The Pharma Innovation Journal 2022; SP-11(3): 68-72

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(3): 68-72

www.thepharmajournal.com
Received: 01-01-2022
Accepted: 04-02-2022

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Seasonal incidence of major sucking pests on okra

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Abstract
The studies entitled 'Seasonal incidence of major sucking pests on okra' were conducted on the research farm of Vegetable Improvement Scheme, Central Experiment Station, Wakawali, under DBSKKV, Dapoli during Summer 2019 and Summer 2020. The major sucking pests recorded in the experimental field were jassid (*Amrasca bigutulla bigutulla* Ishida), aphid (*Aphis gossypii* Glover) and whitefly (*Bemisia tabaci* Gennadius). The population of jassid and aphid were started during 10th SMW while, whitefly during 11th SMW and reached its peak level in 16th (20.75), 15th (12.25) and 14th (5.80) SMW respectively. Correlation of pest incidence and weather parameters revealed that the population of jassid, aphid and whitefly showed positively highly significant correlation with maximum temperature (r=0.713**), (r=0.813**), (r=0.783**) while, positively significant correlation with minimum temperature (r=0.671*), (r=0.623*) and (r=0.612*) respectively. The population of jassid, aphid and whitefly had a positively non-significant correlation with morning relative humidity, wind speed and evaporation. While, negatively non-significant correlation was recorded between aphid and bright sunshine as well as whitefly and evening relative humidity and bright sunshine.

Keywords: Seasonal incidence, sucking pests, okra, weather parameters, correlation

Introduction
Okra (*Abelmoschus esculentus* (L.) Moench) is a commercial vegetable crop belonging to the Malvaceae family, also known as lady's finger due to its shape in many English-speaking countries and bhindi in India. India ranks first in area and production in the world. In India, it was cultivated on an area of 509.0 thousand hectare with an annual production of 6094.9 thousand metric tons and productivity of 12 metric tons per hectare during 2017-18 (Anonymous, 2018) [2]. During the Summer season, it fetches a lucrative price due to shortage of other vegetables in the market. It has good nutritional value particularly high content of calcium and vitamin C (Anitha and Nandihalli, 2008) [1]. Incidence of insect pests is one of the limiting factors in production of okra. According to Rawat and Sahu (1973) [11], okra crop is ravaged by as many as 45 species of insect-pests throughout its growth period. Among these, major sucking pests such as cotton jassid, *A. biguttula biguttula* (Ishida), aphid, *A. gossypii* (Glover) and whitefly, *B. tabaci* (Gennadius) are quite serious and major restraining factors in okra cultivation. Krishnaiah (1980) [8] reported that losses in okra due to leaf hopper, *A. biguttula biguttula* (Ishida) were 50-56 per cent. The aphid, *A. gossypii* (Glover) is a polyphagous sucking pest and also acts as a vector of virus and transmits mosaic and leaf curl diseases in okra. The whitefly, *B. tabaci* (Gennadius) acts as a vector in transmitting viral disease such as yellow vein mosaic in okra. (Butani and Verma, 1976) [3]. Hence, the investigation was undertaken to study the seasonal incidence of major sucking pest on okra and their correlation with weather parameters.

Material and Methods
Separate one raised bed 1 m X 27 m (27sq.m.) size was prepared at research farm of Central Experiment Station, Wakawali for conducting the experiment during two consecutive Summer season *viz*., 2019 and 2020. The seeds of okra variety Varsha Uphar were sown by adopting 45 cm X 30 cm spacing. No insecticidal treatments were applied at any stage of the crop growth. All recommended agronomic and cultural practices were followed to raise a good crop. The number of nymphs and adults of jassid, aphid and whitefly were recorded during early morning from three leaves each one from top, middle and bottom at weekly intervals by observing randomly selected ten plants. The meteorological data of different weather parameters like, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, wind speed and sunshine hours were obtained from Meteorological Observatory, at Irrigation Water Management Scheme, Central Experiment Station, Wakawali.

The correlation was worked out between weather parameters and insect pest population as per Panse and Sukhatme (1967) [10] by using WASP software.

Results and Discussion

The data on seasonal incidence of major sucking pests of okra during Summer 2019, Summer 2020 and pooled are presented in Table 1 and graphically depicted in Figures 1, 2 and 3.

