Weather/Crop Ecology-What Influences *Spodoptera litura* Population

M.G. Hegde, Rohini Sugandi, M. Manu, Aman Vasisht[1], B.S. Yenagi[2] and A. Ashwini

Department of Agricultural Entomology, [1]Department of Agricultural Statistics and [2]Department of Agronomy and
University of Agricultural Sciences, Dharwad-580 008, India
E-mail: mghdwr07@gmail.com

Abstract: The pheromone trap catches of *Spodoptera litura* in groundnut crop ecosystem from 2012 to 2021 are studied with an intention to enumerate the incidence pattern. The pheromone traps with spodolure were installed in AICRP on groundnut at MARS, UAS, Dharwad during *kharif* season (June to November). The trap collections from 26th to 44th SMW is considered for analysis. The peak trap collections (male moths trapped) varied between 32 to 37 SMW. The correlation studies on average of total trap catch from 2012 to 2021 exhibited a significant negative and positive relation respectively with maximum temperature and RH (both morning and evening). Despite of good rainfall and favorable RH, *Spodoptera* population was almost nil during 2016 and 2019 *kharif* season, indicating along with the weather some other factor might play crucial role in deciding the pest population on groundnut crop.

Keywords: *Spodoptera litura*, Pheromone trap, Weather parameter

Groundnut is an important oil seed crop grown on 31.5 million ha worldwide with a total production of 53.6 million metric ton and an average productivity of 1.831 metric t/ha (FAOSTAT, 2020). *Spodoptera litura* Fabricius (Lepidoptera: Noctuidae), has been causing immense damage to various crops including groundnut across India. This insect has been considered as a pest of national importance due to its wide host range and development of proper monitoring system is very much important to develop integrated management practices (Ranga Rao et al 1991). It has been estimated that an infestation level of one larva per plant at seedling/flowering stage may result up to 20 % yield loss in groundnut. The severe infestation can cause 30 to 40 % loss in pod formation. The pheromone traps offer one of the best sampling tools for flying adult insects and has been using commonly for pest surveillance. The interaction between pheromone trap collections and prevailing weather during the period in any area for a fairly long period of time can be used for development of models to predict the seasonal pest incidence (Agarwal and Mehata 2007). Further, studies at ICRISAT indicated that the groundnut crop is vulnerable to damage and defoliation up to 50 days after emergence and needs to be contended. However, at later stage of the crop, when defoliation is severe and more than 50 per cent immediate protection measures have to be taken. The pest has already developed resistance to many insecticides (KiranGandhi et al 2016, Babu and Singh et al 2022). With this in background an attempt was made to enumerate the factors deciding Spodoptera population on groundnut.

MATERIAL AND METHODS

The *S. litura* male moth catches in sex pheromone trap from 2012 to 2021 (10 years) during *kharif* season were considered for this study. A weekly total was obtained from daily average catches of male moths in three pheromone traps located exclusively in groundnut field with a distance of 100 m between traps located at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. The lures were replaced once in every 15 days throughout the season. The sleeve traps with commercially available *S. litura* pheromone (Z,E)-9,11-tetradecadienylacetate and (Z,E)-9,12-tetradecadienyl (at the ration of 10:1) and the quantity of the chemical present was 0.84mg per lure. Male moths trapped from 26 to 44 standard meteorological week (=SMW) were considered for analysis. The average weekly total number of moths trapped and the average weather parameters of the corresponding SMW are considered for analysis. The weather variables such as maximum and minimum temperature, morning and evening relative humidity and total weekly rainfall were considered as independent variables.

RESULTS AND DISCUSSION

The peak trap catches of *Spodoptera* male moths from the year 2012 to 2021 varied and corresponded between 31st to 37th SMW (Table 1). The *Spodoptera* incidence was low during this decade bearing the year 2012, 2015 and 2021. The incidence was almost nil during 2019 and 2016 irrespective of prevailed favorable weather parameters. The

peak trap catches of 292, 148 and 197 moths/trap/week were recorded during 2012-2016, 2017-2021 and 2012-2021, respectively. This indicated that there was decreasing trend in Spodoptera incidence especially 2017 onwards (Table 2). There was no much change in the prevailing weather. However, there was a slight increase in the RH, an important factor deciding Spodoptera population. Morning and Evening RH had positive correlation with pest population at one or two weeks prior to the incidence. Chattopadhyay et al (2019) observed that maximum and minimum temperature ranging from 26-27^{0}C and 21-22^{0}C and morning RH of 90 per cent, a week prior to incidence are critical weather parameters causing the outbreak of *S. litura* in soybean. The prevailed weather was almost similar year to year but corresponding moth collection exhibited variation. It may be difficult to predict the appearance of Spodoptera using pheromone trap catch and prevailed weather factors.

The number of male moths trapped were correlated with corresponding weather parameter such as maximum and minimum temperature, morning and evening Relative Humidity and rainfall. The average total trap catches from 2012 to 2016 was not significant with any weather parameters. However, trap catch between 2017 to 2021 exhibited significant negative and positive relation respectively with maximum temperature and evening RH. Similarly, it was positive and significant with morning RH. The average total trap catches from 2012 to 2021 exhibited significant negative and positive relation respectively with maximum temperature and morning and evening RH (Table 3). The increased temperature probably might have reduced the *Spodoptera* population. The higher moisture positively would have supported Spodoptera population growth and multiplication. The relative humidity ranging from 89 to 92 per cent supported the higher population and growth of *Spodoptera* and negative relation with temperature was also reported in the past by Selvaraj et al (2010). *Spodoptera* population growth is positively supported by higher relative humidity, however, almost nil population was recorded in 2016 and 2019, despite of very favorable RH ranging more than 90, which could not support *Spodoptera* population and this needs to be addressed. There may be few other ecological factors such as environmental resistance and also the changing cropping pattern in the region that may also play vital role in deciding *Spodoptera* population in particular crop ecology. However, pheromone trap may be advocated to design momentary management strategy based on monitoring result and number trapped / unit time (Nayak and Pradhan 2021).

