IMPACT OF JUTE YELLOW MITE, *POLYPHAGOTARSONEMUS LATUS* (BANKS) DENSITY ON HOSTS (*CORCHORUS OLITORIUS* L.) PHENOLOGY AND ASSESSMENT OF YIELD LOSS UNDER FIELD CONDITION

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ABSTRACT: Jute yellow mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) is one of the destructive pests of jute, which has been expanded in recent years in Bangladesh. Jute plants of tossa (*Corchorus olitorius* L.) varieties were considered as treatments viz., O-9897, O-72, OM-1 and O-795. The paired plot treatments (miticide treated and miticide untreated cintrol) were laid out under field condition. The yellow mite impact was studied on three stages of jute plants: 60 DAS (day after sowing), 90 DAS and 120 DAS. The higher number of mite stages observed upto 90 DAS then declined afterward upto 120 DAS in var. OM-1 among four C. olitorius varieties. A damage index scale (0-5) was to assess yellow mite injury to jute plants. The percent infestation and damage index was also used to relate yellow mite injury to different yield contributing characters of plants infested at three different phenological stages. The yield contributing characters of untreated plots showed significant damage at 60, 90 and 120 DAS in C. olitorius varieties compared to treatment plots. The highest fibre yield losses due to mite infestation was found in the variety OM-1 (77.93%) followed by O-795 (75.40%), O-72 (69.59%) and the lowest was in O-9897 (69.35%); the highest stick yield losses was in the variety OM-1(75.56%) followed by O-795 (71.44%) and O-72 (65.87%), the lowest was in O-9897 (65.75%) and the highest seed yield losses was in the variety O-795 (49.08%) followed by OM-1 (47.46%) and O-72 (39.10%), the lowest was in O-9897 (29.94%) under field condition. High yellow mite population in the untreated check decreased plant growth and showed significant yield loss in the variety OM-1.

KEY WORDS: *Polyphagotarsonemus latus*, *Corchorus olitorius*, incidence, yield loss.

Yellow mite is becoming an increasingly important pest of economic crops in the Bangladesh. The genus Corchorus is the most important family Tiliaceae, highlighting the jute as the culture of higher expression economy. Yellow mite (*Polyphagotarsonemus latus*), is one of the most common and destructive pests of jute (*Corchorus olitorius* L.). Both yield and quality of fibre are reduced due to the attack of this pest. Due to the attack of this pest, the vertical growth of the internodes is suppressed thereby side branches are enhanced (Kabir, 1975). Small-sized herbivorous mites are difficult to detect, but their damage often produces dramatic effects on plant morphology and physiology. The yellow mite, *Polyphagotarsonemous latus* (Banks) (Acari: Tarsonemidae), is extremely polyphagous, and is found on more than 60 plant families (Gerson, 1992). The softer portions of the plants such as cotton (Cividanes et al., 1987), eggplant (Queiroz & Oliveira, 1992), jute (Hath, 2000) and grape (Haji et al., 2001) was attacked by this pest. Since yellow mites are very small (body length between 100 and 200 microns) they are unnoticeable until serious damage occurs rapidly to

appeal leaves. Growers who are not familiar with the plant symptoms associated with the presence of yellow mites can first confuse symptoms with a virus, phytotoxicity from a sprayed product, or a nutrient related disorder (Gerson, 1992). The mites are usually found on the upper part of the plant, feeding on the apical shoots and the abaxial side of young leaves. Yellow mites are believed to be cell feeders, having styliform simple chelicerae that are only slightly reversible (Jeppson et al., 1975), with an approximate extended length of 43 microns (Gui et al., 2001). Yellow mite feeding causes a variety of symptoms in different hosts and plant organs. In general, plant growth is inhibited (Peña & Bullock, 1994; Cho et al., 1996a,b). Usually, the young apical leaves are heavily damaged, seem distorted, more rigid, and their edges curl downwards. The fruits, if any appear, may be cracked and sometimes reticulated (Bassett, 1981; Cross & Bassett, 1982; Gerson, 1992; Cho et al., 1996b). The study was designed to (1) determine the response of mite populations to host phenology in jute under field condition and (2) to measure the impact of mite density on yield, fruit number, number of leaves and flowers of different developmental stages of jute plants.

