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STATUS OF ARMYWORM (*MYTHIMNA SEPARATA*) INFESTATION IN RICE AND THEIR BIO RATIONAL MANAGEMENT IN THE KOSHI AGRO-ECOSYSTEM OF BIHAR INDIA

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ABSTRACT

Armyworm (*Mythimna separata*) is potential pest of rice in Koshi region of Bihar and causes heavy damage to the ear head of rice. Surveys were conducted in different villages of Purnea and Saharsa districts under Koshi region during 2018 to 2020. During survey rice crop was found infested with this pest in different village of B. Khoti, Dharam Daha, Rautas, Jalal Garh, Baisa and Dagarua block of Purnea district during month of October to November, 2018. In 2019, its infestation was found in Maisa, Simri and Banama Itahari block of Saharsa district. Further Makund and Bihra village of Satar Kataiya block of Saharsa district found heavily infested with this pest in the last week of November, 2020. Among different management practices evaluated for the armyworm (*Mythimna separata*), emmamectin benzoate 5 SG @220 g/ha was found causing maximum mortality with 2.5 larval population /m^2 and reduces 96.92 % population in comparison to untreated control (81.3 larval population /m^2). Emmamectin benzoate 5 SG @220 g/ha further followed by chlorpyrifos 50%+cypermethrin 5%EC@1 ml/lit and causing reduction in larval population/ m^2 up to 4.67 and reduces 90.77 % population in comparison to untreated control. Among different management practices highest yield (37.92 Quintal/ha) was found with emmamectin benzoate 5 SG @220 g/ha and it causes 123.23 % increase in yield over untreated control. Wood ash (2 Kg) + ripe chilli powder (25 ml) produced lowest yield (22.17 Quintal/ha) with only 30.19 % increase in yield over untreated control.

Keywords **:** Armyworm, *Mythimna separata*, rice, incidence, management.

Introduction

In India, average losses of paddy production due to insect pests are 25-30%. Koshi region of Bihar, particularly in Saharsa, Supaul, Madhepura, Araria and Purnea rice is grown by farmers in large area and they use good agricultural practices for cultivation of rice. Among different types of pest attack on rice causing damage to the plant, it has been observed that the magnitude of problem of Army worm (*Mythimna separata*) has increased in this area due to suitable weather parameter and use of local variety of rice. In India it is found in all the rice growing areas especially along the west coast and delta in Kerala and Tamil Nadu (David and Ananthakrishnan, 2004). In eastern India, it has become a regular pest in western Orissa and has also been recorded in coastal districts of the state. This pest is also recorded from Jharkhand, Bihar

and Chhatisgarh during kharif rice crop in 2008 and 2009.

Army worm (*Mythimna separata*) is potential pest of rice. Its outbreak occurs in particular pockets of rice growing areas. Suitable abiotic factors i.e. temperature, relative humidity and failure of rainfall may cause of outbreak of this pest. Generally, its outbreak comes when Hathia rainfall fails in the month of October-November (Bindra and Singh, 1973, Oku and Koyama, 1976, Chaudhary and Singh , 1980). The caterpillar of this pest cause damage to rice ear head and green cut part of ear head fallen on rice field (Singh and Manchanda ,1981, Sharma and Davies, 1983, Catindig *et al.*, 1994). Caterpillars are nocturnal in nature and start cutting part of ear head from evening to whole night. Its attack is so heavy that in a night this pest cut ear head of complete one field and shifted to side by side another rice field (Sharma *et al.*, 2002, Jiang *et al.*, 2011 Jiang *et al.*, 2014). In the morning caterpillars hide in cracks and middle portion of hills of rice and excrete huge amount of excreta in middle of hills (Koyama and Matsumura, 2019, Bhat *et al.*, 2024). These excreta are sign of identification of infestation of this pest.

So, we can say green cut part of rice ear head in rice field and huge amount of dark brown pellet of excreta of caterpillar is sign of presence of this pest in rice field and causes huge loss. Sometimes farmers harvest paddy before ripening of rice due to attack of this pest.

