

POPULATION DYNAMICS OF INSECT PEST COMPLEX OF BRINJAL IN RELATION TO WEATHER PARAMETERS

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Abstract: An experimental trial was conducted to know the population dynamics of insect pest complex of brinjal in relation to weather parameters consecutively for two years during *Rabi* season 2018-19 and 2019-20 at BRAUSS campus, Mhow, (MP) India. Results revealed that the data on intensity and population fluctuation of major insect pests on *S. melongena*, along with prevailing weather conditions during *Rabi* 2018-19 and 2019-20 were recorded in field. Whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae), Jassid, *Amrasca biguttula biguttula* (Ishida) (Hemiptera: Cicadellidae), Aphid, *Aphis gossypii* (Glover) (Hemiptera: Aphididae) and Shoot and Fruit borer, *Leucinodes orbonalis* (Guen.) (Lepidoptera: Pyraustidae) and predators viz., Ladybird beetle, *Coccinella transversalis* (Fabricius) (Coleoptera: Coccinellidae) and Green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) were recorded during the crop growth period.

Keywords: Population dynamics, Whitefly, Jassid, Aphid, Brinjal, *Leucinodes orbonalis* weather parameters

INTRODUCTION

Brinjal (*Solanum melongena* L.) belongs to the family Solanaceae is one of the most important vegetable crop which grown in South-East Asia where hot and wet climate condition prevails (Thapa 2010). India is the second largest producer of vegetables in the world, next to the China. Brinjal is the most consuming vegetable among the vegetarian people. It is one of the main sources of cash crop for many farmers (Daniel 2007).

In India, brinjal is grown in an area of 730 thousand ha with the production of 12801 thousand metric tones and productivity with 17.5 metric tones/ha. Whereas, in Madhya Pradesh, it occupies an area 51.35 thousand ha with a production of 1073.63 metric tonnes and productivity of 20.91 metric tons/ha (Anonymous 2017). Among the several production constraints of brinjal, the incidence of insect pests are the most important factors. Of them, shoot and fruit borer (*Leucinodes orbonalis*), whitefly (*Bemisia tabaci*), jassid (*Amrasca biguttula biguttula*) are the major insect pests. The whitefly and jassid are major sucking insect pests of brinjal and their incidence not only result in the loss of plant vigour, but also transmit mosaic virus disease which affecting the fruit yield and quality. It has been recognized that measuring the intensity and abundance as well as distribution of pest in relation to weather parameter help in determining pest succession and appropriate time of action and suitable method of management strategies (Chavan *et.al* 2013). Hence, a study of insect pests of brinjal was planned to know the pest population dynamic during *Rabi* season which will be helpful to evolving IPM decision making program towards the brinjal production.

MATERIALS AND METHODS

An investigation on seasonal incidence of insect pests of brinjal was carried out consecutively for two years during *Rabi* season 2018-19 and 2019-20 at BRAUSS campus, Mhow, MP, India. The total plot size was kept 10 x 10m with the spacing of 60 x 60 cm (plant x row) and variety of brinjal was hybrid Harit. Observations on different insect pests of brinjal were recorded weekly interval from randomly selected five plants per plot. It was initiated days after transplanting (DAT) of the brinjal seedlings and continued till the harvest of the crop. For observation of sucking pests, a total of six leaves in which each two leaves from upper, middle and lower canopy of the plant was carefully examined weekly for the presence of the total nymphs and adults of aphid (*Aphis gossypii* Glover), jassid (*Amrasca biguttula biguttula* Ishida) and whitefly (*Bemisia tabaci* Genn.). Similarly, the method of observation was adopted same for natural enemies i.e. lady bird (*Coccinella transversalis* Fabricius) and green lacewing (*Chrysoperla carnea* Stephens).

