RESEARCH ARTICLE

EVALUATE THE EFFICACY OF INSECTICIDES FOR MANAGEMENT OF RICE GALL MIDGE, (*ORSEOLIA ORYZAE* WOOD-MASON) IN RICE FIELD IN NORTHERN HILL OF CHHATTISGARH

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Received-01.08.2022, Revised-12.08.2022, Accepted-26.08.2022

Abstract: A field experiment was conducted at Research-cum-Instructional Farm of Raj Mohini Devi College of Agriculture & Research Station, Ambikapur (C.G.) during Kharif -2021, to study the field efficacy of insecticides (which are listed in Table 1) for the management of rice gall midge**,** *Orseolia oryzae*. The results revealed that chlorantraniliprole 0.4% GR against the rice gall midge, *Orseolia oryzae* was found to be most effective treatment and recorded significantly lowest per cent of silver shoot *i.e.* 3.03% treatment given as main field alone at 25 DAT followed by fipronil 0.3% GR + chlorantraniliprole 0.4% GR *i.e.* 4.57% SS and carbofuran 3% CG + [cartap hydrochloride 4% + fipronil 0.5% CG] *i.e.* 4.78% SS whereas both the treatments were given in nursery at one week before transplantation + main field at 25 DAT. Rests of the treatments were moderately effective in terms of minimum damage of gall midge but also superior over untreated control. However, the maximum per cent of gall midge infestations (9.10% SS) was recorded in untreated control.

Keywords: Efficacy, Insecticides, Management, Rice gall midge, *Orseolia oryzae*

INTRODUCTION

Chhattisgarh state is popularly known as "rice bowl of India" because maximum area is covered under rice during *Kharif* and contribute major share in national rice production. It has geographical area of 13.51 million hectares of which 5.9 million hectares area is under cultivation. Rice occupies major area of 3.74 million hectares out of 5.9 million hectares area in 2016-17.

The Asian rice gall midge, *Orseolia oryzae* (Wood-Mason) is an important rice pest in India. This insect is essentially a wet-season pest and can cause severe damage under favourable weather with high humidity and moderate temperature, resulting in an estimated annual yield loss amounting US$ 80 million in India (Bentur *et al.* 2016) or about US$ 500 million in Asia (Herdt 1991).

Insect pest fauna cause yield loss of about 20-30%, while an average yield loss-span from 21-51% over large area. Among these major insect pest species, gall midge (*Orseolia oryzae* Wood-Mason) is one of the most important pests which is capable of causing considerable loss. The maggot of rice gall midge is responsible for causing gall formation in the central leaf sheath of rice which results in the formation of silver shoot, which later on cannot bear panicles. As such, the pest could be able to cause loss in yield ranging from 10-25% (Prasad and Prasad, 2006). The insect pest plays a significant role and accounts for appreciable reduction in the yield. In Asia, a yield loss in rice due to insect pest is estimated to be 31.5% (Cramer 1967).

The characteristic symptom of attack of this pest on rice plant is the formation of gall commonly called "Silver shoot" or Onion shoots", which is a modified leaf sheath (Hidaka 1974; Hill 1987) and it also causes the production of secondary tillers which may themselves become infested. Infestation of rice gall midge can be managed by applying different chemical insecticides during growing season. In the current study, different newer insecticides were tasted against rice gall midge. The main purpose of this field experiment was to evaluate the most suitable insecticide that could significantly reduce the infestation of rice gall midge.

MATERIALS AND METHODS

A field experiment to evaluate the efficacy of insecticides against rice gall midge in rice was conducted at Research-cum-Instructional Farm of Raj Mohini Devi College of Agriculture & Research Station, Ambikapur (C.G.) during *Kharif* 2021. The crop was planted with all packages of agronomical practices. The details are given below:

Experimental details

Crop	:	Rice
Variety	:	MTU 1010
Plot size	:	5 x 4m^2
Spacing (P x R)	:	15 × 20 cm^2
Date of sowing	:	03/07/2021
Date of transplanting		04/08/2021
Treatment	:	13

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Replication	:	3
Statistical design	:	RBD (Randomized Block Design)

