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INFLUENCE OF PLANTING DATES AND ORGANIC SOIL AMENDMENTS ON THE INCIDENCE OF STEM BORER, *SCROBIPALPA HELIOPA* AND LEAF EATING CATERPILLAR, *SPODOPTERA LITURA* ON BURLEY TOBACCO

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Studies on the effect of planting dates on incidence of *Scrobipalpa heliopa* and *Spodoptera litura* showed that among the five dates of planting, the stem borer infestation was significantly high in the month of July and gradually increased from 10 to 40 DAP. The highest infestation was recorded in plantings done during second week of July. A highly significant and positive correlation was observed between the progressive growth of the crop and stem borer infestation at second week of July (r = 0.96) and first week of August (r = 0.93) planting dates. Negatively skewed distribution of stem borer infestation was observed under different dates of planting and thus control measures are to be initiated from 10 DAP. The caterpillar *spodoptera litura* was significantly low in second week of July followed by first week of August planting and reached a peak in plantings done during third week of September. A strong positive correlation existed between the planting dates and infestation at 80 DAP (r = 0.96). Regression analysis showed that there was 0.8 per cent increase in caterpillar infestation at every delay in planting of 15 days. Most of the planting dates exhibited positively skewed distribution of infestation indicating initiation of control measures from 40 DAP for caterpillar. The crop planted during third week of August not only exhibited significantly lower stem borer and caterpillar infestation but also recorded maximum yields. Influence of organic soil amendments on these insect pests indicated that supplementing 25 per cent of recommended N in the form of either FYM or neem cake was effective in managing the pest infestation with better cured leaf yields as compared to cent per cent recommended dose in the form of in organic fertilizers.

INTRODUCTION

Burley tobacco is an air cured tobacco used for the production of blended cigarettes commonly known as "American blends" as against British type straight Virginia blends. In India burley tobacco is grown mostly in Andhra Pradesh in an area of 13000 ha with a production 18 million kg which vary depending on annual demand. The cropping season starts in July and ends in October and as such it is a monsoon crop. Burley tobacco is grown generally in hilly and nutrient poor soils with low organic matter. Of late the cultivation is extended to plains in Andhra Pradesh with different agro climatic characters compared to hilly areas. A number of insect pests attack burley tobacco in the field. Among these, stem borer, *Scrobipalpa heliopa* Low. and tobacco leaf eating caterpillar *Spodoptera litura* F. are the most important pests in the plains of East Godavari district, Andhra Pradesh. Tobacco stem borer till recently a minor pest of tobacco has of late, become a major pest in Andhra Pradesh. It infests all types of tobacco and the infestation varies from 7 to 75 %. Tobacco leaf eating caterpillar is one of the important polyphagous crop pests (Chari and Patel, 1983) and its extent of damage varies from 80 to 100 per cent (Chari,1987). Different chemical control measures have been evaluated for their efficacy and feasibility of using as a component of integrated pest management programme. (Krishnamurthy *et al.,* 2005). Of late, the pesticide residue problems in tobacco cured leaf is a major cause of concern due to indiscriminate use of pesticides. As a result it becomes necessary to find out alternative methods for insect pest management which include the manipulation of the cultural practices like manipulating the dates of planting and organic amendments. Hence, the present study was aimed at finding the insect pest incidence over time and space in the new habitat of the crop, with particular emphasis on the influence of time of planting and organic soil amendments on the

insect pests of the burley crop viz., stem borer *Scrobipalpa heliopa* Low and leaf eating caterpillar *Spodoptera litura* F.

MATERIALS AND METHODS

The trials were carried out for two consecutive years at Burley Tobacco Research Centre, Kalavacharla during *kharif* 2010 and 2011 to find out the influence of cultural practices *viz.,* planting time and organic amendments on the incidence of stem borer and caterpillar. The variety planted was Banket A1, a popular burleytobacco variety.

