



## Effect of Time of Insecticidal Spray on the Incidence of Bud Necrosis and Stem Necrosis Diseases of Groundnut

G Sowmya Lakshmi, V Manoj Kumar, J Krishna Prasadji and R Lakshmi pathy

Department of Plant Pathology, Agricultural College, Bapatla 522101, Andhra Pradesh

### ABSTRACT

Field experiment was conducted for the management of groundnut bud necrosis disease (GBND) and peanut stem necrosis disease (PSND) in groundnut. Among nine treatments tested during *rabi* 2013-14, insecticidal spray with imidacloprid SL @ 0.0053% at 45 DAS recorded the lower incidence of GBND (3.66%), PSND (2.02%) and average thrips population per plant (4.80) and was on a par with fipronil spray SC @ 5% at 45 DAS. Significant increase in shoot length, number of pods per plant, dry pod yield, 100 seeds weight, shelling percentage and highest B:C ratio was recorded with imidacloprid SL @ 0.0053% at 45 DAS and fipronil SC @ 5% at 45 DAS. Insecticidal protection at 45 DAS was found to be effective and economical in control of both the diseases and thrips population.

**Key words :** Bud necrosis, Groundnut, Insecticides, Stem necrosis, Thrips population.

Groundnut / peanut (*Arachis hypogaea* L.) is an important legume crop grown in the tropical and subtropical regions of the world, mainly for its seed which is rich in oil and proteins. Among the various pathogens that attack groundnut, viral diseases were highly fatal. In India annual losses caused by GBND and PSND were estimated as US \$ 89 million (Reddy *et al.*, 1995) and US \$ 65 million (Reddy *et al.*, 2002), respectively. GBND causing virus was earlier reported as *Tomato Spotted Wilt Virus (TSWV)* but based on serological studies it is now referred to as *Groundnut Bud Necrosis Virus (GBNV)*, a distinct genus classified under the family Bunyaviridae, transmitted by *Thrips palmi* Karny (Reddy *et al.*, 1995). Adults were able to transmit the virus that was acquired by them during larval stage (Black, 1954). Initially PSND was suspected as GBND caused by *GBNV*, but later established as a distinct virus known as *Tobacco Streak Virus (TSV)* of the genus *Illarvirus*, family Bromoviridae (Reddy *et al.*, 2002). Thus, the disease in peanut was named as peanut stem necrosis disease (PSND) transmitted by *Frankliniella schultzei*, *Scirtothrips dorsalis* and *Megalurothrips usitatus* by infected pollen mediated thrip transmission (passive transmission) (Lavakumar *et al.*, 2008). Hence, systemic insecticidal sprays at different stages of the crop were studied to manage the peak activity of thrips and consequently both the diseases.

### MATERIAL AND METHODS

Field trial was conducted during *rabi* 2013-14 at Agricultural College Farm, Bapatla in a randomized block design with nine treatments that were replicated thrice using groundnut variety Narayan. Net plot size of 3.15 x 3.00 m was maintained for each treatment with 45 cm distance between rows and 10 cm between plants. All recommended agronomic practices were followed. The treatment details were given below

T1-Spraying of Imidacloprid SL @ 0.0053% at 15 days after sowing (DAS)  
T2-Spraying of Imidacloprid SL @ 0.0053% at 30 DAS  
T3-Spraying of Imidacloprid SL @ 0.0053% at 45 DAS  
T4-Spraying of Imidacloprid SL @ 0.0053 % at 60 DAS  
T5-Spraying of Fipronil SC @ 5% at 15 DAS  
T6- Spraying of Fipronil SC @ 5% at 30 DAS  
T7- Spraying of Fipronil SC @ 5% at 45 DAS  
T8- Spraying of Fipronil SC @ 5% at 60 DAS  
T9- Unsprayed check (control)

Per cent disease incidence for both the diseases were calculated using the formula

$$\text{Per cent disease incidence (PDI)} = \frac{\text{Number of plants infected in a microplot}}{\text{Total number of plants in a microplot}} \times 100$$

Table 1. Incidence of GBND at weekly interval on groundnut during *rabi* 2013-14.

