

Original Research Article

To Prepare the Crop-Weather-Pest Calendar for Soybean Crop Using Pest Data

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ABSTRACT

An investigation was carried out during 2018-2019 at Department of Agricultural Meteorology, College of Agriculture, Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani, as "Preparation of crop weather calendar of soybean crop under Parbhani Location" with a objective to prepare the crop – weather – pest calendar for soybean crop using pest data. Mean while the population dynamics studies indicated that, population of *Spodoptera litura* was more i.e. 9.5 larvae/mrl during 2006 as compared to remaining years. The population of girdle beetle was maximum found i.e. 36.9% infected plants during 2015 and population of green semilooper is maximum found i.e. 10.4 larvae/mrl during the year 2010 and also the population of Leaf miner was maximum recorded i.e. 6.32 larvae/mrl during the year 2008. In case of phenological observations, the more days recorded in emergence to seedling stage (i.e. 21-29 days) and highest mean maximum and minimum temperature (i.e. 30.7⁰C-35.5⁰C and 22.50C-24⁰C) in pod formation to grain formation and seedling to branching.

Keywords

Soybean, Crop weather calendar, Crop-weather-pest calendar, Girdle beetle, Green semilooper, Temperature etc.

Introduction

Soybean can be grown on a wide range of well drained soils but thrives best on clay looms. Optimum pH for soybean production is in the range of 6 to 6.5. Soybean is rated as moderately salt tolerant crop and reported salinity threshold is about 5 dS m⁻¹. Shallow water tables, particularly during the early growth period can adversely affect the yield. The crop is sensitive to water logging, especially during early stages (AICRP on Agrometeorology, Parbhani Centre). Incidence of soybean pests (girdle beetle, semilooper, leaf miner and *Spodoptera litura*) was studied in relation to weather parameters. Correlations between girdle beetle population

and weather parameters showed significant negative association of girdle beetle with rainfall, maximum temperature and humidity (RH-I and RH-II). Similarly for leaf miner minimum temperature showed significant positive association whereas humidity (RH-II) was negatively correlated. In contrast *Spodoptera litura* population showed significant negative association with minimum temperature and significant positive association with humidity (RH-II) (AICRP on Agrometeorology, Parbhani Centre). The defoliators like *Thysanoplusia orichalcea* (Fab) damage the crop from August to September during kharif and March to May during rabi season. The infestation can result into 30 per cent

undeveloped pods and about 50 per cent yield loss. In case of heavy attack, the caterpillars are also found to feed on flowers and pods. Girdle beetle is more common in Madhya Pradesh, Rajasthan and West Bengal. Its first occurrence was seen in Madhya Pradesh. It has become more and more devastating insect through years. In recent years infestation observed is 60 to 80 per cent in soybean. Pod borer incidence was maximum in the month of July sown crop. The per cent incidence of stem fly was low on soybean sown in second week of June where as it was high with girdle beetle. In soybean population built up of various pests has been found to be influenced by different parameters of climate. The insect being the member of biotic community interacts with other nonliving (abiotic) components of the environment. The outcome of these interactions is population dynamics, the positive and negative growth of the population. Hence, the life system and abundance of insect can be understood by study of interaction between biotic abiotic factors.

Materials and Methods

The study of characteristics of temperature, rainfall, relative humidity, bright sunshine hours, wind speed and evaporation and its impact on crop phenology and incidence of pests is very important.

The data on weather condition favorable for incidence of pest and the nature of the weather warnings were collected. The present investigation was undertaken to study on crop weather pest interaction in soybean for various pests like green semilooper and leaf miner, girdle beetle, *Spodoptera litura*. The investigation is based on the data collection of pests incidence on soybean crop and weather data during *khari* 2002-2017.

Results and Discussions

Bottom part

The part of the crop weather calendar which contain the climatic normals required for major pest and disease of soybean crop as well as susceptible crop phenological stages of soybean crop. The more major pest i.e. green semilooper, leaf miner, *Spodoptera litura* and girdle beetle were observed during branching to flowering, flowering to pod formation and pod formation to grain formation due to insufficient rainfall and aberrant weather condition.