Influence of different dates of planting on the incidence of major insect pests on burley tobacco

The trial was laid out in split plot design with four replications. Main plot treatments were protected and unprotected conditions. The protected crop received need based application of emamectin benzoate 5SG @ 11 g a.i./ha for control of leaf eating caterpillar and flubendiamide 480 SC @ 60 g a.i./ha for control of stem borer. Each main plot was divided into 5 sub plots of 9 x 4.5 m. size comprised of different planting dates commencing from second week of July and subsequent four planting dates at fortnightly intervals. Burley nurseries were raised separately for each date of planting. Recommended doses of fertilizers were given as top dressing and other package of practices were adopted as per schedule. Observations on the incidence of stem borer were recorded at ten days interval commencing from 10 days after planting (DAP) to 40 DAP and for caterpillar, infestation from 20 to 80 days after planting, at 20 days interval was recorded.

Influence of different organic soil amendments on the incidence of major insect pests on burley tobacco

The experiment was conducted in a randomized block design with five replications to determine the efficacy of organic soil amendments on the incidence of stem borer and leaf eating caterpillar. Banket A-1 was planted at 90 x 45 cm in the third week of August. The crop was fertilized with 120 kg N/ha in three equal split doses and recommended doses of phosphorus and potash were applied. The experiment comprised of three organics *viz:* Farm yard manure (FYM), vermi compost and neem cake each @ 25% of recommended basal N in organic form and the rest from inorganic source which was compared with 100% N in the form of ammonium sulphate. One week before planting all the organics in powder form were applied on the ridges by broadcasting method and mixed with soil in respective plots. Recommended doses of fertilizers were given as top dressing and other package of practices were adopted as per schedule. The cured leaf yield was recorded and analysed statistically

RESULTS AND DISCUSSION

Pooled analysis of two years data at different stages of the crop revealed significantly lower infestation of stem borer in protected plots than in unprotected plots. The stem borer infestation was nearly double from 10 to 40 DAP in both protected and unprotected plots. However, the build up of the stem borer infestation was significantly slow in protected plots (Table 1). The progression of caterpillar infestation from 20 to 80 DAP was 14 to 19 per cent lesser in protected plots than in un protected plots (Table 3).

Incidence of stem borer

It is evident from the Table 1 that in sub plots the infestation differed significantly among five dates of plantings. July and August plantings showed significantly higher infestation compared to September plantings. Thus stem borer infestation, decreased with the delay in planting time. It was significantly low in plantings done in third week of September, while plantings in second week of July recorded higher infestation. Though the initial infestation level was low and varied with each planting date, a gradual increase in infestation was observed from 10 to 40 DAP. Tobacco seedlings were susceptible to stem borer infestation from 10 DAP, which was evident from the increase in infestation beyond 10 days and reached a peak at 30 DAP. Interaction between need based application of insecticides and planting dates was found significant at all stages except at 30 DAP.

Table 1: Influence of dates of planting on stem borer infestation (pooled 2010- 2012)

Treatments	Stem borer infestation (%)			
Main plots	**10 DAP**	**20 DAP**	**30 DAP**	**40 DAP**
Protected	2.07 (1.42)	4.97 (1.95)	(4.95) 2.10	(5.05) 2.12
Un Protected	2.62 (1.43)	7.20 (2.60)	(8.42) 2.74	(8.90) 2.79
SEm±	**0.26**	**0.17**	**0.22**	**0.37**
CD (P=0.05)	**NS**	**0.08**	**0.10**	**0.16**
CV (%)	**18.32**	**7.67**	**9.10**	**15.17**
Date of planting				
II wk.July	2.56 (1.54)	7.40 (2.70)	9.25 (2.99)	10.25 (3.14)
I wk. Aug	2.56 (1.58)	7.30 (2.63)	9.80 (3.03)	9.12 (2.92)
III wk. Aug	3.50 (1.82)	8.10 (2.68)	7.12 (2.59)	8.12 (2.80)
I wk. Sept	2.31 (1.30)	5.0 (1.97)	4.0 (1.82)	4.12 (1.84)
III wk. Sept	1.44 (0.87)	7.38 (1.38)	3.3 (1.67)	3.25 (1.57)
SEm±	**0.32**	**0.43**	**0.34**	**0.36**
CD (P=0.05)	**0.16**	**0.11**	**0.14**	**0.23**
CV (%)	**22.56**	**19.0**	**14.02**	**14.54**