MATERIALS AND METHODS

The experiment was conducted in the field of the Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) of Gazipur during the period from March to August, 2009. Jute plants of tossa *(Corchorus olitorius* L.) varieties sown in 15 March, 2009 were considered as treatments viz., O-9897, O-72, OM-1 and O-795. The paired plot treatments were laid out under field condition in randomized complete block design (strip trial) with three replications and consider 30 plants/plot in both treated and untreated situation; the unit plot size was 2×2.1m, row to row distance 30 cm and block to block distance 1 m. After natural population (infestations) build up in the field, when plant age at 28th days the treatment plots were treated with miticide (Mycosul 80 WDG @ 3 gm per litre of water) and repeat treatment after 7 days interval until harvest to kill the nymphs which may hatch out after these treatments (Kabir, 1975) and control plots were left untreated. Young 3rd leaves from the tip described by Alagarmalai et al. (2009) were collected at 60, 90 and 120 days after sowing (DAS), because yellow mites are commonly found on the lower surfaces of young apical leaves and flowers, where they deposit their eggs. The number of mite stages (egg, larva, pupa, female and male) per cm^2 leaf (20 leaves/plot) was counted under a stereomicroscope.

Damage index at different plant ages

The experiment consisted of 10 yellow mite infested plants and 10 uninfested plants of each variety at different ages (60, 90 and 120 DAS), where the percentage of infestation, rating score of yellow mite infested plants were recorded at three stages of plants pre and post harvestation. To establish a damage index per plant, plants were separated into 5 categories of damage followed by Pradhan (1988) method. The rating scores of the categories were: 0= Fresh and healthy leaves, without any changes in colour, 1= Slight changes in colour of leaves, 2= Curling of leaves, 3= 1 to 3 infested leaves dropped from the top, 4= All infested leaves fall prematurely but top shoot alive and 5= Top shoots dead. Different phenology viz., leaf area, fresh leaf weight, dry leaf weight, number of leaves, plant height, base diameter, fibre weight, stick weight, number of flowers per plant, number of pod per plant, pod weight, number of seed per pod, seed weight per plant and 1000' seed weight from both treated and untreated

plots was also assessed at 3 stages (60, 90 & 120 DAS) of plants during the course of study. Leaf area was determined with a leaf area meter (LI-COR, Lambda Instruments Corporation, Lincoln, NE) and water content was determined by subtracting dry leaf weight from fresh leaf weight.

Assessing yield loss

The difference between the weight of yield in treated and untreated plots were considered as loss. The percent loss in yield was calculated using the following formula (Khosla 1977):

$$\text{Per cent loss in yield} = \frac{X1-X2}{X1} \times 100$$

Where, X1 is the mean yield in treated plots. X2 is the mean yield in untreated plots.

Data Analysis

The experimental data were analyzed statistically after appropriate transformation. Densityof mite population data were transformed into square root transformation and Tukey's test (P= 0.05) was done using the program MSTAT and analysis of variance (ANOVA) was usedto determine differences among varieties.Differences in categories for treated and untreated plants were analyzed by t-test (P= 0.05) using the program MSTAT and analysis of variance (ANOVA) was used to determinedifferences among plant ages. Yield data for both treated and untreated condition were transformed in to square root/logarithm transformation where necessary, percent data were transformed into arcsin (y= sin-1 x) or square root (y= x + 0.5) and means were separated by Tukey's test Test (Steeland Torrie 1960).

