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Efficacy of Biorational Insecticides Against Major Insect Pests of Rice

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ABSTRACT: Effective pest management in rice is essential for sustaining crop yields and minimizing economic losses in agriculture. Integrated Pest Management (IPM) strategies typically combine plant-based botanicals and chemical insecticides to manage pest populations. This study was conducted to assess the effectiveness of various botanicals, insecticides, and their combinations against key rice pests during the Kharif seasons of 2019, 2020 and 2021 at the Agricultural Research Station in Ragolu, North Coastal Zone, Andhra Pradesh. The experiment involved five treatments, each comprising different combinations of botanicals and insecticides, including: Neemzal 1% EC at 25-30 DAT + Eucalyptus oil at 45-50 DAT + Cartap hydrochloride 50%SC at 60-65 DAT; Neemzal 1%EC at 25-30 DAT + Neem oil at 45-50 DAT + Triflumezopyrim at 60-65 DAT; an all-botanicals treatment with Neemzal 1%EC at 25-30 DAT, Neem oil at 45-50 DAT, and Triflumezopyrim at 60-65 DAT; an all-insecticides treatment with Chlorantraniliprole 0.4G at 25-30 DAT, Cartap hydrochloride 50%SC at 50-55 DAT, and Triflumezopyrim at 65-70 DAT and an untreated control for comparison. All treatments significantly reduced pest populations compared to the control, owing to their specific modes of action. The results indicated that the combination of Chlorantraniliprole 0.4G at 25-30 DAT + Cartap hydrochloride 50%SC at 50-55 DAT + Triflumezopyrim at 65-70 DAT was most effective, showing lower percent damage of leaves and white ears at pre-harvest, reduced incidence of BPH and WBPH, and higher grain yields. The treatment with Neemzal 1%EC at 25-30 DAT + Neem oil at 45-50 DAT + Triflumezopyrim at 60-65 DAT also resulted in improved grain yields. Overall, the pre-mixed insecticides outperformed individual insecticides in controlling pests.

Keywords: Bio-efficacy, Botanicals, Dead hearts (DH), Damaged leaves (DL)Insecticides, Silver shoot (SS), White ear head (WE).

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food for over half of the global population, with around 90% of it produced and consumed in Asia. As a result, rice cultivation in this region plays a vital role in global food security. Sustaining growth in rice production is a critical challenge, particularly for ensuring food security in developing countries (Bandumula, 2018). Rice, being a key cereal crop, is highly susceptible to various abiotic stresses. These environmental factors disrupt essential physiological and biochemical processes, ultimately reducing rice grain yield (Rasheed *et al.,* 2020). Yield loss is a pressing issue in agriculture, especially as the world faces an increasing population and the need to secure food supplies (Duppala *et al.,* 2022). An estimated 23 million tons of cereal crops are lost annually, amounting to an economic loss of Rs 120 billion (Kumar *et al.,* 2022). Insect pests pose a significant threat to the yields of major staple crops like rice, maize, and wheat, with global yield losses projected to increase by 10 to 25% for each degree of global warming. These losses are expected to be more severe in regions where warming accelerates insect population growth and metabolism (Deutsch *et al.,* 2018).

While over 100 insect species are known to infest rice crops, around 20 of them cause significant economic damage. Some of the most widespread and destructive pests include stem borers, gall midges, leaf folders, brown planthoppers, white-backed planthoppers, and green leafhoppers (Samrit *et al.,* 2018). Although various pest management techniques have been developed, insecticides remain a primary control method. However, the heavy reliance on chemical insecticides has led to the resurgence of certain primary and secondary pests, along with the development of insecticide-resistant populations. The present study assesses the effectiveness of insecticides combined with neem-based products in managing rice pests (Reddy *et al.,* 2022). Given these challenges, it is crucial to explore effective plant-based solutions to reduce the use of insecticides in controlling major rice pests. Such practices can become key components of a more sustainable and efficient pest management strategy for rice crops.

