Chemical and botanical management of leaf crinkle virus disease of greengram

C.H. Punith Kumar, * B.K. Lokesh, M.K. Naik, **M.R. Govindappa, G.R. Guru Prasad ***D.C. Anitha and ****Chandrashekara

ABSTRACT

Greengram is grown mainly as a *Kharif* season crop which suffers from several diseases caused by both fungi and viruses. Among the viral diseases, leaf crinkle is an important disease that infects the crop at various stages of its growth which reduces both quantity and quality of the seed. Effective management of insect vectors of plant pathogens is of crucial importance in minimizing vector-borne diseases in crops. Among the various treatments tested for managing the leaf crinkle virus disease, seed treatment with imidacloprid 60 FS (5 ml/kg) along with two sprays of imidacloprid 17.8 SL (0.03%) at 25 and 40 days after sowing was found highly effective and recorded the lowest per cent disease incidence and least number of aphids.

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INTRODUCTION

Greengram is grown mainly as a *Kharif* season crop. However, its cultivation in *Rabi* season isrestricted to the eastern and southern parts of the country. The major greengram growing states areOrissa, Maharashtra, Andhra Pradesh, Rajasthan, Karnataka and Gujarat. It ranks third among allpulses grown in India after chickpea and pigeonpea. In India the total production of greengram is 10.34lakh tons from an area of 28.19 lakh ha with a productivity of 420 kg ha^{-1} (Anonymous, 2012). The Hyderabad Karnatakaarea particularly Bidar Yadgir and Gulbarga districts have an extensive cultivated area of greengram, pigeonpea and bengalgram. Hence, these regions are called "Pulse bowl" of Karnataka. In Karnataka, it occupies an area of 3.98 lakh ha with a production of 0.85lakh tons and an average yield of 206kg per ha (Anonymous, 2012).

Greengram suffers from several diseases caused by both fungi and viruses. Among the viral diseases, leaf crinkle is an important disease that infects the crop at various stages of growth, reducing both the quantity and the quality of the seed. This disease has become one of the major production constraints in greengram especially during *Kharif* and *Rabi* seasons. The disease can cause crop losses to an extent of 94 per cent depending on the season and the variety cultivated (Kadian, 1980).

Williams *et al.* (1968) first reported the occurrence of the leaf crinkle on blackgram and greengram from the states of Delhi and Uttar Pradesh in India. Leaf crinkle virus is an unclassified virus, seed borne, with narrow host range and is aphid transmitted ssRNA virus (Ashfaq *et al*., 2007).

The first recognisable symptom of the disease under natural conditions appeared on the second trifoliate leaf of greengram which turned light green at 18 days after sowing (DAS). Around 25 DAS, crinkling appeared in addition to enlargement of trifoliate which became more pronounced with age. First and second trifoliate leaves did not show any enlargement, but crinkling with enlargement of leaves was more visible in the third succeeding trifoliate. As the infected plants grow older, extreme crinkling and rugosity on the older trifoliate appear to diminish, crinkling on younger trifoliate remain. Around 30 days after the first appearance of the symptoms, tips of the affected leaflets especially in 4^{th}, 5^{th} and 6^{th} trifoliate curve downwards. The petiole of the lamina touched the surface of the lower leaflets on either side. Thus the affected plants remain stunted giving a bushy appearance.

Effective management of insect vectors of plant pathogens is of crucial importance in minimizing

vector-borne diseases in crops. Insecticides play an important role in managing vector populations by reducing the number of individuals that can acquire and transmit a virus, thereby potentially lowering disease incidence. Certain insecticides also play a role in protecting crop plants by virtue of their anti-feedant properties that interfere with virus transmission. Studies on efficacy of these insecticides help to know which insecticides could effectively control the vector population and disease incidence of leaf crinkle virus, its effect on grain yield and cost benefit ratio as compared to other ones. These studies would help to control the disease with least expenses.

MATERIALS AND METHODS

To know the effectiveness of different management practices against LCV, a field experiment was conducted at College of Agriculture inBheemarayanagudi during 2012-2013 in a Randomized Block Design (RBD) with three replications.The sowings were taken on in the first week of July with a spacing of 30 x 10 cm during *Kharif* season. The trail was laid with different treatments and their combinations in the field under natural epiphytotic condition. Recommended agronomic practices were followed.

