INTERNATIONAL JOURNAL OF PLANT PROTECTION
VOLUME 10 | ISSUE 2 | OCTOBER, 2017 | 275-280

● e ISSN-0976-6855 | Visit us : *www.researchjournal.co.in*

IJPP

RESEARCH PAPER

DOI : 10.15740/HAS/IJPP/10.2/275-280

Bioefficacy of neonicotinoid insecticide as seed treatment against early sucking pests of soybean crop

■ S.K. MISHRA*, VIKAS GUPTA AND R.K. SARAF

Dryland Horticulture Research and Training Centre, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Garhakota, SAGAR (M.P.) INDIA

ARITCLE INFO

Received : 05.07.2017
Revised : 10.08.2017
Accepted : 22.08.2017

KEY WORDS :
Bioefficacy, Neonicotinoid, Imidacloprid, Thiamethoxam, Sucking pests, Seed treatment, Soybean

*Corresponding author:
Email : mishradhrtc@gmail.com

ABSTRACT

A field experiment was conducted at JNKVV, DHRTC farm during 2014 and 2015 to evaluate the effectiveness of imidacloprid and Thiamethoxam, used as seed treatment against the sucking pests of soybean crop. In this experiment numbers of sucking pests were counted at seven days interval starting from 20 days of sowing till five weeks after first observation. The number of jassids and white flies were counted from top three and two middle leaves of randomly selected 5 plants in each plot. The whitefly population was comparatively higher than that of jassids. The overall effect of insecticidal treatments at all the six intervals on sucking pest population revealed that all the treatments were found effective in comparison to untreated check. The treatment of Imidacloprid 600 FS @ 1.50 g. a.i. /kg seed followed by Imidacloprid 600 FS @ 0.75 g. a.i. /kg seed was found most effective against the early sucking pests on soybean. The treatment of Thiamethoxom 70 % WS @ 2g/kg seed was least effective against the sucking pests. All the insecticidal treatments increased the yield of soybean seed significantly over the control. The highest seed yield was obtained from the treatment of imidacloprid 600 FS @ 1.50 g. a.i. /kg seed.

How to view point the article : Mishra, S.K., Gupta, Vikas and Saraf, R.K. (2017). Bioefficacy of neonicotinoid insecticide as seed treatment against early sucking pests of soybean crop. *Internat. J. Plant Protec.*, **10**(2) : 275-280, **DOI : 10.15740/HAS/IJPP/10.2/275-280**.

INTRODUCTION

Soybean is a major oil seed crop of world grown in an area of 103.29 million hectares with production of 251.47 million tonnes and productivity of 2430 kg/ha (Anonymous, 2012). It is now the second largest oilseed crop in India after groundnut. In the world it is cultivated mainly in USA, China, Brazil, Argentina and India. In India, it is grown over an area of 10.02 million hectares with production of 11.64 million tones and productivity of 1161 kg/ha (Anonymous, 2015). The average productivity of soybean crop is quite low due to a number of abiotic and biotic stresses, e.g. non-adoption of improved technology and cultivation in marginal lands having low fertility. In addition, the insect-pests and diseases also cause heavy damage to the yield potential of soybean crop. The soybean crop is damaged at various

Table A : List of test insecticides against early sucking pest on soybean

Treatment No.	Treatment details	Dose g/kg seed
T_1	Thiamithoxam 70% WS	2 g
T_2	Thiamithoxam 70 %WS	4 g
T_3	Imidaclorprid 600 FS (Gaucho 600 FS)	0.45 g
T_4	Imidaclorprid 600 FS (Gaucho 600 FS)	0.6 g
T_5	Imidaclorprid 600 FS (Gaucho 600 FS)	0.75 g
T_6	Imidaclorprid 600 FS (Gaucho 600 FS	1.5 g
T_7	Untreated check	-