S.No.	Treatment	4- January	11- January	18- January	25- January	1- February	8- February	15- February	22- February	1-March	8-March	15-March	22-March	29-March
1	Spraying of Imidacloprid SL @ 0.0053% at 15 (DAS)	0.00 (0.00*)	0.00 (0.00)	0.00 (0.00)	0.54 (4.22)	0.73 (4.81)	1.80 (7.70)	4.16 (11.69)	5.04 (12.95)	6.47 (14.61)	7.03 (15.28)	8.22 (16.56)	8.22 (16.56)	8.22 (16.56)
2	Spraying of Imidacloprid SL @ 0.0053% at 30 DAS	0.00 (0.00)	0.00 (0.00)	0.53 (4.17)	0.53 (4.17)	0.53 (4.17)	1.05 (5.77)	3.16 (10.23)	4.04 (11.59)	4.22 (11.85)	4.57 (12.35)	4.92 (12.80)	4.92 (12.80)	4.92 (12.80)
3	Spraying of Imidacloprid SL @ 0.0053% at 45 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.55 (4.25)	1.45 (6.91)	2.16 (8.37)	2.16 (8.37)	2.34 (8.75)	2.72 (9.49)	3.29 (10.44)	3.66 (11.02)	3.66 (11.02)	3.66 (11.02)
4	Spraying of Imidacloprid SL @ 0.0053 % at 60 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.14 (8.26)	3.92 (11.38)	4.46 (12.09)	8.01 (16.43)	10.12 (18.56)	10.13 (18.57)	11.03 (19.38)	12.43 (20.61)	12.43 (20.61)	12.43 (20.61)
5	Spraying of Fipronil SC @ 5% at 15 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.18 (1.40)	0.35 (2.77)	1.25 (5.95)	3.07 (10.02)	4.17 (11.69)	5.02 (12.90)	5.21 (13.19)	6.28 (14.50)	6.28 (14.50)	6.28 (14.50)
6	Spraying of Fipronil SC @ 5% at 30 DAS	0.00 (0.00)	0.00 (0.00)	0.72 (4.79)	0.72 (4.79)	0.72 (4.79)	1.42 (6.75)	2.15 (8.38)	3.23 (10.24)	4.62 (12.41)	5.53 (13.59)	5.88 (14.00)	5.88 (14.00)	5.88 (14.00)
7	Spraying of Fipronil SC @ 5% at 45 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.74 (4.85)	2.19 (8.46)	3.11 (10.14)	3.11 (10.14)	3.11 (10.14)	3.30 (10.43)	3.85 (11.29)	4.02 (11.54)	4.02 (11.54)	4.02 (11.54)
8	Spraying of Fipronil SC @ 5% at 60 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.04 (5.74)	3.31 (10.44)	5.74 (13.85)	7.32 (15.61)	8.71 (17.04)	8.71 (17.04)	8.88 (17.20)	9.92 (18.32)	9.92 (18.32)	9.92 (18.32)
9	Unsprayed check (control)	0.00 (0.00)	0.00 (0.00)	0.57 (4.34)	3.04 (10.04)	3.62 (10.94)	4.94 (12.85)	8.66 (17.00)	10.68 (19.07)	12.41 (20.62)	13.57 (21.60)	14.32 (22.23)	14.32 (22.23)	14.32 (22.23)
	SEm +	0.00	0.00	0.22	0.65	0.71	0.90	0.80	0.85	0.81	0.78	0.83	0.83	0.83
	CD (P<0.05)	0.00	0.00	0.65	1.96	2.13	2.71	2.39	2.55	2.42	2.34	2.48	2.48	2.48
	CV%	0.00	0.00	25.60	21.33	17.12	16.89	11.52	11.03	9.83	9.28	9.12	9.12	9.12

\*Values in parentheses are arcsine transformed values.

Table 2. Incidence of PSND at weekly interval on groundnut during *rabi* 2013-14.