The following treatments were imposed individually with three replications following RBD. The treatments details include, T_1- Seed treatment with Imidacloprid60 FS (Gaucho ® at 5 ml/kg of seeds), T_2- Seed soaking with Cow urine @ 2.0%, T_3 - T_1 + Two sprays with Imidacloprid 17.8 SL @ 0.03% ,T_4 - T_1 + Two sprays with Cow urine @ 2.0%, T_5 -T_1+ Two sprays with Azadiractin 1500 ppm @ 3 ml/lit, T_6 - T_1 + Two sprays with Profenophos 50EC @ 2 ml /lit, T_7 -T_2+ Two sprays with Imidachloprid 17.8 SL @ 0.03%, T_8 - T_2+ Two sprays with Cow urine @ 2.0%, T_9 -T_2+ Two sprays with Azadiractin 1500 ppm @ 3 ml/lit, T_{10} -T_2+ Two sprays with Profenophos 50 EC @ 2 ml/lit, T_{11} –control.

Incidence of leaf crinkle virus disease was calculated by counting the number of plants infected and total number of plants in a plot by the using following formula.

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

RESULTS AND DISCUSSION

During the studies, the crinkle disease incidence varied from 7.83 to 9.08 per cent before the imposition of first sprays (Table 1). The experimental results revealed that after first spray, the plot imposed with imidacloprid as seed treatment along with imidacloprid spray at 25 and 40 DAS (T_3) recorded significantly lower disease incidence followed by (T_7) cow urine seed treatment with two sprays of imidacloprid 17.8 SL at 25 and 40 DAS showed lower disease incidence. The next best treatments were seed treatment with imidacloprid along with two sprays of profenopho (T_6) which was followed by cow urine seed treatment with two sprays of profenophos (T_{10}). In control plot disease incidence was 33.63 per cent.

Fifteen days after second spray, Imidacloprid seed treatment plot with two sprays of imidacloprid at 25 and 40 days (T_3) showed the lowest per cent of disease incidence of 19.84, followed by cow urine seed treatment along with two sprays of imidacloprid with 21.70 per cent disease incidence. The seed treatment with imidacloprid along with two sprays of profenophos (T_6) emerged as next best treatment with the per cent disease incidence of 25.43, when compared to control plot was recorded 48.77 per cent crinkle disease incidence.

At the end of the experimental period there was significantly the lowest mean disease incidence of 14.44 per cent recorded in imidacloprid seed treatment plot along with two sprays of imidacloprid at 25 and 40 DAS (T_3) which is followed by (T_7) cow urine seed treatment with two sprays of imidacloprid 17.8 SL,seed treatment with imidacloprid along with two sprays of profenophos (T_6), cow urine seed treatment along with two sprays of profenophos (T_{10}), seed treatment with imidacloprid along with two sprays of azadiractin (T_5) and cow urine seed treatment with two sprays of azadiractin (T_9) have been recorded with a mean incidence of 15.50, 18.43, 19.27, 23.23 and 24.45 per cent in order of their effectiveness, whereas in control plotdisease incidence is 30.49 per cent (Table 1).

Seed treatment with imidacloprid along with two sprays of imidacloprid at 25 and 40 DAS (T_3) showed the highest - 52.64 per cent reduction over control followed by seed treatment with cow urine along with two sprays of imidacloprid at 25 and 40

Table 1. Effect of chemicals and botanicals on leaf crinkle virus disease incidence of greengram during *Kharif* 2012