RESULTS AND DISCUSSION

Mite dynamics related to plant age

The number of mite stages varied for different plant stages. The mean number of eggs, larvae, pupae, females and males per cm^2 leaf on different *Corchorus olitorius* varieties (O-9897, O-72, OM-1 and O-795) at different plant stages in field condition is presented in Table 1. Number of eggs, larvae, pupae, females and males increase over time upto 90 DAS and then declined. There were significant differences in the population of eggs, larvae, pupae, females and males among different varieties of jute. The maximum eggs, larvae, pupae, females and males population was found at 90 DAS with *Corchorus olitorius* variety OM-1. The ascending orders of infestation in case of egg population among the varieties were O-9897 (39.22) < O-72 (46.22) < O-795 (53.67) < OM-1 (54.89); larval population among the varieties were O-9897 (37.56) < O-72 (40.55) < O-795 (42.78) < OM-1 (43.11); for pupal population among the varieties were O-9897 (3.22) < O-795 (3.44) < O-72 (3.55) < OM-1 (5.45); in female population among the varieties were O-9897 (4.67) < O-72 (5.00) < O-795 (6.11) < OM-1 (6.78) and male population among the varieties were O-72 (3.67) < O-9897 (3.78) < O-795 (4.22) < OM-1 (5.11), respectively. Similar trend of results were reported by De Coss-Romero and Peña (1998) in pepper plant. Apparently, tarsonemid mouthpart appendages are unsuitable for effective penetration ofrenitent tissues (Jeppson et al., 1975). Thus *P. latus* may not be able to puncture the lignified tissues found in after 90 days old plants as opposed to those tissues in 60-90 days old plants.These data is more potential value in programs for evaluating resistance of jute to *P. latus*. Assessments of plant resistance to *P. latus* carry out at early

growth stages of jute would beparticularly effective for identifying highly resistant plants.

Incidence of *P. latus* on host (*Corchorus olitorius*) phenology and yield

Yellow mites significantly reduced the leaf sizes of untreated plants compared to that of treated plants in all varieties (O-9897, O-72, OM-1 and O-795) at three plant growth stages (Table 2). Fresh leaf weight was reduced at all the three plant stages, but significantly reductions in dry weight was observed for 90 DAS in var. O-795 and 120 DAS in var. OM-1 & var. O-795. The level of significance associated with the soluble solids was also reduced at all the three plant growth stages (Table 3). The numbers of leaves per plant, plant heights, base diameter, fibre weight, stick weight, number of flowers per plant, number of pods per plant, pod weight, number of seed per pod, seed weight and 1000 seed weight per plant were also affected by mite injury at three plant growth stages in all the varieties and was significantly reduced compared to those of uninfested plants (Table 4 and 5). The results suggested that yellow mites reduce height of the infested plants, and it induced lateral shoot growth. Fibre yield, stick yield and seed yield both in treated and untreated situation in different varieties (O-9897, O-72, OM-1 and O-795) and the yield loss due to yellow mite infestation are presented in Table 6. The differences in the fibre yield, stick yield and seed yield in different varieties, which could be avoided by the insecticidal treatment. The yield and yield losses have been found to vary in different varieties. Both in treated and untreated situation the highest fibre yield was obtained in the variety O-9897 (4.08 ton/ha.) followed by O-72 (3.92 ton/ha.), OM-1 (3.83 ton/ha.) and the lowest fibre yield was obtained in O-795 (3.75 ton/ha.). Yield loss was varied because of mite population fluctuations in order to host phenology and environmental condition. The highest fibre yield losses due to mite infestation was found in the variety OM-1 (77.93%) followed by O-795 (75.40%), O-72 (69.59%) and the lowest fibre yield losses was obtained in O-9897 (69.35%). The highest stick yield was obtained in the variety O-9897 (8.75 ton/ha.) followed by O-795 (8.74 ton/ha.), O-72 (8.33 ton/ha.) and the lowest stick yield was obtained in OM-1 (7.92 ton/ha.). The highest stick yield losses was showed in the variety OM-1 (75.56%) followed by O-795 (71.44%), O-72 (65.87%) and the lowest seed yield was found in O-9897 (65.75%). The highest seed yield was obtained in the variety O-9897 (1550.00 kg/ha.) followed by O-72 (1422.50 kg/ha.), O-795 (1397.50 kg/ha.) and lowest was in OM-1 (1385.00 kg/ha.). The highest seed yield losses was found in the variety O-795 (49.08%) followed by OM-1 (47.46%), O-72 (39.10%) and the lowest was found in O-9897 (29.94%). High levels of stress induced by *P. latus* feeding resulted in reduction in vegetative growth, flower development and reduction in quantity & quality of seed might be in response to some anatomical, physiological or biochemical differences between vegetative and reproductive stage of plants. These reductions are chronic feeding on plants younger leaf tissue, which appear to be more susceptible than plants with greater numbers of mature leaves. This effect has been shown to vary with the phenological development of hedera, reported by Nemestothy et al. (1982). Plants with younger hirsute leaves suffered the strongest damage compared to older plants with leaves with less hairs and where cell differentiation has already occurred. These results are similar with the reported by Smith (1935) who stated that the yellow mite cannot survive longer on the tough, mature leaves of most plants. Its result mentioned that about 15.50% (O-9897) and 10.00% (CVL-1) of fibre yield were decreased by the attack of yellow mite in potted plants and 12.30% (O-9897) of fibre yield was decreased

