The Andhra Agric. J 68 (3): 351-357, 2021

Assessment of Damage Potential of *Spodoptera frugiperda* (J. E. Smith) at Different Crop Growth Stages of Maize

N Rajasekhar, , N V V S Durga Prasad, Ch Chiranjeevi, and V Srinivasa Rao

Department of Entomology, Agricultural college, Bapatla, A. P.

ABSTRACT

Experiment was carried out at RARS, Lam, Guntur, with four bulk plots during 2019-20 in both *kharif* and *rabi* in 500 m^2 area each to assess the damage potentials. First plot was maintained completely under unprotected conditions. Second and third plots were maintained in protected conditions up to knee height stage (40 DAS) and reproductive stage (60 DAS) respectively. Whereas fourth plot was maintained under completely protected conditions and data on per cent leaf damage was recorded at weekly interval. Completely unprotected plot recorded 40 and 36% leaf damage at 7 DAS, There -after damage was drastically increased and reached 100% at 42 and 49 DAS during *kharif* and *rabi* seasons respectively. Whereas, completely protected plot, 60 days protected plot and 40 days protected plot recorded 19.09, 45.69, 100% and 7.99, 44.10, 100% leaf damage at 98 DAS respectively during *kharif* and *rabi* seasons.

Keywords: *Spodoptera frugiperda, Completely unprotected plot, completely protected plot, 60 days protected plot and 40 days protected plot.*

The fall Armyworm (FAW) *Spodoptera frugiperda* (J. E. Smith), (Lepidoptera: Noctuidae), is an insect native to tropical and subtropical regions of the Americas (Sparks, 1986; Hruska and Gould, 1997; Nagoshi, 2009; FAO, 2018). The pest accounts for annual crop losses of over US$ 500 million throughout the South-East United States and the Atlantic coast (Young, 1979). In Brazil also FAW is a most destructive and economically important pest in maize (Cruz *et al.,* 1999; Lima *et al.,* 2010; Carvalho *et al.,* 2013; Huang *et al.,* 2014)with an annual estimated loss at U$400 million due to attack of this insect (Figueiredo *et al.,* 2005;Cock *et al.,* 2017). During 2016, the FAW was first noticed in Central and West Africa-Benin, Nigeria, Sao Tome, and Principe, and Togo (Goergen *et al.,* 2016) and further reported and confirmed in the whole of mainland Southern Africa (except Lesotho), Seychelles and Madagascar (FAO, 2018). Later in 2017, the pest was spread to Ghana (Cock *et al.,* 2017) and by January 2018 it was spread toabout44 Sub Saharan African countries, except Djibouti, Eritrea, and Lesotho. A recent investigation by CABI in 12 African countries found that FAW has the potential to inflict yield losses of maize valued at US$2.5-6.2 billion annually (Conrow, 2018).

The FAW was first noticed in the Indian subcontinent at Bangalore rural and Chikkaballapur districts during May and June 2018 (Ganiger *et al.,* 2018) and South Karnataka during the first fortnight of July 2018 (ICAR-NBAIR pest alert, 2018). An investigation by agricultural officials and researchers found FAW in other districts, including Chikkamagaluru, Chitradurga, and Davangere, where 40 to 70 per cent of the crops were infested. The molecular identification of larval populations collected

from different regions of South and Central Karnataka confirmed 100% match with populations from Canada and Costa Rica (ICAR-NBAIR pest alert, 2018). Within a short period (By August 2018) this pest has been reported in most of the corn growing states of India and made the farmers feel panic about the incidence. Since maize is a highly remunerative crop, intensive plant protection measures involving use of a number of insecticides is of common practice (Suneel Kumar *et al*, 2018). A large number of insecticides belonging to different groups viz., the organochlorines, organophosphates, carbamates and synthetic pyrethroids have been widely used to curtail the pest with limited success. The modality of introduction, the capacity of biological and ecological adaptation of FAW across India is still speculative. Hence, the present study on "Assessment of damage Potentials of *frugiperda* at different crop growth stages of maize" was undertaken.