The population of Hadda beetle (*Epilachna vigintioctopunctata*) and green stink bug (*Nezara viridula*) was recorded at weekly interval on randomly selected five plants per plot. The incidence of shoots caused by shoot and fruit borer (*Leucinodes orbonalis* Guen.) was recorded as per cent shoot infestation by counting infested and healthy shoots from 5 randomly selected plants per plot. The per cent shoot damage was computed with the following formula:

$$\% \text{ shoot damage} = \frac{\text{Infested shoot}}{\text{Total infested and healthy shoots}} \times 100$$

Further, at fruiting stage the fruits of brinjal were

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harvested as and when fruits attained size of marketable. During each count the infested fruits were also harvested. After each harvest, the number and weight of infested and healthy fruits were recorded. Later the per cent of infested fruits obtained from different harvests were calculated for each standard week. The fruit infestation which denoted as per cent fruit damage was work out with the following formula:

$$\% \text{ fruit damage} = \frac{\text{Weight/number of infested fruits}}{\text{Total weight/number of fruits}} \times 100$$

RESULTS AND DISCUSSION

Whitefly (*Bemisia tabaci*)

Activity of *B. tabaci* during both the years of study in different weather weeks is presented. The population of whitefly during 2018-19 was recorded from early vegetative stage to maturity stage of crop. Initially, there was 0.80 nymph and adult population of whitefly per plants during first week of October (40 SWM). Population increased progressively upto 14.20 nymph and adult of whitefly per plants during first week of December (49 SWM), Thereafter, there was a gradual decrease in the pest density (9.60/plant) at maturity stage. The whitefly population ranged from 0.80 to 14.20/plant during October to February months. In the present piece of investigation, the maximum activity (14.20/plant) of whitefly was observed during first week of December and noticed throughout the crop growth period.

The population of whitefly during 2019-20 was recorded from early vegetative stage to maturity stage of crop. Initially, there was 0.40 nymph and adult population of whitefly per plants during first week of October (40 SWM). Population increased progressively upto 15.40 nymph and adult of whitefly per plants during second week of February (6 SWM), Thereafter, there was a gradual decrease in the pest density (7.8/plant) at maturity stage. The whitefly population ranged from 0.40 to 15.40/plant during October to February months. The result compare with present findings, recorded the maximum incidence of whitefly on brinjal (9.00/ five plants) during January (2nd SW) and lowest in March (12th SW). Overall incidence was more during January Mathur *et al.*, (2012) whereas recorded peak population of *B. tabaci* at 60 day old crop during 2005 and 2006, while the lowest was on the 30 days old crop. Population density was higher (3.2 - 6.7 adults/leaf) and *B. tabaci* followed a regular distribution, while aggregated distribution was also recorded when the population was low in 2005 (Hasan *et al.*, 2008) In similar to present findings the initial incidence of whitefly was observed after 7 days of transplanting with a mean population of (10.14 and 24.24/6 leaves) during 2010-11 and 2011-12. The pest population reached to

peak by last week of October in 2010-11 and first week of November in 2011-12 with mean of (101.38 and 124.24/6 leaves) (Omprakash *et al.*, 2013)

Jassid (*Amrasca biguttula biguttula*)

Activity of *A. biguttula biguttula* during both the years of study in different weather weeks is presented. During 2018-19 periodical observations, on the incidence of sucking insect pests of brinjal on the crop, revealed that the nymphs and adults of jassid appeared in the first week of October (40 SWM). Initially the population of nymphs and adults of brinjal jassid was 1.60 per plant. The highest jassid population (11.40/plant) was noticed during third week of December (51 SWM), Thereafter, the population gradually decreased reaching 4.6 jassid per plant during second week of February (7th SWM) onwards as the crop approached maturity. The population ranged between 1.60 and 11.40/plant during October to February months.