stages of plant growth by a number of insect-pests *viz.*, jassid (*Amrasca biguttula* Ishida), white fly (*Bemisia tabaci* Genn.), girdle beetle (*Oberia brevis* S.), tobacco caterpillar (*Spodoptera litura*), green semilooper (*Plusia orichalcea* Fab.), Pod borer (*Helicoverpa armigera* Hub.) etc. The chemical control via soil / foliar application has its limitation such as high cost, selectivity, affect on target organisms, development of pest resistance, resurgence of pests, pollution of food and feed, health hazards, toxicity towards plants and animals, environmental pollution etc. (Rahman *et al*., 2008). To overcome these problems, it has now become imperative to minimize the use of insecticides for controlling the pest by way of adoption of other methods like seed treatment. Seed treatment is a highly progressive and demandable technology for management of various crop pests (Taylor *et al*., 2001 and Magalhaes *et al*., 2009). Neonicotinoids have high activity against sucking insects such as aphids and against chewing pests such as beetles and some Lepidoptera (cutworms, for instance). These chemicals are highly systemic in the plant roots and new leaf tissues and can be used for several purposes, especially as seed treatment. Seed treatment refers to the exposure of the seeds to certain agents physical, chemical or biological which are not employed to make the seeds, pest or disease free only but treated to provide the possibility of pest and disease control also, when needed during germination and emergence of young plant and early growth of the plant (Forsberg *et al*., 2003). Seed treatments have played and are still playing a pivotal role in sustainable crop production which is also evidenced from the history of mankind. Keeping this in view, study were undertaken to test the bio-efficacy of neonicotinoid insecticides (imidacloprid and thiamethoxam) as seed treatment against early sucking pest of soybean crop.

MATERIAL AND METHODS

The field experiment was laid out during the year 2014 and 2015 in a Randomized Block Design with three replication having plot size of 5 x 5 m at JNKVV, DHRTC Farm, Garhakota, district- Sagar (M.P.). The cultivar JS-335 were sown on 28th June, 2014 and 30th June, 2015 with all the recommended packages of practices were followed in establishing plants. Different treatment comprising of seven insecticides including untreated check were used as seed treatment against sucking pests of soybean (Table A). 1 ml of product was mixed in 5 ml of water and this product slurry was distributed over the walls of a plastic bag. Seeds were placed in the container which was sealed and shaken for 3 minutes to coat seed uniformly with the insecticide slurry. The seeds were than placed in paper towels and allowed to air dry before sowing. The observations on numbers of sucking pests were counted at seven days interval starting from 20 days of sowing till five weeks after first observation. The number of jassids and white flies were counted from top three and two middle leaves of randomly selected 5 plants in each plot.

RESULTS AND DISCUSSION

Study was carried out during the *Kharif* season of 2014 and 2015 at JNKVV, DHRTC farm to evaluate the bio- efficacy of Imidacloprid 600 FS and Thiamethoxom 70 WS as seed treatment against incidence of sucking pests (jassids + white fly) at the early growth stage of the crop. Sucking pest complex is a serious menace for soybean production, therefore, different doses of Imidacloprid and Thiamethoxom along with standard check. Observation recorded from 2-3 leaf stage at weekly interval for 35-40 days. Observations recorded comprised of nymph and adult count on five leaves (top 3 and middle 2 leaves per plant) from

randomly selected five plants per plot. Data presented in Table 1 and Table 2 for first observation on twenty five days after seed treatment indicated that all the insecticidal treatment were significantly superior over the untreated control. However, the significant difference existed among the treatments. The sucking pest

Table 1 : Efficacy of insecticides as seed treatment against sucking pests of soybean during 2014

Treatments	Dosage	Mean population of sucking pests (Jassids and white fly)							
		22-7-2014	29-7-2014	5-8-2014	12-8-2014	19-8-2014	26-8-2014	Seasonal mean	Yield q/ha.
Thiomethoxom	2ml/kg	8.25	11.25	14.50	17.75	14.10	16.60	13.74	12.10
70%WS		(2.95)	(3.42)	(3.87)	(4.27)	(3.82)	(4.13)		
Thiomethoxom 70%	4ml/kg	8.10	11.15	14.30	17.50	14.30	15.90	13.54	12.50
WS		(2.93)	(3.41)	(3.84)	(4.24)	(3.84)	(4.04)		
Imidacloprid 600 FS	0.45g	6.55	10.80	13.00	15.05	13.80	10.30	11.58	13.80
		(2.65)	(3.36)	(3.67)	(3.94)	(3.78)	(3.28)		
Imidacloprid 600 FS	0.60g	6.00	6.60	9.80	11.25	10.90	8.80	8.89	14.70
		(2.54)	(2.66)	(3.20)	(3.42)	(3.37)	(3.04)		
Imidacloprid 600 FS	0.75g	3.35	5.40	5.85	6.70	8.00	7.50	6.13	16.15
		(1.96)	(2.42)	(2.51)	(2.68)	(2.91)	(2.82)		
Imidacloprid 600 FS	1.50g	3.10	5.25	5.60	6.30	8.30	7.20	5.95	17.10
		(1.89)	(2.39)	(2.46)	(2.60)	(2.96)	(2.77)		
Untreated control	-	10.15	14.05	16.90	18.70	15.60	18.10	15.58	11.40
		(3.26)	(3.81)	(4.17)	(4.38)	(4.01)	(4.31)		
S.E. ±		0.013	0.014	0.006	0.008	0.009	0.007		0.036
C.D. (P=0.05)		0.040	0.043	0.018	0.024	0.029	0.020		0.111