S.No.	Treatment	4- January	11- January	18- January	25- January	1- February	8- February	15- February	22- February	1-March (10.07)	8-March (10.66)	15-March (11.45)	22-March (11.45)	29-March (11.45)
1	Spraying of Imidacloprid SL@ 0.0053%at 15 (DAS)	0.00 (0.00*)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.70 (4.74)	1.07 (5.82)	1.81 (7.58)	2.34 (8.80)	3.06 (10.07)	3.43 (10.66)	3.96 (11.45)	3.96 (11.45)	3.96 (11.45)
2	Spraying of Imidacloprid SL@ 0.0053%at 30 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.71 (4.76)	1.24 (6.36)	2.11 (8.32)	2.82 (9.63)	3.00 (9.96)	3.18 (10.49)	3.18 (10.49)	3.18 (10.49)
3	Spraying of Imidacloprid SL@ 0.0053%at 45 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.55 (4.24)	0.72 (4.82)	0.72 (4.82)	0.92 (5.43)	1.45 (6.90)	1.65 (7.30)	2.02 (8.14)	2.02 (8.14)	2.02 (8.14)
4	Spraying of Imidacloprid SL@ 0.0053 % at 60 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.77 (7.64)	2.12 (8.35)	3.57 (10.83)	3.57 (10.83)	3.91 (11.41)	3.91 (11.41)	3.91 (11.41)	3.91 (11.41)
5	Spraying of Fipronil SC @ 5% at 15 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.54 (4.21)	1.79 (7.68)	2.50 (9.07)	3.21 (10.32)	3.59 (10.92)	3.95 (11.44)	3.95 (11.44)	3.95 (11.44)
6	Spraying of Fipronil SC @ 5% at 30 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.72 (4.79)	1.25 (6.26)	1.95 (8.02)	1.96 (8.04)	2.31 (8.74)	2.85 (9.71)	2.85 (9.71)	2.85 (9.71)
7	Spraying of Fipronil SC @ 5% at 45 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.57 (4.34)	0.95 (5.34)	1.32 (6.59)	1.32 (6.59)	1.28 (6.47)	1.66 (7.33)	1.66 (7.33)	2.20 (8.53)	2.20 (8.53)	2.20 (8.53)
8	Spraying of Fipronil SC @ 5% at 60 DAS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.53 (4.19)	1.74 (7.57)	2.09 (8.27)	4.36 (12.05)	4.36 (12.05)	4.53 (12.29)	4.88 (12.76)	4.88 (12.76)	4.88 (12.76)
9	Unsprayed check (control)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.75 (4.92)	1.49 (6.81)	2.48 (9.05)	3.79 (11.20)	4.57 (12.33)	5.10 (13.03)	6.63 (14.89)	6.63 (14.89)	6.63 (14.89)
	SEM ±	0.00	0.00	0.00	0.03	0.31	0.59	0.68	0.57	0.55	0.52	0.54	0.54	0.54
	CD (P ≤0.05)	0.00	0.00	0.00	0.008	0.94	1.78	2.03	1.71	1.66	1.57	1.61	1.61	1.61
	CV%	0.00	0.00	0.00	9.05	20.75	17.47	16.29	11.11	9.89	8.88	8.49	8.49	8.49

\*Values in parentheses are arcsine transformed values

Table 3. Average thrips population at weekly interval on groundnut during *rabi* 2013-14.

