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Research Article

ECOFRIENDLY PESTICIDES FOR THE MANAGEMENT OF INSECT PESTS IN ORGANIC RICE

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Abstract: Field experiments were conducted during *Rabi* 2015 and 2016 in TNAU, Coimbatore with the rice variety CO 51. Organic package of practices was followed throughout the crop period. Among ecofriendly pesticides tested for the management of major insect pests in rice, the NSKE (5%) application the registered the lowest GLH and BPH population with the better pest control efficiency of 58.05 and 56.74 per cent respectively, for GLH and BPH. Combination of neem oil and pungam oil each at one per cent also performed better against GLH, BPH in addition to stem borers with least dead heart 4.93%) and white ear (2.11%) symptoms. The entomopathogenic fungus *Beauveria bassiana* performed better against leaf folders with better pest control efficiency of 80.64 per cent.

Keywords: *Organic Rice, Insect pests, Eco-friendly approach, Botanicals*

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Introduction

Rice is the staple food crop for more than half the world's population. Introduction and wide adoption of high yielding varieties has led to severe incidence of insect pests in rice. Globally, the yield loss in rice due to infestation of insect pests is around 20%. For the control of these pests, chemical spray is most common practice. The indiscriminate use of synthetic insecticides can be environmentally disruptive and can result in elimination of beneficial insects and accumulation of residues in the harvested produce. Ecofriendly pesticides offer a technically feasible and environmentally acceptable strategy for controlling agronomically important insects [1]. Considering the need of eco-friendly approaches to manage the insect pests, a study is designed to determine the relative efficacy of different eco-friendly pesticides against major pests of organic rice.

Materials and Methods

Two field experiments were conducted during Rabi season with CO51 rice variety in Wetland paddy fields of Tamil Nadu Agricultural University, Coimbatore during 2015-16 and 2016-17. Before rice the green manure *Sesbania aculeata* was raised in the main field and *in-situ* incorporation was done 20 days before transplanting. For the management of insect pests, the designed treatments were imposed, pre and post treatment pest counts were taken and represented as per cent reduction over control (PROC). The treatments as detailed below were imposed.

Treatment details

T_1 - Neem oil (2%)
T_2 - Pungam Oil (2%)
T_3 - Neem oil (1%) + Pungam Oil (1%)
T_4 - NSKE (5%)
T_5 - Vasambu10% Dust @ 25kg/ha
T_6 - *Beauveria bassiana* (2%)
T_7 - Spinosad 45%SC @ 125ml/ha
T_8 - Untreated check

The packages of practices followed for cultivation of rice crop under organic production system is given hereunder.

Nursery practices

Seeds soaked with Pseudomonas fluorescens @ 10g/kg + Azospirillum @ 30g/kg + Phosphobacteria @ 30g /kg. Basal application of well decomposed FYM @ 1.25kg/m^2 + Neem cake @ 50 gm / m^2 + Trichoderma viride @ 4g/m^2. Gypsum application @ 100gm / m^2 at 10 days after sowing to prevent root snapping.

Main field practices

Green manure crop (*Sesbania acculeata*) cultivation and *in-situ* incorporation at 50% flowering stage. Basal application of neem cake @ 250 kg/ha. Basal application of gypsum @ 500 kg/ha (source of Ca and S) at time of last ploughing. Seedling root dip with Azospirillum (1kg/ha) + Phosphobacteria (1kg/ha) in 40 lit. of water for 15 - 30 minute before transplanting. Soil application of Azospirillum @ 2 kg + Phosphobacteria 2 kg mixed with 25 kg of FYM and applied before transplanting. Application of vermicompost @ 1000kg/ha each at active tillering, panicle initiation, heading stages. Foliar spraying of Panchakavya @ 30ml/lit. twice at 30 and 45 DAT as growth promoter. Need based application of liquid Pseudomonas fluorescens @ 2ml/lit. for foliar diseases.

Preparation of 5% NSKE

About 500g Neem seed kernel was ground and soaked in 10L of water. Allowed for 12 hours and filtered. In the extract Khadi soap solution was slowly added (10 ml/lit) and simultaneously stirred up to the disappearance of white turbid colour.

Preparation of oil emulsion (2%)

About 200 ml of neem / pungam oil was mixed with 100 ml of liquid khadi soap. The content was added in to 10 liters of water in 15 litre plastic container and stirred up to the disappearance of white turbid colour and used for the study.