Treatment No.	Treatment details	Before sprays	15 days after first spray	15 days after Second spray	Mean	Percent reduction over control
T_1	Seed treatment with Imidacloprid 60 FS (Gaucho ® at 5 ml /kg of seeds)	8.51	30.22	41.03	26.59	12.79
T_2	Seed soaking with Cow urine @ 2.0%	8.22	31.33	44.67	28.07	7.93
T_3	T_1 + Two sprays with Imidacloprid 17.8 SL @ 0.03%	8.05	15.43	19.84	14.44	52.64
T_4	T_1 + Two sprays with Cow urine @ 2.0%	8.14	29.91	39.45	25.84	15.25
T_5	T_1+ Two sprays withAzadiractin 1500 ppm @ 3 ml/lit	8.33	27.05	34.30	23.23	23.81
T_6	T_1 + Two sprays withProfenophos 50EC @ 2 ml /lit	8.40	21.44	25.43	18.43	39.55
T_7	T_2+ Two sprays with Imidachloprid 17.8 SL @ 0.03%	8.05	16.74	21.70	15.50	49.16
T_8	T_2+ Two sprays with Cow urine @ 2.0%	8.14	30.51	39.98	26.21	14.03
T_9	T_2+ Two sprays withAzadiractin 1500 ppm @ 3 ml/lit	8.19	28.49	36.69	24.45	19.8
T_{10}	T_2+ Two sprays with Profenophos 50 EC @ 2 ml/lit	7.83	22.60	27.38	19.27	36.79
T_{11}	Control	9.08	33.63	48.77	30.49	
	S.Em±	0.36	0.35	0.38		
	C D at 5%	NS	1.04	1.11		

*Sprays were given at 25 and 40 days after sowing

DAS (T_7) with 49.16 per cent reduction. The least reduction of 7.93 per cent of crinkle disease incidence over control was found in seed soaking with cow urine @ 2.0 per cent.

Benefit cost Ratio

Benefit cost ratio for management of greengram crinkle virus disease was significantly influenced by a combination of botanicals and chemicals. The plot seed treatment with cow urine along with two sprays of imidacloprid recorded significantly higher B:C ratio, however, it was found to be on par with the seed treatment with imidacloprid along with two sprays of imidacloprid, which was followed by seed treatment with imidacloprid along with two sprays of profenophos and the lowest benefit cost ratio was recorded in untreated control (Table 2). Among the various treatments tested for managing the leaf crinkle virus disease, the seed treatment by imidacloprid along with two sprays of imidacloprid was found highly effective and recorded the lowest per cent disease incidence and least number of aphids (7.0 aphids per plant at five days after first spray and 5.7 aphids per plant five days after second spray). This consequently led to light incidence of leaf crinkle virus at 40 days after planting (15.43%) and 55 days after planting (Table 3). The efficacy of imidacloprid for the management of aphids was earlier reported by Mote *et al*. (1993), Jarante and Dethe (1994), Dandale *et al*. (2001).

Table 2. Benefit Cost (B:C) ratio for the management of leaf crinkle virus disease of greengram under field conditions during *Kharif* 2012

Treatment No.	Treatment details	Yield (q/ha)	Cost of production (Rs.)	Treatment cost (Rs.)	Total cost (Rs.)	Gross return (Rs.)	Net profit (Rs.)	B : C ratio
T_1	Seed treatment with Imidacloprid 60 FS (Gaucho ® at 5 ml /kg of seeds)	8.12	14911	1125	16036	28420	12384	1.77
T_2	Seed soaking with Cow urine @ 2.0%	6.53	14911	-	14911	22867	7956	1.53
T_3	T_1 + Two sprays with Imidacloprid 17.8 SL @ 0.03%	11.57	14911	1625	16536	40483	23947	2.45
T_4	T_1 + Two sprays with Cow urine @ 2.0%	7.63	14911	1125	16036	26717	10681	1.67
T_5	T_1+ Two sprays with Azadiractin 1500 ppm @ 3 ml/lit	9.54	14911	1885	16796	33390	16594	1.99
T_6	T_1 + Two sprays with Profenophos 50EC @ 2 ml /lit	10.63	14911	1725	16636	37217	20581	2.24
T_7	T_2+ Two sprays with Imidachloprid 17.8 SL @ 0.03%	11.08	14911	500	15411	38768	23357	2.52
T_8	T_2+ Two sprays with Cow urine @ 2.0%	7.02	14911	-	14911	24570	9659	1.65
T_9	T_2+ Two sprays with of Azadiractin 1500 ppm @ 3 ml/lit	8.60	14911	760	15671	30100	14429	1.92
T_{10}	T_2+ Two sprays with Profenophos 50 EC @ 2 ml/lit	10.23	14911	600	15511	35817	20306	2.31
T_{11}	Control	6.13	14911	-	14911	21467	6556	1.44
	S.Em±	0.85						
	C D at 5%	2.51						

In the present study foliar application of the organophosphorous insecticide *i.e*., Profenophos 50 EC at 2 ml/ lit was effective next to the imidachloprid 17.8 SL at 0.03 per cent in reducing the disease incidence and also increasing the yield and yield parameters of greengram. The results are in agreement with several researchers who reported organophosphorous insecticides to reduce non persistently aphid transmitted viruses such as PVY in potatoes, tobacco etch and tobacco vein mottling viruses in tobacco, bean yellow mosaic virus in lupins and cucumber mosaic virus in narrow leafed lupins (Broadbent *et al*., 1956, Lobenstein and Raccah, 1980; Pirane *et al*., 1988; Bwye *et al*., 1997).

