



## Original Research Article

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## Bio-Efficacy and Economics of Effective Dose of Combination and Alone of Insecticides against Insect-Pests of Rice

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### ABSTRACT

#### Keywords

Rice, Leaf folder, Stem borer, Insecticides and bio-efficacy

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Bioefficacy of combination insecticide, Rokat- 44% EC (Profenofos- 40% + Cypermethrin- 4%), a product of Pesticides Industries Ltd. Gurgaon, Haryana was evaluated at three doses 500, 750 and 1000 ml/ha along with four different insecticides against stem borer and leaf folder infesting rice under irrigated conditions at Agricultural Research Station (Agriculture University), Kota, Rajasthan. The results revealed that Rokat 44 % EC (Profenofos 40% + Cypermethrin 4%) @ 1000ml/ha was found significantly superior among all the treatments to control leaf folder (*Cnaphalocrocis medinalis* Guenee) and stem borer (*Scripophaga incertulas* Walker) pests of Rice with higher grain yield. The next treatments in order of efficacy were Profenofos 50 EC @ 1000 ml/ha and Acephate 75 SP @ 1000 g/ha.

### Introduction

Rice, *Oryza sativa* L., is the most important food crop of India and one of the major constraints of rice production in India is the occurrence of insect pests at various stages of crop growth, about 40 per cent losses in yield and the monetary value of these losses has been estimated in the tune of rupees 29,000 million (Gupta and Raghuraman, 2003). Besides stem borer complex, in recent year's leaf folder and plant hoppers have assumed major pests causing considerable damage to the rice crop. The rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) is an important pest during mid tillering stage in almost all rice growing countries of Asia (Khan *et al.*, 1988). Reports showed that

severe infestation of this pest ranged from 60-70 percent leaf damage and significant yield losses (Srivastava, 1989). Damage during vegetative phase (50 per cent) contributed more to yield reduction than the reproduction (30 per cent) or ripening phase (20 per cent) (Gupta and Raghuraman, 2003).

To manage all the pests attacking at different phases of crop growth, various scientists recommended different insecticides separately or in combination for leaf folder and stem borer, Buprofezin, an insect growth regulator and chitin synthesis inhibitor is especially effective against homopteran pests, such as plant hoppers (Wang *et al.*, 2008). The combination products with molecules of various groups of insecticides have wider

scope for effective check on the whole pest spectrum attacking rice crop. Accordingly, the recent thrust is to evaluate and select suitable combination products for each pest situation depending on the spectrum of toxicity of these individual compounds. Therefore, a combination product comprising of Profenofos-40%+ Cypermethrin-4% (Roket-44% EC) developed by M/s Pesticides Industries Ltd. Gurgaon, Haryana was tested against insect-pests infesting rice under humid climatic conditions of Rajasthan.

### Materials and Methods

Field experiments were conducted at Agricultural Research Station (Agriculture University), Kota, Rajasthan for two consecutive seasons during *Kharif* 2013 and 2014. The cultivar Pusa Sugandha-4 was transplanted at 25-30 days old seedling in a plot size of 5.0 m x 3.0 m with a spacing of 25 x 25 cm row to row and plant to plant. Nine treatments were taken including four insecticide molecules with Acephate as standard check and an untreated control with three replications in randomized block design. The test insecticides viz., Roket-44 % EC (Profenofos 50% + Cypermethrin 4%) @ 500, 750 and 1000 ml/ha were compared with recommended insecticides Profenofos -50 EC @ 1000 ml/ha; Cypermethrin -10 EC @ 500 ml/ha and Lambda-cyhalothrin 5% EC @ 250 ml/ha whereas Acephate also taken at two doses 1000 and 500 gm/ha. Two sprays were made at 25<sup>th</sup> and 45<sup>th</sup> days after transplanting of seedlings with Knapsack sprayer. Observations were recorded one day before and 7<sup>th</sup> and 15<sup>th</sup> day after application of insecticide on the basis of count taken on number of dead heart at vegetative stage and white ears at reproductive stage and total number of tillers/panicles from 10 selected hills for yellow stem borer (*Scirpophaga incertulas*). The per cent incidence was calculated by using following formula.