During 2019-20 the population of jassid appeared in the second week of October (41 SWM). Initially the population of nymphs and adults of brinjal jassid was 1.00 per plant. The highest jassid population (11.00/plant) was noticed during first week of December (49 SWM), Thereafter, the population gradually decreased reaching 9.8 jassid per plant during second week of December (50 SWM) onwards as the crop approached reproductive stage. The population ranged between 1.00 and 11.00/plant during October to February months. The result compare with present findings (Mathur *et al.*, 2012) revealed that the incidence of leafhopper (*A. biguttula biguttula*) on brinjal varied from 15-110 per five plants and was maximum during 52nd Standard week (SW) and minimum during March (12th SW) and showed significant negative correlation with both maximum and minimum temperature and wind speed while a positive correlation was observed with mean relative humidity and non- significant correlation with rain fall. The result compare with present findings (Savita *et al.*, 2011) the incidence of leafhopper on brinjal commenced from 6th week after sowing *i.e.*, second week of October (41st SW) with an average population 0.03 leafhopper per plant during 1st year and in 2nd year it was started from second week of October (41st SW) with an average population level of 0.15 leafhopper per leaf. Maximum population of leafhopper was observed during February (5th week) to March (1st week). In similar to present findings (Omprakash *et al.*, 2013) the initial incidence was observed at 7 days after transplanting with a mean population of 6.02 and 8.08 per six leaves, respectively during 2010-11 and 2011- 2012. The pest population reached to peak by fourth week of October in 2010-11 and last week of October in 2011-12 with mean of 52.42 and 68.24 per six leaves, respectively.

Aphid (*Aphis gossypii*)

Activity of *A. gossypii* during both the years of study in different weather weeks is presented. During the

year 2018-19 initially the population of aphid was 2.20 per plant. The highest aphid population (2.80/plant) was noticed during last week of October (43 SWM), Thereafter, the population gradually decreased reaching 0.60 aphid per plant during second week of December (50th SWM) onwards as the crop approached maturity. The population ranged between 0.60 and 2.80/plant during October to December months.

During the year 2019-20 first appearance aphid population was 2.00 per plant. The highest aphid population (2.60/plant) was noticed during fourth week of October (43 SWM), Thereafter, the population gradually decreased reaching 1.80 aphid per plant during fourth week of October (44th SWM) onwards as the crop approached vegetative. The population ranged between 2.00 to 2.60/plant during October to December months. The result compare with present findings.(Singh *et al.*, 2005) Aphid (*A. gossypii*) was recorded from 3rd week of August and reached maximum during 3rd week of November with an intensity of 4.28 aphids per leaf and 92.20 per cent incidence. The result compare with present findings. (Savita *et al.*,2009) Aphid appeared in the fifth week of October and fourth week of November with an average population of 1.81 mean aphids per leaf. The population peaked in first (19.84 mean aphid /leaf) and third week of January (41.67 mean aphid /leaf).

Brinjal shoot and fruit borer (*Leucinodes orbonalis*)

Activity of *L. orbonalis* during both the years of study in different weather weeks is presented. During 2018-19 periodical observations, on the incidence of shoot and fruit borer on brinjal crop revealed that the infested shoots (1.40%) first appeared during last week of October and reached to its peak infestation (7.80 %) during second week January. Initial fruit infestation (8.20%) was noticed during fourth week of January and reached to highest infestation (9.80%) during fourth week of February, when the shoot and fruit borer infestation was active from late vegetative stage to late flowering cum fruiting stage of brinjal crop and the maximum activity of brinjal shoot and fruit borer was recorded during the fruiting stage cum maturity.

Whereas, during the year 2019-20 the incidence of shoot and fruit borer on brinjal crop, revealed that the infested shoots (0.40%) first appeared during last week of October and reached to its peak infestation (2.60 %) during last week of November. Initial fruit infestation (1.20%) was noticed during second week of January and reached to highest infestation (1.80%) during second week of February, when the shoot and fruit borer infestation was active from vegetative stage of brinjal crop and the maximum activity of brinjal shoot and fruit borer was recorded during the fruiting stage cum maturity.

In present findings(Ghananand *et al.*, 2012) investigated on incidence of shoot and fruit borer (*L.*

orbonalis) on brinjal. The results revealed that shoot and fruit borer appeared first time in 35th SW during both the years (2005 and 2006). The shoot damage increased thereafter and reached at its maximum level of 4.0 larvae per plant in 44th SW in first year 2005-2006. The maximum population recorded in 45th SW during second year was 4.67 larvae per plant. No shoot damage was recorded in the field after 42nd SW in the experimental plot during both the years.