Pest data of soybean Girdle beetle, Green semilooper, leaf miner, and *Spodoptera litura* in relation to weather parameters at Parbhani location from 2002 - 2017 (As per available)

Girdle beetle is one of the most serious pest of soybean. female lay eggs inside the stem up to 200 to 300 eggs. Grub is the damaging stage which is completed in 24 to 38 days. The pupal period is 8 to 10 days. It takes 45 to 55 days for whole life cycle and 1 to 2 generations per year. The incidence of girdle beetle started from 31st MW (0.252 %) and first peak activity was observed at 34th MW (0.419 %). When the weather conditions Tmax-27.5⁰C, Tmin-15.3⁰C and RH-I 91%, RH-II 76%. The similar results were given by Khobragade et al. (2016).

The data presented in table 1 and fig. 1. The population of girdle beetle was maximum i.e. 36.9 % during 2015. The weather parameters viz. rainfall, Tmax, Tmin, RH-I, RH-II and BSH were 65.2 mm, 33.4⁰C, 21.7⁰C, 79 %, 49 % and 6.7 hrs. respectively.

Table.1 Mean pest of soybean (Girdle beetle) in relation to weather parameters at Parbhani location during 2002-2017

Year	Weather Parameter						Pest Incidence Girdle beetle % Infestation per plants
	RF(mm)	Tmax(⁰ c)	Tmin(⁰ c)	RH I (%)	RH II (%)	BSH(Hrs)	
2002	45.1	29.8	21.6	86	68	6.4	1.25
2003	60.3	30.2	22.5	88	70	4.8	2.2
2004	25.6	30.8	21.7	85	65	5.4	4.6
2005	30.9	30.7	21.3	85	66	5.1	3.4
2006	61.7	30.8	21.9	82	64	4.5	9.33
2007	52.1	31.5	20.03	85	62	4.6	2.69
2008	17.6	31.8	21.4	85	63	5.5	10.7
2009	44.4	31.0	24.6	81	58	6.01	12.7
2010	74.7	29.6	22.3	89	68	4.6	6.3
2011	40.8	30.8	25.7	90	65	4.4	10
2012	35.8	30.9	22.3	90	64	5.1	25.5
2013	42.9	29.4	21.3	85	59	4.1	36.5
2014	61.4	32.3	20.9	82	57	5.4	22.6
2015	65.2	33.4	21.7	79	49	6.7	36.9
2016	52.3	30.7	21.8	88	66	5.6	8.7
2017	40.4	29.4	19.7	86	65	5.5	9.5

Table.2 Mean pest of soybean (Green semilooper) in relation to weather parameters at Parbhani location during 2002-2017

Year	Weather Parameter						Pest incidence
	RF(mm)	Tmax(⁰ c)	Tmin(⁰ c)	RH I (%)	RH II (%)	BSH(Hrs)	Green Semilooper larvae / mrl
2002	39.7	30	21.4	97	66	4.8	1.58
2003	49.9	30.03	22.2	88	70	4.5	7.2
2004	21	31.4	21.6	85	64	5.1	6.3
2005	33.9	30.71	20.9	87	65	5.05	8.2
2006	61.3	30.72	21.7	73	64	4.9	0
2007	52.8	31.3	19.6	86	63	4.7	3.5
2008	34.8	30.8	21.1	69	65	5.1	7.3
2009	47.3	30.5	27.8	78	59	5.7	7.5
2010	69.4	29.5	22.5	89	60	4.9	10.4
2011	36.6	30.9	27.8	89	64	9.2	8.4
2012	41.8	31.1	22.2	90	64	5.2	9.03
2013	55.3	28.7	21.01	83	59	4	0.37
2014	61.3	32.2	20.5	83	52	6.2	2.45
2015	72.7	31.2	21.3	78	45	6.1	1.87
2016	51.5	30.8	21.8	87	66	6.5	4.45
2017	40.3	29.4	20.9	86	65	6.2	2.95

Table.3 Mean pest of soybean (leaf miner) in relation to weather parameters at Parbhani location during 2002-2017