Table 1. Treatment details:

Crop stage	Tr. No.	Treatments	Dosage
Seed treatment	T_1	Thiamethoxam 25% WG	4g/kg seed
Nursery alone at one week before transplantation	T_2	Carbofuran 3% CG	33kg/ha
	T_3	Fipronil 0.3% GR	25kg/ha
	T_4	Chlorantraniliprole 0.4% GR	10kg/ha
Main field alone at 25 DAT	T_5	Carbofuran 3% CG	33kg/ha
	T_6	Fipronil 0.3% GR	25kg/ha
	T_7	Chlorantraniliprole 0.4% GR	10kg/ha
Seed treatment + Main field at 25 DAT	T_8	Thiamethoxam 25% WG + Fipronil 0.3% GR	4g/kg seed + 25kg/ha
	T_9	Thiamethoxam 25% WG + Chlorantraniliprole 0.4% GR	4g/kg seed + 10kg/ha
	T_{10}	Thiamethoxam 25% WG + [Cartap hydrochloride 4% + Fipronil 0.5% CG]	4g/kg seed + 20kg/ha
Nursery at one week before transplantation + Main field at 25 DAT	T_{11}	Fipronil 0.3% GR + Chlorantraniliprole 0.4% GR	25kg/ha + 10kg/ha
	T_{12}	Carbofuran 3% CG + [Cartap hydrochloride 4% + Fipronil 0.5% CG]	33kg/ha + 20kg/ha
Untreated control	T_{13}	Untreated control	Water spray

The required quantity of insecticides was calibrated and applied in the field.

METHOD OF OBSERVATIONS

The data of rice gall midge infestations as silver shoots were recorded from randomly selected 10 hills per plot at each 30, 50 and 65 DAT. The effectiveness of insecticides against rice gall midge in rice were assessed on the basis of total number of infested tillers (silver shoot) and healthy tillers and to calculate the percentage infestation of the pest as follows:

$$\text{Tiller infestation (\%SS)} = \frac{\text{No. of infested tillers}}{\text{Total no. of tillers}} \times 100$$

RESULTS AND DISCUSSION

The field efficiency of insecticides which are listed above in Table 1. with control as without treatment were tested in order to provide better protection to rice against gall midge damage during *Kharif* -2021 and data were recorded on the basis of percentage silver shoot damage in definite interval in growing period of rice which are presented in Table 2.

Gall midge incidence as per cent silver shoot (%SS) in rice at 35 DAT

The result revealed that all the treatment registered as significantly lower percentage of silver shoot damage caused by gall midge *Orseolia oryzae* in rice as compared to untreated control during 35 DAT. Among all insecticides, chlorantraniliprole 0.4% GR treatment given in main field alone at 25 DAT showed significantly lowest per cent of silver shoot damage (2.94%), followed by fipronil 0.3% GR (treatment given in nursery alone at one week before transplantation) and chlorantraniliprole 0.4% GR (treatment given in nursery alone at one week before transplantation) with 3.57% SS and 3.99% SS, respectively. The next level best treatments were thiamethoxam 25% WG + chlorantraniliprole 0.4% GR (treatment given in seed treatment + main field at 25 DAT), carbofuran 3% CG (treatment given in main field alone at 25 DAT), carbofuran 3% CG + [cartap hydrochloride 4% + fipronil 0.5% CG] (treatment given in nursery at one week before transplantation + main field at 25 DAT), thiamethoxam 25% WG +[(cartap hydrochloride 4% + fipronil 0.5% CG] (treatment given as seed treatment + main field at 25 DAT) and carbofuran 3% CG (treatment given in nursery alone at one week before transplantation) recorded as 4.16, 4.20, 4.22, 4.35 and 4.48% SS, respectively. Rest of the treatments was moderately effective but significantly superior over untreated control. Whereas, significantly highest per cent of silver shoot (8.68%) was observed in untreated control.