In similar to present findings (Shah *et al.*, 2011) revealed that brinjal was attacked by *L. orbonalis* from September to February. While, maximum infestation (46.6 %) was recorded in the first week of February, however, minimum infestation was recorded in the 4th week of October (6.60 %) and second week of November (6.60 %). In similar to present findings (Savita *et al.*, 2009) reported that the incidence of brinjal shoot and fruit borer started to appear from first week of November (44th standard week) with 3.76 per cent damaged fruits and 20.64 per cent weight loss and the subsequent year, it started from third week of November (46th standard week) with 12.28 per cent damaged fruit and 12.46 per cent weight loss. Maximum population of brinjal shoot and fruit borer was noticed on 5th and 2nd week of December during 1st and 2nd year, respectively. The damaged fruit and fruit weight loss varied from 3.76 to 45.45 per cent and 3.00 to 67.71 per cent in 1st year and 5.71 to 44.26 per cent and 3.00 to 51.33 per cent in 2nd year.

Population dynamics of natural enemies of insect pest complex of brinjal

Lady bird beetles (*Coccinella transversalis*)

During the year 2018-19 the lady bird beetle population (1.80 /plant) first recorded on the brinjal crop during last week of October. In subsequent observations, there was gradual increase and reached to the highest lady bird beetle population (2.60/plant) during second week of November and gradually declined (1.20/plant) at harvest. The lady bird beetle population ranged from 0.80 to 2.60/plant was during October to January months.

Whereas during the year 2019-20 the lady bird beetle population (0.80 /plant) first recorded on the brinjal crop during third week of October. In subsequent observations, there was gradual increase and reached to the highest lady bird beetle population (2.40/plant) during third week of November and gradually declined (1.60/plant) at harvest. The lady bird beetle population ranged from 0.80 to 2.40/plant was during October to January months.

The result compare with present findings (Bhatt 2004)lady bird beetles indicated that sucking pests viz; jassid, *Amrasca biguttula biguttula*; whitefly, *Bemisia tabaci* and aphid, *Aphis gossypii* appeared during early vegetative stage and was active throughout the crop life span. The population of natural enemies viz; ladybird beetle *Coccinella*

sempunctata also coincided with their host population.

Green lacewing (*Chrysoperla carnea*)

During the year 2018-19 the Green lacewing (0.80 /plant) first recorded on the brinjal crop during second week of December. In subsequent observations, there was gradual increase and reached to the highest Green lacewing population (2.00/plant) during fourth week of December and gradually declined (0.60/plant) at harvest. The Green lacewing population ranged from 0.60 to 2.00/plant was during December to January months.

During the year 2019-20 the Green lacewing (0.60 /plant) first recorded on the brinjal crop during second week of December. In subsequent observations, there was gradual increase and reached to the highest Green lacewing population (1.60/plant) during fourth week of December and gradually declined (0.60/plant) at harvest. The Green lacewing population ranged from 0.60 to 1.60/plant was during December to January months.

The result compare with present findings (Bhatt 2004) study on succession of important insect pests and their natural enemies indicated that sucking pests viz; jassid, *Amrasca biguttula biguttula*; whitefly, *Bemisia tabaci* and aphid, *Aphis gossypii* appeared during early vegetative stage and was active throughout the crop life span, whereas the activity of shoot and fruit borer, *Leucinodes orbonalis* observed initially on shoots and subsequently on fruit during the fruit formation stage of the crop. The population of natural enemies viz; green lacewing and *Chrysoperla carnea* also coincided with their host population.