$$\text{Per cent Incidence} = \frac{\text{Number of dead heart/white ears}}{\text{Total number of tillers/panicles}} \times 100$$

Similarly, observations on leaf folder (*Cnaphalocrocis medinalis*) damage were recorded one day before application of insecticide on randomly selected 10 hills. After pre application of observations, the damaged leaves were removed. Further, after 7<sup>th</sup> and 15<sup>th</sup> days after each application, leaf damage incidence was recorded and converted in to per cent leaf damage based on damaged leaves and total leaves from 10 randomly selected hills. The per cent of leaf damage was calculated by using following formula.

$$\text{Per cent of leaf damage} = \frac{\text{Number of damage leaves}}{\text{Total number of leaves}} \times 100$$

Grain yield was recorded plot wise and converted into q/ha for each treatment. The data on percent incidence of dead heart/white ears by stem borer and percent leaf damage by leaf folder and grain yield at harvest was subjected to the statistical analysis after appropriate transformation.

### Results and Discussion

#### Efficacy against leaf folder

As evident from Table 1, all the treatments were found significantly superior over control after 7 and 15 days of spray of application. The treatment Roket 44EC @ 1000 ml/ha was found superior with lowest percent leaf damage at 7 and 15 days of spray application. The next treatment in order of efficacy were Profenofos 50 EC @ 1000 ml/ha alone and Acephate 75 SP @ 1000 g/ha at both interval in both spray, which is statistically at par followed by Roket 44 EC @750 ml/ha, Cypermethrin 10 EC @ 500 ml/ha Acephate 75 SP @ 500 g/ha and Lambda-cyhalothrin 5

EC @ 250 ml/ha. The treatment Rokat 44 EC @ 500 ml/ha was found lowest in efficacy in both spray at 7 and 15 days interval. The leaf folder infestation in control plot was observed in increasing order in both sprays at different intervals. The effectiveness of combination

product Profenofos 40% + Cypermethrin 4 % against leaf folder in present study corroborate with findings of Bhavani (2006), Sontakke and Mahapatra (2014) testing of combination insecticides, buprofezin + deltamethrin against leaf folder of rice.

**Table.1** Bio-efficacy of Rokat 44% EC (Profenofos 40% + Cypermethrin 4%) against leaf folder of rice and grain yield (mean of *Kharif* 2013 and 2014)

S. No.	Treatments	Percent leaf damage						Grain Yield (q/ha)
		1 <sup>st</sup> Spray			2 <sup>nd</sup> Spray			
		1DB	7 DA	15 DA	1DB	7 DA	15 DA	
1.	Rokat 44% EC @ 500 ml/ha	15.90 (23.90)	17.20 (24.50)	21.10 (27.35)	22.03 (28.00)	23.33 (28.88)	26.53 (31.00)	35.74
2.	Rokat 44% EC @ 750 ml/ha	14.93 (22.73)	16.90 (24.27)	19.23 (26.01)	20.20 (26.71)	20.17 (26.68)	24.10 (29.40)	39.20
3.	Rokat 44% EC @ 1000 ml/ha	15.77 (23.40)	16.73 (24.15)	17.30 (24.58)	18.10 (25.18)	18.80 (25.70)	21.80 (27.83)	41.48
4.	Profenofos 50% EC 1000 ml/ha	16.53 (23.99)	16.77 (24.17)	18.03 (25.13)	18.47 (25.45)	18.93 (25.79)	22.70 (28.45)	40.42
5.	Cypermethrin 10% EC @ 500 ml/ha	15.90 (23.50)	16.97 (24.32)	19.23 (26.01)	24.03 (29.36)	21.00 (27.27)	24.47 (29.65)	36.07
6.	Acephate 75% SP 500 g/ha	16.33 (23.84)	17.00 (24.35)	19.40 (26.13)	26.63 (31.07)	21.17 (26.88)	24.67 (29.75)	37.38
7.	Acephate 75% SP 1000 g/ha	16.27 (23.79)	16.83 (24.22)	18.43 (25.43)	21.33 (27.51)	19.27 (26.04)	23.97 (29.31)	39.71
8.	Lambda-cyhalothrin 5% EC 250 ml/ha	14.90 (22.71)	17.23 (24.37)	19.43 (26.16)	24.03 (29.36)	22.43 (28.27)	25.57 (30.37)	36.23
9.	Untreated control	15.90 (23.50)	22.83 (28.54)	29.67 (33.00)	35.03 (36.29)	43.27 (41.13)	54.33 (47.49)	32.40
	S Em±	0.56	0.31	0.51	0.64	0.52	0.46	0.54
	C D at 5%	NS	0.93	1.54	1.96	1.59	1.40	1.65

