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Seasonal incidence of fall armyworm, S. *frugiperda* (J.E. Smith) and their natural enemies in relation to weather parameters

Ghoderao TN, Suradkar AL and Tupe AP

Abstract
The field experiment were conducted on the field of progressive farmer Shree. Baburao Mhaske Domegoan, Taluka Ambad, Dist. Jalna under the guidance of college of agriculture Badnapur during *kharif* 2021, to know the seasonal incidence of fall armyworm, *Spodoptera frugiperda* egg masses of fall armyworm 28th SMW 3th week of July with the mean population of 0.10 larvae/plant and 0.30 egg masses/plant respectively. The peak populations were observed in the 2nd week of August (32nd SMW) with mean population of 3.20 larvae/plant and egg masses of fall armyworm were 0.80 egg masses/plant. The correlation between fall armyworm *Spodoptera frugiperda* with weather parameters during *kahrif* 2021 results indicate that the population demonstrated a non-significant negative correlation with maximum temperature, minimum temperature, morning humidity, evening humidity and rainfall. The correlation between egg masses of FAW in relation to weather parameters indicate that the population demonstrated a non-significant positive correlation with morning, evening humidity and rainfall. The natural enemies like LBB, predatory spider and predatory bug were also recorded during a season with ranged from 1.2 to 2.2 per plant, 0.2 to 2.2 per plant and 0.4 to 0.85 per plant respectively. The population of LBB reached to peak in 31th SMW with 2.20 per plant.

Keywords: Seasonal, armyworm, natural, enemies, weather parameters

Introduction
Maize or corn (*Zea mays* L.) is a crop of global importance, which holds a unique position in world agriculture. Maize belongs to the family of Poaceae, originated from South America, from where it was taken to all parts of the world.

In India maize production estimated about 20240 tonnes in *kharif* and 8470 tonnes in rabi. Although in 2018-19 production were decreased by 20220 tonnes in *kharif* and 7580 tonnes in *rabi* (Indiastat). In Chhattisgarh, it is well informed in an area of 226.79 hec. With productivity of 2458 kg/hec. of *kharif* season. Although 74.45 ha. Area and 1950 kg/ha. Productivity of rabi season in 2017-18 (Annual report 2017-18).

Although 139 insect pests cause varying degree of damage to maize crop, only about a dozen of these are quite serious and require control measures like maize stalk borer, pink stem borer, and shoofly are the insects of national importance while the armyworm, jassids, thrips, aphids, pyrilla, grasshoppers, white grub, cut worms, hairy caterpillars, termites, and the leaf miner are more serious regional level insect pests (NIPMP, 2001). Amongst the most serious pests shoot fly and maize stem bore, (Chilo partellus Swinhoe, Sesamia inferens Walker) occurs as serious pests in India (Manjunath, 2013).

The fall army worm is a lepidopteron pest that feeds in large numbers on leaves and stems of more than 80 plant species, causing major damage to economically cultivated grasses such as maize, rice, sorghum, sugarcane but also other vegetable crops and cotton. The literature on this pest is extensive (Ashley *et al.*, 1989) [2].

On maize, if 5% of seedlings are cut or 20% of whorls of small plants (during the 1st 30 days) are infested, it is recommended that an insecticide be applied (King and Saunders, 1984) [4]; on sorghum the pest threshold level is regarded as one (or two) larvae per leaf whorl and two per head (Pitre, 1985) [6].

The studies on seasonal incidence of insect pests and their natural enemies of maize crop and their correlation with the weather parameters provide basic information about seasonal occurrence of insect pests and their natural enemies. This provides an opportunity for the development of management strategies significant for the control of these pests.

Materials and Methods

A field experiment was conducted on the field of progressive farmer Shree. Baburao Mhaske Domegoan, Taluka Ambad, Dist. Jalna under the guidance of College of Agriculture Badnapur during *kharif* 2021 under field condition to know the seasonal incidence of larvae of fall armyworm, egg masses of FAW and their natural enemies maize in relation to weather parameters *viz.*, maximum temperature, minimum temperature, relative humidity (morning and evening) and rainfall. The hybrid of maize variety use for study is Fortuner.