Table 2: Linear correlation and regression analysis of stem borer infestation at different stages of the crop

Planting dates	**Regression equation crop stages and stem borer infestation**	**r^2**
II wk.July	y= 0.2994 + 0.2768 x	0.96
I wk. Aug	y= 0.5200 + 0.2592 x	0.93
III wk. Aug	y= 1.3054 + 0.2011 x	0.87
I wk. Sept	y= 1.0631 + 0.1001 x	0.78
III wk. Sept	y= 1.3800 + 0.0838 x	0.04
	Planting dates and stem borer infestation (40 DAP)	
	y= 12.672 – 1.9 x	- 0.96

The observations recorded on distribution of stem borer in unprotected plots showed a strong positive correlation between age of the crop and infestation at each planting date (Table 2). Regression analysis showed that the increase in infestation from 10 to 40 DAP as 0.27 per cent in second week of July, 0.20 to 0.25 per cent in August and 0.8 to 1 per cent in September plantings. A reverse trend of decrease in infestation was observed with regression equation between infestation and planting date at 40 DAP showing a strong negative correlation (r = - 0.96) and there was 1.9 per cent decrease in infestation at every fortnightly delay in planting, with an exception in the first week of September. Further, it was also established that most of the planting dates exhibited negatively skewed distribution, except plantings done in the first week of September and thus control measures are required during 10 to 30 DAP (Table 5).

Table 3: Influence of dates of planting on leaf eating caterpillar infestation (pooled 2010- 2012)

Treatments	Cater pillar infestation (%)				Yield kg/ha
Main plots	20 DAP	40 DAP	60 DAP	80 DAP	
Protected	1.90 (1.11)	(2.60)1.58	3.82 (1.92)	5.02 (2.20)	1154
Un Protected	3.60 (1.77)	(3.47)1.81	5.37 (2.29)	6.87 (2.59)	1112
SEm±	**0.38**	**0.40**	**0.12**	**0.22**	**118**
CD (P=0.05)	**0.17**	**0.18**	**0.05**	**0.09**	**0.0**
CV(%)	**26.16**	**23.56**	**5.70**	**9.00**	**10.43**
Date of planting					
II wk.July	0.81 (0.58)	2.62 (1.51)	3.31 (1.77)	4.12 (1.97)	1066
I wk. Aug	1.75 (1.04)	2.69 (1.61)	3.87 (1.95)	4.87 (2.18)	1195
III wk. Aug	2.75 (1.61)	3.31 (1.77)	5.06 (2.21)	6.50 (2.52)	1302
I wk. Sept	4.37 (1.99)	2.94 (1.68)	4.81 (2.18)	6.70 (2.57)	1156
IIIwk. Sept	4.06 (1.97)	3.87 (1.91)	5.94 (2.41)	7.30 (2.73)	1048
SEm±	**0.38**	**0.29**	**0.23**	**0.25**	**90**
CD (P=0.05)	**0.23**	**0.25**	**0.07**	**0.13**	**73.31**
CV (%)	**26.18**	**16.99**	**11.02**	**10.24**	**7.97**

Figures in parenthesis are arc sin transformed values

Venkateswarlu *et al.* (2005) reported that in the agency area of East Godavari the incidence was 10 to 12 %, 10 to 25 % and 4 to 18 % during 2000- 01, 2001-02 and 2003-03 seasons, respectively. Further Chari and Ramaprasad (1988) reported that late planted crop in the plains was more prone to attack by stem borer The plains of East Godawari come under the south coast zone of agro climatic region. The average annual rainfall is 996 mm with frequent delay in onset of monsoon and consequent delay in planting. In contrast, the average annual rainfall is 1128 mm in the hilly regions of this zone (www.dacnet.nic.in, 2012) and early plantings are in practice. Our results also confirms the delay in the onset of monsoon favours higher incidence of tobacco stem borer in the plains.