Jassid, (*A. biguttula biguttula* Ishida)

Summer 2019

The pest incidence was first noticed in the 10th SMW (05th March to 11th March) *i.e.* 0.60 jassids per three leaves, then incidence increased continuously up to the 15th SMW (9th April to 15th April) and then it showed declined trend but remained till maturity of the crop. The maximum pest incidence (21.70 jassids/3 leaves) was recorded in 15th SMW (9th April to 15th April).

Summer 2020

The pest incidence was initiated from 10th SMW (05th March to 11th March) *i.e.* 1.10 jassids per three leaves, then incidence increased continuously up to the 16th SMW (16th April to 22nd April) and then it showed declined trend but remained till maturity of the crop. The maximum pest incidence (22.30 jassids/3 leaves) was recorded in 16th SMW (16th April to 22nd April).

Pooled data (Summer 2019 and 2020)

Pooled data of both the years revealed that, the incidence of jassid population was in the range of 0.85 to 20.75 jassids per three leaves. The pest incidence started from 10th SMW (05th March to 11th March) *i.e.* 0.85 jassids per three leaves, then incidence increased continuously up to the 16th SMW (16th April to 22nd April) and then it showed declined trend but remained till maturity of the crop. The maximum pest incidence (20.75 jassids/3 leaves) was recorded in 16th SMW (16th April to 22nd April).

The above findings are in confirmation with the earlier research workers like Jayasimha *et al.*, (2012) [6] revealed an incidence of leafhopper, ranging from 0.25 to 16.44 leafhoppers per leaves. Dhandge *et al*., (2018) [4] revealed that the peak population of jassids was observed at 17th SMW (16.1 jassids/3 leaves) and 15th SMW (15.3 jassids/3 leaves) of Summer during 2016 and 2017 respectively.

Aphid, (*A. gossypii* Glover)

Summer 2019

The pest incidence was first noticed in the 10th SMW (05th March to 11th March) *i.e.* 1.90 aphids per three leaves, then incidence increased continuously up to the 15th SMW (9th April to 15th April) and then it showed declined trend but sustained till harvesting of the crop. The maximum pest incidence (11.70 aphids/3 leaves) was observed in 15th SMW (9th April to 15th April).

Summer 2020

The pest incidence was initiated from 11th SMW (12th March to 18th March) *i.e.* 2.40 aphids per three leaves, then incidence increased continuously up to the 15th SMW (9th April to 15th April) and then it showed declined trend but sustained till harvesting of the crop. The maximum pest incidence (12.80 aphids/3 leaves) was observed in 15th SMW (9th April to 15th April)

Pooled data (Summer 2019 and 2020)

Pooled data of both the years revealed that, the incidence of aphid population was in the range of 0.95 to 12.25 aphids per three leaves. The pest incidence started from 10th SMW (05th March to 11th March) *i.e.* 0.95 aphids per three leaves, then incidence increased continuously up to the 15th SMW (9th April to 15th April) and then it showed declined trend but sustained till harvesting of the crop. The maximum pest incidence (12.25 aphids/3 leaves) was observed in 15th SMW (9th April to 15th April).

The results of above findings are discussed here with earlier research worker like Shanthi *et al*., (2020) [12] reported that in the Summer okra crop, aphid population reached maximum in 15th SMW (third week of April 2016) *i.e.* 7.54 and 7.32 nos. per leaf in partially weeded and weeded plots, respectively.

Table 1: Seasonal incidence of major sucking pests on okra during Summer 2019, Summer 2020 and pooled

SMW	Mean population/ three leaves/ plant								
	Jassid			Aphid			Whitefly		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.60	1.10	0.85	1.90	0.00	0.95	0.00	0.00	0.00
11	1.40	1.80	1.60	2.70	2.40	2.55	0.40	0.90	0.65
12	3.90	5.50	4.70	5.20	6.20	5.70	1.30	2.10	1.70
13	6.70	8.40	7.55	7.60	8.20	7.90	4.30	5.10	4.70
14	11.20	13.60	12.40	9.80	9.50	9.65	5.60	6.00	5.80
15	21.70	15.20	18.45	11.70	12.80	12.25	5.10	4.40	4.75
16	19.20	22.30	20.75	10.20	12.50	11.35	3.70	4.20	3.95
17	16.60	18.80	17.70	9.50	8.80	9.15	3.80	3.10	3.45
18	12.50	13.40	12.95	6.40	5.20	5.80	2.70	2.50	2.60
19	7.90	6.70	7.30	5.80	4.30	5.05	2.20	1.80	2.00
20	2.90	2.40	2.65	3.20	2.90	3.05	1.60	1.30	1.45