under field condition (Faruquzzaman, 1987). De Coss-Romero (1998) reported about 80% of yield reduced by *P. latus* in green house pepper plant. The above discussion concluded that the variety OM-1of *C. olitorius* showed most susceptible against *P. latus* under field condition. The knowledge that the damage arises from mite responses to the phenological stage of the crop can enhance the efficiency and value of yellow mite monitoring programs and control strategies by focusing attention on the critical periods in jute crop. We observed in economic crop jute, *Corchorus olitorius* L.,that rapidly increases of yellow mite numbers coincided with different stages of the plant. However, under field conditions it is difficult to determine whether enlarged yellow mite populations on vegetative or reproductive host plant stages resulted from an enhanced mite growth rate compounded over time, or from immigration from outside sources.

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Table 1. Comparison of mean number of population at different stages of yellow mite per cm2 of the leaf at three DAS of *C. olitorius* under field condition.

Variety	Egg			Larva			Pupa			Female			Male		
	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS
O-9897	37.56c (6.13)	39.22c (6.26)	35.22a (5.93)	30.56b (5.52)	37.56a (6.12)	27.67b (5.26)	2.22c (1.48)	3.22b (1.78)	1.89c (1.36)	3.67b (1.91)	4.67b (2.15)	2.89b (1.70)	3.55a (1.88)	3.78b (1.94)	3.33a (1.82)
O-72	42.89bc (6.55)	46.22b (6.80)	35.56a (5.96)	37.89a (6.15)	40.55a (6.36)	31.00ab (5.57)	3.11bc (1.76)	3.55b (1.88)	2.89b (1.69)	4.56ab (2.13)	5.00b (2.23)	4.00ab (2.00)	3.56a (1.87)	3.67b (1.90)	3.00a (1.73)
OM-1	54.11a (7.35)	54.89a (7.41)	38.89a (6.23)	39.11a (6.25)	43.11a (6.57)	35.22a (5.93)	4.78a (2.18)	5.45a (2.33)	4.55a (2.13)	5.33a (2.31)	6.78a (2.60)	4.55a (2.13)	3.89a (1.97)	5.11a (2.26)	3.56a (1.89)
O-795	48.56ab (6.97)	53.67a (7.33)	38.22a (6.18)	38.00a (6.16)	42.78a (6.54)	32.00a (5.66)	4.33ab (2.08)	5.44a (2.33)	3.78ab (1.95)	5.22a (2.29)	6.11ab (2.47)	4.54a (2.13)	3.78a (1.94)	4.22ab (2.04)	3.44a (1.85)

Means followed by same letter in column do not differ by Tukey's test (P = 0.05).
Figures in the parentheses are the square root transformed mean values.