Pest observation

GLH / BPH

The number of GLH and BPH in 10 randomly selected hills were counted and the mean value is calculated.

Table-1 *Effect of biorational pesticides on GLH population (no./hill) in organic rice*

Treatment	First year			Second year			Mean of 2 years			
	PT	7DAS	14DAS	PT	7DAS	14DAS	PT	7DAS	14DAS	PROC
T_1	3.22(1.79)	2.71(1.65)	2.50(1.58)	5.10(2.26)	3.23(1.80)	2.61(1.62)	2.86(1.69)	2.97(1.72)	2.56(1.60)	42.15(40.48)
T_2	3.54(1.88)	3.22(1.79)	2.76(1.66)	5.22(2.28)	3.61(1.90)	3.19(1.79)	3.15(1.77)	3.42(1.99)	2.98(1.59)	33.05(35.09)
T_3	3.40(1.84)	2.34(1.53)	2.12(1.46)	5.05(2.25)	2.84(1.69)	2.22(1.49)	2.76(1.66)	2.59(2.23)	2.17(2.14)	50.21(45.12)
T_4	3.33(1.82)	2.08(1.44)	1.54(1.24)	5.21(2.28)	2.55(1.60)	1.84(1.36)	2.44(1.56)	2.32(2.44)	1.69(2.36)	58.05(49.63)
T_5	3.29(1.81)	3.35(1.83)	3.36(1.83)	4.93(2.22)	4.47(2.11)	3.93(1.98)	3.33(1.82)	3.91(2.64)	3.65(2.56)	20.92(27.22)
T_6	3.42(1.85)	3.40(1.84)	3.39(1.84)	5.14(2.27)	5.25(2.29)	4.35(2.09)	3.41(1.85)	4.33(3.82)	3.87(2.75)	14.23(22.16)
T_7	3.18(1.78)	1.62(1.27)	2.07(1.44)	5.28(2.30)	3.26(1.81)	3.54(1.88)	2.63(1.62)	2.44(2.99)	2.81(2.93)	45.08(42.18)
T_8	3.41(1.85)	3.66(1.91)	3.91(1.98)	5.22(2.28)	5.63(2.37)	5.91(2.43)	3.66(1.91)	4.65(3.16)	4.91(3.09)	-
S Ed	0.11	0.16	0.11	0.24	0.25	0.25	0.11	0.21	0.18	-
CD(p=0.05)	NS	0.34	0.24	NS	0.54	0.53	NS	0.44	0.39	-

Table-2 *Effect of biorational pesticides on BPH population(no./hill) in organic rice*

Treatment	First year			Second year			Mean of 2 years			
	PT	7DAS	14DAS	PT	7DAS	14DAS	PT	7DAS	14DAS	PROC
T_1	2.91(1.71)	2.63(1.62)	2.22(1.49)	2.70(1.64)	2.06(1.44)	1.75(1.32)	2.57(1.60)	2.35(1.53)	1.99(1.24)	36.36(37.08)
T_2	2.62(1.62)	2.44(1.56)	2.36(1.54)	2.92(1.71)	2.21(1.49)	2.08(1.44)	2.49(1.58)	2.33(1.53)	2.22(1.41)	33.28(35.23)
T_3	2.45(1.57)	1.72(1.31)	1.54(1.24)	2.80(1.67)	1.75(1.32)	1.42(1.19)	2.00(1.41)	1.74(1.32)	1.48(1.49)	52.79(46.60)
T_4	2.56(1.60)	1.94(1.39)	1.27(1.13)	2.71(1.65)	1.44(1.20)	1.24(1.11)	1.92(1.39)	1.69(1.30)	1.26(1.22)	56.74(48.87)
T_5	2.59(1.61)	2.45(1.57)	2.63(1.62)	2.72(1.65)	2.28(1.51)	2.53(1.59)	2.61(1.62)	2.37(1.54)	2.58(1.12)	27.42(31.58)
T_6	2.45(1.67)	2.70(1.64)	3.08(1.75)	2.83(1.68)	3.33(1.82)	3.11(1.76)	2.77(1.66)	3.02(1.74)	3.10(1.61)	10.26(18.68)
T_7	2.38(1.54)	2.16(1.47)	2.05(1.43)	2.94(1.81)	1.31(1.14)	1.10(1.05)	2.22(1.49)	1.74(1.32)	1.58(1.76)	51.32(45.76)
T_8	2.58(1.61)	2.93(1.71)	3.21(1.79)	2.92(1.71)	3.57(1.89)	3.93(1.98)	2.90(1.70)	3.25(1.80)	3.57(1.26)	-
S Ed	0.07	0.08	0.11	0.19	0.18	0.25	0.09	0.13	0.18	
CD (p=0.05)	NS	0.17	0.24	NS	0.39	0.53	NS	0.28	0.39	