MATERIAL AND METHODS

This study was carried out at the Agricultural Research Station in Ragolu, situated at 83.240° E longitude and 18.240° N latitude, with an elevation of 27 meters above mean sea level (MSL). The area receives an average annual rainfall of 1111 mm over 57 rainy days, typical of the North Coastal districts of Andhra Pradesh. The evaluation involved testing new insecticides in combination with botanicals, as recommended by ICAR-IIRR, using a randomized block design (RBD) on the BPT-5204 variety during the Kharif seasons of 2019, 2020, and 2021. The treatments (Table 1) were replicated three times, with plot sizes ranging from 20 to 25 square meters and a plant spacing of 20 x 15 cm, following the recommended fertilizer application rates of 120 kg N, 60 kg P2O5, 50 kg K2O and 50 kg ZnSO4 per hectare. Insect populations were monitored in the experimental fields and using light traps at 10-day intervals to determine the optimal timing for insecticide application. Counts of silver shoots and dead hearts were taken from 20 plants using stratified random sampling 15 days after each treatment, along with total tiller counts. The same method was used to assess white ears at pre-harvest, alongside total production tillers. Additionally, grain yield per plot was recorded at harvest. The collected data was analyzed statistically, and an F-Test was conducted using R software version 4.2.1 to determine the best-performing treatment combinations.

RESULTS AND DISCUSSION

Utilization of insecticides still continues to be an integral part of insect pest management strategy in rice. There is every need to test the new molecules of insecticides especially combination products to assess their spectrum of efficiency. The trial is conducted to study the efficacy of new insecticide molecules (Rathee and Dalal 2018). So far, the major emphasis has been to use the insecticides effectively at low dosagesand specific to a pest or a group of pests. For instance, neonicotinoids are effective against sucking pests but with low efficiency against Leaf folder and stem borer. On the other hand, synthetic pyrethroids are good against Leaf folder but usually cause resurgence of plant hoppers. Therefore, the emphasis during this year has been on evaluation of new molecules of insecticides as well as in combination with bio-pesticide products (Chander *et al.,* 2018).

During *kharif*, 2019, (Table 2) percent of silver shoots ranged from 0.15 in Neemzal 1%EC 25-30 DAT + Eucalyptus oil 45-50 DAT + Cartap hydrochloride 50%SC 60-65 DAT to 0.77 inuntreated control, percent of dead hearts varied from 0.14 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 0.99 in untreated control, percent of damaged leaves varied from 0.65 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50% SC50-55 DAT + Triflumezopyrim 65-70 DAT to 7.18 in untreated control, percent of white ear heads varied from 0.73 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50% SC50-55 DAT + Triflumezopyrim 65-70 DAT to 4.97 in untreated control and with reference to BPH and WBPH populations number varied from 37.83 & 56.50 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50% SC50-55 DAT + Triflumezopyrim 65-70 DATto 56.00 & 68.50 in untreated control. However, grain yield was ranged from 12.16 in untreated control to 14.21 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride50%SC50-55 DAT + Triflumezopyrim 65-70 DAT(Kg/plot). Further, among five treatments, spray of Chlorantraniliprole 0.4G 25-30 DAT+ Cartap hydrochloride 50% SC50-55 DAT+ Triflumezopyrim 65-70 DAT resulted in lower per cent of damaged leaves (2.81 and 1.35 at 30 and 50 DAT, respectively) and white ears at pre-harvest (0.73%), lower incidence of BPH (32.50, 40.25 and 40.75/hill at 30, 50 and 75 DAT, respectively) and WBPH(28.75, 51.25 and 56.50 no./hill at 30, 50 and 75 DAT, respectively) and higher grain yield of 14.21 kgs/ plot ($25m^2$) followed by Neemzal 1%EC 25-30 DAT + Eucalyptus oil 45-50 DAT + Cartap hydrochloride 50%SC 60-65 DAT and were almost on par with each other, Similar effective combination was identified by Horgan and Penalver-Cruz, 2022 in their studies on compatibility of insecticides with rice resistance to planthoppers as influenced by the timing and frequency of applications.

During *kharif*, 2020, (Table 3) percent of silver shoots ranged from 0.16 in Neemzal 1%EC 25-30 DAT + Eucalyptus oil 45-50 DAT + Cartap hydrochloride 50%SC 60-65 DAT & Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50% SC50-55 DAT + Triflumezopyrim 65-70 DAT to 0.44 in Untreated control, percent of dead hearts varied from 0.08 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 0.34 in untreated control, percent of damaged leaves varied from 1.35 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 4.22 in untreated control, percent of white ear heads varied from 0.26 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 3.49 in untreated control and with reference to BPH and WBPH populations number varied from 40.75&11.25 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 49.25&36.25 in untreated control. However, grain yield was ranged from 10.00 in untreated controlto 17.38 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50%SC50-55 DAT + Triflumezopyrim 65-70 DAT (Kg/plot). Further, among five treatments, spray of Chlorantraniliprole 0.4G 25-30 DAT+ Cartap hydrochloride 50%SC50-55 DAT+ Triflumezopyrim 65-70 DAT resulted in lower per cent of damaged leaves (0.48 and 0.65 at 30 and 50 DAT, respectively) and white ears at pre-harvest (0.26%), lower incidence of BPH (18.75 no./hill at 75 DAT) and WBPH (11.25no./hill at 75 DAT) followed by Neemzal 1%EC 25-30 DAT + Eucalyptus oil 45-50 DAT + Cartap hydrochloride 50%SC 60-65 DAT and were almost on par with each other, On the basis of grain yield of different treatments it was observed that, There is no significant difference was observed among the treatments, but significantly superior over control plot, Renuka *et al.* (2020) in their studies on efficacy of some biointensive and insecticides based IPM modules against rice plant hopper in coastal Odisha identified the similar management strategy as effective.