Gall midge incidence as per cent silver shoot (%SS) in rice at 50 DAT

During 50 DAT all the treatment showed significantly least percentage of silver shoot damage in rice except untreated control, where the damage ranging was observed as 3.13-9.45% SS. Chlorantraniliprole 0.4% GR (treatment given in main field alone at 25 DAT) maintain their superiority and recorded lowest per cent of silver shoot damage (2.94%), followed by carbofuran 3% CG + [cartap hydrochloride 4% + fipronil 0.5% CG] (treatment given in nursery at one week before transplantation + main field at 25 DAT) and fipronil 0.5% CG + chlorantraniliprole 0.4% GR (treatment given in nursery at one week before transplantation + main field at 25 DAT) as 4.16 and 4.48% SS, respectively. Rests of the treatments were moderately effective but significantly superior over untreated control during 50 DAT, whereas significantly highest per cent of silver shoot was observed on untreated control (*i.e.* 9.45% SS).

Gall midge incidence as per cent silver shoot (%SS) in rice at 65 DAT

The data on per cent silver shoot of *Orseolia oryzae* recorded at 65 DAT and result revealed that chlorantraniliprole 0.4 GR (treatment given in main field alone at 25 DAT) was showed significantly lowest per cent silver shoot *i.e.* 3.01% followed by carbofuran 3% CG (treatment given in main field alone at 25 DAT), chlorantraniliprole 0.4% GR (treatment given in nursery alone at one week before transplantation), thiamethoxam 25% WG + [cartap hydrochloride 4% + fipronil + 0.5% CG] (treatment given as seed treatment + main field at 25 DAT), fipronil 0.3% GR + chlorantraniliprole 0.4% GR (treatment given in nursery at one week before transplantation + main field at 25 DAT) and thiamethoxam 25% WG + chlorantraniliprole 0.4% GR (treatment given as seed treatment + main field at 25 DAT) with 4.31, 4.59, 4.69, 4.69 and 4.76% SS, respectively. Rests of the treatments were moderately effective but significantly superior over untreated control during 65 DAT, whereas, significantly highest per cent of silver shoot was recorded in untreated control *i.e.* 9.18%.

Overall mean gall midge incidence as per cent silver shoot (%SS) in rice

The result of overall mean percentage of rice gall midge damage showed that all the treatments were significantly superior over untreated control, where the infestation level ranged from 3.03 to 9.10% SS. The chlorantraniliprole 0.4% GR (where the treatment given as main field alone at 25 DAT) was showed significantly lowest per cent of silver shoot caused by rice gall midge *i.e.* 3.03% followed by fipronil 0.3% GR + chlorantraniliprole 0.4% GR (treatment given as nursery at one week before transplantation + main field at 25 DAT) *i.e.* 4.57%SS and carbofuran 3% CG + (cartap hydrochloride 4% +fipronil + 0.5% CG) (where the treatment given as nursery at one week before transplantation + main field at 25 DAT) *i.e.* 4.78%SS. The treatment of carbofuran 3% CG (treatment given as main field alone at 25 DAT), thiamethoxam 25% WG + fipronil 0.3% GR (treatment given as seed treatment + main field at 25 DAT), thiamethoxam 25% WG + [cartap hydrochloride 4% + fipronil 0.5% CG] (treatment given as seed treatment + main field at 25 DAT), thiamethoxam 25% WG + chlorantraniliprole 0.4% GR (treatment given as seed treatment + main field at 25 DAT), fipronil 0.3% GR (treatment given as main field alone at 25 DAT), chlorantraniliprole 0.4% GR (treatment given as nursery alone at one week before transplantation) and carbofuran 3% CG (treatment given as nursery alone at one week before transplantation) were recorded as second level best treatment with 5.05, 5.26, 5.56, 5.58, 5.64, 5.65 and 5.75%SS, respectively. Rests of the treatments were showed moderately effective but significantly superior over untreated control, whereas, significantly highest per cent of silver shoot was recorded in untreated control *i.e.* 9.10%.