SMW- Standard Meteorological Week

Whitefly, (*B. tabaci* Gennadius)

Summer 2019

The pest incidence was first noticed in the 11th SMW (12th March to 18th March) *i.e.* 0.40 whiteflies per three leaves, then incidence increased continuously up to the 14th SMW (2nd April to 8th April) and then it showed declined trend but sustained till maturity of the crop. The maximum pest incidence (5.60 whiteflies/3 leaves) was found in 14th SMW (2nd April to 8th April).

Summer 2020

The pest incidence was initiated from 11th SMW (12th March to 18th March) *i.e.* 0.90 whiteflies per three leaves, then incidence increased continuously up to the 14th SMW (2nd April to 8th April) and then it showed declined trend but sustained till maturity of the crop. The maximum pest incidence (6.00 whiteflies/3 leaves) was found in 14th SMW (2nd April to 8th April).

Pooled data (Summer 2019 and 2020)

Pooled data of both the years revealed that, the incidence of whitefly population was in the range of 0.65 to 5.80 whiteflies per three leaves. The pest incidence started from 11th SMW (12th March to 18th March) *i.e.* 0.65 whiteflies per three leaves, then incidence increased continuously up to the 14th SMW (2nd April to 8th April) and then it showed declined trend but sustained till maturity of the crop. The maximum pest incidence (5.80 whiteflies/3 leaves) was found in 14th SMW (2nd April to 8th April).

The above findings are comparable with the result of Dhandge *et al*., (2018) [4] who revealed that the incidence of whitefly population started from 11th SMW (3.9 whiteflies/3 leaves) and 10th SMW (3.2 whiteflies/3 leaves) and reached to its peak at 16th SMW (16.2 whiteflies/3 leaves) and (15.7 whiteflies/3 leaves) of Summer during 2016 and 2017 respectively.

Correlation between pest incidence and weather parameters

The data on correlation between weather parameters and pest incidence of jassid, aphid and whitefly during Summer 2019 and Summer 2020 and pooled are presented in Table 2.

Jassid, (*A. biguttula biguttula* Ishida)

During Summer 2019 the jassid population showed positively significant correlation with maximum temperature (r=0.638*) and minimum temperature (r=0.651*). While, positively non-significant correlation with morning relative humidity (r=0.551), wind speed (r=0.480) and evaporation (r=0.264).

During Summer 2020 the jassid population showed positively significant correlation with minimum temperature (r=0.668*) and evening relative humidity (r=0.648*). While, positively non-significant correlation with maximum temperature (r=0.522), wind speed (r=0.335), bright sunshine (r=0.269) and evaporation (r=0.525).

The pooled data of jassid population showed positively highly significant correlation with maximum temperature (r=0.713**) and positively significant correlation with minimum temperature (r=0.671*). Whereas, positively non-significant correlation with morning relative humidity (r=0.483), evening relative humidity (r=0.329), wind speed (r=0.426), bright sunshine (r=0.116) and evaporation (r=0.435).

The present findings are in close agreement with Jat *et al*., (2019) [5] who revealed that the leafhopper population had positive significant correlation with maximum and minimum temperature. Shanthi *et al*., (2020) [12] revealed that leafhoppers had a significantly positive relationship with maximum and minimum temperature while negatively correlated with relative humidity.

Aphid, (*A. gossypii* Glover)

During Summer 2019 the aphid population showed positively highly significant correlation with maximum temperature (r=0.759**) and positively significant correlation with minimum temperature (r=0.651*) and morning relative humidity (r=0.635*). While, positively non-significant correlation with wind speed (r=0.382) and evaporation (r=0.297).

During Summer 2020 the aphid population showed positively significant correlation with maximum temperature (r=0.636*) and minimum temperature (r=0.603*). While, positively non-significant correlation with evening relative humidity (r=0.464), wind speed (r=0.103) and evaporation (r=0.379).