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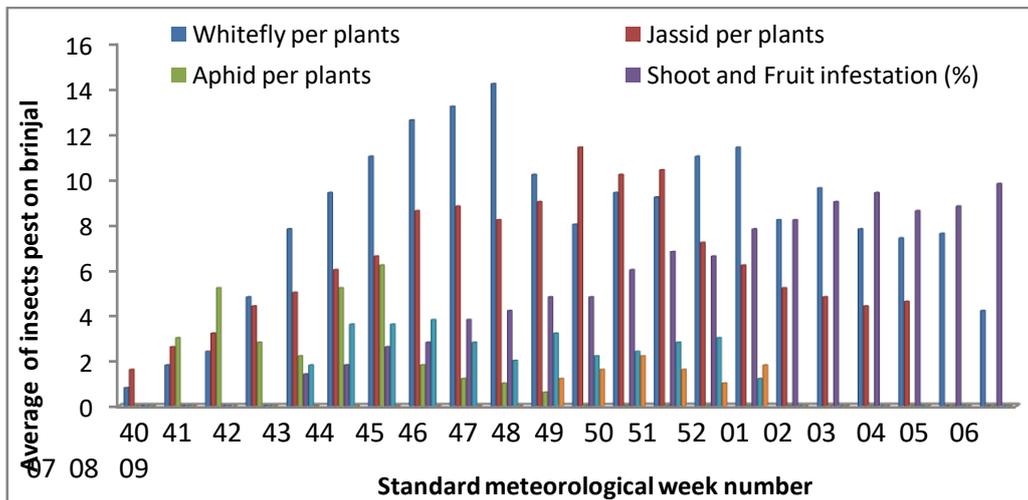


Fig. 1: Seasonal incidence of major insect pests and their natural enemies on brinjal during the crop growth period (*Rabi* 2018- 2019)

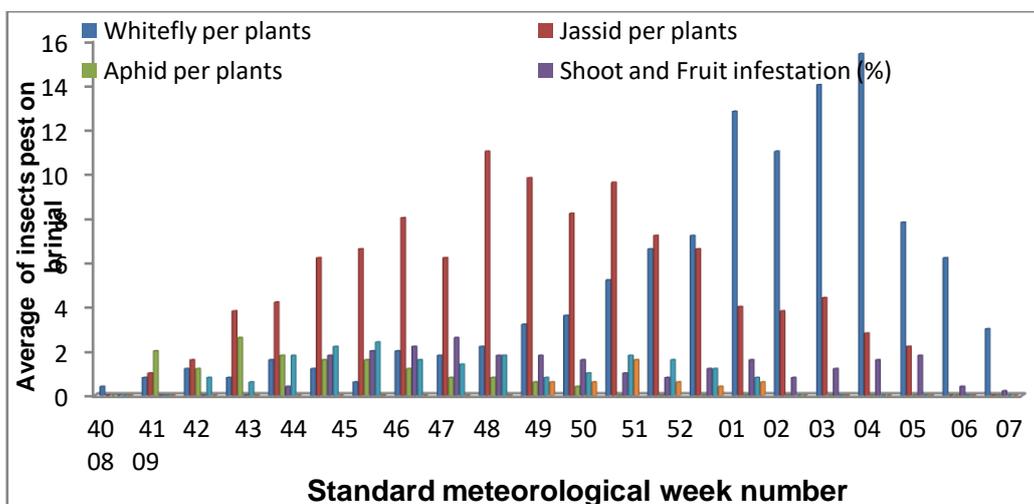


Fig. 2: Seasonal incidence of major insect pests and their natural enemies on brinjal during the crop growth period (2019-2020)

Table 1. Seasonal incidence of major insect pests and their natural enemies on brinjal during the crop growth period (*Rabi* 2018- 2019)