MATERIAL AND METHODS

Experiment was carried out at RARS, Lam, Guntur, with Four bulk plots during 2019-20 and 2020-21 in both *kharif* and *rabi* in 500 m^2 area each to assess the damage potentials. First plot was maintained completely under unprotected conditions. Second and third plots were maintained in protected conditions up to knee height stage (40 DAS) and reproductive stage (60 DAS) respectively. Fourth plot was maintained under completely protected conditions with recommended spraying practices.

Data was taken at weekly interval on per cent plant damage from 10 randomly selected plants and damage grades were given according to Davis and Williams (1992) damage score.

Per cent leaf damage was calculated by using the following formula given by Davis and Williams (1992):

$$\text{Per cent leaf damage} = \frac{\text{No. of damaged leaves}}{\text{Total no. of leaves}} \times 100$$

Statistical Analysis:

The collected data was transformed to arc sine transformation and analysed the data on per cent leaf damage which has subjected to ANOVA.

RESULTS AND DISCUSSION

Assessment of Damage Potentials of *S. frugiperda* in Maize during *Kharif* 2019 - 20

At 7 DAS, completely protected plot (protected from germination to harvesting) and 60 days protected plot (protected from germination to 60 days) and 40 days protected plot (protected from germination to 40 days) statistically did not show any difference in per cent leaf damage as they received same pesticide spraying (Emamectin benzoate 5% SG) up to 42 DAS. Whereas, completely unprotected plot recorded 40.00% leaf damage and statistically differ with other treatments at 7 DAS, Thereafter *S. frugiperda* damage was drastically increased and reached 100% at 42 DAS (Table.1).

At 49 DAS, 40 days protected plot recorded 14.70% leaf damage and statistically differed with the other treatments as chemical protection was stopped at 40 DAS. Thereafter damage has increased drastically and reached 100% leaf damage at 84 DAS. Whereas, completely protected plot and 60 days protected plot recorded 5.16 and 5.67% leaf damage respectively and statistically at par with one another.

At 77 DAS, 60 days protected plot recorded 15.60% leaf damage and statistically differed with the other treatments as chemical protection was stopped. Completely protected plot recorded 6.60% leaf damage and statistically differ with other treatments. Whereas, 40 days protected plot and unprotected

plot recorded 88.90 and 100% leaf damage and statistically differ with one another.

At 98 DAS, completely protected plot and 60 days protected plot recorded 19.09 and 45.65% leaf damage and statistically differ with one another. Whereas, 40 days and unprotected plots recorded 100% leaf damage.

Assessment of Damage Potentials of *S. frugiperda* during *Rabi* 2019-20

At 7 DAS, Completely protected plot and 60 days protected plot and 40 days protected plot recorded 6.50, 6.90 and 7.50% leaf damage and were statistically did not show any difference as they received same pesticide spraying (Emamectin benzoate 5% SG) up to 42 DAS. Whereas, completely unprotected plot recorded 36.00% leaf damage and statistically differ with other treatments, there after *S. frugiperda* infestation has drastically increased and reached 100% at 49 DAS (Table.2).

At 49 DAS, 40 days protected plot recorded 10.63% leaf damage and statistically differed with the other treatments as chemical protection was stopped at 42 DAS. Thereafter damage has increased drastically and reached 100% leaf damage at 91 DAS. Whereas, completely protected plot and 60 days protected plot recorded 5.01 and 7.66 % leaf damage respectively and statistically at par with one another.

At 77 DAS, 60 days protected plot recorded 14.52% leaf damage and statistically differed with the other treatments as chemical spraying was stopped at 60 DAS. Whereas, completely protected plot, 40 days protected plot and unprotected plot recorded 7.99, 91.50 and 100% leaf damage respectively and were statistically differ with one another.

At 98 DAS, completely protected plot and 60 days protected plot recorded 7.99 and 44.10% leaf damage and were statistically differ with one another. Whereas, 40 days protected and unprotected plots recorded 100% leaf damage.