Table 2. Comparison of mean percent infestation, damage rating, leaf area of jute plants infested with yellow at three plant stages under field condition.

Variety	% infestation						Damage rating						Leaf area (cm^2)					
	60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS	
	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control
O-9897	0.00 b	77.33 a	0.00 b	77.33 a	0.00 b	63.81 a	0.00 b	1.73 a	0.00 b	1.44 a	0.00 b	1.67 a	14.07 a	7.22 b	18.80 a	9.80 b	17.13 a	13.77 b
O-72	0.00 b	70.67 a	0.00 b	80.00 a	0.00 b	64.76 a	0.00 b	2.13 a	0.00 b	1.78 a	0.00 b	1.33 a	13.20 a	6.69 b	17.63 a	11.87 b	19.60 a	14.87 b
OM-1	0.00 b	78.67 a	0.00 b	86.67 a	0.00 b	70.47 a	0.00 b	2.33 a	0.00 b	1.81 a	0.00 b	1.67 a	13.17 a	7.53 b	17.10 a	12.50 b	19.80 a	12.61 b
O-795	0.00 b	77.67 a	0.00 b	84.00 a	0.00 b	71.43 a	0.00 b	2.30 a	0.00 b	1.69 a	0.00 b	1.33 a	12.86 a	7.94 b	19.53 a	11.27 b	19.47 a	11.80 b

Means for each parameter within rows followed by the same letter are not significantly different (t-test, P=0.05).

Table 3. Comparison of mean fresh leaf weight, dry leaf weight and soluble solids at three jute plant stages infested with yellow mite under field condition.

Variety	Fresh leaf weight (g)						Dry leaf weight (g)						Soluble solids (g)					
	60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS	
	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control
O-9897	0.32 a	0.13 b	0.22 a	0.13 b	0.23 a	0.16 b	0.09 a	0.06 a	0.05 a	0.03 a	0.07 a	0.08 a	0.23 a	0.07 b	0.17 a	0.09 b	0.16 a	0.08 b
O-72	0.29 a	0.13 b	0.21 a	0.17 b	0.33 a	0.23 b	0.08 a	0.05 a	0.05 a	0.04 a	0.07 a	0.08 a	0.21 a	0.08 b	0.16 a	0.12 b	0.25 a	0.15 b
OM-1	0.31 a	0.15 b	0.22 a	0.12 b	0.30 a	0.25 b	0.09 a	0.05 a	0.05 a	0.05 a	0.07 a	0.11 b	0.22 a	0.10 b	0.16 a	0.07 b	0.23 a	0.14 b
O-795	0.30 a	0.13 b	0.25 a	0.16 b	0.37 a	0.24 b	0.08 a	0.06 a	0.07 a	0.04 b	0.12 a	0.05 b	0.22 a	0.08 b	0.18 a	0.12 b	0.25 a	0.19 b

Means for each parameter within rows followed by the same letter are not significantly different (t-test, P=0.05).

Table 4. Comparison of mean number of leaves, plant height and base diameter at three jute plant stages infested with yellow mite under field condition.

Variety	No. leaves/plant						Plant height (m)						Base diameter (mm)					
	60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS		60 DAS		90 DAS		120DAS	
	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control
O-9897	23.47 a	18.53 b	124.72 a	83.89 b	66.17 a	48.17 b	1.71 a	1.57 b	3.39 a	3.06 b	3.47 a	3.25 b	13.27 a	11.53 b	19.89 a	15.00 b	19.07 a	15.87 b
O-72	26.67 a	24.00 b	102.11 a	84.67 b	65.17 a	48.83 b	1.88 a	1.66 b	3.21 a	2.94 b	3.47 a	3.23 b	11.43 a	10.33 b	18.89 a	14.45 b	18.63 a	15.57 b
OM-1	28.60 a	25.40 b	88.11 a	52.89 b	51.33 a	33.00 b	1.76 a	1.55 b	3.34 a	2.98 b	3.44 a	3.09 b	13.80 a	12.75 b	23.20 a	17.78 b	22.80 a	19.33 b
O-795	29.00 a	24.47 b	129.22 a	80.45 b	64.17 a	49.83 b	1.89 a	1.78 b	3.34 a	3.01 b	3.51 a	3.35 b	13.27 a	11.53 b	20.44 a	15.67 b	20.14 a	16.40 b