S.No.	Treatment	4- January	11- January	18- January	25- January	1- February	8- February	15- February	22- February	1-March	8-March	15-March	22-March	29-March
1	Spraying of Imidacloprid SL @ 0.0053% at 15 (DAS)	3.13 (1.77*)	1.2 (1.09)	1.47 (1.21)	2.40 (1.52)	4.60 (2.14)	8.53 (2.92)	9.87 (2.11)	10.60 (3.25)	10.80 (3.28)	9.33 (3.05)	10.20 (3.19)	9.47 (3.07)	8.93 (2.99)
2	Spraying of Imidacloprid SL @ 0.0053% at 30 DAS	1.13 (1.06)	4.07 (2.01)	6.20 (2.49)	2.27 (1.65)	2.87 (1.69)	4.93 (2.19)	6.27 (2.10)	7.40 (2.71)	8.67 (2.93)	7.27 (2.69)	8.07 (2.81)	7.60 (2.73)	6.87 (2.61)
3	Spraying of Imidacloprid SL @ 0.0053% at 45 DAS	1.07 (1.00)	2.87 (1.69)	5.30 (2.30)	7.33 (1.61)	8.40 (2.89)	9.8 (3.12)	2.40 (1.84)	2.87 (1.64)	4.73 (2.16)	5.80 (2.39)	6.07 (2.44)	5.67 (2.38)	4.80 (2.19)
4	Spraying of Imidacloprid SL @ 0.0053 % at 60 DAS	0.53 (0.69)	2.27 (1.49)	4.27 (2.06)	6.27 (1.51)	7.45 (2.71)	10.87 (3.28)	11.27 (2.52)	12.33 (3.51)	7.47 (2.72)	7.73 (2.78)	6.93 (2.63)	7.80 (2.77)	6.67 (2.58)
5	Spraying of Fipronil SC @ 5% at 15 DAS	2.33 (1.52)	0.67 (0.75)	0.87 (0.89)	2.13 (1.45)	3.20 (1.76)	6.13 (2.45)	7.73 (2.09)	8.67 (2.93)	10.20 (3.18)	9.07 (3.01)	8.46 (2.91)	9.67 (3.10)	8.87 (2.98)
6	Spraying of Fipronil SC @ 5% at 30 DAS	1.53 (1.20)	4.00 (2.00)	4.47 (2.10)	1.87 (1.73)	2.73 (1.63)	4.53 (2.13)	6.73 (2.01)	7.10 (2.65)	9.67 (3.11)	8.93 (2.98)	12.27 (3.49)	10.60 (3.26)	8.93 (2.98)
7	Spraying of Fipronil SC @ 5% at 45 DAS	0.60 (0.74)	2.13 (1.45)	3.67 (1.90)	5.33 (1.55)	6.53 (2.52)	7.87 (2.79)	1.67 (1.96)	2.33 (1.52)	5.27 (2.29)	5.60 (2.34)	5.20 (2.28)	4.80 (2.19)	4.47 (2.09)
8	Spraying of Fipronil SC @ 5% at 60 DAS	0.80 (0.89)	3.13 (1.76)	4.13 (2.01)	5.20 (1.59)	7.40 (2.71)	9.27 (3.20)	10.67 (2.43)	11.60 (3.41)	6.07 (2.45)	7.20 (2.67)	7.73 (2.77)	8.07 (2.83)	7.67 (2.77)
9	Unsprayed check (control)	2.07 (1.43)	4.27 (2.06)	5.33 (2.31)	6.47 (2.41)	7.60 (2.75)	10.40 (2.96)	12.13 (3.20)	14.53 (3.81)	15.47 (3.92)	13.53 (3.68)	15.93 (3.99)	13.00 (3.59)	11.80 (3.42)
	S <sub>Em</sub> ±	0.14	0.13	0.15	0.15	0.17	0.20	0.18	0.18	0.18	0.17	0.18	0.17	0.14
	CD (P ≤ 0.05)	0.42	0.40	0.46	0.46	0.52	0.59	0.54	0.53	0.53	0.51	0.54	0.51	0.41
	CV%	21.13	14.72	13.97	13.21	12.91	12.27	11.85	10.80	10.55	10.31	10.59	10.29	8.61

\*Values in parentheses are arcsine transformed values

Table 4. Effect of chemicals on growth and yield characters in GBND and PSND affected groundnut during *rabi* 2013-14.