Incidence of leaf eating caterpillar

The caterpillar damage was significantly low from 20 to 80 DAP in plantings done during July and closely followed by plantings done in August (Table 3). Crop raised in September showed significantly higher infestation during corresponding period of observation. It was evident that the infestation increased with delay in planting and maximum was observed in second week of September planted crop. September plantings received more rainfall than early planted crop, which probably contributed to higher infestation of the pest in late planting. Miyahara *et al.* (1971) reported four generations of *S.litura* between July and October in Japan. Most eggs were laid in September. Selvaraj et al (2010) reported the build up of *S.litura* showed positive correlation with relative humidity, sun shine and dew fall in cotton in Tamilnadu. Kumar *et al.* (2009) reported that the incidence of *S.litura* commenced from fourteen days after sowing in groundnut and peak incidence occurred from 50-60 days after sowing. The R value indicated the influence of weather on incidence was 98 %.

Interaction between planting dates and caterpillar infestation in protected plots was non significant at all stages except at 80 DAP. These findings were in conformity with those of Prasad and Srinivasulu (2000), who reported that the infestation due to *S.litura* was very high in the month of August and early September under southern light soil tobacco grown in Prakasam

Table 4: Linear correlation and regression analysis of caterpillar infestation at different stages of the crop

	Regression equation crop stages and caterpillar infestation	r^2
II wk.July	y= - 0.0080 + 0.0542 x	0.98
I wk. Aug	y= 0.2310 + 0.0598 x	0.99
III wk. Aug	y= 0.4206 + 0.0771 x	0.98
I wk. Sept	y= 0.9645 + 0.0696 x	0.87
III wk. Sept	y= 0.8980 + 0.0829 x	0.94
	Planting dates and caterpillar infestation	
	y= 3.441 + 0.8198 x	0.96

Table 5: Spatial distribution of insect pests as influenced by different dates of plantings on burley tobacco

	Mean	Med	Variance	SD	Co-eff. Skewness	Co-eff. Kurtosis
Stem borer, *S. heliopa*						
II wk. July	7.66	9.18	16.46	4.05	-1.67	2.71
I wk of Aug.	7.06	8.12	8.64	2.93	-1.74	3.16
III wk. Aug.	5.81	6.37	1.68	1.29	-1.91	3.70
I wk. Sept.	2.90	2.87	0.30	0.55	0.13	-4.78
III wk. Sept.	0.81	0.87	0.057	0.23	-0.85	-1.28
Leaf eating caterpillar, *S. litura*						
II wk. July	2.15	2.25	2.22	1.49	-0.42	-0.41
I wk of Aug.	3.28	2.87	2.78	1.66	0.95	-0.60
III wk. Aug.	4.0	3.50	3.99	1.99	0.87	-1.15
I wk. Sept.	4.94	4.69	2.33	1.52	0.89	1.23
III wk. Sept.	5.50	5.31	2.54	1.59	0.52	-1.42

district. Further it was confirmed that hot and humid weather with moderate disturbances due to heavy rains and gales that prevail in tobacco crop season in coastal Andhra Pradesh is congenial for rapid multiplication of *S. litura* (Sitaramaiah *et al.* 2001).

