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EVALUATION OF DIFFERENT MUTANTS AGAINST INSECT AND MITE PESTS WITH NATURAL ENEMIES IN COASTAL JUTE ECOSYSTEM

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Abstract

Jute is a rapid growing agricultural fiber crop and renewable source of biomass. The study was conducted to evaluate different jute mutants against insect and mite pests with associated natural enemies. Results revealed that 8 insect and mite pests and 8 natural enemies were recorded from coastal jute ecosystem. Jute hairy caterpillar and yellow mite were found to be the most damaging pests in jute field. Significantly the lowest per cent plant infestation per 5 rows was recorded in mutant BJC-214 (14.37) followed by BJC-7370 (14.81) and the highest per cent plant infestation (30.77) was found in mutant VM-1. Significantly the lowest per cent leaf infestation was in mutant HC-3 (25.40) followed by HC-95 (31.08) while the highest per cent leaf infestation per plant was recorded in mutant BJC-83 (46.30). In case of leaf area damage, the lowest per cent was observed in mutant HC-3 (9) followed by CVL-1 (10) and the highest was in mutant CVE-3 (45) followed by mutant 0-72 (30). Among different mutants, HC-3, CVL-1 and BJC-214 were found to be less infested by jute hairy caterpillar and these mutants could be used for multilocational trial for final recommendation as the tolerant mutants.

Key words: Jute mutants, Insect pests, Jute hairy caterpillar, Natural enemies

Introduction

Bangladesh is one of the major jute producing countries where about 90% of the world's jute is produced. Jute (*Corchorus* spp.; Malvales: Malvaceae) and mesta (*Hibiscus* spp.; Malvales: Malvaceae) are natural plant fibers of commercial importance after cotton. Two species of jute *viz*., *Corchorus capsularis* L. and *C. olitorius* L. are the most important fibre crops, and these are extensively grown in Bangladesh as a cash crop. In here about 6,72,615 hectares of land were under jute cultivation and the total production was about 75,01,011 bales in the year of 2014 - 2015 (BBS 2016). Several factors are responsible for the decrease of yield of jute, of which the loss due to insect pest is the major concern. Different harmful insects, mites and beneficial insects are found to occur in jute field from seedling stage to harvest. Forty species of insects and mites are considered to be the pests of jute in Bangladesh (Kabir 1975), of which jute hairy caterpillar (*Spilarctia obliqua* Wlk.), jute semilooper (*Anomis sabulifera* Guen), stem