Materials and Methods

Surveys were conducted for status of Army worm in different blocks of Purnea and Saharsa districts that is situated in Koshi region of Bihar. The experiment was conducted in farm area of Mandan Bharti Agricultural College, Agwanpur, Saharsa during the above said period. For evaluating the effectiveness of the management practices, nine treatments including control viz. Cartaphydrochloride 50WP @1 g/lit of water, emmamectin benzoate 5 SG @220 g/ha, azadirachtin (0.1 %) @ 5 ml/lit, garlic extract+ vegetable oil+ liquid soap(85g:50ml:10ml)for 20litre solution, wood ash (2 Kg)+ ripe chilli powder (25 ml) , *Bacillus thuringiensis* kurstaki @ 1 gm/lit, chlorpyrifos 20EC@2.5 ml/lit, chlorpyrifos 50%+cypermethrin 5%EC@1 ml/lit were tested during the peak period (October-November). The trial was laid in a randomized block design with three replications and data of larval population/m^2 before spray and mortality of larva after three days of each spray were taken in 2018, 2019 and 2020 (Table 1). Population reduction of larvae taken over untreated control in per cent. The three-meter distance was maintained between the treatment plots and the control plot was 5m apart from the treatment plot. The same research designs, field layout, cultivation practices, pesticide spray and data collection protocols were followed for all the three years. Finally, grain yield and yield increased over untreated control in per centage were calculated from each plot in all the three years (Table 2).

Results and Discussion

Mythimna separata has eggs, larvae, pupa and adult in their life cycle. Followings are detail:

Egg : Eggs are small, spherical and creamy-white when freshly laid. Laid in clusters (50–150 eggs) on the lower surface of leaves or on dry grasses. Female moth covers the egg mass with hairy scales from its abdomen, giving a fuzzy appearance. Incubation period: about 3–5 days depending on temperature.

Larval Stage (Caterpillar): Newly hatched larvae are light green with a black head. Mature larvae become brownish-green to dark brown with distinct longitudinal stripes on the body. They have 6 larval instars. Initially scrape leaf surface. Later voraciously feed on leaves, often leaving only the midrib. When population is high, larvae move in large groups (“army” movement) from one field to another. Larval period is about 14–20 days.

Pupal Stage: Full-grown larvae enter the soil (2–5 cm depth) and form an earthen cell. Pupa is reddish brown to dark brown and pupal period is about 7–12 days.

Adult Stage (Moth): Adult moth is medium-sized, brownish-grey. Forewings show dark spots and wavy lines, hind wings are pale with darker margins. Adults are nocturnal and strong fliers, capable of long-distance migration. Female lay 500–1000 eggs during her lifetime and adult longevity is about 7–10 days. Entire life cycle completes in about 30–40 days under favourable conditions.

The survey were conducted on infestation of the pest from different blocks of three district of Koshi region i.e. Purnea and Saharsa and heavy infestation was reported i.e. ranges from 51.04 to 64.85 larva per m^2 .Infestation reported from Latraha and Latugarh village of B.kothi block,Paras Mani village of Dharam Daha block, Sahan village of Rautas block, Gargata village of JalalGarh block, Gandwash village of Baise block, Sogunia village of Dagarua block and Hijla village of Baise block in Purnea district during 20.10.2018 to 25.11.2018. Surveys were conducted in Sahpur, Sonbarsa raj, Saur Bazar, Patarghat, kaff area but army worm not found in this area. Latter it is found in Bhelwa, Telwa, Birgawn under Mahisi block,

Chakbhro in simri block. Further it also reported from Maharas, Sarbela, Sahuriya, Itahari panchayat of Banma Itahari Block of Saharsa district in October-November, 2019.In 2020, the Incidence of army worm reported on 17/10/2020 from Mali chowk under Sonbarsa Block as well as Saur Bazar (Sahuria) and Satar Kataiya (Bihra) of Saharsa district.