*Average mean of three replications Figure in parentheses are $\sqrt{x+0.5}$ transformed values

Table 2 : Efficacy of insecticides as seed treatment against sucking pests of soybean during 2015

Treatments	Dosage	*Mean population of sucking pests (Jassids and white fly)							
		20-7-015	27-7-2015	3-8-2015	10-8-2015	17-8-2015	24-8-2015	Seasonal mean	Yield q/ha.
Thiomethoxom 70% WS	2g/kg	9.75	12.35	14,20	11.25	13.60	13.90	12.37	13.05
		(4.47)	(3.58)	(3.83)	(3.42)	(3.75)	(3.79)		
Thiomethoxom 70% WS	4g/kg	9.50	11.55	14.05	10.60	12.15	12.70	11.89	13.40
		(3.16)	(3.47)	(3.81	(3.33	(3.55)	(3.63)		
Imidacloprid 600 FS	0.45	8.00	11.05	13.70	10.10	11.90	12.30	11.17	14.10
		(2.91)	(3.39)	(3.76	(3.25	(3.52)	(3.57)		
Imidacloprid 600 FS	0.60	7.80	8.30	12.60	9.70	11.30	11.80	10.25	14.80
		(2.88)	(2.96)	(3.61)	(3.19)	(3.43)	(3.50)		
Imidacloprid 600 FS	0.75	4.35	7.80	11.50	9.40	10.20	11.15	9.15	16.25
		(2.20	(2.88)	(3.46)	(3.14)	(3.27)	(3.41)		
Imidacloprid 600 FS	1.50	3.85	6.40	9.90	8.30	10.70	10.90	8.25	17.20
		(2.08)	(2.62)	(3.22)	(2.96)	(3.34)	(3.37)		
Untreated control	-	11.45	12.90	14.50	12.50	14.40	16.30	13.67	12.60
		(3.45)	(3.66)	(3.87)	(3.60)	(3.86)	(4.09)		
S.E.±		0.006	0.022	0.005	0.007	0.016	0.022		0.106
C.D. (P=0.05)		0.017	0.067	0.015	0.020	0.049	0.070		0.034

*Average mean of three replications Figure in parentheses are $\sqrt{x+0.5}$ transformed values

population ranged from 3.10 to 10.15 and 3.85 to 11.45 per plant during *Kharif* 2014 and 2015, respectively. The minimum number of sucking pests was recorded in treatment of Imidacloprid 600 FS @ 1.50 g.a.i./kg seed was significantly superior over the remaining treatments and was most effective against the sucking pests. The maximum number of sucking pests was recorded in untreated check. One week after the first observation, the minimum sucking pest population (5.25) recorded in the treatment of Imidacloprid 600 FS @ 1.50 g.a.i./kg seed followed by treatment of Imidacloprid 600 FS @ 0.75 g.a.i./kg seed which provided 5.40 sucking pest population per plant and both treatment were found significantly superior over other treatments but at par with each other during 2014. In 2015, the sucking pest population ranged from 6.40 to 12.90 per plant. Two weeks after the first observation, the population of sucking pests ranged from 5.60 to 16.90 and 9.90 to 14.50 per plant during 2014 and 2015, respectively. Imidacloprid 600 FS @ 1.50 g.a.i./kg seed continued to express its supremacy over other treatments in controlling the sucking pests. It was significantly superior over rest of the treatments. Three weeks after the first observation, the sucking pest population ranged from 6.30 to 18.70 and 8.30 to 12.50 sucking pests per plant during 2014 and 2015, respectively. Like the previous observations, plot treated with Imidacloprid 600 FS @ 1.50 g.a.i./kg seed with 6.30 and 8.30 sucking pests per plant was least infested by sucking pests. It was significantly more effective than the remaining treatments. Observation taken on fifth week revealed that the minimum number of sucking pest population was recorded in the plot treated with Imidacloprid 600 FS @ 0.75g.a.i./kg seed .ranged from 8.00 to 15.60 and 10.20 to 14.40 sucking pests per plant during 2014 and 2015, respectively. Imidacloprid 600 FS when applied @ 1.50 g.a.i./kg seed continued to exhibit its superiority over other treatments in controlling the sucking pests. In the sixth week, it was noticed that the effect of seed treatment was diminishing as is indicated by increase in pest population in treatments of thiamethoxom and untreated check during 2014. The data recorded in the sixth week showed that sucking pest population per plant ranged from 7.20 to 18.10 and 10.90 to 16.30 during 2014 and 2015, respectively. Based on seasonal mean, the overall effect of insecticidal treatments at all the six intervals on sucking pest population revealed that all the treatments were found effective in comparison to untreated check. The treatment of Imidacloprid 600 FS @ 1.50 g.a.i. /kg seed followed by Imidacloprid 600 FS @ 0.75 g.a.i. /kg seed was found most effective against the early sucking pests on soybean. The treatment of Thiamethoxom 70 WS @ 2g/kg seed was least effective against the sucking pests. The present results agreed fully with the previous findings of many investigators who evaluated the efficacy of neonicotinoid insecticide used as seed treatment against early sucking pests of different crops. Lind *et al*. (1998a and b) reported that Imidacloprid is a broad-spectrum insecticide that kills most insect species. The present findings are in accordance with Abbas (1999) who reported that seed treatment with imidacloprid 70 WS was highly effective against the leafhopper population and it offers protection upto 60 DAS against sucking pests in groundnut. Dandale *et al*. (2001); Satpute *et al*. (2001); Vadodaria *et al*. (2001); Aioub *et al*. (2002); Dhandapani *et al*. (2002); Kannan *et al*. (2004); Mohapatra and Sahu (2005) and Bhosle *et al*. (2009) reported that seed treatment with imidacloprid proved most effective in protecting the crop from sucking pest complex in cotton. Dey *et al*. (2005) and Sinha and Sharma (2007) reported that imidacloprid provided effective control of early sucking pest complex such as aphids, leafhoppers, thrips and whiteflies at 25 days after sowing in okra. El-Naggar (2006) reported that imidacloprid as well as thiamethoxam were effective against thrips for 7 weeks after planting . El-Dewy (2006) revealed that imidacloprid as well as thiamethoxam had relatively fast initial effects with long residual action against thrips and immature stages of whitefly, with a moderate effect on jassids and adults stages of whitefly The present results are in conformity with the earlier reports.