Year	Weather Parameter						Pest incidence
	RF(mm)	Tmax(⁰ c)	Tmin(⁰ c)	RH I (%)	RH II (%)	BSH(Hrs)	Leaf miner larvae / mrl
2002	39.7	30	21.4	97	66	4.8	4.2
2003	49.9	30.03	22.2	88	70	4.5	0.13
2004	21	31.4	21.6	85	64	5.1	0.08
2005	33.9	30.71	20.9	87	65	5.05	0.05
2006	61.3	30.72	21.7	73	64	4.9	0.82
2007	52.8	31.3	19.6	86	63	4.7	1.98
2008	34.8	30.8	21.1	69	65	5.1	6.32
2009	47.3	30.5	27.8	78	59	5.7	0.19
2010	69.4	29.03	22.5	89	60	4.9	0.14
2011	36.6	30.9	25.5	89	64	9.2	0.56
2012	41.8	31.1	22.2	90	64	5.2	0
2013	55.3	28.7	21.01	83	59	4	0.04
2014	61.3	32.2	20.5	83	52	6.2	0.08
2015	72.7	33.2	21.3	67	48	6.1	5.36
2016	51.5	30.8	21.8	87	66	6.5	0.48
2017	40.3	29.4	20.9	86	65	6.2	2.22

Table.4 Mean pest of soybean (*Spodoptera litura*) in relation to weather parameters at Parbhani location during 2002-2017

Year	Weather Parameter						Pest incidence
	RF(mm)	Tmax(⁰ c)	Tmin(⁰ c)	RH I (%)	RH II (%)	BSH(Hrs)	<i>Spodoptera litura</i> larvae / mrl
2002	43.1	29.8	21.5	86	67	4.7	4.5
2003	55.3	30.1	22.3	88	70	4.6	1.5
2004	21.08	31.4	21.6	85	64	5.9	0
2005	61.8	30.7	21.8	83	64	4.6	0.95
2006	33.5	30.6	21.05	88	66	5.3	9.5
2007	52.5	31.4	19.7	86	63	4.7	3.22
2008	20.01	31.0	21.3	86	64	5.3	1.95
2009	45.1	30.9	25.7	80	56	5.8	2.5
2010	70.8	29.4	22.5	89	61	5.2	2.4
2011	40.2	30.9	26.8	89	65	4.4	2.41
2012	36.4	31.1	22.1	89	64	5.2	3.7
2013	45.2	29.0	21.4	84	60	4	8
2014	61.6	32.2	20.6	86	67	4.7	6.5
2015	83.6	33.2	21.5	88	70	5.2	7.9
2016	51.5	30.7	21.7	87	65	5.7	4.12
2017	42.2	29.5	19.3	87	67	5.6	5.95

Fig.1 Mean pest of soybean (Green semi looper) in relation to weather parameters at Parbhani location during 2002-2017

