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Bio-rational management of yellow mite in dark jute (*Corchorus olitorius* L.) under Terai region of West Bengal

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Abstract
An experiment was conducted to determine the effect of relatively cheaper, safer inputs of compatible management combination on yellow mite. The experiment was laid out in randomized block design with seven treatments replicated thrice. Two spraying of each treatment was done at 15 days interval. The effect of treatment was significant on post treatment mite population recorded after spray for both the season. Among the treatments, T_5 [*Lecanicillium lecanii* (2x108 cfu/gm)@3gm/lit at 35 DAS+Spiromesifen 240 SC@0.7 ml/lit at 50 DAS] was found to be the most effective combination. The post treatment observation during 2015 and 2016 at 7 days after treatment indicated significantly less number of mites i.e.(1.47 and 2.30 mites/sq. cm) and (1.02 and 0.83 mites/sq. cm) respectively in the treatment T_5. Among the treatments, maximum plant height (222.24 and 221.14 cm) yield (36.29 and 37.44 q/ha) and benefit cost ratio (1.25 and 1.32) were also observed in treatment T_5.

Keywords: Yellow mite, management, botanicals, Bioagents, Chemical acaricide

Introduction
Jute is an important renewable natural fibre crop next to cotton [7]. It is mainly cultivated in India, Bangladesh, China, Nepal and Thailand [5]. In India jute cultivation is confined to the states of West Bengal, Bihar, Assam, Andhra Pradesh, Orissa, Meghalaya and some parts of Nagaland with an area of 0.62, 0.14, 0.07, 0.02, 0.02 and 0.02 million hectares respectively [12]. Among different states of India, West Bengal alone contributes 80% of national jute production [3]. Jute fibre is used for making bags, decoratives, textiles and geotextiles. It has many advantages over synthetics and it is eco-friendly to the environment. Its production and productivity is hampered by number of abiotic and biotic stresses [2]. Among them yellow mite, *Polyphagotarsonemus latus* (Banks) is devastating and often causing yield losses [18]. Yellow mite is the most economically important pest of jute causing leaf curl through sucking cell sap from tender epical leaf (Fig.2). The pest is reported from almost all the jute growing countries affecting equally both the cultivated species of jute with the estimated fibre yield loss of 42% [13].

Inappropriate crop management practices with indiscriminate use of synthetic pesticides to ensure higher crop yield have adversely affected both biological and physical environment, leading to the pollution of biosphere and rapid build-up of resistance and resurgence of insect pests and diseases [6]. The damage is caused due to high toxicity and non-biodegradable nature of the pesticides and due to the residues in soil, water and crops that ultimately affect human health. Thus, efforts are needed to search new selective and biodegradable pesticides. In the move towards green pesticides and the continuing need for developing new crop protection tools is essential [10].

Due to wide host range and changing climatic conditions management of mite has become difficult. Application of chemicals also helps to develop pesticide-resistant strains of mite. According to Rahman [16], any single method of pest control tactics cannot achieve an acceptable level of control for yellow mite. Thus, due to the importance of pest and difficulty of its control through prevalent methods, it seems that there is urgent need for the development of integrated control by a combination of several methods that are effective coupled with eco-friendly in nature. These eco-friendly management modules are cost effective, durable and free from environment pollution. Therefore, an attempt has been made to manage the yellow mite, *Polyphagotarsonemus latus* (Banks) in bio-rational management strategies.

2. Materials and Methods

Field experiment was conducted for bio-rational management of yellow mite infecting *Corchorus olitorius* (dark jute) during kharif season of 2015 and 2016 at instructional farm of Uttar Banga Krishi Viswavidyalaya (UBKV), Cooch Behar in randomized block design (RBD) with three replications using variety, JRO-204 in a plot size of 3 ×4 m^2 with spacing 30 cm X 8 cm after thinning at 21-25 days after sowing. The recommended integrated package of practices were followed as and where required. Different integrated treatments include:T_1: Neem (Azadirachtin 10,000ppm) @3 ml/lit at 35 DAS and 50 DAS; T_2: *Lecanicillium lecanii* (2 x 10^8cfu/gm) @ 3 gm/lit at 35 DAS and 50 DAS; T_3: Spiromesifen 240 SC @ 0.7 ml/lit at 35 DAS and 50 DAS; T_4: Neem (Azadirachtin 10,000ppm) @ 3 ml/lit at 35 DAS + *Lecanicillium lecanii* (2 x 10^8cfu/gm) @ 3 gm/lit at 50 DAS; T_5: *Lecanicillium lecanii* (2 x 10^8cfu/gm) @ 3 gm/lit at 35 DAS + Spiromesifen 240 SC @ 0.7 ml/lit at 50 DAS; T_6: Spiromesifen 240 SC @ 0.7 ml/lit at 35 DAS + Neem (Azadirachtin 10,000ppm) @ 3 ml/lit at 50 DAS; T_7: Control. After natural population (infestations) build up in the field, at the plant age of 35 and 50 days the plots were treated with the treatments and control plots were left untreated. Yellow mite infestation was recorded from young second unfolded leaf of 10 randomly selected plants/ plot, as yellow mites are commonly found on the lower surfaces of young apical leaves and flowers, where they deposit their eggs. Pre-treatment observations were taken from all the plots before application of treatment at 35 and 50 days after sowing. Post-treatment observations for mite population were recorded after both the spray (35and 50days after sowing) at 3 and 7days after treatment. The number of mite irrespective of different stages (egg, larva, pupa, male and female) per cm^2 leaf was counted with 10x magnifying lens. Plant height (cm), basal diameter (cm), green biomass (q/ha) and fibre yield (q/ha) were also recorded and the data were processed with square root transformed prior to statistical analysis for the test of significance. Economic parameters such as cost of production, net return and benefit cost ratio (BCR) were calculated by considering local market price of required inputs and outputs.