S. No.	Week No.	Whitefly/ plants	Jassid /plants	Aphid /plants	Shoot and Fruit infestation (%)	Lady bird beetle / plants	Green lace wing /plants
1.	40	0.80	1.60	0.00	0.00	0.00	0.00
2.	41	1.80	2.60	3.00	0.00	0.00	0.00
3.	42	2.40	3.20	5.20	0.00	0.00	0.00
4.	43	4.80	4.40	2.80	0.00	0.00	0.00
5.	44	7.80	5.00	2.20	1.40	1.80	0.00
6.	45	9.40	6.00	5.20	1.80	3.60	0.00
7.	46	11.00	6.60	6.20	2.60	3.60	0.00
8.	47	12.60	8.60	1.80	2.80	3.80	0.00
9.	48	13.20	8.80	1.20	3.80	2.80	0.00
10.	49	14.20	8.20	1.00	4.20	2.00	0.00
11.	50	10.20	9.00	0.60	4.80	3.20	1.20
12.	51	8.00	11.40	0.00	4.80	2.20	1.60
13.	52	9.40	10.20	0.00	6.00	2.40	2.20
14.	1	9.20	10.40	0.00	6.80	2.80	1.60
15.	2	11.00	7.20	0.00	6.60	3.00	1.00
16.	3	11.40	6.20	0.00	7.80	1.20	1.80
17.	4	8.20	5.20	0.00	8.20	0.00	0.00
18.	5	9.60	4.80	0.00	9.00	0.00	0.00
19.	6	7.80	4.40	0.00	9.40	0.00	0.00
20.	7	7.40	4.60	0.00	8.60	0.00	0.00
21.	8	7.60	0.00	0.00	8.80	0.00	0.00
22.	9	4.20	0.00	0.00	9.80	0.00	0.00

Table 2. Seasonal incidence of major insect pest and their natural enemies on brinjal at weekly interval, during the crop growth period (*Rabi* 2019-2020)

S. No.	Week No.	Whitefly /plants	Jassid /plants	Aphid /plants	Shoot and Fruit infestation (%)	Lady bird beetle /plants	Green lace wing /plants
1.	40	0.40	0.00	0.00	0.00	0.00	0.00
2.	41	0.80	1.00	2.00	0.00	0.00	0.00
3.	42	1.20	1.60	1.20	0.00	0.80	0.00
4.	43	0.80	3.80	2.60	0.00	0.60	0.00
5.	44	1.60	4.20	1.80	0.40	1.80	0.00
6.	45	1.20	6.20	1.60	1.80	2.20	0.00
7.	46	0.60	6.60	1.60	2.00	2.40	0.00
8.	47	2.00	8.00	1.20	2.20	1.60	0.00
9.	48	1.80	6.20	0.80	2.60	1.40	0.00
10.	49	2.20	11.00	0.80	1.80	1.80	0.00
11.	50	3.20	9.80	0.60	1.80	0.80	0.60
12.	51	3.60	8.20	0.40	1.60	1.00	0.60
13.	52	5.20	9.60	0.00	1.00	1.80	1.60
14.	1	6.60	7.20	0.00	0.80	1.60	0.60
15.	2	7.20	6.60	0.00	1.20	1.20	0.40

16.	3	12.80	4.00	0.00	1.60	0.80	0.60
17.	4	11.00	3.80	0.00	0.80	0.00	0.00
18.	5	14.00	4.40	0.00	1.20	0.00	0.00
19.	6	15.40	2.80	0.00	1.60	0.00	0.00
20.	7	7.80	2.20	0.00	1.80	0.00	0.00
21.	8	6.20	0.00	0.00	0.40	0.00	0.00
22.	9	3.00	0.00	0.00	0.20	0.00	0.00

Table 3. Meteorological data during the crop growth period (*Rabi* 2018-2019)