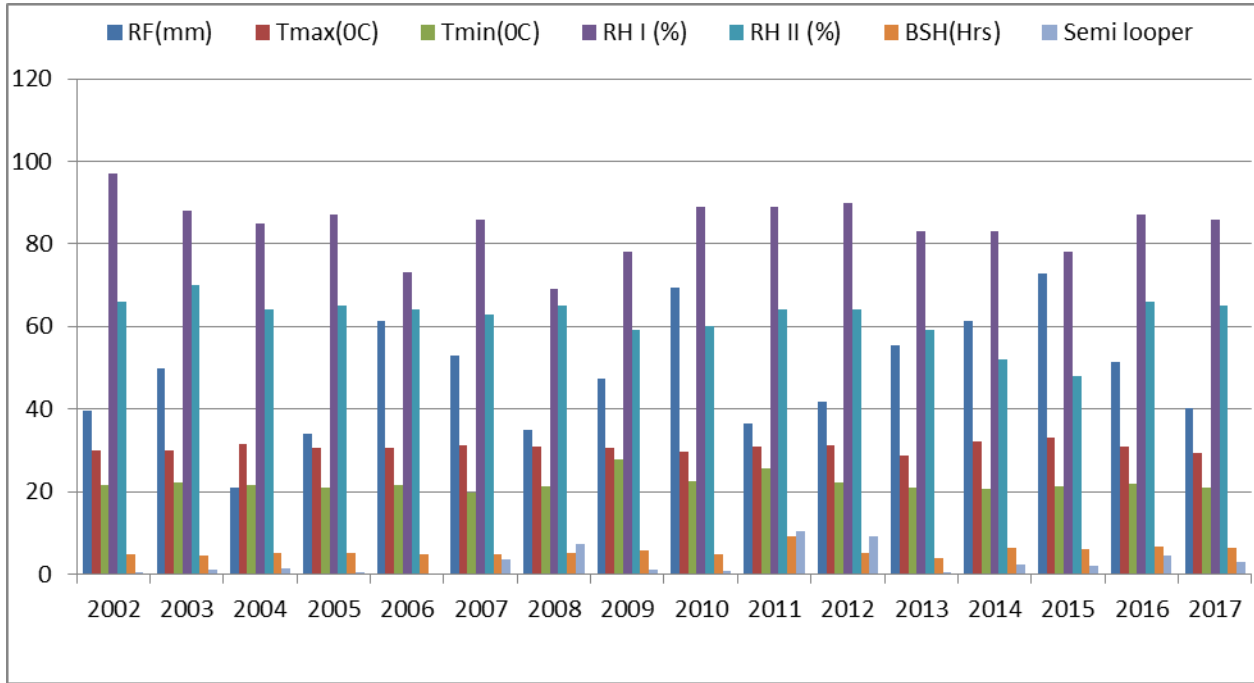


Fig.2 Mean pest of soybean (Girdle beetle) in relation to weather parameters at Parbhani location during 2002-2017

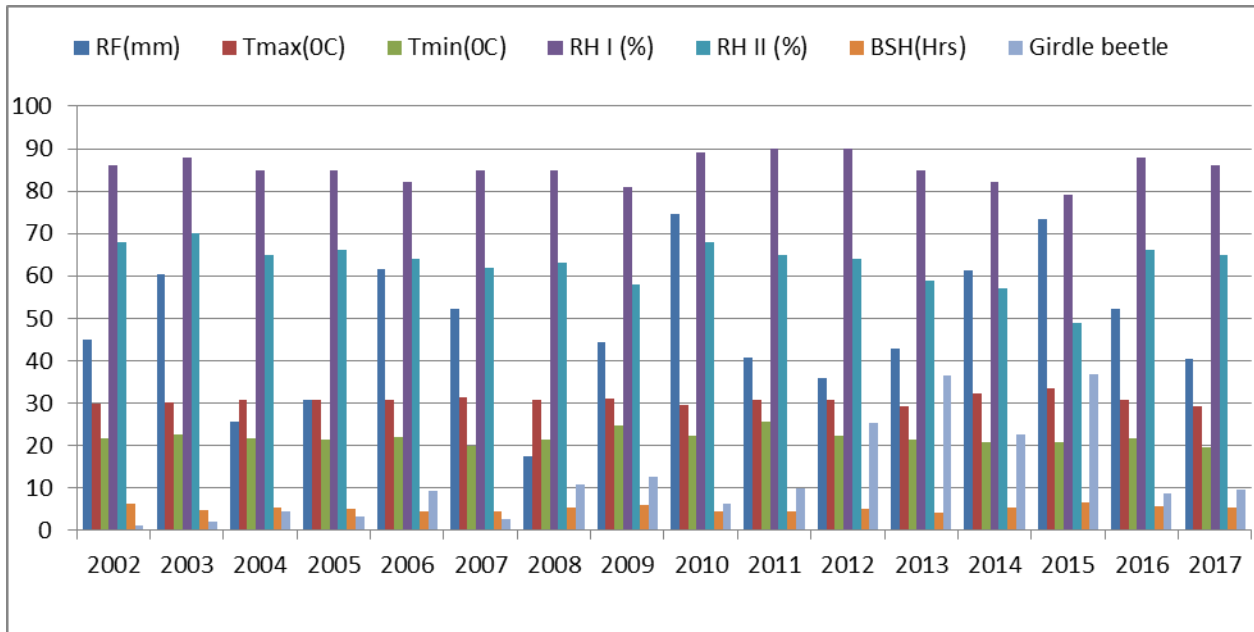


Fig.3 Mean pest of soybean (Leaf miner) in relation to weather parameters at Parbhani location during 2002-2017