The current findings partially supported with the work of Kumar *et al*. (2007) who revealed that nursery application of isazophos 3G @ 0.75 kg a.i./ha was recorded lowest gall midge infestation (4.98% silver shoot), higher grain (60.02 q/ha) and biomass yield (61.91 q/ha). Fipronil 0.3G @ 1.0 kg a.i./ha were the next best insecticides on at par with each other. Cartap hydrochloride 4G @ 0.75 kg a.i. and monocrotophos 36SL @ 0.5 a.i./ha were the least effective. While Yadav *et al*. (2018) reported spinoterom + methoxyfenozide 36% EC @400 ml/ha was most effective against rice gall midge, which in turn, was found to be at par with rynaxypyr 20% SC @150 ml/ha and flubendiamide 480 SC @50 ml/ha. Similarly, Seni and Pal (2021) also found that lambda-cyhalothrin 4.9% CS @ 550 ml ha^{-1} was significantly superior against reducing the gall midge incidence at 20 and 35 DAT. Archana and Halappa (2012) reported that fipronil 40%WG @ 1gm/l and carbofuran 3%G @ 10kg/ha were superior and recorded least incidence of silver shoot (8.0 and 8.8%, respectively). Logiswaran *et al*. (1987) reported that carbofuran 3%G, chlorpyriphos 40%EC, monocrotophos 36% WSC and cartap hydrochloride 4%G were the lowest prevalence of gall midge. Das *et al.* (2007) reported fipronil (Regent 5%SC) @ 0.05 % + soil drenching of nursery with same insecticide @ 100 g a.i./ha proved to be effective against gall midge incidence in the main field. But the current finding revealed that chlorantraniliprole 0.4% GR (where the treatment given as main field alone at 25 DAT) recorded lowest per cent of silver shoot *i.e.* 3.03% followed by fipronil 0.3% GR + chlorantraniliprole 0.4% GR *i.e.* 4.57% SS and carbofuran 3% CG + (cartap hydrochloride 4% +fipronil + 0.5% CG) *i.e.* 4.78% SS (where both the treatments given as nursery at one week before transplantation + main field at 25 DAT), and carbofuran 3%G and fipronil 0.3% GR were second level best also recorded during 2021.

CONCLUSION

Based on the above findings, it is concluded that gall midge, *Orseolia oryzae* (Wood-Mason) was found to be the most damaging species and showed consistency with higher infestation during the crop period. Results showed that chlorantraniliprole 0.4% G was most effective insecticide followed by fipronil

0.3% GR + chlorantraniliprole 0.4% GR, thiamethoxam 25% WG + chlorantraniliprole 0.4% GR and carbofuran 3% CG + [cartap hydrochloride 4% + fipronil 0.5% CG] due to higher grain yield, low cost of the treatments and less damage by the pest.