The completely unprotected plot 100 per cent leaf damage was observed at 42 DAS in *kharif* and at 56 DAS in *rabi* seasons, these findings are more or less similar with the findings of Sari *et al.* (2021) who reported 86.67 to 100% leaf damage in 20 days protected plots in Nan Duo and Kinali sub districts of West panama, and also with findings of Oscar *et al.* (2013) who observed 82% leaf damage at 2-3 fully grown leaf stage. Whereas, in case of 40 days protected plot 100% leaf damage was recorded at 98 DAS. These findings also in agreement with the findings of Sari *et al.* (2021) who reported 72.50 to 89.14 per cent damage in 40 days protected crop. However, our results differ with the findings of Oscar *et al.* (2013) who observed only 53% leaf damage at vegetative stage (9 leaf stage).

In case of 60 days protected crop 40.00% leaf damage was observed at 98 DAS. These results differ with Sari *et al.* (2021) who reported only 14 to 16% damage in 60 days protected crop. Whereas, completely protected plot recorded an average of 11.00% leaf damage, this might be due to inconvenience of spraying practices in grown up crop and it is unavoidable leaf damage. Omprakash *et al.* (2021) and Sari *et al.* (2021) stated that at 80 DAS leaf damage by the FAW larvae was not observed due to hardness of leaves.

The present results indicate that after 60 days of crop FAW larvae prefer to feed on cob rather than the leaves. These findings are corroborate with the findings of Pannuti *et al* (2015) who observed feeding scenarios by rearing larvae on the different corn tissues. At 60 days crop revealed that closed tassel and silk had the highest larval survival (57.50% each), whereas, the lowest larval survival percentages were observed on leaf (10%) and opened tassel (0%)

Table.1. Assessment of damage potential of *S. frugiperda* at different crop growth periods in maize during *kharif* 2019-20

Per cent leaf damage/plant/week*														
Treatment	7 DAS	14 DAS	21 DAS	28 DAS	35 DAS	42 DAS	49 DAS	56 DAS	63 DAS	70 DAS	77 DAS	84 DAS	91 DAS	98 DAS
Completely Protected Plot	11.5	8.15	7	6.5	5	5.2	5.16	5.75	6.5	6.92	6.6	9.88	13.98	19.09
	(19.82)a	(16.58)a	(15.34)a	(12.92)a	(11.77)a	(12.48)a	(12.64)a	(12.70)a	(13.63)a	(14.00)a	(14.29)a	(18.22)a	(19.48)a	(25.32)a
60 Days Protected Plot	11.5	9.58	7.75	6.54	5	5.75	5.67	6.5	6.58	7.25	15.6	32.03	39.98	45.65
	(19.82)a	(18.03)a	(16.64)a	(13.71)a	(11.77)a	(12.70)a	(13.17)a	(13.63)a	(14.45)a	(14.57)a	(22.80)b	(33.86)b	(39.67)b	(42.36)b
40 Days Protected Plot	13.75	13.86	8.92	7.16	6	6.5	14.7	27.6	50.3	74.6	88.9	100	100	100
	(21.76)a	(21.85)a	(17.37)a	(13.81)a	(12.58)a	(13.63)a	(21.68)b	(31.46)b	(45.17)b	(59.95)b	(74.91)c	(90.00)c	(90.00)c	(90.00)c
Completely Unprotected Plot	40	78.87	85.27	94.66	98.88	100	100	100	100	100	100	100	100	100
	(39.23)b	(62.63)b	(67.43)b	(81.49)b	(88.05)b	(90.00)b	(90.00)c	(90.00)c	(90.00)c	(90.00)c	(90.00)d	(90.00)c	(90.00)c	(90.00)c
SEm	3.64	2.91	2.67	2.57	1.59	1.51	1.39	1.65	1.45	1.54	2.5	0.85	1.98	2.34
CD (P = 0.95)	10.19	9.44	7.61	7.4	4.35	4.4	4.05	4.81	4.22	4.49	7.26	2.57	6.8	6.8
CV%	59.62	37.24	30.46	26	15.27	14.91	12.84	14.2	11.28	10.96	15.67	5	12.39	11.97

*Figures in parentheses are angular transformed values.
In each column the values having the same alphabet are non significant.