Treatments	Shoot length (cm)	Root length (cm)	Pods / Plant	Yield (kg ha <sup>-1</sup> )	100 seed weight (g)	Shelling percentage	B: C ratio
Imidacloprid SL @ 0.0053% at 15 DAS	19.27	9.50	13.27	1292.24	38.82	59.33 (50.42)	0.31
Imidacloprid SL @ 0.0053% at 30 DAS	25.31	9.53	14.93	1509.70	39.63	62.67 (52.38)	0.54
Imidacloprid SL @ 0.0053% at 45 DAS	28.17	10.01	15.93	1555.56	49.67	67.73 (55.42)	0.58
Imidacloprid SL @ 0.0053 % at 60 DAS	21.87	9.66	12.20	1216.93	41.21	57.33 (49.25)	0.24
Fipronil SC @ 5% at 15 DAS	20.05	9.12	13.13	1278.36	38.27	61.20 (51.50)	0.27
Fipronil SC @ 5% at 30 DAS	24.48	9.62	14.07	1448.84	36.43	64.27 (53.33)	0.44
Fipronil SC @ 5% at 45 DAS	27.83	9.91	15.40	1520.28	43.19	66.67 (54.88)	0.51
Fipronil SC @ 5% at 60 DAS	20.95	9.11	11.93	1259.26	41.40	56.67 (48.89)	0.25
Unsprayed check	18.83	8.56	10.93	1195.41	34.93	52.67 (46.55)	0.23
S Em <sub>±</sub>	1.36	0.59	0.66	84.42	2.36	1.80	
CD (P ≤ 0.05)	4.07	1.75 <sup>NS</sup>	1.99	253.07	7.08	5.41	
CV %	10.24	10.73	8.50	10.72	10.13	6.08	

Values in Parentheses are arcsine transformed values

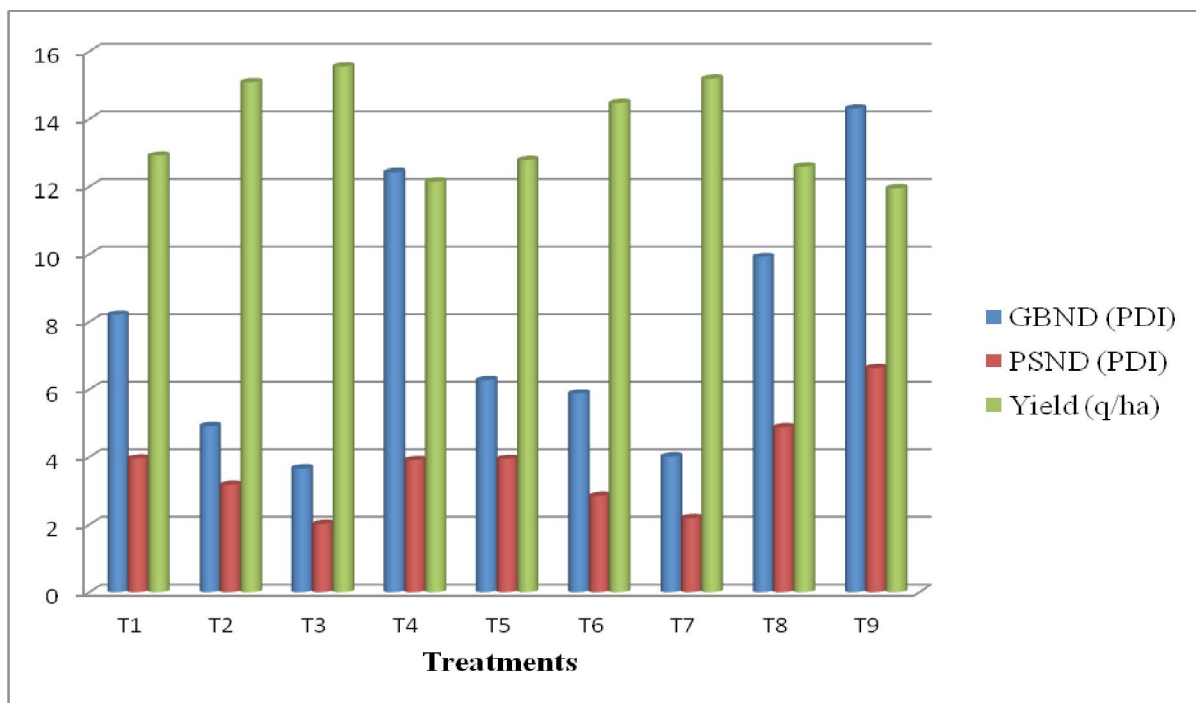


Fig 1. Effect of insecticides on incidence of GBND, PSND and dry pod yield during *rabi* 2013-14

Average thrips population per plant was recorded at week-days interval from 10 DAS to 10 days before harvesting. Shoot length, root length, number of pods per plant, dry pod yield, 100 seeds weight and shelling percentage and B:C ratio was calculated separately for each treatment after crop harvest.