Table 1. Pheromone trap catches of *Spodoptera litura* (2012 to 2021)

SMW	No. of adult male moths trapped/week										Mean
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	
26	28	0	0	0	33	9	0	3	36	13	12
27	45	0	0	0	42	13	7	4	70	17	20
28	62	0	6	3	24	28	17	4	83	21	25
29	93	0	9	16	25	32	26	4	162	100	47
30	138	5	11	27	20	48	39	0	196	112	60
31	139	37	30	41	17	113	97	1	223	144	84
32	220	78	61	56	21	171	158	0	217	195	118
33	374	45	89	79	5	89	71	0	164	214	113
34	648	56	105	645	4	69	60	0	130	256	197
35	624	85	126	424	0	54	46	1	82	293	174
36	382	39	181	314	0	45	45	0	49	335	140
37	297	18	263	206	0	33	28	1	36	246	113
38	240	30	218	138	0	21	19	1	27	185	88
39	151	146	174	91	0	12	5	0	19	75	67
40	153	188	77	59	0	7	0	0	6	40	53
41	79	9	23	21	0	3	0	0	4	2	14
42	28	0	6	7	0	0	0	0	0	2	4
43	13	0	6	0	0	0	0	0	0	1	2
44	2	0	6	0	0	0	0	0	0	0	1

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Table 2. Prevailing weather and corresponding trap collection during the period from 2012-2021

SMW	Period	Number of male moths trapped /week/trap			Maximum temperature (°C)			Minimum temperature (°C)			Morning relative humidity (%)			Evening relative humidity (%)			Rainfall (mm)		
		2012 to 2016	2017 to 2021	2012 to 2021	2012 to 2016	2017 to 2021	2012 to 2021	2012 to 2016	2017 to 2021	2012 to 2021	2012 to 2016	2017 to 2021	2012 to 2021	2012 to 2016	2017 to 2021	2012 to 2021	2012 to 2016	2017 to 2021	2012 to 2021
26	25th to 1st July	12	12	12	28.2	28.4	28.3	20.7	21.0	20.8	90	90	90	71	71	71	24	21	23
27	2nd to 8th July	17	22	20	27.5	28.1	27.8	20.7	20.8	20.7	90	92	91	72	75	73	22	29	25
28	9th to 15th July	19	31	25	27.3	26.9	27.1	20.7	20.5	20.6	91	91	91	77	82	80	29	33	31
29	16th to 22nd July	29	65	47	26.8	26.6	26.7	20.9	20.8	20.9	92	91	91	77	83	80	31	50	40
30	23rd to 29th July	40	79	60	26.2	26.6	26.4	20.6	20.7	20.7	93	91	92	79	80	79	47	30	38
31	30th Jul to 5th August	53	116	84	26.5	26.9	26.7	20.4	20.6	20.5	92	91	92	78	83	80	49	46	48
32	6th to 12th August	87	148	118	26.2	26.9	26.5	19.8	20.6	20.2	89	91	90	71	82	77	24	96	60
33	13th to 19th August	118	108	113	26.6	26.4	26.5	19.8	20.4	20.1	89	92	90	72	85	78	11	35	23
34	20th to 26th August	292	103	197	27.9	27.6	27.8	20.3	20.4	20.3	90	91	91	71	80	75	23	12	17
35	27th to 2nd September	252	95	174	27.5	27.6	27.5	20.1	20.4	20.3	92	92	92	74	79	77	29	15	22
36	3rd to 9th September	183	95	139	27.9	28.1	28.0	19.1	20.5	19.8	87	91	89	66	78	72	16	45	30
37	10th to 16th September	157	69	113	27.8	28.6	28.2	20.5	20.2	20.4	92	91	91	73	74	73	28	20	24
38	17th to 23rd September	125	51	88	26.8	28.2	27.5	19.4	20.3	19.8	87	90	89	71	76	73	18	22	20
39	24th to 30th September	112	22	67	28.3	28.8	28.6	19.6	20.2	19.9	86	91	89	65	76	71	33	32	32
40	1st to 7th October	95	11	53	28.7	30.4	29.6	20.1	20.4	20.3	91	89	90	69	71	70	24	41	33
41	8th to 14th October	26	2	14	29.6	29.9	29.8	19.8	20.5	20.2	88	91	90	60	69	65	18	34	26
42	15th to 21st October	8	0	4	31.1	29.5	30.3	18.3	20.0	19.2	73	90	81	40	70	55	31	59	45
43	22nd to 28th October	4	0	2	28.9	29.5	29.2	18.1	18.9	18.5	75	83	79	49	67	58	33	20	27
44	29th Oct to 4th November	2	0	1	29.7	29.8	29.8	17.6	17.8	17.7	77	79	78	50	60	55	0	1	1

Table 3. Relation between trap catches and weather parameter

Moth catches	Temperature		Relative humidity		Rainfall
	Maximum	Minimum	Morning	Evening	
Moth catch (2012-2016)	-0.244	0.167	0.359	0.318	-0.105
Moth catch (2017-2021)	-0.762**	0.389	0.490*	0.786**	0.382
Moth catch (2012-2021)	-0.476*	0.291	0.497*	0.539*	0.015

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