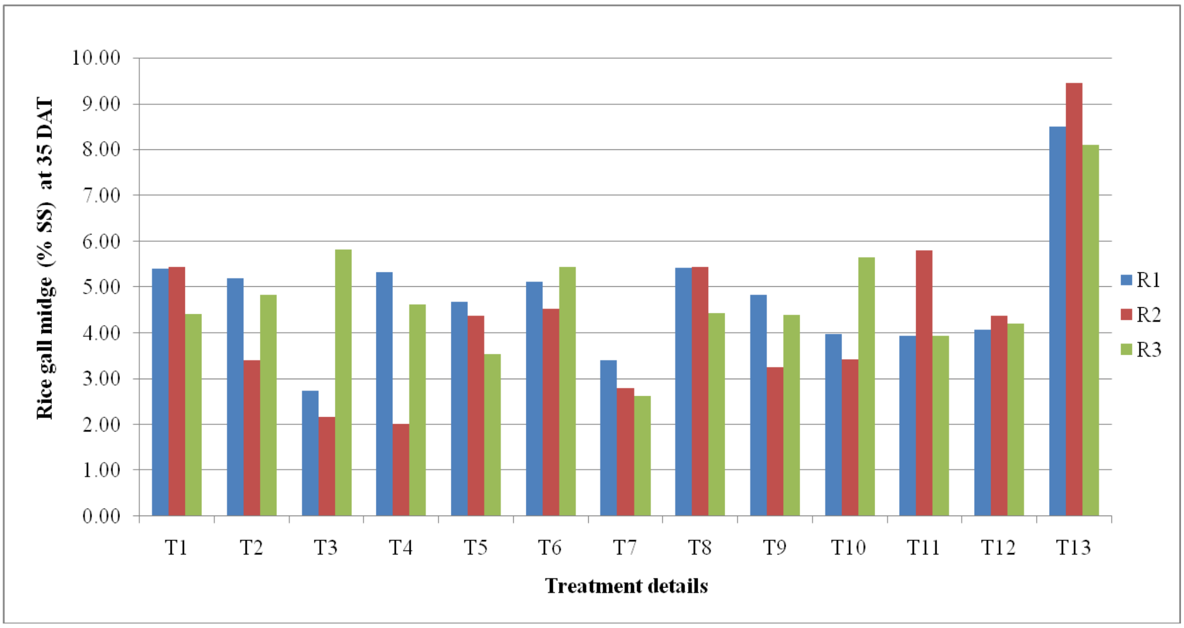
ACKNOWLEDGEMENT

Authors would like to thanks to the Head of Section (Entomology) and Dean, R.M.D College of Agriculture and Research Station, Ambikapur (C.G.) for providing all the necessary facilities to perform this research work.

Table 2. Field efficacy of insecticides against rice gall midge as per cent silver shoots in rice during Kharif - 2021

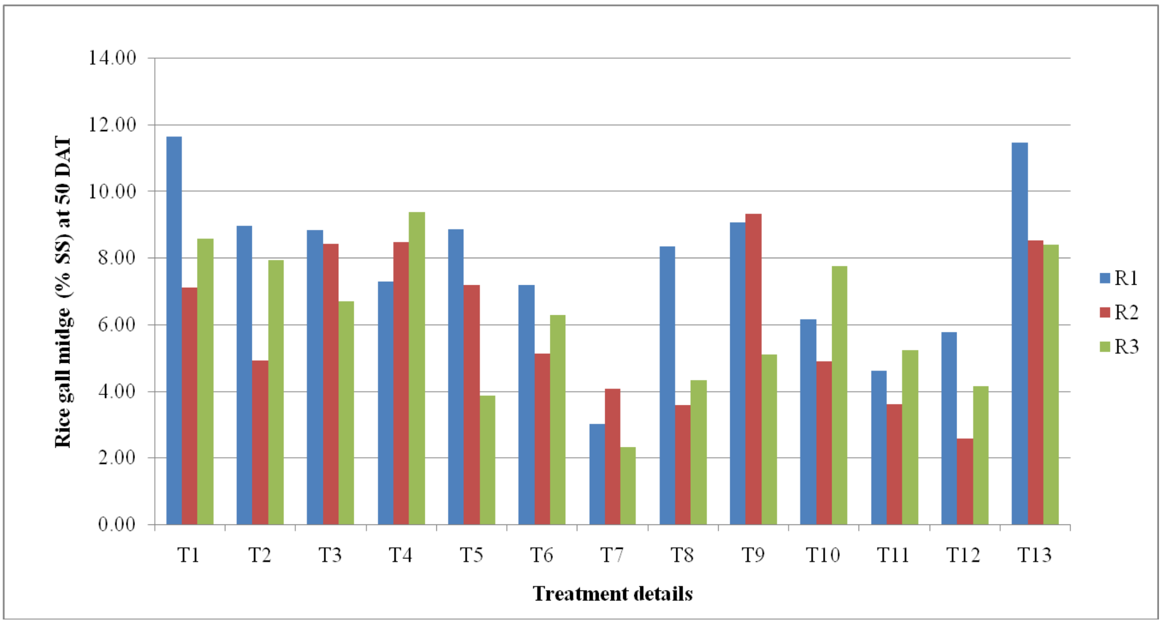
Crop stage	Tr. No.	Treatments	Dosage	Rice gall midge infestation (%SS)			
				35 DAT	50 DAT	65 DAT	Pooled
Seed treatment	T_1	Thiamethoxam 25% WG	4g/kg seed	5.08 (13.01)	9.10 (17.47)	6.01 (13.90)	6.73
Nursery alone at one week before transplantation	T_2	Carbofuran 3% CG	33kg/ha	4.48 (12.17)	7.27 (15.53)	5.51 (13.44)	5.75
	T_3	Fipronil 0.3% GR	25kg/ha	3.57 (10.64)	7.97 (16.36)	6.51 (14.73)	6.02
	T_4	Chlorantraniliprole 0.4% GR	10kg/ha	3.99 (11.31)	8.38 (16.80)	4.59 (12.34)	5.65
Main field alone at 25 DAT	T_5	Carbofuran 3% CG	33kg/ha	4.20 (11.80)	6.64 (14.72)	4.31 (11.98)	5.05