S. No.	SWM	Temperature (°C)		Rain-fall (mm)	Cloud cover (octa)	Wind speed (kmph)	Wind direction (deg.)	Relative humidity (%)	
		Maxi -mum	Mini -mum					Maxi -mum	Mini -mum
1.	40	34.31	20.06	2.79	2.57	2.43	124.14	85.86	31.71
2.	41	34.31	18.10	2.79	4.29	3.00	112.00	79.86	32.14
3.	42	34.03	19.17	0.00	3.71	6.74	187.86	67.00	25.00
4.	43	33.11	15.70	0.00	2.00	2.29	203.14	66.43	18.29
5.	44	30.74	16.07	0.00	1.43	2.00	138.57	77.71	29.86
6.	45	30.03	12.66	0.00	2.57	4.14	145.00	69.14	22.71
7.	46	30.07	13.24	0.00	2.57	4.29	206.71	69.00	21.71
8.	47	29.87	15.61	0.00	2.14	4.86	134.00	67.71	27.57
9.	48	26.40	11.69	0.00	4.71	5.86	169.43	86.14	31.57
10.	49	24.66	12.71	0.00	2.29	6.71	90.29	70.00	37.43
11.	50	22.83	9.79	2.79	3.57	6.29	97.14	81.57	36.71
12.	51	22.91	4.86	0.00	2.57	5.29	128.71	80.00	30.00
13.	52	22.21	5.71	0.00	2.43	6.71	71.14	73.29	24.14
14.	1	24.23	6.46	0.00	3.00	6.00	174.00	82.43	27.14
15.	2	22.66	6.19	0.00	2.29	6.71	90.57	78.43	31.29
16.	3	26.19	9.33	0.00	1.00	7.00	124.43	64.86	23.29
17.	4	22.61	11.41	0.00	3.14	8.00	126.57	82.43	34.14
18.	5	25.39	8.29	0.00	3.43	6.43	198.00	82.00	26.71
19.	6	24.36	8.51	0.00	1.57	9.57	139.43	69.86	24.71
20.	7	24.86	7.10	0.00	1.71	5.14	103.14	71.57	25.43
21.	8	29.64	13.83	0.21	3.57	6.71	153.43	74.86	28.29
22.	9	28.07	14.03	0.40	4.00	14.67	141.67	75.67	28.33

Table 4. Meteorological data during the crop growth period (*Rabi* 2019-2020)

S. No.	SWM	Temperature (°C)		Rain-fall (mm)	Cloud cover (octa)	Wind speed (kmph)	Wind direction(deg.)	Relative humidity (%)	
		Maxi -mum	Mini -mum					Maxi -mum	Mini -mum
1.	40	30.43	20.40	5.29	5.57	8.57	228.71	99.86	58.29
2.	41	30.99	19.31	1.19	3.57	5.29	199.14	98.29	43.43
3.	42	30.06	18.97	0.43	2.29	4.14	108.14	95.57	42.71
4.	43	26.59	20.00	0.69	6.86	4.71	100.57	91.71	51.57
5.	44	30.03	19.33	4.57	4.86	4.29	128.14	94.57	53.71
6.	45	29.97	18.60	0.00	4.71	4.43	137.14	90.00	43.57
7.	46	29.34	14.63	0.00	1.29	5.57	128.86	87.57	31.43
8.	47	28.37	14.53	0.00	2.71	4.14	115.29	86.86	35.43
9.	48	28.51	15.11	0.00	1.29	5.29	133.57	87.71	35.86

10.	49	25.01	12.26	0.00	3.00	5.71	72.14	87.14	39.14
11.	50	24.57	12.91	2.79	4.43	4.43	151.57	96.71	52.29
12.	51	22.11	9.69	0.00	4.43	3.57	75.14	99.86	57.71
13.	52	21.36	8.07	0.00	2.71	5.00	95.57	93.29	40.71
14.	1	20.19	9.86	0.00	2.86	4.86	87.86	97.86	59.43
15.	2	22.54	7.91	0.57	2.14	7.86	126.71	97.14	37.71
16.	3	20.89	9.39	0.00	2.14	4.00	91.43	98.43	57.86
17.	4	24.14	10.14	0.00	1.43	4.71	114.43	88.71	44.43
18.	5	23.16	8.69	0.00	1.00	9.29	130.43	86.43	39.14
19.	6	23.73	8.86	0.00	1.00	7.86	86.71	84.71	33.71
20.	7	27.91	9.23	0.00	1.00	6.14	87.71	87.14	26.29
21.	8	29.04	12.24	0.00	1.00	3.71	107.29	80.43	27.57
22.	9	29.00	13.05	0.00	1.50	3.00	137.00	75.75	22.75

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