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weevil (*Apion corchori* Marshall), grey weevil (*Myllocerus discolor* Bohemus) and yellow mite (*Polyphagotarsonemus latus* Banks) were recorded as the major pests of jute. About 12% yield loss is caused by insect pests alone (Anon. 1987). Jute suffers a great loss in yield and quality of fibres due to the severe attack by the jute hairy caterpillar, *Spilosoma obliqua* (Walker) in the field during the jute growing season (Kabir and Khan 1969). The young caterpillars remain in clusters up to 3rd instar and feed on the lower epidermis of leaves, but from the fourth instar they spread over the field, eat up whole leaf tissues leaving only ribs, and thus adversely affect the yield of jute fibre. Besides jute, this insect was also found to attack sunflower, pulse, groundnut, radish and soybean, cotton, brinjal, cabbage, cauliflower, linseed, peas and many leguminous plants (Mallik *et al*. 1996, Kabir 1966). The jute semilooper, a cosmopolitan pest, is reported from the entire jute growing region all over the world and has estimated to damage up to 90% of the leaves of jute plant in some cases (Tripathi and Ghose 1964). Damage to jute foliage results in poor plant growth and ultimately low fibre quantity (Tripathi and Ghose 1964, Sing and Das 1979, Das and Sing 1976, Das *et al*. 1995). In general the pest of second generation is comparatively more destructive to the fibre crop (Sing and Das 1979) and in 81% cases the 7 - 9 leaves of upper part of the standing crop are damaged (Dutta 1958). In some cases the extent of damage may extend up to 91% covering 9th position of the leaf of the tiller. Pre monsoon rains followed by drought condition are congenial for the outbreak of semilooper and may lead up to 50% loss of crop as reported by Dutta (1958). Yellow mite (*Polyphagotarsonemus latus* Banks) and red mite (*Oligonychus coffeae* Nietner) are considered as the other major pests (Das and Sing 1977) in India, are destructive pests and attack both the cultivated jute species (Martinez and Mendez 1994, Roe *et al*. 1996, Karmakar 1997, Chakravarthy *et al*. 1998). The damage of yellow mite is generally known as “Telenga” or Telchita”. The infestation usually appears on the apical leaves and a reduction of 10 - 17% fibre yield may be caused (Ahmed and Jalil 1993). Different methods *viz*., cultural, mechanical, biological and chemical are used to control jute pests but none of them provides effective and sound control. Farmers apply high doses of inorganic fertilizers and different types of toxic and hazardous type of newer insecticides in high quantum without any concern to the environment (Das and Sing 1986). In addition to that continuous and heavy use of synthetic insecticides creates several problems, including pesticide resistance (Rustanmani *et al*. 1985, Duguet and Wu 1986), and health hazards (Bhaduri *et al.* 1989). Primarily, chemicals of same group and in higher concentration affect other crop field and nearby crop ecosystem and it will make unquestionably more resistant pest in future because of the applied higher concentration. Secondly, several new chemicals with novel mode of action are available in market, but it may not be suitable unless their field efficiency and baseline data for toxicity is generated (RPMN 2007). Further, use of synthetic chemical insecticides

although successfully control the pest(s), it destroy predators, parasitoids and beneficial microbes causing imbalance in the ecosystem. The jute ecosystem supports large number of natural enemies of crop pests (Rahman and Khan 2009) and their importance in integrated approach for management of pests of jute has been developed (Rahman and Khan 2010). Therefore, it is urgent need to find out eco-friendly alternative approach for the management of jute pests. Considering the above facts the present research program was under taken to evaluate some jute mutants against jute hairy caterpillar and yellow mite and to know the incidence of insect pest and mite with associated natural enemies on these mutants in coastal jute ecosystem.

Materials and Methods

The experiment was conducted under natural field conditions at agricultural farm of Patuakhali Science and Technology University (PSTU), Dumki, Patuakhali during May to September, 2012. The experimental field was high land with sandy loam texture belonging to the Ganges Tidal Floodplain (AEZ 13). Twelve advanced mutants/lines *viz*., 0-9897, 0-72, 0-795, HC-2, HC-3, HC-95, BJC-83, BJC-214, BJC-7370, CVL-1, CVE-3 and VM-1 (715) were used as study materials to evaluate against jute hairy caterpillar and yellow mite and also to know the incidence pattern of insect pest with associated natural enemies. The experiment was laid out in randomized complete block design with three replications. The size of the individual plot was 4 m × 2.5 m and spacing between plot to plot and line to line was 0.5 m and 0.3 m, respectively. Seeds of 12 advanced mutants/lines of jute were collected from Bangladesh Jute Research Institute for conducting this experiment. The seeds were sown after final land preparation. All the agronomic practices including land preparation, sowing of seeds, fertilizer application and intercultural operations were done in raising the crop by the farm labours under constant supervision. Incidence of insect pests with associated natural enemies was recorded from seedling to harvesting. Infestations of jute plants under natural field condition were recorded at 60 days after sowing (DAS). Infested and uninfested plants and leaves were collected from five randomly selected rows of each plot to determine the level of infestation. The total number was counted and percentage of infested plants was calculated. The percentage of leaf infestation per plant was calculated again from five randomly selected plants. The percentage of leaf area damaged by jute hairy caterpillar was determined by eye estimation. The percentage of infestation was calculated by the following formula.

$$\text{Percentage of plants or leaves infested} = \frac{B}{A} \times 100$$

where, A = Number of total plants or leaves,

B = Number of infested plants or leaves

Data obtained from the experiment were statistically analyzed following ANOVA by using MSTAT-C programme and means were compared by DMRT.