1. Design of experiment	Randomized Block Designs
2. Variety	Fortuner
3. Spacing	60x20cm
4. Plot size	10x10m
5. Date of sowing	4 July *Kharif* 2021
6. Season	*Kharif* 2020-21

The observation was recorded from 10 randomly selected plants for egg masses, larval population of *S. frugiperda* and natural enemies. The weekly observation was taken since from seedling to harvesting during early morning and the average larval population and the egg masses were presented per meter row length. The crop was kept untreated throughout the season. The data generated during the investigation was correlated with weather parameters. (Rainfall, temp, RH, etc.).

Results and Discussion

The data recorded on seasonal incidence of fall armyworm affecting the maize during *kharif* 2021 is presented in Table 1 and Fig 1. shows that the population of fall armyworm was observed from 27th SMW to 40th SMW of 2021, indicate that the occurrence of fall armyworm was observed throughout the season. FAW (*S. frugiperda)* population on maize ranged from 0.10 to 3.2 larvae/plant. There was increased in attacked of FAW (*S. frugiperda*) from second fourth night of July to second forth night of October which ranged from 0.10 to 3.20 larvae/plant. The peak population of FAW (*S. frugiperda*) 3.20 larvae/plant was noticed in 30th to 34th SMW. There after the population went on decreasing. The second peak of FAW (*S. frugiperda*) incidence was observed in 37th MW (2.7 larvae/plant).

The data regarding population of egg masses of FAW (*S. frugiperda*) presented in table 1 and graphically presented in fig 2 showed that population of egg masses ranged from 0.30 to 0.80 on maize observed from 27th SMW to 40th SMW 2021. Incidence of egg masses of FAW (*S. frugiperda*) started from second fortnight of July (28th July) to second fortnight of October (40th SMW). The pick incidence of egg masses

Data incorporated in table 1 indicate that the fall armyworm larval population had negatively non-significant correlation with maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and rainfall also i.e (r= -0.414), (r= - 0.320), (r= -0.196), (r=-0.196) and (r= -0.081) respectively.

Kumar *et al*, (2020) [5] reported by during the *khrif* and *rabi*, occurrence of *S. frugiperda* in terms of larval population which showed significant positive correlation with the maximum temperature (r= 0.7205) and negative correlation and significant relationship with relative humidity (r= -0.673) and rainfall (r= -0.829) in Perambalur district.

According to data presented in table 1 egg masses number had non- significant negative correlation with maximum temperature (r= -0.414) and significant negative correlation with minimum temperature (r= -0.637), non- significant positive correlation with morning relative humidity (r= 0.084) and evening relative humidity (r= 0.112) while the impact of rainfall on egg masses was positively non-significant (r=0.027)

Duraimurugan, (2018) [3] revealed that the ovipostion of *S. frugiperda* showed significant negative correlation with morning relative humidity and minimum temperature r= -0.634 and r= -0.768 respectively. The maximum oviposition of *S. frugiperda* on castor was recorded from 33rd SMW to 46th SMW.

Table 1: Seasonal incidence of fall armyworm, *S. frugiperda* (J.E. Smith) in relation to weather parameters during *kharif* 2021

SMW	*S. frugiperda*		Natural Enemies			Weather parameters				
	Egg masses	Larvae	*Coccinellids*	Spiders	Predatory bug	Temperature (◦C)		Rainfall (mm)	R.H (%)	
						Max.	Min.		Morn.	Even.
27	0.00	0.00	0.00	0.00	0.00	33.4	23.7	2.14	78.8	61.2
28	0.30	0.10	1.20	0.20	0.40	30.4	22.2	18.71	95.8	80.0
29	0.55	1.80	1.80	0.90	0.30	29.0	22.8	12.71	95.1	87.5
30	0.60	3.00	2.00	2.20	0.40	28.2	22.1	0.00	83.2	72.1
31	0.70	2.80	2.20	1.80	0.50	29.7	21.8	0.00	83.2	63.4
32	0.80	3.20	1.90	2.30	0.65	31.7	22.4	0.00	71.2	54.7
33	0.75	2.40	1.80	1.60	0.70	30.7	21.2	31.85	93.2	86.7
34	0.72	2.60	1.60	2.00	0.85	30.5	21.8	1.14	91.5	70.7
35	0.60	2.00	1.20	2.10	0.80	29.4	22.0	22.71	92.4	84.4
36	0.50	2.60	1.20	1.70	0.75	29.1	23.4	43.85	95.8	91.4
37	0.40	2.70	1.40	1.20	0.70	28.5	21.5	1.14	93.1	81.7
38	0.65	1.90	1.80	1.60	0.65	28.7	21.7	25.57	96.1	88.7
39	0.72	1.80	2.00	1.80	0.50	29.1	21.2	12.42	97.5	89.7
40	0.70	1.89	1.80	2.00	0.55	28.0	21.0	3.71	98.0	82.5