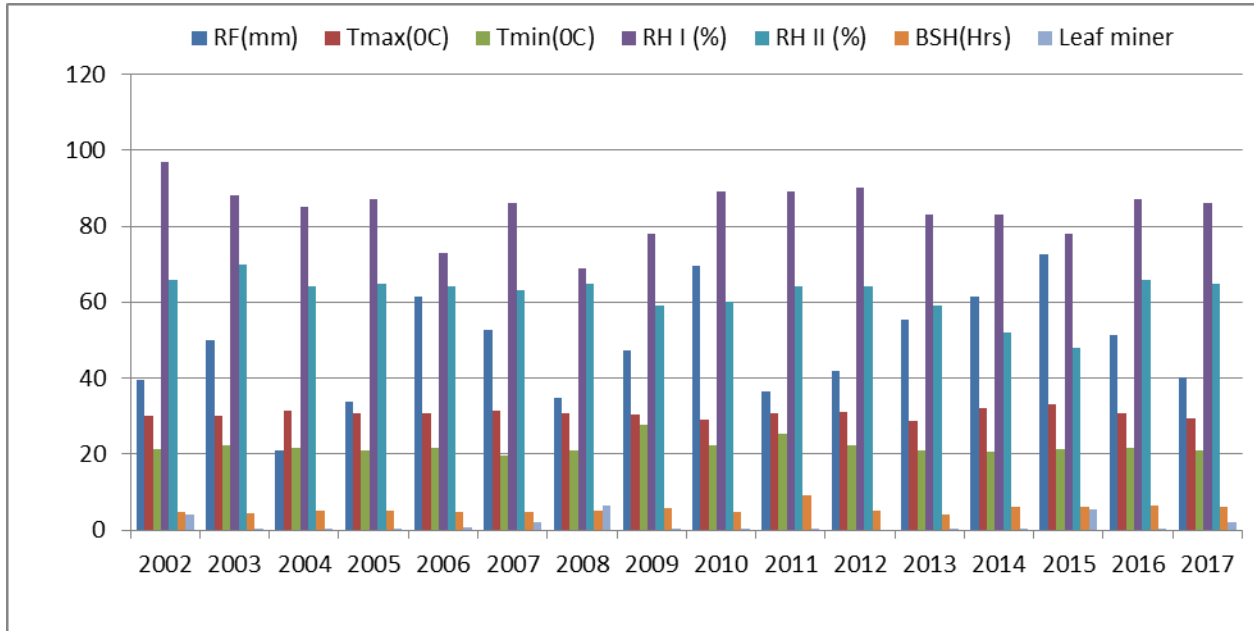
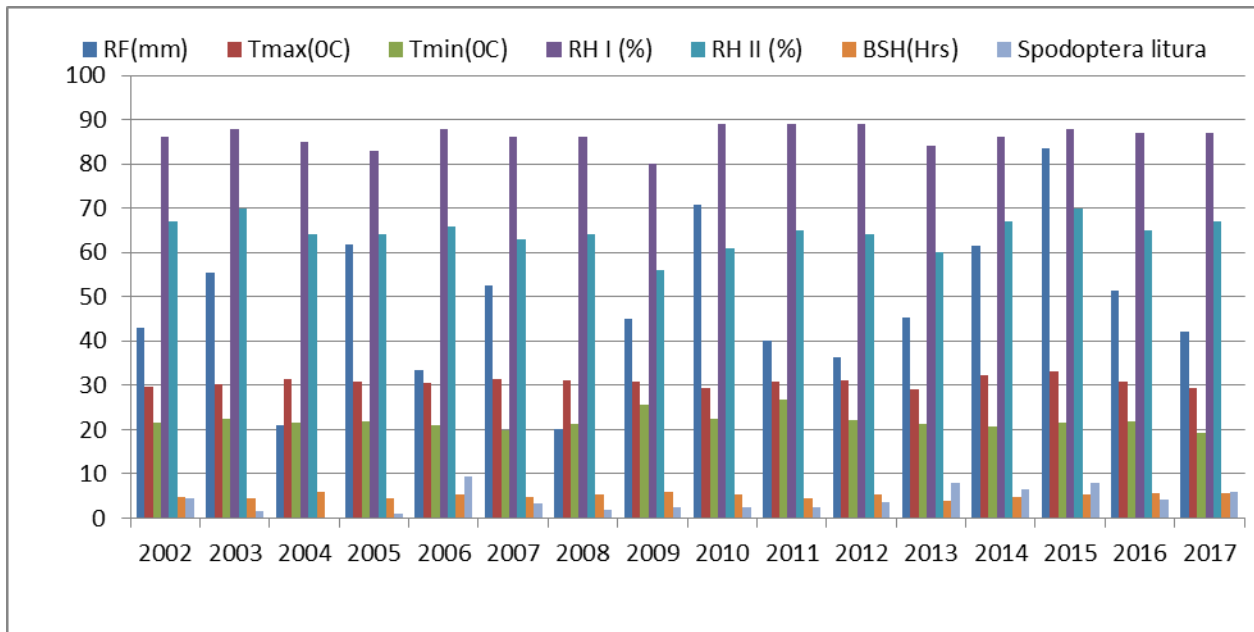
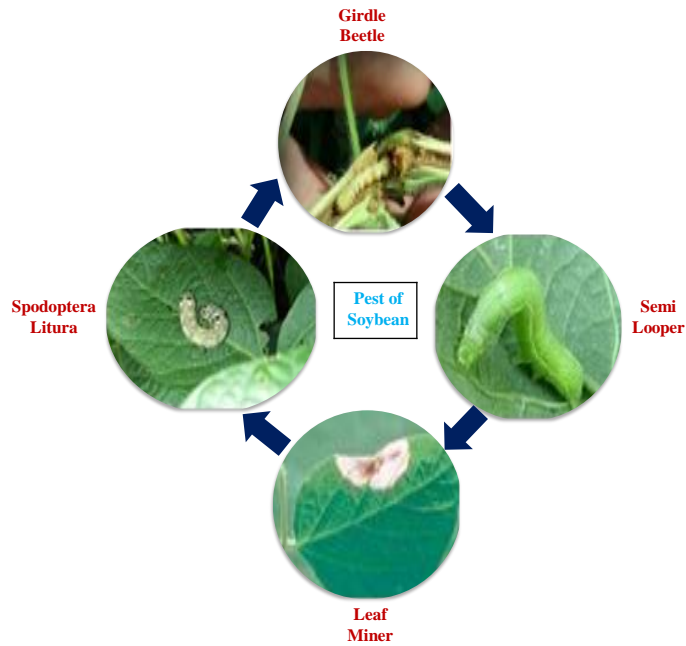