Seed treatment of imidacloprid followed by two sprays of azadiractin 1500 ppm at 3 ml/lit and seed treatment with cow urine followed by two sprays of azadiractin were moderately effective by recording an incidence of 27.05 and 36.69 per cent at 15 days after first spray, while 34.30 and 36.69 per cent of crinkle incidence observed at 15 days after second spray. Lower aphids count of 9.67 and 11.33 per plant at five days after first spray and 16.7 and 18.3 aphids per plant at five days after second spray was

Table 3. Effect of different chemicals and botanicals on vector population in greengram during *kharif* 2012 under field condition

Treatment No.	Treatment details	Average number of aphids on three top leaves/Plant					
		First spray at 25 DAS			Second spray at 40 DAS		
		1 DBS	5 DAS	Per cent reduction over control	1 DBS	5 DAS	Per cent reduction over control
T_1	Seed treatment with Imidacloprid 60 FS (Gaucho ® at 5 ml /kg of seeds)	14.53	15.87	31.97	24.67	30.3	17.43
T_2	Seed soaking with Cow urine @ 2.0%	16.10	15.07	35.40	30.33	36.0	1.90
T_3	T_1 + Two sprays with Imidacloprid 17.8 SL @ 0.03%	15.17	7.00	69.99	14.33	5.7	84.4
T_4	T_1 + Two sprays with Cow urine @ 2.0%	15.33	16.00	31.41	25.00	23.0	37.3
T_5	T_1 + Two sprays with Azadiractin 1500 ppm @ 3 ml/lit	14.23	9.67	58.55	20.33	16.7	54.4
T_6	T_1 + Two sprays with Profenophos 50EC @ 2 ml /lit	15.83	9.50	59.27	18.00	10.0	72.75
T_7	T_2 + Two sprays with Imidachloprid 17.8 SL @ 0.03%	14.20	9.00	61.42	14.67	6.7	81.74
T_8	T_2 + Two sprays with Cow urine @ 2.0%	15.90	17.00	27.13	28.00	28.0	23.70
T_9	T_2 + Two sprays with Azadiractin 1500 ppm @ 3 ml/lit	15.47	11.33	51.43	21.00	18.3	50.13
T_{10}	T_2 + Two sprays with Profenophos 50 EC @ 2 ml/lit	15.10	11.00	52.85	19.00	11.0	70.02
T_{11}	Control	16.23	23.33		31.00	36.7	
	S.Em±	1.11	0.34		0.49	0.23	
	C D at 5%	3.27	1.0		1.47	0.67	

observed. The results of the present study were supported by Roychaudhary and Jain (1996) who studied the effect of neem oil sprays on aphids and reported that it is more toxic to nymphs, causing 100 per cent mortality than to the adult stage in which it causes 60 to 98 per cent mortality. Chandrashekhar and Balsubramanian (2002) reported higher percentage of reduction in aphid population and yellow mosaic virus disease incidence in greengram due to foliar spray of neem oil 60 EC at 3 per cent. Similar results with regard to ULCV disease incidence were recorded in neem oil treated plot by Ravindra Babu (1987). Similarly Baniyamin *et al*. (2011) reported that the minimum ULCV disease incidence and vector population was observed on plants sprayed with neem (2.0%) followed by akk (2.52%). Kannan and Doraiswamy (1993) noticed reduction in cowpea mosaic with one per cent emulsion of *Azardictina indica* and increased the yield up to 890 kg. Neem oil was presumed to contain antifeedant and repellent properties. Verma (1974) identified two compounds *viz.*, nimbidin and nimbin in neem oil which inhibited local lesion formation.