The pooled data of aphid population showed positively highly significant correlation with maximum temperature (r=0.813**) and positively significant correlation with minimum temperature (r=0.623*). Whereas, positively non-significant correlation with morning relative humidity (r=0.463), evening relative humidity (r=0.032), wind speed (r=0.297) and evaporation (r=0.425).

The present findings are in close agreement with Khating *et al*., (2016) [7] who revealed that the minimum temperature showed positive significant correlation with aphids. While, morning relative humidity showed positive non-significant correlation with occurrence of aphids. Lal *et al*., (2020) [9] reported that the populations of aphids had significantly positive correlation with maximum temperature and evaporation.

Table 2: Correlation between weather parameters and major sucking pests of okra during Summer 2019, Summer 2020 and pooled

Sucking pests	Year	Correlation coefficient (r) (Weather parameters)						
		Temp. Max.	Temp. Min.	RH-I	RH-II	WS	BSS	EVP
Jassid	2019	0.638*	0.651*	0.551	-0.114	0.480	-0.036	0.264
	2020	0.522	0.668*	-0.124	0.648*	0.335	0.269	0.525
	Pooled	0.713**	0.671*	0.483	0.329	0.426	0.116	0.435
Aphid	2019	0.759**	0.651*	0.635*	-0.341	0.382	-0.148	0.297
	2020	0.636*	0.603*	-0.203	0.464	0.103	-0.028	0.379
	Pooled	0.813**	0.623*	0.463	0.032	0.297	-0.101	0.425
Whitefly	2019	0.707*	0.672*	0.737**	-0.339	0.311	-0.148	0.297
	2020	0.629*	0.547	-0.332	0.337	0.057	-0.158	0.357
	Pooled	0.783**	0.612*	0.519	-0.037	0.199	-0.232	0.397

N=12

** Correlation is significant at the 0.01 level r value = 0.708

* Correlation is significant at the 0.05 level r value = 0.576

Whitefly, (*B. tabaci* Gennadius)

During Summer 2019 the whitefly population showed positively highly significant correlation with morning relative humidity (r=0.737**), while positively significant correlation with maximum temperature (r=0.707*) and minimum temperature (r=0.672*). Whereas, positively non-significant correlation with wind speed (r=0.311) and evaporation (r=0.297).

During Summer 2020 the whitefly population showed positively significant correlation with maximum temperature (r=0.629*). While, positively non-significant correlation with minimum temperature (r=0.547), evening relative humidity (r=0.337), wind speed (r=0.057) and evaporation (r=0.357).

The pooled data of whitefly population showed positively highly significant correlation with maximum temperature (r=0.783**) and positively significant correlation with minimum temperature (r=0.612*). Whereas, positively non-significant correlation with morning relative humidity (r=0.519), wind speed (r=0.199) and evaporation (r=0.397).

The present findings are in close agreement with Jat *et al*., (2019) [5] who reported that the whitefly population exhibited positive significant correlation with maximum and minimum temperature. Shanthi *et al*., (2020) [12] revealed that whitefly had a significantly positive relationship with maximum and minimum temperature while, negatively correlated with relative humidity.