Effect of insecticides on the yield of soybean:

Perusal of the data of soybean seed yield for two years presented in Table 1 and 2 revealed that all the insecticidal treatments performed significantly better than control. The highest seed yield of 17.10 q/ha and 17.20 q/ha was obtained in the plots treated with Imidacloprid 600 FS @ 1.50 g.a.i./kg seed in 2014 and 2015, respectively. The minimum seed yield of 12.10 q/ha was obtained in the treatment of thiomethoxom 70WS @ 2g / kg seed, followed by 12.50 q/ha in thiomethoxom 70WS @ 4g/kg seed in comparison to 11.40 q/ha in control

during 2014, whereas, 13.05 and 13.40 q/ha was obtained in the respective treatments in comparison 12.60 q/ha in control during 2015. The present findings are in accordance with Netam *et al.* (2013) who reported that Imidacloprid 600 FS when applied as seed treatment at the rate of 0.75 g. a.i/kg seed was most effective against the sucking pests of soybean upto four week of seed germination. Patil *et al.* (2008) also confirmed efficacy of new formulation of thiamethoxam 500 FS against the sucking pests. Further, they also opined that it could be a better option for the management of the sucking pests due to their safety to natural enemies and systemic action. Seed treatment formulations of thiamethoxam and imidacloprid have not only been accepted by the farmers and seed companies but also have occupied prime position in the integrated pest management and insecticide resistance management programmes (Anonymous, 1997).

REFERENCES

Abbas, K.K. (1999). Studies on impact of insect pests at different crop stages of Groundnut (*Arachis hypogaea*). M.Sc. (Ag.) Thesis, Acharya N.G. Ranga Agricultural University, Hyderabad (A.P.) INDIA.

Aioub, A.A.A., Raslan, S.A.A., Gomaa, E.A., Desuky, W.M. and Zaki, A.A. (2002). Management of sap sucking insect populations on cotton plants by imidacloprid application and NPK fertilization. *Zagazig J. Agric. Res.*, **29** (1): 269–289.

Anonymous (1997). *Annual progress report of AICRP on oilseeds* (*sunflower*), Directorate of Oilseeds Research, ICAR. Hyderabad, India, pp. 167.

Anonymous (2012). *Director's report and summary tables of experiments of AICRP on soybean*, NRCS, Indore

Anonymous (2015). *Director's report and summary tables of experiments* 2014- 15, All India Coordinated Research Project on Soybean, ICAR-Directorate of Soybean Research, Indore, India, pp 329.

Bhosle, B.B., Agale, D.A. and Kadam, D.R. (2009). Bioefficacy of different insecticides against Thrips in Bt cotton. *Pestology*, **33** (9): 26-28.