Fig. 1 : Caterpillars hide in middle portion of hills of rice in morning and huge amount of excreta found in hills

Fig. 2 : Caterpillar of army worm and partial cut part of rice ear head fallen on rice field

Fig. 3 : Infested rice field

Fig. 4 : Larvae of Army worm

Fig. 5 : Adult

Caterpillars are reared in laboratory for study their life cycle and found pupa and adult of this insect. Further the Incidence of Army worm reported on 25/11/2020 from Makuna and Bihra village under Satar katahiya Block of Saharsa district.

Different management practices were evaluated for management of the armyworm (*Mythimna separata*) and larval population /m^2 were counted after three days of each treatment. Among all treatments emmamectin benzoate 5 SG @220 g/ha was found causing maximum mortality with 2.5 larval population /m^2 and reduces up to 96.92 % larval population in comparison to untreated control (81.3 larval population /m^2). These were closely followed by chlorpyrifos 50%+ cypermethrin 5%EC@1 ml/lit with 4.67 larval population /m^2, Cartaphydrochloride 50WP @1 g/lit of water with 6.84 larval population/m^2, Chlorpyriphos 20EC @ 2.5 ml/lit with 7.5 larval population /m^2, *Bacillus thruriensis* kurstaki @ 1 ml/lit with 9.5 larval population /m^2, Azadirchtin(0.1%) @ 5 ml/lit with 12.8 larval population /m^2, Garlic extract+ vegetable oil+liquid soap(85 g:50 ml:10 ml)for 20 litre solution with 22.5 larval population /m2 and Wood ash(2 Kg)+ ripe chilli powder (25 ml) with 29.2 larval population /m^2 and caused population reduction over untreated control 96.92 %, 94.26 % ,91.59 %,90.77 %,88.31 %,84.26 %,72.32 %,64.08 % respectively.

Table 1: Larval population/m^2 and population reduction over untreated control (%) of Army worm (*Mythimna separata*) in pre spray and after spray of different new molecules of pesticides.

Treatments	Larval population/m^2								Population reduction over untreated control (%)
	Pre-spray				Three day after spray				
	2018	2019	2020	Mean	2018	2019	2020	Mean	
T_1-Cartaphydrochloride 50WP @1 g/lit of water	72.3	73.67	76	73.99	7.67	6.00	6.00	6.84	91.59
T_2-Emmamectin benzoate 5 SG@220 g/ha	70.7	72.67	74.33	72.57	3.33	1.67	1.56	2.5	96.92
T3-Azadirchtin (0.1%) @ 5 ml/lit	74	75.33	77.67	75.67	13.67	12.00	12.00	12.8	84.26
T4-Garlic extract+ vegetable oil+ liquid soap (85 g:50 ml:10ml) for 20 litre solution	82	84	85.67	83.89	23.67	21.33	22	22.5	72.32
T5-Wood ash (2 Kg) + ripe chilli Powder (25 ml)	71	72	74.67	72.56	30.67	27.67	29	29.2	64.08
T6-*Bacillus thruriensis kurstaki* @ 1 ml/lit	69.7	69.33	73.33	70.79	10.33	8.67	8.67	9.5	88.31
T7. Chlorpyriphos 20EC @ 2.5 ml/lit	68.7	69.67	72.33	70.23	8.33	6.67	6.67	7.5	90.77
T_8- Chlorpyrifos 50%+Cypermethrin 5%EC@ 1ml/lit	70	71	73.67	71.57	5.33	4.00	3.67	4.67	94.26
T9-Untreated Control	76	77	79.67	77.56	83.33	79.33	81.67	81.3	-
C.D. (P = 0.05)					10.35	10.24	10.38	10.3	
SE(m)					3.42	3.39	3.422	3.41	

The variation of damage percentage of M. separata in the field can be affected by various factors (Sharma *et al*., 2002) such as dispersal capacity of the pests, insect characteristics, insect host finding characteristics etc. The effectiveness of these materials also affected by their qualities and quantities. Cook *et al*., 2002 reported that spinosad was effective to control the beet armyworm compared to non-treated control.