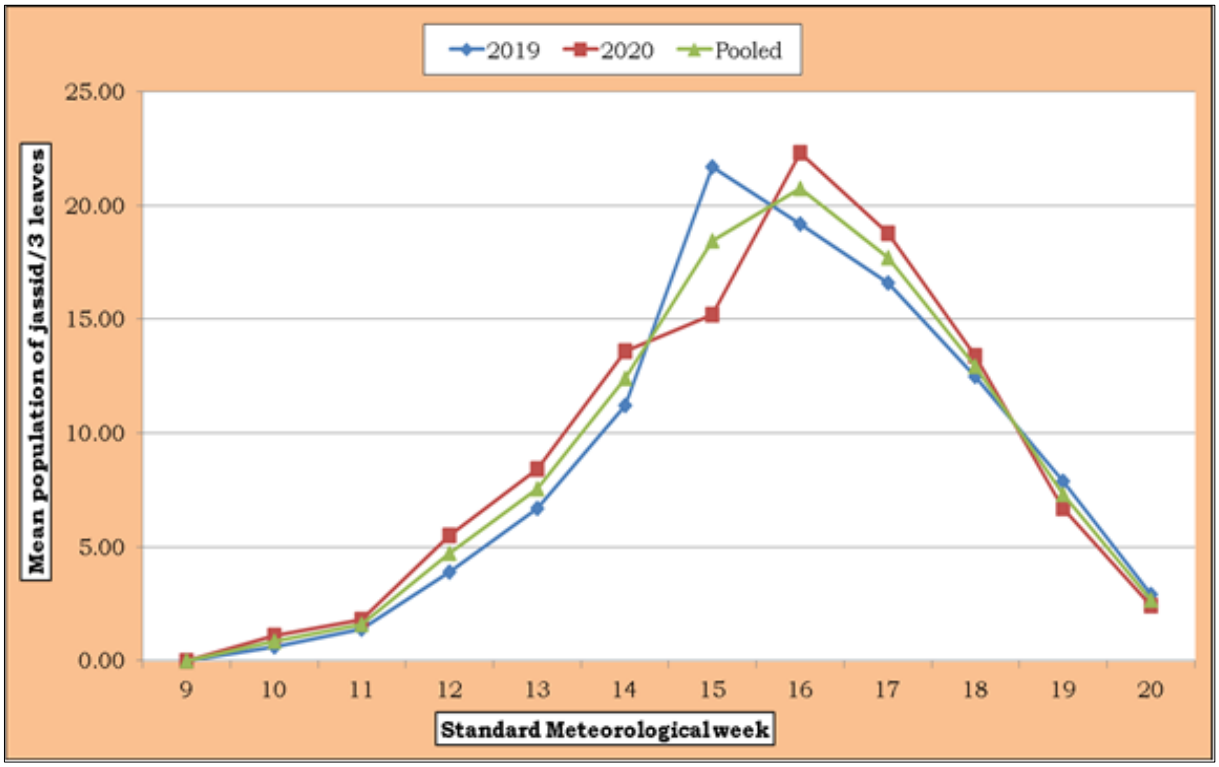

Fig 1: Seasonal incidence of jassids on okra during Summer 2019, Summer 2020 and pooled