Fig.4 Mean pest of soybean (*Spodoptera litura*) in relation to weather parameters at Parbhani location during 2002-2017





Girdle Beetle	Tmax :29.4-33.4 ⁰ C, Tmin 19.7-25.7 ⁰ C, RH-I 79-90%, RH-II 49-70%
Semilooper	Tmax :29.4-31.2 ⁰ C, Tmin 18.6-27.8 ⁰ C, RH-I 69-97%, RH-II 45-70%
Leaf miner	Tmax :29-32.2 ⁰ C, Tmin 19.6-25.5 ⁰ C, RH-I-67-90%, RH-II 48-70%
Spodoptera Litura	Tmax :29.5-33.2 ⁰ C, Tmin 19.3-26.8 ⁰ C, RH-I-80-89, RH-II 56-70%

Crop weather pest calendar of Soybean crop under Parbhani location

The population of girdle beetle, was minimum i.e. 1.25 % during 2002. The weather parameters viz. rainfall, Tmax, Tmin, RH-I, RH-II and BSH were 45.1 mm, 29.8⁰C, 21.6⁰C, 86%, 68% and 6.4 hrs. respectively.

Green semilooper lay 200-300 eggs on leaves. 4 to 5 larval instars are completed in 16 to 18 days. The pupal period lasts for 7 to 8 days and then adult in 6 to 8 days.

The data presented in table 2 and fig. 2. The population of green semilooper was maximum i.e. 10.4 larvae/mrl during 2010. The weather parameters viz. rainfall, Tmax,

Tmin, RH-I, RH-II and BSH were 69.4 mm, 29.5⁰C, 22.5⁰C, 89%, 60 % and 9.29 hrs. respectively whereas, the population of green semilooper was not recorded in the year 2006.

Leaf miner moths lay single, white shiny eggs on the young foliage. A female can lay up to 473 eggs within average of 186 eggs. Five larval instars are completed in 9 to 17 days. Pupation takes place inside the mine or webbed leaves. The pupal period lasts for 3 to 7 days. The leaf miner has a restricted host range which includes groundnut and soybean.

The data presented in table 3 and fig. 3. The population of leaf miner, was maximum i.e. 6.32 larvae/mrl during 2008. The weather parameters viz. rainfall, Tmax, Tmin, RH-I, RH-II, BSH were 34.83 mm, 30.8⁰C, 21.10⁰C, 69%, 65%, 5.1 hrs. respectively and the population of leaf miner was not recorded in the year 2012.

The tobacco caterpillar *Spodoptera litura* has been reported to be a major pest on Soybean. Egg masses containing about 40-400 eggs are laid on leaves. They hatch in 3 to 4 days. Six larval instars are completed in 15-21 days. Adults emerge in about 10 days. The larvae are polyphagous. The incidence of *Spodoptera litura* started from 31st MW (0.052) larvae/mrl and increased steadily with its first peak, in 36th MW. When the weather conditions Tmax-30.4⁰C, Tmin-18.7⁰C, RH-I 80%, RH-II 71% (Khobragade et al. 2016).