Stem borer

The observations on stem borer damage were recorded in 10 randomly selected hills at vegetative and reproductive stages [2]. The per cent dead heart and white ears was calculated as detailed below.

Per cent dead heart = [Number of tillers with dead heart / Total number of tillers] x 100

Per cent white ear = [Number of white ears / Total number of panicles]x 100

Leaf Folder

The observations on leaf folder damage were recorded in 10 hills at random and the total number of leaves and damaged leaves (consider as damaged leaf only if one-third of the leaf area is damaged) were counted. The per cent damage was calculated as detailed below.

Per cent damage = [Number of damaged leaves / Total number of leaves in 10 randomly selected hills] x 100

Results and Discussion

Green leaf Hopper (GLH)

The GLH population in the pre-treatment count was more during second year when compared to first crop [Table-1]. The mean pre-treatment count ranged from 2.44 to 3.66 nos. per hill. At 7 DAS, the mean GLH count was the lowest (2.32/hill) in NSKE 5% applied treatment when compared to untreated check (4.65 nos./hill). The next best treatment was combined application of neem oil (1%) and pungam oil (1%) with the pest load of 2.59 nos./hill when compared to standard check (Spinosad). At 14 DAS also, the mean GLH population was lowest (1.69 nos./hill) in NSKE (5%) applied plots followed by neem oil (1%) and pungam oil (1%) oil combination sprayed treatment (2.17 mos./hill) which were on par with standard check, spinosad (T7). The untreated check (T8) registered the highest GLH population of 4.91 nos./hill [3].

The PROC was more (58.05) in NSKE (5%) applied plots followed by neem oil (1%) + pungam oil (1%) with the PROC of 50.21. Whereas, the lowest PROC of 14.23 was registered in untreated control. The better control of GLH with the combined application of neem oil (1%) and pungam oil (1%) might be due to synergetic, antifeedant and growth inhibitory effects of neem in combination with pungam oil and which was in accordance with the findings in rice crop [4].

Brown plant hopper (BPH)

The mean BPH population in the pre-treatment counts ranged from 2.38 to 2.91 nos./hill. Whereas, in the post treatment count taken at 7 DAS, the lowest BPH population of 1.69 nos./hill was noticed in NSKE 5 % applied treatment which was on par with neem oil (1%) + pungam oil (1%) applied treatment (1.74 nos./hill). At 14 DAS also, the foliar spraying of NSKE @ 5% recorded the lowest BPH population of 1.26 nos./hill which was on par with neem oil (1%) + pungam oil (1%) applied treatment with the BPH count of 1.48 nos./hill [Table-2] [5].

The PROC was more (56.74) in NSKE (5%) applied treatment followed by neem oil (1%) + pungam oil (1%) application (52.79) and the standard check (51.32). The superior efficacy of NSKE against BPH could be due to its Juvenile hormone minic activity which leads to their reduced emergence which was in accordance with the findings of Ramraju and Sundarababu, (1989) [6].

Stem borer

The dead heart and white ear damage symptoms respectively, during vegetative and flowering stages of the rice crop was counted and the damage per cent was calculated and given in [Table-3]. The both dead heart and white ear symptoms were more during second year when compared to the first year. The mean dead heart per cent was less (3.60) in spinosad applied plots followed by NSKE @ 5% sprayed plots (4.07) and combined application of neem oil @ 1% and pungam oil @ 1% (4.93).

The PORC was more (59.9%) in NSKE @ 5% application followed by combine application of neem and pungam oils each at one per cent (51.43%). The same trend was observed in white ear damage symptoms also with the PROC of 64.10% in NSKE and 58.38% in combined application of neem oil one per cent and pungam oil one per cent. The better control of stem borers with neem and pungam derivatives might be due to the presence of biologically active compounds in neem (azadirachtin, nimbin, nimbidin and nimbolides) and pungam (kanjone, kanugin, karangin, neoglabrin, pinnatin, pongamol, pongapin, quercitin, saponin which was corroborated with the findings in rice [7].