Percent reduction of pest under field condition was recorded using the following formula – (%) Reduction= $(N-N_1/N) \times 100$ (Rahman, *et. al.*, 2016)

Where,

N = Number of mite infested plant in control plot

N_1 = Number of mite infested plant in treated plot

2.1 Statistical analysis

Statistical analysis and interpretation of results were done by calculating values of C.D. (critical difference) at 5% level of significance through analysis of variance technique as described by Gomez and Gomez [8]

3. Results and Discussion

Data obtained (Table 1 and 2) for two years were analysed to conclude the results of applied integrated management of yellow mite. All the pesticide treatments were superior over control. Significant reduction of mite population with respect to control was observed at 4th day and 7th day after two time application of the pesticides i.e. on 35 days after sowing (DAS) and 50 days after sowing (DAS) for both the season during 2015 and 2016. In terms of suppression of mite population, all the treatments were close to each other. Four day after first spray highest reduction of mite population was observed in treatment T_5 (*Lecanicillium lecanii* (2 x 10^8cfu/gm) @ 3 gm/lit at 35 DAS + Spiromesifen 240 SC @ 0.7 ml/lit at 50 DAS) followed by T_3 (Spiromesifen 240 SC @ 0.7 ml/lit at 35 DAS and 50 DAS). This trend of pesticide efficacy continued up to seven day after first and second application of treatments. Highest reduction (Fig.1) of mite infestation was found after 7 days of first spraying with the treatment T_5 causing a reduction of 88.80% and 90.06%mite in jute plant for two season respectively. Similar observation was recorded after 7 days of second spraying in treatment T_5 with the percent reduction of 76.12% and 92.18% in respect of control. Significant variation was observed in plant height and fibre yield during both the cropping season. The results revealed that among the treatments highest plant height was found in treatment T_5 (222.24 cm and 221.14 cm). Highest fibre yield (36.29 q/ha and 37.44 q/ha) and benefit cost ratio (1.25 and 1.32) was recorded in the plots treated with treatment *Lecanicillium lecanii* (2 x 10^8cfu/gm) @ 3 gm/lit at 35 DAS + Spiromesifen 240 SC @ 0.7 ml/lit at 50 DAS closely followed by T_6 (34.43q/ha and 35.93 q/ha) and T_3 (35.19q/ha and 35.12 q/ha) respectively.

Same kind of result was also observed by Prasad [15], Rahman [17] and Talukder [19] who had tested different chemicals, botanicals and biological agents against yellow mite. According to Rahman [18], neemazal 50,000 ppm @ 1 ml/lit of water and endosulfan 35 EC at 350g a.i./ha reduced mite population up to 56.56% and 72.19% respectively. Anil [1] showed that, mahogany and karanja oil was effective to reduce the damage of jute leaves by *Polyphagotarsonemus latus*. Keita [11] recorded maximum percent reduction of yellow mite on jute after application of Ambush 1.8 EC @ 0.5 ml/l. Chari [4] found neem oil at 1% concentration was highly effective against yellow mite. The jute plant infestations caused by yellow mite was reported to vary from 0.50 to 1.83 percent during 2001–2002 in various IPM treatments as compared to 6.07–12.97 percent during 2000–2001 [14]. Yeasmin [20] observed that after application of neem oil increased 24.64% plant height, 27.87% basal diameter over control and gave the highest amount of fibre yield (2.68 t/ ha). Hence, use of low dose of Spiromesifen, integrated with *Lecanicillium lecanii* seems to be best method of bio-rational management of yellow mite without environmental pollution.

Table 1: Bio-rational management of Yellow mite in Jute and their effect on fibre yield of the Crop during 2015.