The data related to correlation coefficients between weather parameters and ladybird beetle population presented in Table.1 indicate that the correlation between ladybird beetle population on maize and maximum temperature (-0.589*) show negative significant correlation, minimum temperature show positive significant correlation (0.653*) whereas morning humidity show positively non-significant correlation and evening humidity shows negatively non-significant correlation, (r=119) and (r=-0.127) respectively. Rainfall shows negatively non-significant correlation (- 0.116).

Ankita *et al.* (2020) [1] reported that the activity of *coccinellids* was first observed during first week of August (0.4 beetle

plant^{-1}) and the maximum activity was noticed during fourth week of September (2.0 beetle plant^{-1}). The population of *coccinellid* beetles exhibited non-significant positive correlation with relative humidity (r= 0.095) while, non-significant negative correlation with maximum temperature (r= -0.287) and rainfall (r= - 0.057) in maize ecosystem.

The data presented on correlation coefficient between weather parameters and spider population presented in table 1 indicate that the correlation between spider population on maize show negatively non- significant correlation with the maximum temperature. minimum temperature, morning humidity, evening humidity as well as rainfall also i.e.–r=-0.441, r= -0.471, r=-0.083, r=-0.008 and r=-0.48, respectively

Sider *et al.* (2017) [7] revealed that population of spiders was observed from 32nd SMW (0.8 spiders/plant) however, the highest population was noticed during 39th SMW (4.4 spiders/plant) thereafter, the population decreased gradually and reached to 0.3 spiders plant^{-1} during 44th SMW in maize. The spider population showed non-significant positive correlation with maximum temperature (r= 0.074), minimum temperature (r= 0.28) morning relative humidity (r= 0.27) and evening relative humidity (r= 0.15). However, rain fall (r= -0.20), wind velocity (r= - 0.39) and sun shine hours (r=-0.14) showed non-significant negative correlation with spider.

The data presented to correlation coefficient between weather parameters and predatory bug population presented in table 1 indicate that the correlation between predatory bug on maize show the positively non- significant with maximum temperature (r=0.209) and morning relative humidity (r=357). Whereas minimum temperature, rainfall and evening relative humidity shows that negatively non-significant r=-0.012, r=-0.290 and r=-0.271 respectively.

Suyal *et al.* (2018) [8] reported the correlation between the weather parameters and population of predatory bug was non-significant however, the population was positively correlated with maximum temperature, morning RH and evening RH but negatively association was observed with minimum temperature, wind velocity and rainfall.

Table 2: Correlation coefficient between FAW (*S. frugiperda*) and their natural enemies with weather Parameters

Name of Pests	Correlation coefficients (r)				
	Temperature		Relative humidity		
	Maximum	Minimum	Morn.	Eve.	Rainfall
Larvae	-0.414^{NS}	-0.320^{NS}	-0.196^{NS}	-0.196^{NS}	-0.081^{NS}
Egg masses	-0.414^{NS}	-0.637*	0.084^{NS}	0.112^{NS}	0.027^{NS}
LBB	-0.589*	0.653*	0.119^{NS}	-0.127^{NS}	-0.116^{NS}
Spider	-0.441^{NS}	-0.471^{NS}	-0.083^{NS}	-0.008^{NS}	-0.048^{NS}
Predatory bug	0.209^{NS}	-0.012^{NS}	0.357^{NS}	-0.271^{NS}	-0.290^{NS}