Table. 2. Assessment of damage potential of *S. frugiperda* at different crop growth periods in maize during *rabi* 2019-20

Per cent leaf damage/plant/week*														
Treatment	7 DAS	14 DAS	21 DAS	28 DAS	35 DAS	42 DAS	49 DAS	56 DAS	63 DAS	70 DAS	77 DAS	84 DAS	91 DAS	98 DAS
Completely Protected Plot	6.5	6.47	6.65	5.9	4.47	4.6	5.01	5.53	6.17	6.39	7.99	8.78	8.49	7.99
	(13.94)a	(13.65)a	(14.06)a	(13.17)a	(11.62)a	(11.68)a	(12.49)a	(12.96)a	(13.60)a	(14.40)a	(16.39)a	(17.11)a	(16.82)a	(16.38)a
60 Days Protected Plot	6.9	6.71	6.66	6	5.62	5.72	7.66	8.13	8.38	8.19	14.52	22.19	33.86	44.1
	(13.99)a	(13.84)a	(13.86)a	(13.50)a	(12.91)a	(13.16)a	(15.13)a	(15.77)a	(16.78)b	(16.59)a	(22.30)b	(27.84)b	(35.21)b	(41.48)b
40 Days Protected Plot	7.5	6.71	6.6	6.3	5.65	6.03	10.63	27.6	53.1	79.48	91.5	96.21	100	100
	(14.41)a	(13.84)a	(14.01)a	(13.53)a	(11.82)a	(13.71)a	(18.92)b	(31.51)b	(46.80)b	(63.69)b	(73.24)c	(82.85)c	(90.00)c	(90.00)c
Completely Unprotected Plot	36	57.76	61.88	81.14	95.89	97.85	100	100	100	100	100	100	100	100
	(36.66)b	(49.48)b	(52.30)b	(64.77)b	(82.62)b	(86.22)b	(90.00)c	(90.00)c	(90.00)c	(88.15)c	(90.00)d	(90.00)d	(90.00)c	(90.00)c
SEm	2.13	1.87	1.74	1.82	1.91	1.89	1.22	1.24	0.89	1.16	0.52	1.7	1.36	1.34
CD (P = 0.95)	6.47	5.45	5.06	5.3	5.43	5.48	3.55	3.61	2.59	3.98	1.51	4.94	3.95	3.91
CV%	35.74	26.15	23.42	22	19.89	19.17	11.35	10.47	6.76	9.48	3.26	9.88	7.43	7.17

*Figures in parentheses are angular transformed values.

In each column the values having the same alphabet are non significant.

respectively. During entire crop growth period no other pest incidence was not observed due to complete dominance of FAW infestation.

CONCLUSION

For every ten days farmers has to spray for better yields in maize, even after silking stage also 2-3 sprays are required to avoid cob damage otherwise may cause 20 per cent yield loss. Forty days protected plot recorded 100 per cent leaf damage at 84 and 91 DAS in *kharif* and *rabi* seasons respectively. Whereas completely unprotected plot recorded 100 per cent leaf damage at 42 and 49 DAS in *kharif* and *rabi* seasons respectively.

LITERATURE CITED

Carvalho R A, Omoto C, Field L M, Williamson M S and Bass C 2013 Investigating the molecular mechanisms of organophosphate and pyrethroid resistance in the fall armyworm *Spodoptera frugiperda*. *PLoS ONE* 8 (4): 1-11.

Cock M J W, Beseh P K, Buddie A G, Cafá G and Crozier J 2017 Molecular methods to detect *Spodoptera frugiperda* in Ghana, and implications for monitoring the spread of invasive species in developing countries. *Scientific Reports*. 7: 1-10.

Conrow Joan 2018 Destructive fall armyworm now invading India.https://allianceforscience.cornell.edu

Cruz I, Figueiredo M L C, Oliveira A C and Vasconcelos C A 1999 Damage of *Spodoptera frugiperda* (J.E. Smith) in different maize genotypes cultivated in soil under three levels of aluminum saturation. *International Journal of Pest Management*. 45 (4): 293-296

Davis F M and Williams W P 1992 Visual rating scales for screening whorl-stage corn for resistance to fall armyworm. Mississippi Agricultural & Forestry Experiment Station, Technical Bulletin, *Mississippi State University*. 186 : 1-9.