During *kharif*, 2021, (Table 4) percent of silver shoots ranged from 0.05 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50% SC50-55 DAT + Triflumezopyrim 65-70 DAT to 3.00 in Untreated control, percent of dead hearts varied from 1.30 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 3.80 in untreated control, percent of damaged leaves varied from 0.33 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 3.60 in untreated control, percent of white ear heads varied from 1.60 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 8.90 in untreated control and with reference to BPH and WBPH populations number varied from 16.00&7.20 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride50%SC50-55 DAT + Triflumezopyrim 65-70 DATto 52.20&35.30 in untreated control. However, grain yield was ranged from 5155 in untreated control to 7368 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50% SC50-55 DAT + Triflumezopyrim 65-70 DAT (Kg/ha). Further, among five treatments, in the Insecticide-Botanicals Evaluation Trial (IBET), spraying of Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50%SC 50-55 DAT + Triflumezopyrim 65-70 DAT resulted in lower per cent of damaged leaves and white ears at pre-harvest, lower incidence of BPH & WBPH and higher grain yield of 73.68 q/ha followed by spray of Neemzal 1%EC 25-30 DAT +Eucalyptus oil 45-50 DAT + Cartap hydrochloride 50% SC 60-65 DAT with grain yield of 68.68 q/ha. Sardar,*et al.,*2019 in their studies on, Time oriented mortality of brown planthopper, *Nilaparvata lugens* by some new chemistry insecticides had identified the similar results.

Effectiveness of Neemzal 1% on pests of paddy were also noted by (Choudhary *et al.,* 2017) on yellow stem borer, (Longkumer and Misra, 2020) on green paddy leafhopper, rice hispa, rice leaffolder, (Kumari and Prasad 2020) on gall midge, (Kaur *et al.,* 2022) on brown plant hopperand on yellow stem borer and leaf folder (Paramasiva *et al.,* 2021); Neem oil on yellow stem borer (Madhu *et al.,* 2020), on storage and crop pests (Kambrekar *et al.,* 2022) and other major pests (Jena *et al.,* 2022); Eucalyptus oil on , yellow stem borer, brown plant hopper, white backed plant hopper (WBPH), gallmidge (Seni, 2019), on storage grain pests (Mohammed and Nasr,2020) and storage pests (Kathirvelu*et al.,* 2020); Chlorantraniliprole on leaf folder, yellow stem borer (Sabitha *et al.,* 2022) and brown planthopper (Reddy *et al.,* 2022); Cartap hydrochloride on yellow stem borerand rice leaf folder (Samanta *et al.,* 2020) on leaf folder and BPH (Mohapatra *et al.,* 2022) and rice Gundhi Bug (Padhan and Raghuraman, 2018); Triflumezopyrim on Leaf folder and Yellow stem borer (Thorat*et al.,* 2019) and rice planthoppers, *Nilaparvata lugens* and *Sogatella furcifera* (Jun *et al.,* 2020).

Mean data of 2019, 2020 and 2021 (Table 5) revealed that, percent of silver shoots ranged from 0.09 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 1.40 in untreated control, percent of dead hearts varied from 0.51 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 1.71 in untreated control, percent of damaged leaves varied from 0.78 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 5.00 in untreated control, percent of white ear heads varied from 0.86 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 5.80 in untreated control and with reference to BPH and WBPH populations number varied from 31.53& 25.00 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50%SC50-55 DAT + Triflumezopyrim 65-70 DAT to 52.48& 46.48 in untreated control. However, grain yield was ranged from 4673 in untreated controlto 6668 in Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50%SC50-55 DAT + Triflumezopyrim 65-70 DAT (Kg/ha). Further, among the five treatments in Insecticide-Botanicals Evaluation Trial (IBET) trial spraying of Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50%SC 50-55 DAT + Triflumezopyrim 65-70 DAT resulted in lower per cent of damaged leaves and white ears at pre-harvest, lower incidence of BPH & WBPH and higher grain yield of 6668 q/ha followed by spray of Neemzal 1%EC 25-30 DAT + Neem oil 45-50 DAT+ Triflumezopyrim 60-65 DAT with grain yield of 5943 q/ha. All the treatments recorded lower per cent of damaged leaves and white ears at pre-harvest, lower incidence of BPH & WBPH and higher grain yield and significantly superior to control.