	T_6	Fipronil 0.3% GR	25kg/ha	5.02 (12.94)	6.20 (14.38)	5.69 (13.76)	5.64
	T_7	Chlorantraniliprole 0.4% GR	10kg/ha	2.94 (9.85)	3.13 (10.12)	3.01 (9.91)	3.03
Seed treatment + Main field at 25 DAT	T_8	Thiamethoxam 25% WG + Fipronil 0.3% GR	4g/kg seed + 25kg/ha	5.10 (13.03)	5.41 (13.23)	5.28 (13.17)	5.26
	T_9	Thiamethoxam 25% WG + Chlorantraniliprole 0.4% GR	4g/kg seed + 10kg/ha	4.16 (11.73)	7.83 (16.11)	4.76 (12.52)	5.58
	T_{10}	Thiamethoxam 25% WG + [Cartap hydrochloride 4% + Fipronil 0.5% CG]	4g/kg seed + 20kg/ha	4.35 (11.96)	6.26 (14.42)	4.69 (12.44)	5.56
Nursery at one week before transplantation + Main field at 25 DAT	T_{11}	Fipronil 0.3% GR + Chlorantraniliprole 0.4% GR	25kg/ha + 10kg/ha	4.55 (12.26)	4.48 (12.18)	4.69 (12.47)	4.57
	T_{12}	Carbofuran 3% CG + [Cartap hydrochloride 4% + Fipronil 0.5% CG]	33kg/ha + 20kg/ha	4.22 (11.84)	4.16 (11.62)	5.95 (14.10)	4.78
Untreated control	T_{13}	Untreated control	Water spray	8.68 (17.12)	9.45 (17.85)	9.18 (17.63)	9.10
CD (p= 0.05)				2.434	3.05	2.83	
SE(m±)				0.829	1.041	0.965	