Treatment	No. of mite population /cm^2 on second unfold leaf at different days						Plant height (cm)	Fiber Yield (q/ha)	B:C
	Pre treatment (35DAS)	4 day post application (39 DAS)	7day post application (42DAS)	Pre treatment (50DAS)	4 day post application (53DAS)	7day post application (57DAS)			
T_1	13.43 (3.66)	9.23 (3.04)	7.30 (2.69)	8.87 (2.96)	7.17 (2.68)	5.73 (2.39)	210.80	30.30	1.04
T_2	12.57 (3.54)	8.20 (2.86)	5.70 (2.37)	7.43 (2.72)	5.33 (2.31)	4.83 (2.20)	210.85	30.58	1.05
T_3	12.10 (3.47)	6.93 (2.62)	2.90 (1.65)	9.77 (3.14)	4.23 (2.06)	3.13 (1.75)	217.97	35.19	1.21
T_4	12.83	9.90	5.07	8.17	5.40	4.15	202.41	29.85	1.03

	(3.58)	(3.14)	(2.24)	(2.85)	(2.32)	(2.03)			
T_5	12.63 (3.55)	6.50 (2.53)	1.47 (1.14)	8.70 (2.93)	3.57 (1.88)	2.30 (1.50)	222.24	36.29	1.25
T_6	11.77 (3.43)	7.03 (2.65)	4.53 (2.12)	8.67 (2.93)	4.43 (2.10)	3.07 (1.75)	217.19	34.43	1.18
T_7	13.33 (3.65)	12.07 (3.46)	13.10 (3.60)	9.57 (3.08)	8.17 (2.86)	9.63 (3.10)	199.46	28.76	0.99
CD(P=0.05)	NS	0.43	0.72	NS	0.24	0.31	10.22	0.82	

*Figures in the parenthesis are √x transformed values, B:C = Benefit cost Ratio, NS= None Significant, DAS= Days after sowing

Table 2: Bio-rational management of Yellow mite in Jute and their effect on fibre yield of the Crop during 2016

Treatment	No. of mite population /cm² on second unfold leaf at different days						Plant height (cm)	Fiber Yield (q/ha)	B:C
	Pre treatment (35DAS)	4 day post application (39 DAS)	7day post application (42DAS)	Pre treatment (50DAS)	4 day post application (54DAS)	7day post application (57DAS)			
T_1	7.94 (2.82)	3.32 (1.82)	1.98 (1.40)	8.22 (2.87)	3.46 (1.86)	1.44 (1.20)	205.19	31.32	1.10
T_2	8.76 (2.96)	3.88 (1.97)	2.16 (1.47)	7.75 (2.78)	3.08 (1.76)	1.34 (1.16)	212.55	32.10	1.13
T_3	7.90 (2.81)	2.82 (1.68)	1.15 (1.07)	7.85 (2.80)	2.35 (1.53)	1.00 (1.00)	218.06	35.12	1.24
T_4	8.72 (2.95)	3.75 (1.94)	2.08 (1.44)	8.78 (2.96)	3.78 (1.94)	1.76 (1.33)	211.56	30.68	1.08
T_5	8.04 (2.84)	2.35 (1.53)	1.02 (1.01)	7.80 (2.79)	1.82 (1.33)	0.83 (0.91)	221.14	37.44	1.32
T_6	7.78 (2.79)	3.50 (1.87)	1.30 (1.14)	7.92 (2.81)	2.74 (1.65)	1.04 (1.02)	220.24	35.93	1.27
T_7	8.20 (2.86)	9.21 (3.03)	10.26 (3.20)	8.47 (2.91)	9.54 (3.09)	10.65 (3.26)	203.18	29.98	1.06
CD(P=0.05)	NS	0.11	0.13	NS	0.19	0.11	4.38	0.95	

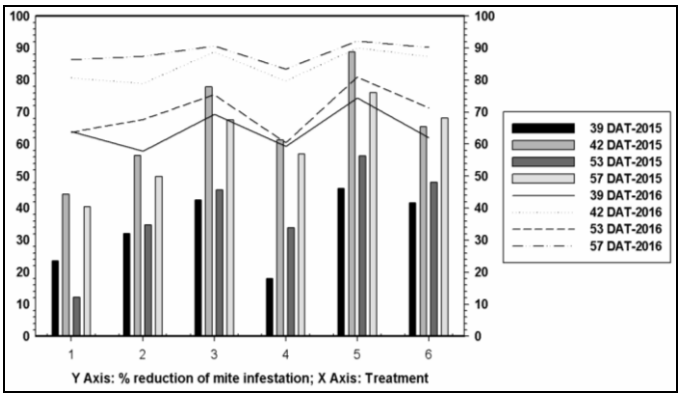

Fig 1: Percent reduction of mite population over control at different time interval after application of treatments during 2015 and 2016.

Fig 2: Yellow mite infested jute leaf

4. Conclusion

From the results of this two-year experiment, it was seen that yellow mite of jute caused by *Polyphagotarsonemus latus* is a major pest of jute (*C. olitorious*) in Terai region of West Bengal that results in economic losses. Very limited alternative and effective method is available to manage this mite in the field. So, it may be concluded that treatment with *Lecanicillium lecanii* (2 x 10^8cfu/gm) @ 3 gm/lit at 35 DAS + Spiromesifen 240 SC @ 0.7 ml/lit at 50 DAS was found to be more superior eco-friendly treatment in controlling of yellow mite in jute.

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