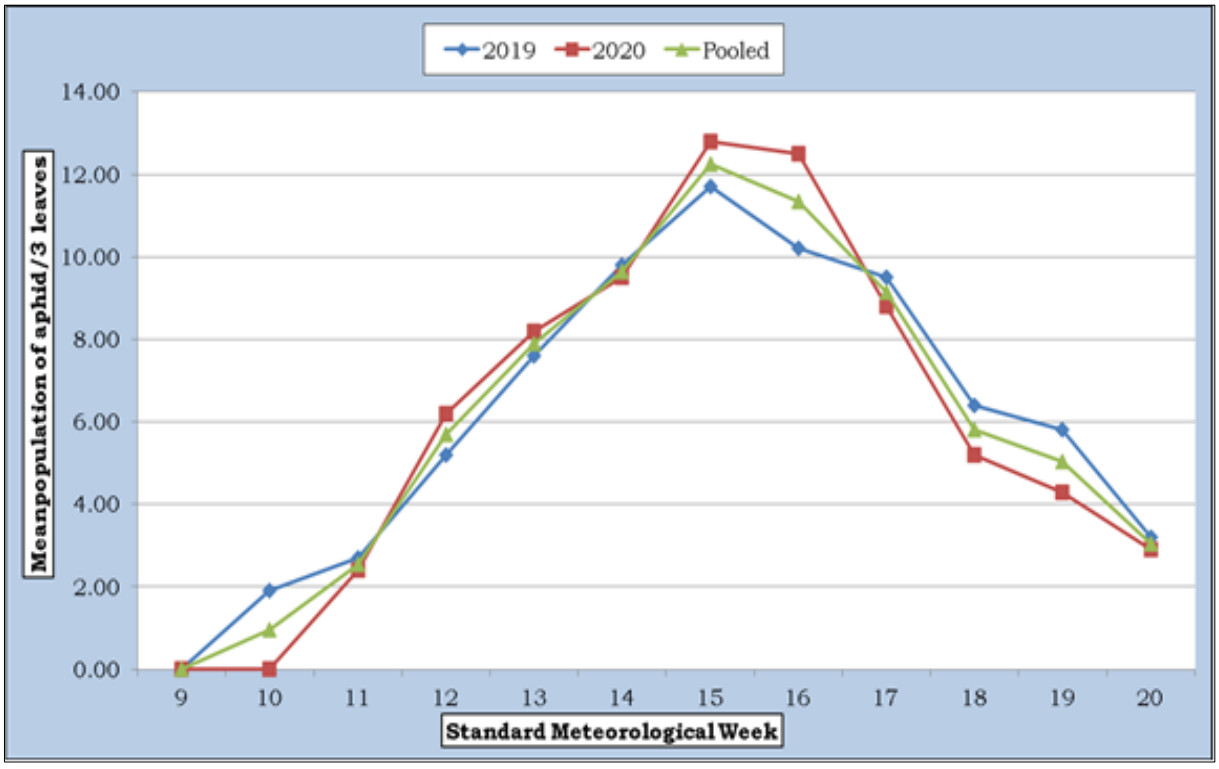

Fig 2: Seasonal incidence of aphids on okra during Summer 2019, Summer 2020 and pooled

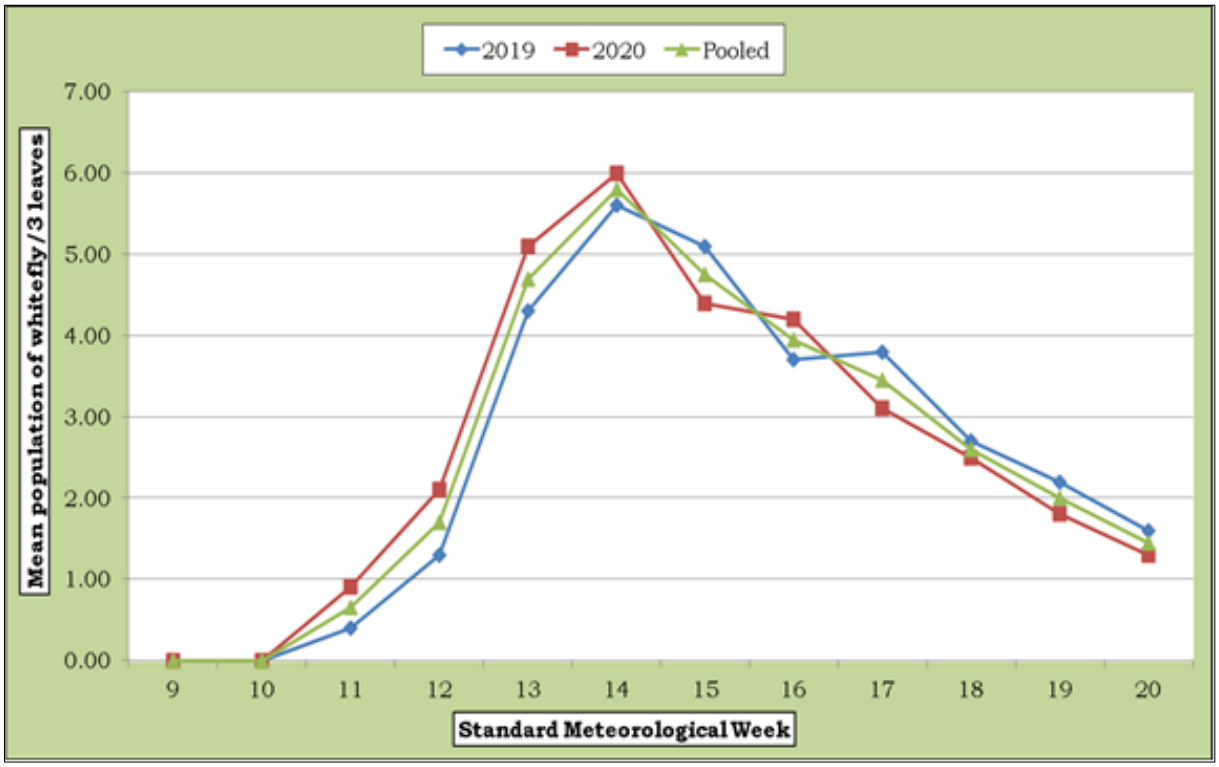

Fig 3: Seasonal incidence of whiteflies on okra during Summer 2019, Summer 2020 and pooled

Conclusion

The overall results of the present study revealed that, the weather parameters play an important role in the incidence of sucking pest on okra crop. The population of jassid, aphid and whitefly was significantly positively influenced by the maximum and minimum temperature while, positively non-significant with morning relative humidity, wind speed and evaporation.

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