** Significant at 1% and * Significant at 5%.

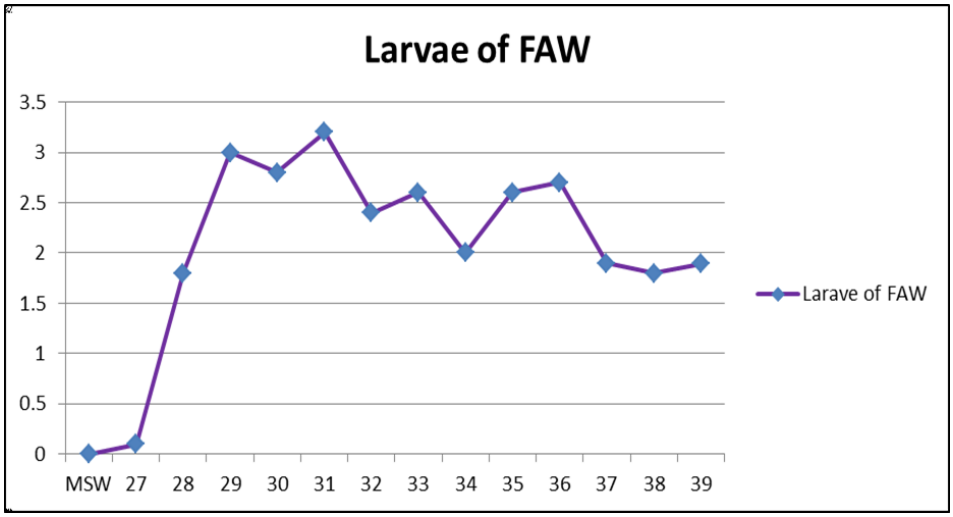

Fig 1: Seasonal incidence of *S. frugiperda* on maize

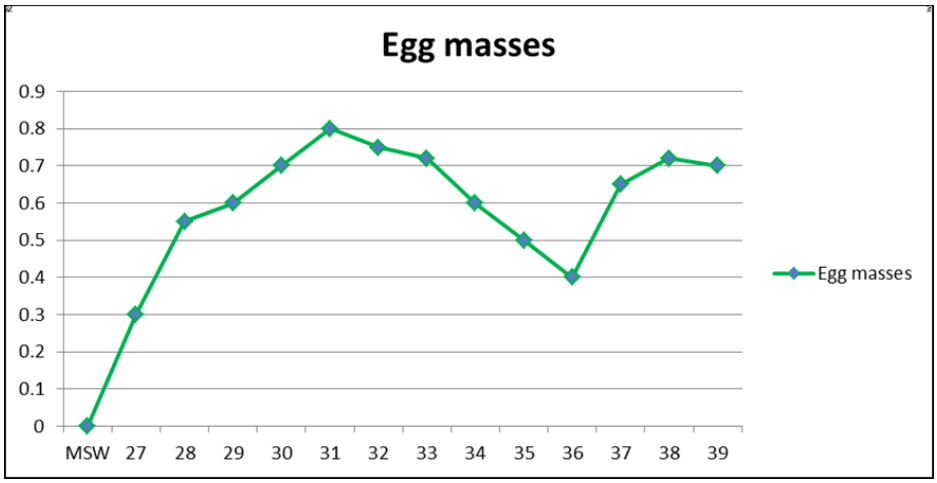

Fig 2: Seasonal incidence egg masses of FAW (*S. frugiperda)* on maize

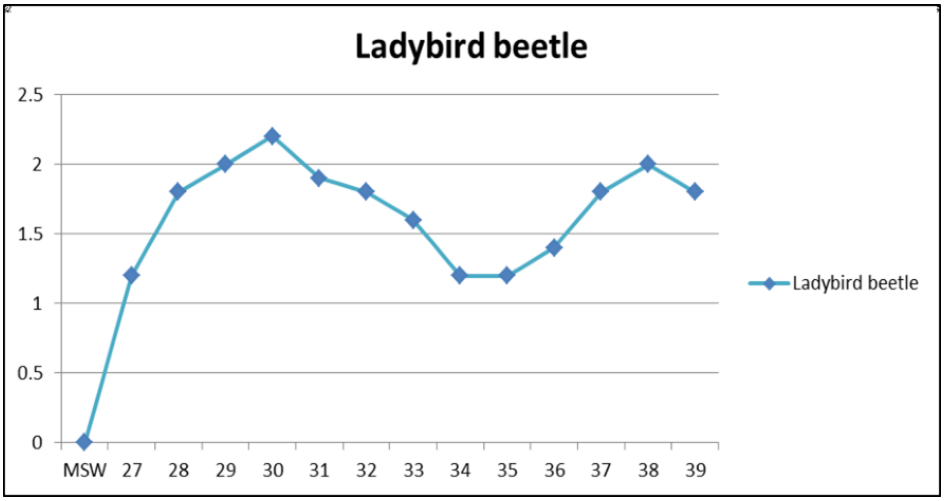

Fig 3: Seasonal incidence of LBB on maize

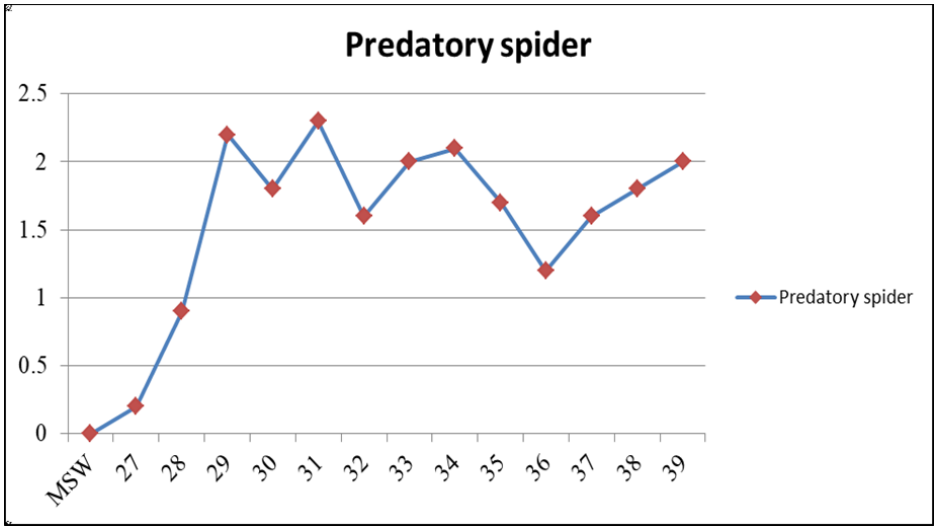

Fig 4: Seasonal incidence of predatory spider on maize

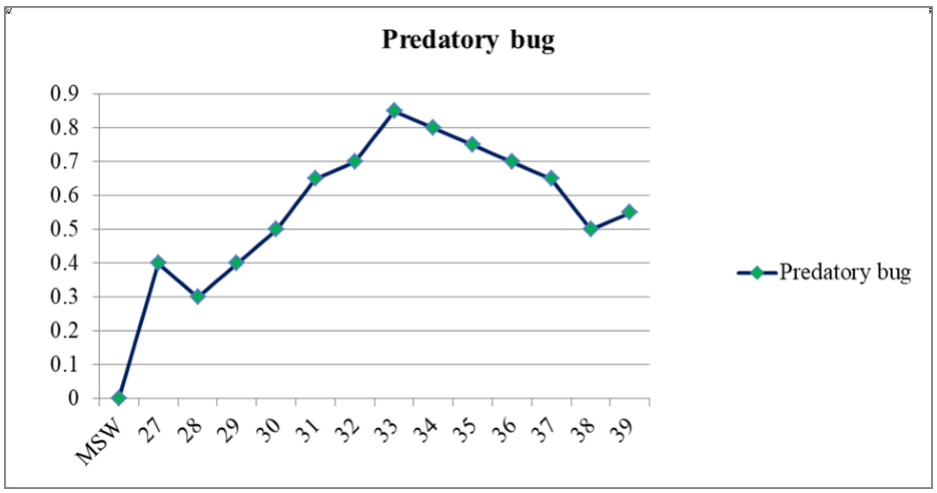

Fig 5: Seasonal incidence of Predatory bug on maize

Conclusion

The peak period of egg masses and larvae of fall armyworm noticed in first fortnight of August to end of September, LBB was noticed during first week of July to first week of October, predatory spider last week of July to second fortnight of September and predatory bug second week of August to last week of September noticed during *kharif* season.. Negative impact of temperature on egg laying of fall armyworm, its larvae, and natural enemies was noticed while positive impact of relative humidity on egg laying of FAW.

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