The data presented in table 4 and fig. 4. The population of *Spodoptera litura*, was maximum i.e. 9.5 larvae/mrl during 2006. The weather parameters viz. rainfall, Tmax, Tmin, RH-I, RH-II and BSH were 33.5 mm, 30.6⁰C, 21⁰C, 88%, 66% and 5.3 hrs. respectively and the population of *Spodoptera litura* was not reported in the year 2004.

It is concluded as per available of pest data the incidence of green semilooper, was maximum i.e. 10.4 larvae/mrl during 2010. The weather parameters viz. rainfall, Tmax, Tmin, RH-I, RH-II and BSH were 69.4 mm, 29⁰C, 22.5⁰C, 89%, 60% and 9.29hrs. respectively.

The population of leaf miner, was maximum i.e. 6.32 larvae/mrl during 2008. The weather parameters viz. rainfall, Tmax, Tmin, RH-I, RH-II and BSH were 34.83 mm, 30.8⁰C, 21.10⁰C, 69%, 65% and 5.1 hrs. respectively.

The population of *Spodoptera litura*, was maximum i.e. 9.5 larvae/mrl during 2006. The weather parameters viz. rainfall, Tmax, Tmin, RH-I, RH-II and BSH were 33.5 mm, 30.6⁰C, 21⁰C, 88%, 66% and 5.3 hrs. respectively.

The population of girdle beetle, was maximum i.e. 36.9 % during 2015. The weather parameters viz. rainfall, Tmax, Tmin, RH-I, RH-II and BSH were 65.2 mm, 33.4⁰C, 21.7⁰C, 79%, 49% and 6.7 hrs. respectively.

The population dynamics studies indicated that, population of green semilooper was more i.e. 10.4 larvae/mrl during 2010 as compared to remaining years. The population of leaf miner was more i.e. 6.32 larvae/mrl during 2008. While the population of *Spodoptera litura* was more i.e. 9.5 larvae/mrl during 2006 as compared to throughout the years and the population of girdle beetle was more i.e. 36.9 % during 2015. The micro level i.e. (field experimental level) study is required for accurate results on soybean insect pests population and effect of weather parameters on pest incidence.

References

- Ahirwar R., Devi P. and Gupta R. (2015) Seasonal incidence of major insect pests and their biocontrol agents of soybean crop (*Glycine max* L. Merrill). Academic Journals Vol. 10 (12), pp. 402-406.
- Bhate M. D., More D.G. and Bokan S. C. (2017) Population Dynamics of Major Pest of Soybean in Relation to Weather Parameter. International Seminar on Global Climate Change: Implications for Agriculture and Water Sectors (CCAW2017).
- Chaudhary H. R., Baldevram, Meghwal, H. P. and Chamanjadon. (2012)

- Evaluation of organic modules against insect pests of soybean. *Indian journal of Entomology*, 74(2): 163-166.
- Dhurgude S. S., Bhosle B. B., Patait D. D., Bhede B. V., Zavar P. R. and Badgajar A. G. (2015) Efficacy of different insecticides against leaf miner on soybean. *Journal of Entomology Research*, 39(4); 365-368.
- Gadad H., Hegde M. and B Alikai R. A. (2013) Seasonal incidence of *Spodoptera litura* and leaf miner in rabi / summer groundnut Department of Agricultural Entomology, University of Agricultural Science, Dharwad 580005, India *J. Exp. Zool. India* vol. 16, No. 2 , pp, 619-622.
- Khobragade A.M., Jayewar N.E. and Tamboli N.M. (2016) Abundance of insect pest of soybean as influenced by abiotic factors. *National Seminar on Breeding of field crops for biotic and abiotic stresses in relation to climate change* (ISBN 978-93-85162-831).
- Shali R., Khandwe, N. and Sharma, S. (2013) Efficacy of insecticide against defoliators and stem borers of soybean. of Entomology college of agriculture, sehore.466001, India. *Ann. Pl. Protec. Sci.* 21(2): 250-253.
- Yadav P., Banerjee S., Gupta M.P. and Yadav V.K. (2015). Effect of Weather Factors on Seasonal Incidence of Insect-Pests of Soybean. - *A Journal of Multidisciplinary Advance Research* 46 Vol.4 No.1, 46 – 51.