Table 1: Treatment Details.

Treatment No.	Botanicals &/Insecticide	Dose
T1	Botanical-insecticides Neemzal 1%EC 25-30 DAT Eucalyptus oil 45-50 DAT Cartap hydrochloride 50%SC 60-65 DAT	 2.0 ml 2.0 ml 2.0 g
T2	Botanical-insecticides Neemzal 1%EC 25-30 DAT Neem oil 45-50 DAT Triflumezopyrim 60-65 DAT	 2.0 ml 10.0 ml 0.48 ml
T3	All botanicals Neemzal 1%EC 25-30 DAT Eucalyptus oil 45-50 DAT Neem oil 60-65 DAT	 2.0 ml 2.0 ml 10.0ml
T4	All insecticides Chlorantraniliprole 0.4G 25-30 DAT Cartap hydrochloride 50%SC50-55 DAT Triflumezopyrim 65-70 DAT	 1.0 g/m^2 2.0 g 0.48ml
T5	Untreated control (Water spray)	--

Table 2: Efficacy of botanicals & insecticides on insect pests of paddy during *kharif*, 2019.

	50 DAT			BPH /10 hills	WBPH/10 hills	% WE at pre-harvest	Grain yield (Kg/plot) (25m^2)
	% SS	%DH	% DL	75 DAT	75 DAT		
T1	0.15 [1.57]^a	0.38 [3.02]^{abc}	1.97 [7.85]	45.75 (6.80)^b	60.00 (7.77)	0.84 [5.16]^{ab}	5520^{ab}
T2	0.32 [2.76]^{ab}	0.56 [4.16]^{bcd}	3.23 [9.91]	46.42 (6.85)^b	63.25 (7.98)	1.12 [6.05]^{ab}	5196^{bc}
T3	0.57 [4.26]^b	0.65 [4.52]^{bcd}	5.54 [13.50]	49.08 (7.04)^b	66.00 (8.14)	1.48 [6.96]^b	5028^c
T4	0.07 [0.77]^a	0.14 [1.53]^a	0.65 [4.50]	37.83 (6.18)^a	56.50 (7.54)	0.73 [4.77]^a	5684^a
T5	0.77 [5.0]^b	0.99 [5.64]^d	7.18 [15.44]	56.00 (7.51)^c	68.50 (8.30)	4.97 [12.74]^c	4864^c
F- test	Sig.	Sig.	NS	Sig.	NS	Sig.	Sig.
CD (p=0.05)	2.3	2.38	3.43	0.45	0.75	2.27	0.87
CV%	15.59	14.8	23.08	4.28	6.11	20.65	4.30

Note: * Leaf damage by leaf folder,

Table 3: Efficacy of botanicals & insecticides on insect pests of paddy during *kharif*, 2020.

	50 DAT			BPH /10 hills	WBPH/10 hills	% WE at pre-harvest	Grain yield (Kg/plot) (25m^2)
	% SS	%DH	% DL	75 DAT	75 DAT		
T1	0.16 [1.65]^a	0.17 [1.67]^b	2.44 [8.80]^b	41.00 (6.44)^a	22.25 (4.75)^b	0.83 [4.99]^b	6000^a
T2	0.25 [2.48]^b	0.17 [1.66]^b	2.81 [9.54]^{bc}	42.50 (6.55)^{ab}	23.00 (4.83)^b	1.77 [7.57]^c	6252^a
T3	0.33 [2.81]^c	0.17 [1.66]^b	3.85 [11.23]^{cd}	46.00 (6.82)^{ab}	26.00 (5.13)^c	2.15 [8.37]^c	5752^a
T4	0.16 [1.65]^a	0.08 [0.81]^a	1.35 [6.68]^a	40.75 (6.42)^a	11.25 (3.39)^a	0.26 [2.52]^a	6952^a
T5	0.44 [3.72]^{cd}	0.34 [3.39]^c	4.22 [11.84]^d	49.25 (7.04)^b	36.25 (6.00)^c	3.49 [10.72]^d	4000^b
F- test	NS	NS	Sig.	Sig.	NS	Sig.	Sig.
CD (p=0.05)	2.74	2.67	1.84	0.51	1.13	2.33	5.34
CV%	72.23	94.21	12.42	4.96	16.15	23.49	11.58

Note: * Leaf damage by leaf folder,

Table 4: Efficacy of botanicals & insecticides on insect pests of paddy during *kharif*, 2021.