Means for each parameter within rows followed by the same letter are not significantly different (t-test, P=0.05).

Table 5. Comparison of mean fibre weight, stick weight, number of flowers, number of pods per plant, pod weight per plant, number of seed per pod, seed weight per plant and 1000 seed weight recorded at three jute plant stages infested with yellow mite under field condition.

Variety	Fibre weight (g)		Stick weight (g)		No. flowers		Pod/plant		Pod weight/plant (g)		Seed/pod		Seed weight/plant (g)		1000 seed weight (g)	
	120DAS		120DAS		120DAS		120DAS		120DAS		120DAS		120DAS		120DAS	
	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control	Treated	Unteated control
O-9897	16.33 a	5.00 b	35.00 a	12.00 b	38.33 a	27.70 b	27.67 a	14.33 b	10.01 a	7.48 b	134.59 a	116.07 b	6.20 a	4.34 b	1.83 a	1.67 b
O-72	15.67 a	4.67 b	33.33 a	11.33 b	38.22 a	19.14 b	21.80 a	12.40 b	9.81 a	5.77 b	112.13 a	100.41 b	5.69 a	3.43 b	1.73 a	1.57 b
OM-1	15.33 a	3.33 b	31.67 a	7.67 b	35.10 a	23.06 b	27.40 a	13.67 b	10.63 a	6.63 b	123.48 a	107.75 b	5.54 a	2.91 b	1.93 a	1.77 b
O-795	15.00 a	3.67 b	35.00 a	10.00 b	38.95 a	25.78 b	27.27 a	18.00 b	10.14 a	7.45 b	135.36 a	130.47 b	5.59 a	2.82 b	1.60 a	1.43 b

Means for each parameter within rows followed by the same letter are not significantly different (t-test, P=0.05).

Table 6. Yield loss of *C. olitorius* varieties due to *P. latus* infestation under field condition.

Variety	Fibre yield (ton/ha)			Stick yield (ton/ha)			Seed yield (kg/ha)		
	Treated	Unteated control	Loss(%)	Treated	Unteated control	Loss(%)	Treated	Unteated control	Loss(%)
O-9897	4.08 a (2.02)	1.25 a (1.11)	69.35 a (56.42)	8.75 a (2.96)	3.00 a (1.73)	65.75 b (54.20)	1550.00 a (3.19)	1085.00 a (3.03)	29.94 b (33.31)
O-72	3.92 a (1.98)	1.17 ab (1.08)	69.59 a (56.60)	8.33 a (2.89)	2.83 a (1.68)	65.87 b (54.24)	1422.50 a (3.15)	858.33 b (2.93)	39.10 ab (38.61)
OM-1	3.83 a (1.96)	0.83 b (0.91)	77.93 a (62.07)	7.92 a (2.81)	1.92 b (1.38)	75.56 a (60.42)	1385.00 a (3.14)	726.67 c (2.87)	47.46 a (43.53)
O-795	3.75 a (1.94)	0.92 ab (0.95)	75.40 a (60.34)	8.74 a (2.96)	2.50 ab (1.58)	71.44 ab (57.69)	1397.50 a (3.14)	705.83 c (2.85)	49.08 a (44.45)

In a column, treatment means having the same letter(s) are not significantly different by Tukey's test (P=0.05).
Figures in the parentheses are the transformed mean values.