Among different management practices highest yield (37.92 Quintal/ha) was found with emmamectin benzoate 5 SG @220 g/ha and it causes123.23 % increase in yield over untreated control (17.11 Quintal/ha). In yield parameter further emmamectin benzoate 5 SG @220 g/ha was followed by chlorpyrifos 50%+cypermethrin 5%EC@1 ml/lit with 36.44 Quintal/ha and caused 114.71 % increase in yield over untreated control, Cartaphydrochloride 50WP @1 g/lit of water with 33.24 Quintal/ha and caused 96.46 % increase in yield over untreated control. Chlorpyriphos 20EC @ 2.5 ml/lit was found at par with *Bacillus thruriensis* kurstaki @ 1 ml/lit and produced 32.34 and 30.49 Quintal/ha rice grain with 91.30 % and 80.19 % increase in yield over untreated control. Azadirchtin(0.1%) @ 5 ml/lit was found at par with garlic extract+ vegetable oil+liquid soap (85 g:50 ml:10 ml) for 20 litre solution and produced 25.08 and 23.63 Quintal/ha rice grain with 47.48 % and 38.76 % increase in yield over untreated control. Wood ash (2 Kg) + ripe chilli powder (25 ml) produced lowest yield (22.17 Quintal/ha) with only 30.19 % increase in yield over untreated control.

Amendez *et al*.,2002 and Williams *et al*.,2004 also reported that spinosad has the potentiality to control the many lepidopteran pests. The damage percentage on Metarhizium, NPV and Multineem treated plots also demonstrated the higher damage than others chemical-based pesticides. The effect of multineem and furadan were almost similar. Hence there is the potential of replacing the furadan, a chemical based pesticide by multineem, which is neem safe based bio-pesticide. Mainali *et al*., 2014 reported similar in his research that cypermethrin was the effective insecticide for armyworm management.

Table 2: Mean grain yield and increase in yield over untreated control (%) in different treatments.

Treatments	Grain yield (Quintal/ha)				Increased in yield over untreated control(%)
	2018	2019	2020	Mean	
T_1-Cartaphydrochloride 50WP @1 g/lit of water	33.26	32.19	34.26	33.24	96.46
T_2- Emmamectin benzoate 5 SG@220 g/ha	37.05	37.32	39.38	37.92	123.23
T_3- Azadirchtin (0.1%) @ 5 ml/lit	25.10	24.03	26.1	25.08	47.48
T_4- Garlic extract+ vegetable oil+ liquid soap (85 g:50 ml:10ml) for 20 litre solution	23.65	22.58	24.65	23.63	38.76
T_5-Wood ash (2 Kg) + ripe chilli Powder (25 ml)	22.30	21.07	23.13	22.17	30.19
T_6- *Bacillus thruriensis kurstaki* @ 1 ml/lit	30.65	29.38	31.45	30.49	80.19

T_7 -Chlorpyriphos 20EC @ 2.5 ml/lit	32.50	31.23	33.30	32.34	91.30
T_8- Chlorpyrifos 50%+Cypermethrin 5%EC@ 1ml/lit	35.80	35.73	37.80	36.44	114.71
T_9 - Untreated Control	17.36	15.96	18.02	17.11	-
C.D.	4.10	3.90	3.93	3.98	
SE(m)	1.36	1.30	1.3	1.32	

From the study, it can be summarized that generally its outbreak comes when Hathia rainfall fails in the month of September-October. The caterpillar of this pest cause damage to rice ear head and green cut part of ear head fallen on rice field. Caterpillars are nocturnal in nature and start cutting ear head from evening to whole night. In the morning caterpillars hide in cracks and middle portion of hills of rice and It excrete huge amount of excreta in middle of hills. These excreta are sign of identification of infestation of this pest.

It can be effectively managed by frequent visit of rice field after formation of ear head of rice and be casus when Hathia rain fall fail in month of September-October. Identify the pest (caterpillar of Army worm hide in cracks of soil. When population of caterpillar of army worm exceeded from 0.4 to 1 larvae/hill at panicle stage and partial green cut part of rice ear head found fallen on the ground then spray with emmamectin benzoate 5 SG @ 220 g /ha in field as well as on bunds of field after 4.0PM and repeat after 7 days interval of first spray if pest found the field.

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