## RESULTS AND DISCUSSION

Incidence of bud necrosis was least when sprayed with imidacloprid SL @ 0.0053% at 45 DAS (3.66%) and was on a par with fipronil SC @ 5% spray (4.02%) and imidacloprid SL @ 0.0053% (4.92%) at 45 DAS (Table 1 and Fig 1). Per cent disease incidence of stem necrosis was least when sprayed with imidacloprid SL @ 0.0053% at 45 DAS (2.02) and was on a par with fipronil SC @ 5% at 45 DAS (2.20) and fipronil SC @ 5% at 30 DAS (2.85) (Table 2 and Fig 1).

Average thrips population per plant was the lowest with spraying of fipronil @ 5% spray at 45 DAS (4.47) and was on a par with imidacloprid SL @ 0.0053% at 45 DAS (4.80). Spraying of imidacloprid @ 0.0053% at 45 DAS (4.80) was on a par with spraying of imidacloprid SL @ 0.0053% at 60 DAS (6.67) which was on a par with spraying of imidacloprid SL @ 0.0053% at 30 DAS (6.87), spraying of fipronil @ 5% at 45 DAS (4.47), spraying of Fipronil SC @ 5% at 15 DAS (8.87), spraying of fipronil SC @ 5% at 30 DAS (8.93) and Spraying of imidacloprid SL @ 0.0053% at 15 days after sowing (DAS) (2.99). Among all the treatments, unsprayed check) has registered significantly highest thrips population (11.80) (Table 3).

Chemical treatment to control GBND and PSND showed more shoot length in imidacloprid SL @ 0.0053% at 45 DAS (28.17 cm) followed by spraying of fipronil SC @ 5% at 45 DAS (27.83 cm), spraying of imidacloprid SL @ 0.0053% at 30 DAS (25.31 cm) and spraying of fipronil SC @ 5% at 30 DAS (24.48 cm). However, no significant difference in root length was observed among the treatments. Dry pod yield (1555.56 kg ha<sup>-1</sup>), number of pods per plant (15.93) and shelling percentage (67.73%) was highest in spraying of imidacloprid SL @ 0.0053% at 45 DAS and was on a par with spraying of fipronil SC @ 5% at 45 DAS, spraying of fipronil SC @ 5% at 30 DAS and spraying of imidacloprid SL @ 0.0053% at 30 DAS (Table 4).

100 seed weight was significantly higher in spraying of imidacloprid SL @ 0.0053% at 45 DAS (49.67 g) was on a par with spraying of fipronil SC @ 5% at 45 DAS (43.19 g) (Table 4 & Fig.1). Among the treatments, highest B:C (0.58) was obtained for imidacloprid SL @ 0.0053% at 45 DAS followed by spraying of imidacloprid SL @ 0.0053% at 30 DAS (0.54), spraying of fipronil SC @ 5% at 45 DAS (0.51), spraying of fipronil SC @ 5% at 30 DAS (0.44), spraying of imidacloprid SL @ 0.0053% at 15 DAS (0.31), spraying of fipronil SC @ 5% at 15 DAS (0.27), spraying of fipronil SC @ 5% at 60 DAS (0.25), spraying of imidacloprid SL @ 0.0053% at 60 DAS (0.24) and Unsprayed check (control) (0.23) (Table 4).