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 Cotton and yield of seed cotton. *Pestology,* **25**(3): 20-23.

Dey, P.K., Jana, S.K., Chakraborty, G. and Somchoudhury, A.K. (2005). Evaluation of Imidacloprid (70 WS and 20 SL) against sucking pest complex of okra, *Abelmoschus esculentus. J. Entomological Res.*, **29**(3): 215-218.

Dhandapani, N., Dhivahar, P. and Palanisamy, S. (2002). Evaluation of new molecules, clothianidin (Poncho 600 FS) and imidacloprid (Gaucho 600 FS) as seed treatment against sucking pests of cotton. p. 127–130. In: "Resources management in plant protection during twenty first century" (B.S. Babu, K.S. Varaprasad, K. Anitha, Ed.). **2**. Plant Prot. As. India, Hyderabad (A.P.) INDIA.

El-Dewy, M.H.E. (2006). Toxicological studies on some pests attacking cotton. Ph. D. Thesis, Fac. Agric., Kafr El-Sheikh Univ., Egypt, 101 pp.

El-Naggar, J.B. (2006). Population density of certain early cotton season insects and associated predators influenced by seed treatments. *J. Agric. Sci. Mansoura Univ.*, **13** (11): 7423–7434.

Forsberg, G., Kristensen, L., Eibel, P., Titone, P. and Haiti, W. (2003). Sensitivity of cereal seeds to short duration treatment with hot, humid air. *J. Plant Disease & Protec.*, **110** (1): 1-16.

Kannan, M., Uthamasamy, S. and Mohan, S. (2004). Impact of insecticides on sucking pests and natural enemy complex of transgenic cotton. *Curr. Sci.*, **86** (5) : 726-729.

Lind, R.J., Clough, M.S., Earley , F.G.P.,Wonnacott, S. and Reynolds, S.E. (1998a). Characterization of the relationship between binding sites for imidacloprid and other nicotinic ligands in insects. *Pest Sci*., **55**: 1029-1031.

Lind, R.J., Clough, M.S., Reynolds, S.E. and Earley, F.G.P. (1998b). Imidacloprid lebels high- and low affinity nicotinic acetylcholine receptor – like binding sites in the aphid Myzus persicae (Hemiptera: Aphididae). *Pestic. Biochem. Physiol*., **62** : 3-14

Magalhaes, L.C., Hunt, T.E. and Siegfried, B.D. (2009). Efficacy of neonicotinoid seed treatments to reduce soybean aphid populations under field and controlled conditions in Nebraska. *J. Econ. Entomol.*, **102**: 187-195.

Mohapatra, L.N. and Sahu, B.B. (2005). Management of early season sucking pests of cotton through seed dressing insecticides. *Pestol.*, **29** (10) : 28-30.

Netam, H.K., Gupta, R. and Soni, S. (2013). Bioefficacy of insecticides as seed treatment against early sucking pest of soybean crop. *Int. J. Sci. Res*., **2** (1) : 688-690.

Patil, S.B., Udikeri, S.S., Renuka, B.H., Guruprasad, G.S., Shaila, H.M. and Abilasha, C. (2008) New seed dresser thaimethoxam 500 FS – No compromise in efficacy against sucking pests: An experimental evidence from cotton. *Pestology*, **32**: 13- 16.

Rahman, M.M.E., Ali, M.E., Ali, M.S., Rahman, M.M. and Islam, M.N. (2008). Hot water thermal treatment for controlling seed-

borne mycoflora of maize. *Internat. J. Sustain. Crop Prod*., **3**(5): 5-9.

Satpute, N.S., Katole, S.R., Nimbalkar, S.A., Sarnaik, D.N and Satpute, U.S. (2001). Efficacy of imidacloprid and thiamethoxam as seed treatment against cotton jassid, *Amrasca devastans* distant. *J. Appl. Zoological Res.*,**12** (1): 88-90.

Sinha, S.R. and Sharma, R.K. (2007). Efficacy of neonicotinoids against okra insect pests. *Pesticide Res. J*., **19** (1) : 42-44.

Taylor, A.G., Eckenrode, C.J. and Straub, R.W. (2001). Seed coating technologies and treatments for onions: challenges and progress. *Hort. Sci.*, **36**: 199- 205.

Vadodaria, M.P., Patel, V.G., Patel, C.J., Patel, R.B. and Maisuria, I. M. (2001). Thiamethoxam (Cruiser) 70 WS: A new seed dresser against sucking pests of cotton. *Pestology*, **25** (9): 13-19.