In the present study, the seed treatment with imidacloprid followed by two sprays of imidacloprid drastically reduced the spread of leaf crinkle virus disease and significantly increased yields compared to control plot. This may be attributed to the superior knockdown activity of imidacloprid which has a systemic as well as contact effect and it is a second generation nicotinic

acetylcholine receptor, which acts on the central nervous system of aphids and causes paralysis leading to death of aphids (Jhangir Shah *et al*., 2007).

Studies on management of leaf crinkle virus disease proved the superiority of insecticidal spray in controlling aphid vector over all other management practices. Therefore instead of using imidacloprid for seed treatment it is advisable to shift to this type of natural (cow urine) cost effective and eco-friendly formulation provided.

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REFERENCES

Anonymous. 2004. Recommended dietary allowance for Indians. *Survey of Indian Agriculture,* Pub. *The Hindu***, PP**. 54.

Anonymous. 2012. Area Production and Productivity of mungbean in India. Ministry of Agriculture, Government of India.

Ashfaq, M., Ashlam Khan, M., Mughal, S. M., Javed, N., Tariq, M. and Bashir, M. 2007. Evaluation of urdbean germplasm for resistance against urdbean leaf crinkle virus. *Pakistan Journal of Botany,* **39**(6): 2013-2111.

Broadbent, L. 1957. Insecticidal control of the spread of plant viruses. *Review of Entomology,* **2**: 339-354.

Bwye, A. M., Proudlove, W., Birlandier, F. A. and Jones, R. A. C. 1997. Effects of applying insecticides to control aphid vectors and cucumber mosaic virus in narrow Leafedlupins (*Lupinusangustifolius*). *Australian Journal of Experimental Agriculture*, **37**: 93-102.

Chandrasekharan, M. and Balasubramanian, G. 2002. Evaluation of plant products and insecticides against sucking pests of greengram. *Pestology,* **26**(1): 48-50.

Dandale, H. G., Thakare, A. Y., Tikar, S. N., Rao, N. G. V. and Nimbalkar, S. A.2001. Effect of seed treatment on sucking pests of greengram and yield of seed. *Pestology*, **25**(3): 20-23.

Jahangir Shah, M., Amir Ahmad, Mumtaz Hussain, Malik M. and Bashir Ahmad, 2007. Efficiency of different insecticides against sucking insect-pest complex and effect on the growth and yield of mungbean (*Vignaradiata*). *Pakistan Journal of Entomology*, **29**(2): 83-86.

Jarande, N. T. and Dethe, M. D. 1994.Imidacloprid for effective control of sucking pests of cowpea, *Pestology*, **18**(12): 15-18.

Kadian, O. P. 1980. Studies on leaf crinkle disease of urdbean [*Vignamungo* (L.) Hepper], mungbean [*Vignaradiata* (L.) Wilczek] and its control. *Ph. D. Thesis*, Haryana Agricultural University, Hisar, **PP.** 117.

Kannan, N. R. and Doraiswamy, S. 1993. Management of cowpea aphid borne mosaic virus (CAMV) using plant products. *Madras Agricultural Journal*, **80**(7): 393-395.

Lobenstein, G. and Raccah, B. 1980. Control of non- persistently transmitted aphid borne viruses. *Phytoparastica*, **8**: 221-235.

Pirane, T. P., Raccah, B. and Madden, L. V. 1988. Suppression of aphid colonization by insecticides on the incidence of potyviruses in tobacco. *Plant Diseases*, **72**: 350-353.

Roy Choudhury, R. and Jain, R. K. 1996.Neem for the control of aphid and whitefly vectors and

virus diseases of plants. *In Neem and Environment*. **PP.** 763-769.

Williams, F. J., Grewal, J. S. and Amin, K. S. 1968. Serious and new disease of pulse crops in Indian in 1966. *Plant Diseases,* **52**: 300-304.

C.H. Punith Kumar[1], * B.K. Lokesh, M.K. Naik, **M.R. Govindappa, G.R. Guru Prasad ***D.C. Anitha and ****Chandrashekara

Department of Plant Pathology, University of Agricultural Sciences, Raichur, Karnataka

*Department of Plant Pathology, University of Agricultural Sciences, Dharwad, Karnataka

**Department of Plant Pathology, MARS, UAS Raichur, Karnataka,

***Department of Crop Physiology, University of Agricultural Sciences, Dharwad,

****Department of Entomology, University of Agricultural Sciences, Raichur, Karnataka

[1]Communication author

Email: punith3057@gmail.com