*Figure in parenthesis are arcsine transformed values
CD at 5% level of significant



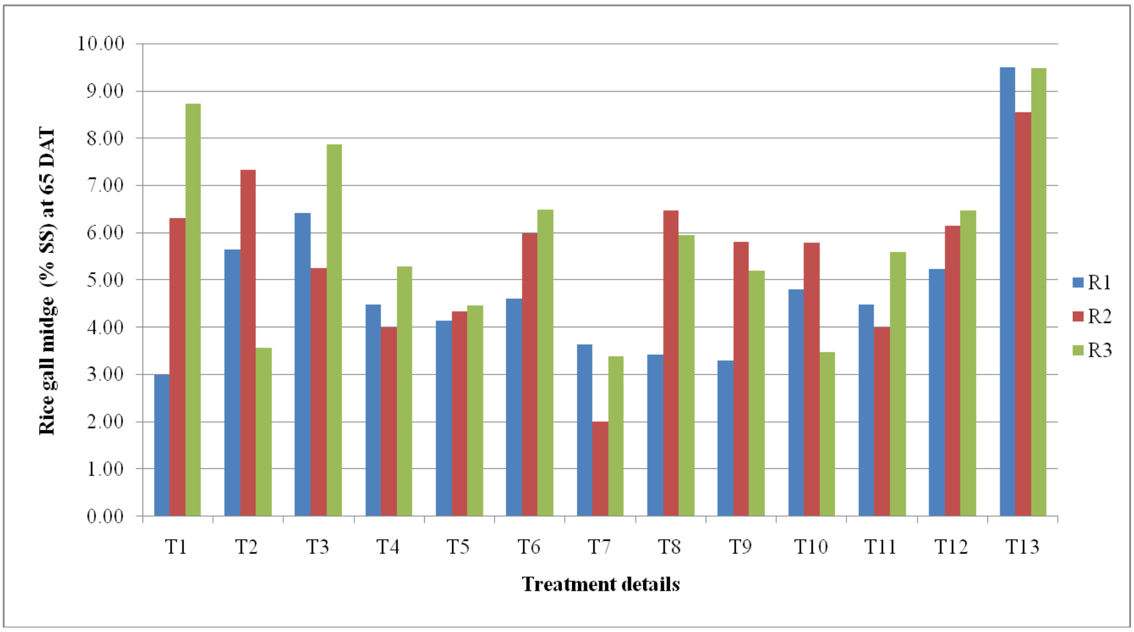
T_1= Thimethoxam 25% WG, T_2 = Carbofuran 3% CG, T_3 = Fipronil 0.3% GR, T_4= Chorantraniliprole, T_5 = Carbofuran 3% CG 0.4 % GR, T_6 = Fipronil 0.3% GR, T_7 = Chorantraniliprole 0.4 % GR, T_8 = Thiamethoxam 25% WG + Fipronil 0.3% GR, T_9 = Thiamethoxam 25% WG + Chlorantraniliprole 0.4% GR, T_{10} = Thiamethoxam 25%WG + (Cartap hydochoride4%+ Fipronil 0.5% CG), T_{10} = Thiamethoxam 25%WG + (Cartap hydochoride4%+ Fipronil 0.5% CG), T_{11} = Fipronil 0.3% GR + Chorantraniliprole 0.4% GR, T_{11} = Fipronil 0.3% GR + Chorantraniliprole 0.4% GR, T_{12} = Carbofuran 3% CG+ (Cartap hydochloride 4%+ Fipronil 0.5% CG)

Fig. 1: Evaluation of insecticides against rice gall midge as per cent silver shoot (%SS) in rice at 35DAT during Kharif -2021



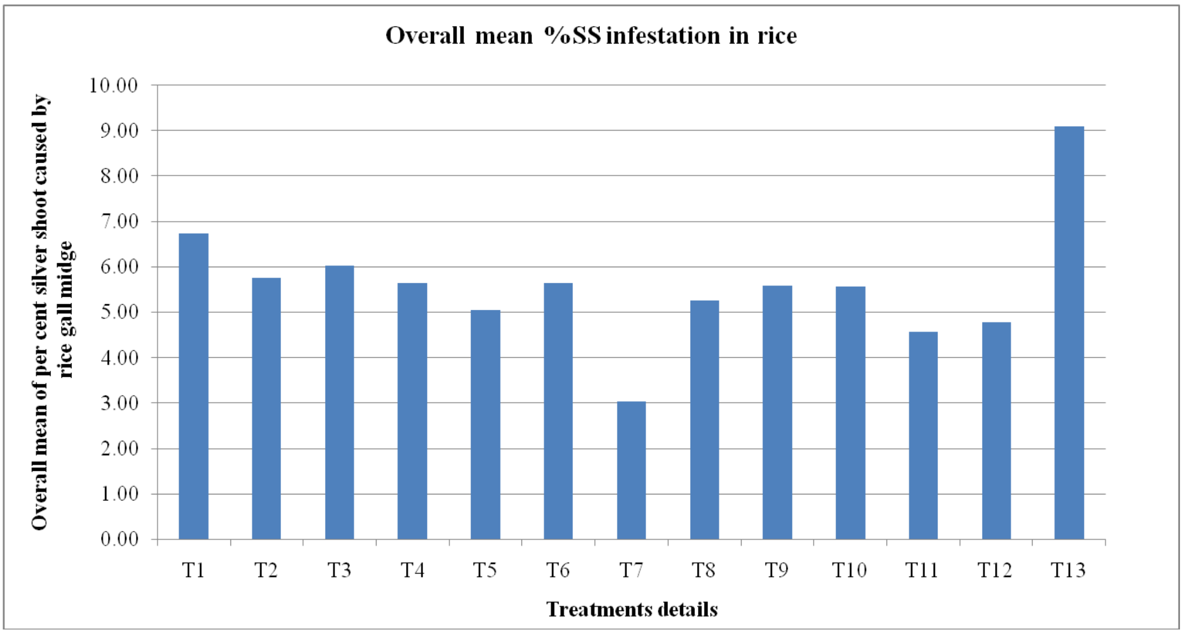
T_1= Thimethoxam 25% WG, T_2 = Carbofuran 3% CG, T_3 = Fipronil 0.3% GR, T_4= Chorantraniliprole, T_5 = Carbofuran 3% CG 0.4 % GR, T_6 = Fipronil 0.3% GR, T_7 = Chorantraniliprole 0.4 % GR, T_8 = Thiamethoxam 25% WG + Fipronil 0.3% GR, T_9 = Thiamethoxam 25% WG + Chlorantraniliprole 0.4% GR, T_{10} = Thiamethoxam 25%WG + (Cartap hydochoride4%+ Fipronil 0.5% CG), T_{10} = Thiamethoxam 25%WG + (Cartap hydochoride4%+ Fipronil 0.5% CG), T_{11} = Fipronil 0.3% GR + Chorantraniliprole 0.4% GR, T_{11} = Fipronil 0.3% GR + Chorantraniliprole 0.4% GR, T_{12} = Carbofuran 3% CG+ (Cartap hydochloride 4%+ Fipronil 0.5% CG)