DA: Days After, DB: Days Before

Figures in parenthesis are angular transformed values

**Table.2** Bio-efficacy of Rokat 44% EC (Profenofos 40% + Cypermethrin 4%) against stem borer of rice (mean of *Kharif* 2013 and 2014)

S. No.	Treatments	Percent dead heart						Percent white ears (70 DAT)
		1 <sup>st</sup> Spray			2 <sup>nd</sup> Spray			
		1DB	7 DA	15 DA	1DB	7 DA	15 DA	
1.	Rokat 44% EC @ 500 ml/ha	4.15 (11.75)	4.37 (12.07)	5.15 (13.11)	5.31 (13.32)	5.96 (14.13)	6.74 (15.05)	6.63 (14.92)
2.	Rokat 44% EC @ 750 ml/ha	4.14 (11.74)	4.22 (11.86)	4.37 (12.06)	5.11 (13.07)	5.00 (12.92)	5.45 (13.50)	5.75 (13.87)
3.	Rokat 44% EC @ 1000 ml/ha	3.71 (11.10)	3.86 (11.33)	3.89 (11.38)	3.95 (11.46)	4.11 (11.70)	4.59 (12.37)	5.09 (13.04)
4.	Profenofos 50% EC 1000 ml/ha	3.59 (10.92)	3.88 (11.36)	4.02 (11.56)	5.01 (12.94)	4.45 (12.18)	5.17 (13.15)	5.43 (13.47)
5.	Cypermethrin 10% EC @ 500 ml/ha	4.12 (11.71)	4.31 (11.98)	4.84 (12.70)	5.31 (13.32)	5.21 (13.20)	5.93 (14.10)	5.96 (14.13)
6.	Acephate 75% SP 500 g/ha	4.26 (11.92)	4.22 (11.88)	4.80 (12.64)	6.83 (15.15)	5.15 (13.12)	5.52 (13.59)	5.75 (13.87)
7.	Acephate 75% SP 1000 g/ha	3.87 (11.35)	3.99 (11.52)	4.33 (12.01)	4.20 (11.82)	4.84 (12.71)	5.32 (13.31)	5.63 (13.73)
8.	Lambda cyhalothrin 5% EC 250 ml/ha	4.26 (11.92)	4.33 (12.01)	4.84 (12.71)	8.50 (16.95)	5.65 (13.75)	6.20 (14.41)	5.99 (14.17)
9.	Untreated control	4.00 (11.54)	5.76 (13.89)	7.57 (15.97)	9.52 (17.97)	15.65 (23.31)	21.22 (27.43)	24.46 (29.64)
	S Em±	0.20	0.19	0.23	0.34	0.38	0.22	0.23
	C D at 5%	NS	0.59	0.70	1.03	1.16	0.66	0.70

DA: Days After, DB: Days Before, DAT: Days After Transplanting  
 Figures in parenthesis are angular transformed values