Leaf folder

The leaf folder incidence [Table-4] of the experimental field was more (5.63-12.17%) during the first year compared to second year crop, where the damage level was in the range of 4.64-7.35 per cent only. In first year, the pre-treatment damage per cent was ranged from 5.63 to 5.80 per cent. Whereas, in post treatment count at 7 DAS, the per cent leaf damage was minimum (2.54) in Spinosad application which was on par with 2% *Beauveris bassiana* (2.92) and 5% NSKE application (2.97). Whereas, at 14 DAS the Spinosad application was on par with 2% *B. bassiana* (2.07%), 5% NSKE (2.12%) and Neem oil (1%) + Pungam oil (1%) applied treatments (2.28%).

Table-3 *Effect of eco-friendly pesticides against stem borers in organic rice*

Treatment	First year		Second year		Mean of 2 years		PROC	
	Dead heart	White ear	Dead heart	White ear	Dead heart	White ear	Dead heart	White ear
T_1	4.50(5.10)	1.87(1.88)	6.70(2.58)	3.25(1.79)	5.70(2.48)	2.61(1.61)	43.84(41.46)	48.52(44.15)
T_2	4.77(4.90)	1.88(1.18)	7.22 (2.68)	3.84(1.95)	6.15(2.56)	3.06(1.70)	39.41(38.89)	39.64(39.02)
T_3	4.27(5.21)	1.18(1.87)	5.31(2.30)	2.93(1.70)	4.93(2.31)	2.11(1.42)	51.43(45.82)	58.38(49.82)
T_4	3.61(3.80)	1.04(1.04)	4.15(2.02)	2.4 5(1.55)	4.07(2.09)	1.82(1.34)	59.90(50.71)	64.10(53.19)
T_5	7.11(6.40)	3.33(3.33)	10.60(3.25)	4.64(2.14)	8.92(3.08)	4.14(1.78)	12.12(20.37)	18.34(25.36)
T_6	6.22(5.80)	2.32(2.32)	9.35(3.05)	4.33 (2.37)	7.94(2.57)	3.45(1.84)	21.77(27.81)	31.95(34.42)
T_7	3.31(3.08)	1.25(1.25)	3.73(1.92)	1.70 (1.30)	3.60(1.90)	1.62(1.36)	64.53(53.45)	68.05(55.58)
T_8	8.15(7.89)	3.75(3.75)	11.44(3.38)	5.82 (2.41)	10.15(3.26)	5.07(2.23)	-	-
S Ed	0.45	0.35	0.49	0.24	0.52	0.23	-	-
CD (p=0.05)	0.96	0.76	1.05	0.51	1.11	0.49	-	-

Table-4 *Effect of eco-friendly pesticides against leaf folder in organic rice*

Treatment	First year			Second year			Mean of 2 years			
	PT	7DAS	14DAS	PT	7DAS	14DAS	PT	7DAS	14DAS	PROC
T_1	5.63(2.53)	3.18(1.61)	2.53(1.25)	4.91(2.21)	3.84(1.95)	3.63(1.89)	5.27(2.37)	3.51(1.78)	3.08(1.57)	68.44(55.82)
T_2	6.05(2.56)	3.37(1.56)	3.52(1.59)	5.20(2.28)	4.57(2.11)	4.86(2.19)	5.63(2.42)	3.97(1.84)	4.19(1.89)	57.07(49.06)
T_3	5.90(2.68)	3.13(1.70)	2.28(1.34)	4.82(2.19)	3.33(1.81)	2.90(1.70)	5.36(2.44)	3.23(1.76)	2.59(1.52)	73.46(58.99)
T_4	5.66(2.61)	2.97(1.68)	2.12(1.31)	4.64(2.14)	3.05(1.73)	2.52(1.56)	5.15(2.38)	3.01(1.71)	2.32(1.44)	76.23(60.82)
T_5	5.92(2.56)	4.33(1.78)	3.48(1.44)	5.31(2.30)	4.92(2.01)	4.25(1.71)	5.62(2.43)	4.63(1.90)	3.87(1.60)	56.80(48.91)
T_6	5.96(2.67)	2.92(1.78)	2.07(1.57)	4.92(2.21)	2.64(1.61)	1.71(1.30)	5.44(2.44)	2.78(1.70)	1.89(1.44)	80.64(63.90)
T_7	6.08(2.71)	2.54(1.79)	1.69(1.39)	5.02(2.24)	1.94(1.37)	1.42(1.17)	5.55(2.48)	2.24(1.58)	1.56(1.28)	84.07(66.48)
T_8	5.80(2.55)	7.72(3.01)	12.17(4.45)	5.15(2.26)	6.48(2.53)	7.35(2.69)	5.48(2.41)	7.10(2.77)	9.76(3.57)	-
S Ed	0.31	0.22	0.52	0.34	0.41	0.64	0.33	0.32	0.61	-
CD(p=0.05)	NS	0.48	0.72	NS	0.88	1.37	NS	0.68	1.31	-