The present findings were confirmed by a strong positive correlation between the crop stages and caterpillar infestation at each planting (Table 4). Regression analysis showed that intensity of infestation from 20 to 80 DAP as 0.05 per cent in July second week, 0.05 to 0.07 per cent in August and 0.06 to 0.08 per cent in September plantings. There was a marginal increase of caterpillar infestation as the crop grew till 40 DAP and progressive delay in planting recorded higher infestation. Further, there was strong positive correlation between the planting dates and infestation at 80 DAP (r = 0.96). Regression analysis showed that there was 0.8 per cent increase in caterpillar infestation at every delay in planting. Infestation at different planting dates was highly variable and less consistent in nature (Table 4). Most of the planting dates exhibited ositively skewed distribution indicating necessity of control measures for the pests from 40 to 80 DAP (Table 5).

Planting dates will vary according to the onset of monsoon in different tobaccos. Hence, it necessitates the study of insect pest behavior at different planting dates. It was established that stem borer infestation increases with long dry spells and humid weather coupled with intermittent rains encourages caterpillar infestation. Stem borer infestation was generally low in early plantings in the month of July and August in the high altitude belt of East Godavari compared to late plantings done after August (CTRI, 2005). It is quite contrary with the observations made in the plains of East Godavari, where in the infestation was higher in the early plantings than late plantings. Alterations in time of planting have been found useful in the management of insect pests in various crops (Selvaraj *et al.*, 2010).

Cured leaf yield

Cured leaf yield was significantly high in August planted crop as compared to other dates of plantings. Plantings done either earlier to August or late in September recorded significantly low yields. The yield of July plantings was drastically reduced due to high incidence of stem borer. Where as plantings in third week of August suffered significantly less stem borer and caterpillar infestation and recorded maximum yields. Burley tobacco needs sufficient precipitation coupled with high atmospheric relative humidity which was available during August in this region. Based on these observations it was concluded that the right time of planting under normal weather conditions was August and it can be expected that the crop raised during this period suffers manageable infestation of stem borer and caterpillar with relatively low yield loss. Planting of burley tobacco in August was found to have given better yields in East Godavari plains (CTRI, 2011).

Influence of different organic amendments on the incidence of major insect pests on burley tobacco

Pooled analysis of the two seasons data showed the incidence of stem borer and caterpillar was low (Table 6). Stem borer infestation in the plots which received 25% of recommended N through organic sources *viz.*, FYM, vermi compost and neem cake showed relatively lower infestation as compared to the plots which received 100% recommended N in the form of ammonium sulphate. Among the three organic sources, FYM treated plots showed relatively lower infestation at all the stages of the crop followed by neem cake, however, the differences were non significant. Caterpillar infestation at 30 and 40 DAP varied between 2.78 to 4.25 per cent and the differences among the treatments were non significant. The infestation at 50 DAP was low in FYM treated plots followed by neem cake and vermi compost and significantly superior to plots received 100 per cent N in the form of ammonium sulphate. Cured leaf was relatively high in FYM applied plots closely followed by neem cake and vermi compost.

On critical perusal of data on pest infestation and cured leaf yields it is evident that supplementation of 25 per cent of recommended N in the form of either FYM or neem cake was effective in reducing the pest infestation with higher cure leaf yield. Reported that application of 50 tons of neem cake per hectare reduced nearly 50 per cent infestation of stem borer compared to application of purely inorganic source of nitrogen. This may be a costly affair, however, cumulative effect of adding organic matter for supply of N through manures or cakes can be realized by successive use for considerable length of time. In our experiment the infestations were comparatively lower in the second year than the previous year. Integrated nutrient management with balanced use of manures and inorganic fertilizers were found to be supportive for integrated pest management in tobacco and groundnut (DBT, 2002).

REFERENCES

CTRI. 2005. Annual Report, Central Tobacco Research Institute (ICAR), Rajahmundry.

CTRI. 2011. Annual Report, Central Tobacco research Institute (ICAR), Rajahmundry.