	50 DAT			BPH /10 hills	WBPH/10 hills	% WE at pre-harvest	Grain yield (Kg/ha.)
	% SS	%DH	%DL*	75 DAT	75 DAT		
T1	1.6 [7.2]cd	2.2 [8.6] ab	1.29 [6.5]cd	35.1 (5.9)abcd	26.9 (5.2) b	3.9 [11.5]d	6295d
T2	1.86 [7.2]c	3.6 [10.9] c	1.11 [5.9] c	31.9 (5.7)abc	25.00 (5.0) b	2.9 [9.9]bc	6380c
T3	0.17 [2.04]ab	2.9 [9.8] cd	0.57 [4.30]ab	29.3 (5.4)ab	22.00 (4.7) c	2.6 [9.3]b	6868b
T4	0.05 [0.87]a	1.3 [6.4] a	0.33 [3.26]a	16.0 (4.1)a	7.2 (2.7) a	1.6 [7.3]a	7368a
T5	3.0 [9.95]e	3.8 [11.2] e	3.60 [10.9]e	52.2 (7.4)abcde	35.3 (5.9) c	8.9 [17.4]e	5155e
F- test	Sig.	Sig.	Sig.	NS	NS	Sig.	Sig.
CD (p=0.05)	1.33	0.51	1.13	3.98	0.16	1.38	5.16
CV%	16.4	4.36	12.60	8.34	2.3	8.59	4.45

Note: * Leaf damage by leaf folder,

Table 5: Efficacy of botanicals & insecticides on insect pests of paddy during *kharif* (Mean of 2019, 2020and 2021).

	50 DAT			BPH /10 hills	WBPH/10 hills	% WE at pre-harvest	Grain yield (Kg/ha.)
	% SS	%DH	%DL*	75 DAT	75 DAT		
T1	0.64 [4.3]c	0.92 [5.2]b	1.90 [7.9]c	40.62 (6.4)abcd	36.38 (5.9) ab	1.86 [7.7]b	5938c
T2	0.81 [5.1] d	1.44 [6.9]cd	2.40 [9.07] d	40.27 (6.4)abc	37.08 (6.1)bc	1.93 [7.8]c	5943b
T3	0.36 [3.5]b	1.24 [6.5]c	3.32 [4.2]ab	41.46 (6.4)ab	38.10 (6.2)bcd	2.08 [8.1]d	5883d
T4	0.09 [1.3]a	0.51 [4.1]a	0.78 [3.2]a	31.53 (5.6)a	25.0 (5.0) a	0.86 [5.1]a	6668a
T5	1.40 [6.7]e	1.71 [7.6]e	5.00 [11.3]e	52.48 (7.3) e	46.48 (6.8) e	5.80 [13.9]e	4673e
F- test	**Sig.**	**Sig.**	**Sig.**	**NS**	**NS**	**Sig.**	**Sig.**
CD (p=0.05)	**1.03**	**0.89**	**1.32**	**0.25**	**0.50**	**0.74**	**122**
CV%	**17.05**	**10.11**	**12.70**	**2.61**	**6.31**	**5.98**	**11.5**

Note: * Leaf damage by leaf folder,

CONCLUSIONS

The three-year experimental trials demonstrated that among the five treatments in the Insecticide-Botanicals Evaluation Trial (IBET), the application of Chlorantraniliprole 0.4G at 25-30 DAT + Cartap hydrochloride 50% SC at 50-55 DAT + Triflumezopyrim at 65-70 DAT resulted in the lowest percentage of damaged leaves and white ears at pre-harvest, along with a reduced incidence of BPH and WBPH. This treatment also achieved the highest grain yield of 6668 q/ha. The next best treatment was Neemzal 1% EC at 25-30 DAT + Neem oil at 45-50 DAT + Triflumezopyrim at 60-65 DAT, which produced a grain yield of 5943 q/ha. All treatments showed significantly lower percentages of damaged leaves and white ears, reduced pest incidence, and higher grain yields compared to the control.

FUTURE SCOPE

Application of botanicals alone or botanical followed by insecticides against the pest complex as a whole to reduce the cost of insecticidal application to the farmer. Spraying of Chlorantraniliprole 0.4G 25-30 DAT + Cartap hydrochloride 50%SC 50-55 DAT + Triflumezopyrim 65-70 DAT was identified as potential combination in management rice pests in north coastal zone of Andhra Pradesh.

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Conflict of Interest. None.

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