Sreekanth *et al.* (2003); Sreekanth *et al.* (2004) and Kumar and Williams (2013); have reported that imidacloprid 0.0035% seed treatment, followed by imidacloprid 0.008% foliar spray at 15, 30 and 45 days after sowing (DAS) exerted superior control of mungbean leaf curl incidence and T. palmi population during kharif and rabi seasons which is in accordance with the investigation reports. Present results were also in concurrence with the investigation report of Prasadarao *et al.* (2003) that the seed treatment with imidacloprid followed by regular spraying of systemic insecticide at early stages of the groundnut crop has effectively controlled PSND. Sunkad and Naik (2013) reported the significance of systemic insecticides in the control of disease transmitting vectors. Thiribhuvanamala *et al.* (2013) reported the management of vector with imidacloprid (0.0375%) at the initial stages that contributed for reduction in vector population, PDI of GBND (3.4%) in tomato crop which in turn increased the yield with B:C ratio of 2.3.

Studies on GBND and PSND management have revealed that the crop could be protected from heavy losses by spraying of insecticides like imidacloprid SL @ 0.0053% at 45 DAS and fipronil SC @ 5% at 45 DAS through vector control. Spraying of these two insecticides at 45 DAS could effectively influence the shoot length, number of pods per plant, dry pod yield, 100 seeds weight, shelling percentage and B:C ratio. Insecticidal protection was found to be more economical if the applications were timed at 45 DAS which coincide with the peak vector activity.

## LITERATURE CITED

- Black L M 1954** Parasitological Reviews: Arthropod transmission of plant viruses. *Experimental Parasitology*, 3: 72-104.
- Kumar V M and Williams P 2013** Evaluation of chemicals for control of mungbean leaf curl and its vector *Thrips palmi* Karny in Allahabad district of Uttar Pradesh. *The Andhra Agricultural Journal*, 60: 89-93.
- Lavakumar P, Prasadarao R D V J, Reddy A S, Madhavi J, Anitha K and Waliyar F 2008** Emergence and spread of *Tobacco Streak Virus* menace in India and control strategies. *Indian Journal of Plant Protection*, 36: 1-8.
- Prasadarao R D V J, Reddy A S, Waliyar F, Sreenivasulu P and Lavakumar P 2004** Peanut Stem Necrosis. In: *Methods manual on Serological and Neucleic Acid Based Methods for the Detection of Plant Viruses*, ICRISAT Asia Centre, India. 20-25.
- Reddy A S, Prasadarao R D V J, Thirumaladevi K, Reddy S V, Mayo M A, Roberts I, Satyanarayana T, Subramaniam K and Reddy D V R 2002** Occurrence of *Tobacco Streak Virus* on peanut (*Arachis hypogaea* L.) in India. *Plant Disease*, 86: 173.
- Reddy A S, Ratna A S, Vijayalakshmi K, Rangarao G V, Naidu R A and Wightman J A 1995** Peanut Bud Necrosis Disease: An Overview. In *Proceedings of a Meeting on Recent Studies on Peanut Bud Necrosis Disease*, 20 Mar 1995, ICRISAT Asia Center, India. 3-8.
- Sreekanth M, Sriramulu M, Prasadarao R D V J, Babu B S and Babu T R 2003** Relative efficacy and economics of different imidacloprid schedules against *Thrips palmi* (Karny), the vector of *Peanut Bud Necrosis Virus* on mungbean (*Vigna radiata* L. Wilczek). *Indian Journal of Plant Protection*, 31: 43-47.
- Sreekanth M, Sriramulu M, Prasadarao R D V J, Babu B S and Babu T R 2004** Evaluation of certain new insecticides against *thrips palmi* (karny), the vector of *Peanut Bud Necrosis Virus* (PBNV) on mungbean (*Vigna radiata* l. wilczek). *International Pest Control*, 46: 315-317.
- Sunkad G and Naik M K 2013** Effect of peanut bud necrosis disease (PBNB) on growth and yield parameters of groundnut at different stages of infection. *Indian Phytopathology*, 66: 406-407.
- Thiribhuvanamala G, Murugan M, Jayalakshmi V, Manoranjitham S K, Devi P R and Rabindran R 2013** Strategic approaches for the management of *Peanut Bud Necrosis Virus* disease of tomato. *Pest Management in Horticultural Ecosystems*, 19: 67-72.

(Received on 18.03.2015 and revised on 14.10.2015)