Chari, M.S. and S.N. Patel. 1983. Cotton leaf

Table 6: Influence of organic amendments on the incidence on stem borer and leaf eating caterpillar

Treatment	% Stem borer infestation			% *S. litura* infestation			Yield
	20 DAP	30 DAP	40 DAP	30 DAP	40 DAP	50 DAP	kg/ha
FYM	3.81 (11.25)	5.13 (13.08)	5.45 (13.50)	3.06 (10.07)	3.34 (10.52)	5.13 (13.08)	1330
Vermi compost	4.27 (11.92)	5.27 (13.26)	5.61 (13.68)	3.08 (10.09)	3.89 (11.36)	5.55 (13.61)	1280
Neem cake	3.73 (11.13)	5.29 (13.29)	5.54 (13.60)	2.78 (9.60)	4.07 (11.63)	5.45 (13.50)	1292
Inorganic fertilizers	4.80 (12.64)	6.28 (14.50)	6.50 (14.76)	3.57 (10.88)	4.25 (11.89)	6.42 (14.66)	1206
SEm±	**1.29**	**1.53**	**1.29**	**1.08**	**1.66**	**1.15**	**116**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**1.06**	**-**
CV (%)	**11.02**	**11.30**	**9.30**	**10.67**	**14.58**	**8.40**	**8.6**

Figures in parenthesis are under arc sin transformed values

worm, *Spodoptera litura* Fab. Its biology and integrated control measures**. Cotton Develop.** 13(1): 7-8.

Chari, M.S. 1987. Insect pests of tobacco and their management. Plant protection in field crops (Lead paper of the National seminar on plant protection in field crops, 29-31, January,1986, CPPTI, Hyderabad) by Plant Protection Association of India, Hyderabad, pp. 349-68.

Chari, M.S. and G. Ramaprasad. 1988. Integrated control of pests on tobacco. Proc. National symposium on Integrated pest control-Progress and perspectives, October, 15-17, pp. 42-52.

DBT. 2002. Final report of DBT project on "Role of biological resources for management of *Spodoptera litura* F. and *Helicoverpa armigera* on tobacco and groundnut in coastal Andhra Pradesh.

Krishnamurthy, V., R. Subba Rao and K.D. Singh. 2005. Indian Burley Tobacco- Its Production and quality for export. CTRI, Rajahmundry. Pp. 69.

Kumar, B., Vinoth, T.N. Balasubramanyan and R. Jagannathan. 2009. Seasonal incidence and influence of weather factors on the incidence of *S. litura* (Fab) on groundnut. ICAFI. **J. Life Sci.** 3(1): 61-5.

Miyahara,Y., T. Wakikado and A. Tanaka. 1971. Seasonal changes in the number and size of egg masses of *Prodenia lituira*. **Japanese J. Appl. Entomol. Zool.** 15: 139-42.

Prasad, J.V. and R. Sreenivasulu. 2000. Pest succession and dynamics in FCV tobacco under southern light soil conditions. **Tob. Res.** 26: 24–8.

Selvaraj, S., D. Adiroubane, V. Ramesh and A.L. Nayanan. 2010. Impact of ecological factors

on incidence and development of tobacco cutworm *S. litura* (Fabricious) in cotton. **J. Bio. Pesticides** 3(1): 43-6.

Sitaramaiah, S., U. Sreedhar, G. Ramaprasad and S.V.V. Satyanarayana. 2001. Management of tobacco leaf eating caterpillar, *Spodoptera litura* F. with insecticide baits in NLS tobacco. **Tob. Res**. 27(1): 7-11.

Venkateswarlu, P., U. Sreedhar, S. Sitaramaiah, S. Nageswara Rao, S.V.V. Satyanarayana and I.V. Subba Rao. 2005. Effect of organic cakes on tobacco stem borer, *Scrobipalpa heliopa* Lower in burley tobacco. **Tob. Res.** 31(1&2): 74-8.

www.dcanet.in.Agricultural informatics division, National Informatics centre, New Delhi.