**Table.3** Economics and Incremental Benefit Cost Ratio of insecticides in Rice (mean yield of *Kharif* 2013 and 2014)

S. No.	Treatments	Mean Yield (q/ha)	Additional yield over control (q/ha)	Gross Return (Rs)	Cost of insecticides (Rs)	Net Return (Rs.)	ICB R
1	Roket 44% EC @ 500 ml/ha	35.74	3.34	7682/-	310/-	7372/-	<b>23.78</b>
2	Roket 44% EC @ 750 ml/ha	39.20	6.80	15640/-	465/-	15175/-	<b>32.63</b>
3	Roket 44% EC @ 1000 ml/ha	41.48	9.08	20884/-	620/-	20264/-	<b>32.68</b>
4	Profenofos 50% EC @ 1000 ml/ha	40.42	8.02	18446/-	533/-	17913/-	<b>33.60</b>
5	Cypermethrin 10% EC @ 500 ml/ha	36.07	3.67	8441/-	270/-	8171/-	<b>30.26</b>
6	Acephate 75% SP @ 500 g/ha	37.38	4.98	11454/-	300/-	11154/-	<b>37.18</b>
7	Acephate 75% SP @ 1000 g/ha	39.71	7.31	16813/-	600/-	16213/-	<b>27.02</b>
8	Lambda cyhalothrin 5% EC @ 250 ml/ha	36.23	3.83	8809/-	150/-	8659/-	<b>57.73</b>
9	<b>Untreated control</b>	<b>32.40</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>

Note: Sale Price of Rice is Rs. 2300/- per quintal

Cost of insecticides: Roket =Rs. 610/ lit., Profenofos= Rs. 533/ lit., Acephate= Rs. 600/ kg.

Cypermethrin = Rs. 540/ lit. and Lambda-cyhalothrin = Rs. 600/ lit.

### Efficacy against stem borer

Data of Table 2 revealed that dead heart and white ear incidence was observed lowest in treatment against stem borer and found superior over all other treatments. Profenofos 50 EC @ 1000 ml/ha and Acephate 75 SP @ 1000 g/ha were statistically at par with Roket 44 EC @ 1000 ml/ha in both spray at 7 and 15 days interval and 70 days after transplanting for dead heart and white ears. The next treatments in order of efficacy were Roket 44 EC @ 750 ml/ha, Acephate 75 SP @ 500 g/ha, Cypermethrin 10 EC @ 500 ml/ha and Lambda-cyhalothrin 5 EC @ 250 ml/ha in both spray at 7 and 15 days interval in reducing dead heart and white ears at 70 days after transplanting. However, Roket 44 EC @ 500 ml/ha was found lowest in reducing dead

heart and white ears in both spray. These results were confirmed with the result of Krishnamoorthy *et al.*, 2012 a and 2012 b; Srinivasan *et al.*, 2012 and the result of Kartikeyan *et al.*, 2012 testing of efficacy of a new insecticides combination (flubendiamide + buprofezin) against rice stem borer.

### Grain yield

Roket 44 EC @ 1000 ml/ha was found superior with highest grain yield 41.48 q/ha and statistically at par with Profenofos 50 EC @ 1000 ml/ha and Acephate 75 SP @ 1000 g/ha grain yield 40.48 and 39.71q/ha, respectively (Table 1). The yield (37.38 q/ha) of standard check Acephate 75 SP @ 500 g/ha was superior from Lambda-cyhalothrin 5 EC @ 250 ml/ha (36.23 q/ha) and Cypermethrin

10 EC@ 500 ml/ha (36.07 q/ha). Whereas lowest yield 35.74q/ha was recorded in treatment Rokat 44 EC @ 500 ml/ha, but it was found significantly superior to untreated control (32.40 q/ha).

### **Economic evaluation**

Data on economic evaluation, presented in Table 3 shows that the highest additional grain yield (q/ha) over control and net return (Rs/ha) was worked out in the treatment of Rokat 44 EC @ 1000 ml/ha followed by Profenofos 50 EC @ 1000ml/ha and Acephate 75 SP @ 1000 g/ha. However, maximum ICBR (57.73) found with Lambda-cyhalothrin 5EC @ 250 ml/ha treatment followed by Acephate 75 SP @ 500 h/ha (37.18), Profenofos 50 EC @ 1000 ml/ha (33.60) and Rokat 44 EC @ 1000 ml/ha (32 68).

Based on present findings it is concluded that combination of Profenofos 40% + Cypermethrin 4% EC @ 1000 ml/ha can be used safely for the control of leaf folder and stem borer collectively. The sole product of Profenofos 50 EC @ 1000 ml/ha and Acephate 75 SP @ 1000 g/ha also found effective and best in control of stem borer and leaf folder in rice.

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