FAO 2018 Integrated management of the fall armyworm on maize: A guide for Farmer Field Schools in Africa, 1-139

Figueiredo M L C, Penteado-Dias A M and Cruz I 2005 Relationship between fall armyworm and their natural biological control agents in the maize crop. *Brasilia*. 41 (12): 1693-1698.

Ganiger P C, Yeshwanth H M, Muralimohan K, Vinay N, Kumar A R V and Chandrashekara K 2018 The occurrence of the new invasive pest, fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae), in the maize fields of Karnataka, India. *Current Science*. 115 (4): 25.

Goergen G, Lava K P, Sankung S B, Abou Togola and Manuele Tamo 2016 First report of outbreaks of the fall Armyworm *Spodoptera frugiperda* (J E Smith) (Lepidoptera, Noctuidae), a new alien invasive pest in west and central Africa. *PLoS ONE*. 11 (10): 1-9.

Hruska A J and Gould F 1997 Fall armyworm (Lepidoptera: Noctuidae) and *Diatraea lineolata* (Lepidoptera: Pyralidae): Impact of larval population level and temporal occurrence on maize yield in Nicaragua. *Journal of Economic Entomology*. 90 (2): 611-622

Huang F, Qureshi J A, Meagher R L, Reisig D D, Head G P and Andow D A 2014 Cry1F

resistance in fall armyworm *Spodoptera frugiperda*: single gene versus pyramided Bt maize. *PLoS ONE*. 9 (11): 1-10.

ICAR 2018 (Indian Council for Agricultural Research)- NBAIR Pest alert, *Spodotera frugiperda* (J.E. Smith).

Lima M S, Silva P S L, Oliveir O F, Silva K M B and Freitas F C L 2010 Corn yield response to weed and fall armyworm controls. *Planta Daninha*. 28 (1): 103–111.

Nagoshi R 2009 Can the amount of corn acreage predict fall armyworm (Lepidoptera: Noctuidae) infestation levels in nearby cotton. *Journal of Economic Entomology*. 102:210-218.

Omprakash N, Shylesha A N, Jagadeesh P, Venkatesan T, Lalitha Y and Ashika T R 2021 Damage, distribution and natural enemies of invasive fall armyworm *Spodoptera frugiperda* (J. E. smith) under rainfed maize in Karnataka, India. *Crop Protection*. 143: 1-7.

Oscar R A, Fernando N and Virla E G 2013 Evaluation of the attack rates and level of damages by the fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae), affecting corn-crops in the northeast of Argentina. *Revista de la Facultad de Ciencias Agrarias*. 45 (2): 1-12.

Pannuti L E R, Baldin E L L, Hunt T E and Paula-Moraes S V 2015 On-Plant larval movement and feeding behavior of fall armyworm (Lepidoptera: Noctuidae) on reproductive corn stages. *Environmental Entomology*. 9: 1-9.

Sari S P, Suliansyah I, Nelly N and Hamid H 2021 The occurrence of *Spodoptera frugiperda* attack on maize in West Pasaman District, West Sumatra, Indonesia. IOP Conference Series: *Earth and Environmental Science*. 741: 1-9.

Sparks A N 1986 Fall armyworm (Lepidoptera: Noctuidae) potential for area-wide management. *Florida Entomology*. 69 (3): 603–614.

Suneel Kumar G V, Madhumathi T, Sairam Kumar D V, Manoj Kumar V and Lal Ahamad M 2018 Effect of biorational insecticides to predatory coccinellids and spiders in maize ecosystem. *The Andhra Agricultural Journal*. 65 (1): 148-154.

Young J R 1979 Fall armyworm: control with insecticides. *Florida Entomology*. 62:130–133.

Received on 01.06.2021 and Accepted on 01.09.2021