In second year, the pre-treatment damage was in the range of 5.27-5.63 per cent. Whereas, in post treatment count at 7 DAS, foliar spraying of Spinosad recorded the lowest damage (2.24%) which was at par with *Beauveria bassiana* (2.78%). The next best treatment was application of 5% NSKE with 3.01% damage which was also on par with combined application of neem oil (1%) + pungam oil (1%) (3.23%) and neem oil alone (3.51%). At 14 DAS, also the standard check (Spinosad) recorded the lowest damage of 1.56 per cent, but which was on par with *Beauveria bassiana* (1.89), 5% NSKE (2.32%) and combination of neem oil (1) and pungam oil (1%) application (2.69%) [8].

The per cent reduction over control was more during first year crop when compared to the second-year crop. The PROC was better in *Beauveria bassiana* applied treatments this might be due to the prevalence of favourable weather conditions for better performance of entomopathogenic fungus during winter (Rabi) season. Among the botanicals, the mean PROC more (76.23%) in NSKE (5%) followed by one per cent each of neem and pungam oil (76.43%), 2% neem oil alone (68.44%), 2% pungam oil alone (57.07%) and vasambu 10% D (56.80%). These findings are similar to those of Bajya and Ranjith (2018) [9] who proved the effectiveness of *Beauveria bassiana* against rice leaf folder [10].

Conclusion

After taking two years studies on the eco-friendly management of major insect pests in rice, it can be to concluded that, the NSKE (5%) and combination of neem oil (1%) and pungam oil (1%) were most effective against GLH, BPH and stem borers with more than 50% reduction over control. The performance of *Beauveria bassiana* was also better for the management of rice leaf folders with 80% PROC. More over these eco-friendly pesticides have proved their safety to the natural enemies of pests under rice ecosystems. The rice grains produced through this approach also free from insecticide residues and there is a greater scope safe rice production, supply and export.

Application of research: Study of ecofriendly pesticides for the management of insect pests in organic rice

Research Category: Pest Management

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University: Tamil Nadu Agricultural University, Coimbatore, 641003, India
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Study area / Sample Collection: Agricultural Research Station, Bhavanisagar, 638 451

Cultivar / Variety / Breed name: Rice

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References

[1] Aktar W., Sengupta D. and Chowdhury A. (2009) *Interdiscipl Toxicol*, 2, 1-12.
[2] Gomez K.A. and Bernardo R.C. (1974) *J.Econ. Entomol*., 67, 509-513.
[3] Adhikari B., Padhi J. and Sthitapragyan S. (2019) *J. of Entomol. and Zoology Studies*, 7(2), 194-197.
[4] Rajappan K., Ushamalini C., Subramanian N. and Abdul Kareem, A. (2000) *Phytoparasitica*. 15(10), 15-19.
[5] Samrit R.M., Chaudhari B.N., Chopkar P.S. Shelke S.B. and Uparkar A.L. (2020) *J. of Entomol. and Zoology Studies*, 8(6), 1893-1897.
[6] Ramraju K. and Sundarababu P. (1989) *International Rice Research Newsletter*, 1(2), 14.
[7] Kaul B.K. and Sharma P.K. (1999) *J. Ent. Res*, 23, 377-379.
[8] Upesh Kumar (2017) *Int. J. Plant Protection*, 10 (1), 21-25.
[9] Rao N.S., Rajendran R. and Raguraman S. (2002) *J. Ent. Res*., 26, 233-238.
[10] Bajya D.R. and Ranjith M. (2018) *Indian Journal of Entomology*, 80(1), 68-72.