environment before carrying out the study of insect pests. With this view, the quantitative estimation of aphid, *R. padi* population (major insect pest of wheat) and its major natural enemies (predator, ladybird beetle (*Coccinella septempunctata* Linn.) was carried out in relation to abiotic factors, like temperature (maximum and minimum), relative humidity, rainfall and sunshine hours under the prevailing agro-climatic conditions. The present results are presented in Table 1 and 2 indicated that the population of aphid, *R. padi* initially appeared in the 49th Meteorological week (fourth week of November) during Rabi, 2018-19. The aphid population reached to its peak in the 4th Meteorological week (fourth week of January) (160.90 aphid/shoot/plant) at 27.2 ^{0}C maximum, 7.5 ^{0}C minimum temperature, 57 % relative humidity and 8.8 sunshine hours.

Thereafter, the population declined gradually and completely disappeared in the 8th Meteorological week (third week of February). The minimum temperature had significant negative correlation (r = -0.5539) and maximum temperature & relative humidity had non-significant negative correlation with aphid population. Thus, the results showed that the aphid population was affected significantly by some of the weather factors.

The present findings are in close approximation to those of Khan (2012) [6] who reported that infestation of aphid on wheat crop started in the mid of January and reached to its

peak during mid of February/March. Akhtar and Shahida (2002) [1] reported that aphid population appeared on 9th January and reached to its peak on 26th February. Similar results were also reported by Singh (2008) [10] which supports the present findings. Wang *et al.* (2002) [13] reported 25 ^{0}C to be the optimum temperature for development of *R. maidis*.

The results indicated that minimum temperatures (r = -0.5539) and relative humidity played a pivotal role in multiplication of aphid as correlation of these abiotic factors with aphid population was found negative non-significant. It was concluded that the aphid population was not affected significantly by maximum temperature and relative humidity. The present findings partially corroborate with the findings of Roy choudhury and Jain (1993) [8] who reported that the incidence of alate aphid showed a positive correlation with relative humidity and negative with mean, maximum and minimum temperatures. The results are in full conformity with that of Sikandar *et al.* (2011) [9] who reported that aphid count was low in January due to cold but started to increase in the month of February.

The population of natural enemies (*Coccinellid* predator, *C. septempunctata* Linn.) was first observed in the 50th Meteorological week (second week of December) in *rabi*, 2018-19. The findings corroborated with the results of Singh (2008) [10] who observed the peak of *coccinellid* beetles after one week of peak period of aphid infestation. The maximum population was recorded in the 2nd Meteorological week (second week of January) (6.50/m^2) at 28.3 ^{0}C maximum and 5.9 ^{0}C minimum temperature, 52 per cent mean relative humidity and 8.9 sunshine hours. The results are in conformity with the findings of Srivastava *et al.* (2003) [11] who reported that 30 ^{0}C temperature was optimum for the development of ladybird beetle, *C. septempunctata*. The ladybird beetle population had non-significant negative correlation with maximum temperature (r=-0.2615) and minimum temperature had significant negative correlation (r=-0.6207) and non significant negative correlation with morning & evening relative humidity (r=-0.4251 & r=-0.4103). The present findings also corroborate with the findings of Tank and Korat (2007) [12] who reported that relative humidity was negatively correlated and sunshine hours was positively correlated with *C. sexmaculata* population on wheat crop. The results indicated that with the increase in maximum temperature and sunshine hours, the population of *coccinellid* predator, *C. septempunctata* was also increased, whereas, with the increase in relative humidity the population was decrease.

Table 1: Seasonal incidence of the pest on wheat

Met Week	Date of Observation	No. of aphid/ shoot/plant	No. of Jassid /plant	No. of Natural enemies/m^2	Temperature (^{0}C)		Humidity (%)		Rain Fall (cm)
					Max.	Min.	Morn.	Even	
47	19.11.2018	0.00	1.00	0.00	32.0	15.8	77	41	14.8
48	26.11.2018	0.00	3.30	0.00	29.4	11.0	74	42	0
49	3.12.2018	7.00	9.10	0.00	29.6	12.8	81	39	0
50	10.12.2018	12.20	18.50	1.40	28.5	10.2	78	39	0
51	17.12.2018	24.30	23.20	2.10	27.3	7.5	69	39	0
52	24.12.2018	44.70	33.70	3.10	26.9	6.1	72	32	0
1	1.1.2019	75.70	34.20	3.40	29.0	5.5	71	28	0
2	8.1.2019	123.80	21.30	6.50	28.3	5.9	73	31	0
3	15.1.2019	152.20	2.00	4.10	30.7	8.7	73	33	0
4	22.1.2019	160.90	0.00	1.10	27.2	7.5	75	40	0
5	29.1.2019	60.70	0.00	0.00	27.2	7.9	74	38	0
6	5.2.2019	10.50	0.00	0.00	27.3	7.6	73	38	0
7	12.2.2019	1.40	0.00	0.00	31.6	9.6	77	30	0
8	19.2.2019	0.00	0.00	0.00	34.1	11.9	72	26	0

Table 2: Correlation coefficient (r) of wheat aphid with aboitic factors and natural enemies

	Abiotic factor	Wheat aphid (*R. padi*)	Jassid	Natural enemies
1.	Temperature			
a)	Max.	-0.31835$^{(NS)}$	-0.41529$^{(NS)}$	-0.26152$^{(NS)}$
b)	Min.	-0.55394*	-0.5404*	-0.62075*
2.	Humidity			
a)	Morn.	-0.25408$^{(NS)}$	-0.37547$^{(NS)}$	-0.42512$^{(NS)}$
b)	Even.	-0.14251$^{(NS)}$	-0.29269$^{(NS)}$	-0.41034$^{(NS)}$

*Significant at 5% level (p+=0.05) = 0.0.5324

** Highly significant at 1 % level (p=0.01) = 0.6614

The incidence of Jassid on wheat was also recorded. The maximum (34.20 Jassid/plant) population of the Jassid/plant was recorded in 1st Meteorological week when the maximum and minimum temperatures were 29.0 and 5.5 °C, respectively.

Conclusion

With reference to above results, it could be concluded that:

- The aphid found to be the major insect pest of the wheat crop initiated in the first week of December, increased and reached to peak (160.90 aphid/shoot/plant) at 27.2^{0}C maximum temperature, 7.5 ^{0}C minimum temperature, 57 per cent relative humidity and 8.8 sunshine hours.
- The maximum temperature had non significant negative correlation (r=-0.3183) and relative humidity had non-significant negative correlation (r=-0.254) with aphid population. The increase in maximum and minimum temperature the population of aphid was decreased.
- The population of natural enemies on wheat crop reached to maximum (6.50 per m^2) in the second week of January at 28.3 ^{0}C maximum temperature, 5.9 ^{0}C minimum

temperature, 52 per cent relative humidity and 8.9 sunshine hours.

- The maximum temperature had non significant negative correlation (r=-0.2615) and minimum temperature had significant negative relation and relative humidity had non-significant negative correlation (r= -0.425) with the population of natural enemies.

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