Fig. 2: Evaluation of insecticides against rice gall midge as per cent silver shoot (%SS) in rice at 50 DAT during Kharif -2021



$T_{1=}$ Thimethoxam 25% WG, T_{2} = Carbofuran 3% CG, T_{3} = Fipronil 0.3% GR, T_{4}= Chorantraniliprole, T_{5} = Carbofuran 3% CG 0.4 % GR, T_{6} = Fipronil 0.3% GR, T_{7} = Chorantraniliprole 0.4 % GR, T_{8} = Thiamethoxam 25% WG + Fipronil 0.3% GR, T_{9} = Thiamethoxam 25% WG + Chlorantraniliprole 0.4% GR, T_{10} = Thiamethoxam 25%WG + (Cartap hydochoride4%+ Fipronil 0.5% CG), T_{10} = Thiamethoxam 25%WG + (Cartap hydochoride4%+ Fipronil 0.5% CG), T_{11} = Fipronil 0.3% GR + Chorantraniliprole 0.4% GR, T_{11} = Fipronil 0.3% GR + Chorantraniliprole 0.4% GR, T_{12} = Carbofuran 3% CG+ (Cartap hydochloride 4%+ Fipronil 0.5% CG)

Fig. 3: Evaluation of insecticides against rice gall midge as per cent silver shoot (%SS) in rice at 65 DAT during Kharif -2021



$T_{1=}$ Thimethoxam 25% WG, T_{2} = Carbofuran 3% CG, T_{3} = Fipronil 0.3% GR, T_{4}= Chorantraniliprole, T_{5} = Carbofuran 3% CG 0.4 % GR, T_{6} = Fipronil 0.3% GR, T_{7} = Chorantraniliprole 0.4 % GR, T_{8} = Thiamethoxam 25% WG + Fipronil 0.3% GR, T_{9} = Thiamethoxam 25% WG + Chlorantraniliprole 0.4% GR, T_{10} = Thiamethoxam 25%WG + (Cartap hydochoride4%+ Fipronil 0.5% CG), T_{10} = Thiamethoxam 25%WG + (Cartap hydochoride4%+ Fipronil 0.5% CG), T_{11} = Fipronil 0.3% GR + Chorantraniliprole 0.4% GR, T_{11} = Fipronil 0.3% GR + Chorantraniliprole 0.4% GR, T_{12} = Carbofuran 3% CG+ (Cartap hydochloride 4%+ Fipronil 0.5% CG)

Fig. 4: Overall mean of per cent of silver shoot caused by rice gall midge in rice after insecticidal treatments during Kharif 2021

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