Results and Discussion

Incidence of insect pests and natural enemies: As jute is grown during the summer season, a number of insect pests infest throughout the crop cycle. Insect pests *viz*., jute hairy caterpillar, jute semilooper, stink bug, hooded hopper, field cricket, sulphur butterfly, leaf eating caterpillar, red pumpkin beetle and ants were found to infest different mutants of jute after 60 DAS. Among them, jute hairy caterpillar was dominant and devastating. Beside these, jute yellow mite caused damage to the leaves of jute mutants. Similarly, the jute agro-ecosystem supports large number of natural enemies. Natural enemies *viz*., lady bird beetle, ground beetle, damsel fly, dragon fly, house fly, rove beetle, wasp and spider were observed on different mutants in jute ecosystem. Among them, lady bird beetle, spider and dragon flies were the most abundant (Ttable 1). In general 40 species of insects and mites attack on jute in Bangladesh as reported by Kabir (1966). Das and Sing (1986) and Rahman and Khan (2012) had enlisted a profile of insect pests in relation to the growth stage of the jute plant damaging jute crop. Rahman and Khan (2012) recorded 70 different species of pest belong to insects, mites and nematodes feeding on jute which appeared at different growth stages of jute in two consecutive years of observations.

Out of this, jute hairy caterpillar *Spilarctia* (= *Spilosoma*) *obliqua* (Walker) is of prime importance (Kabir and Khan 1968). Apart from jute hairy caterpillar, jute semilooper (*Anomis sabulifera* Guen.), Bihar hairy caterpillar (*Spilarctia obliqua* Wlk.), indigo caterpillar (*Spodoptera exigua* Hubner), stem girdler (*Nupserha bicolor* Dutt), stem weevil (*Apion corchori* Marshall), grey weevil (*Myllocerus discolor* Bohemus), yellow mite (*Polyphagotarsonemus latus* Banks) and red mite (*Oligonychus coffeae* Nietner) were recorded on *olitorius* jute var. JRO-54 from seedling to harvest stages of jute crop in India (Das and Sing 1977). Rahman and Khan (2012) observed Grey weevil (*Myllocerus discolor*) as a voracious feeder of tender leaves of jute seedlings during 2nd week of May and remained active throughout the crop season with peak infestation of 33.56% plant damage and 36% leaf damage in the first week of June in 2004. Rahman and Khan (2010) has been developed the importance of natural enemies in integrated approach for management of pests of jute.

Table 1. Incidence of insect pests and natural enemies on different mutants of Jute at Dumki, Patuakhali during May to September, 2012.

Sl. No.	Common name	Scientific name	Family	Order
	Insect and mite pests			
1	Jute hairy caterpillar	*Spilarctia obliqua* Walk.	Arctiidae	Lepidoptera
2	Jute semilooper	*Anomis sabulifera* Guen.	Noctuidae	lepidoptera
	Jute stem weevil	*Apion corchori* Marshall	Curculionidae	Coleoptera
	Jute grey weevil	*Myllocerus discolor* Bohemus	Curculionidae	Coleoptera
3	Hemipteran bug	Unidentified	Pentatomidae	Hemiptera
	Hooded hopper	*Otinotus elongates* Kif	Cercopidae	Hemiptera
4	Field cricket	*Brachytrypes portentosus*	Gryllidae	Orthoptera
5	Sulphur butterfly	Unidentified	Pieridae	Lepidoptera
6	Red pumpkin beetle	*Aulacophora* sp.	Chrysomelidae	Coleoptera
7	Ant	*Camponotus compressus*	Formicidae	Hymenoptera
8	Yellow mite	*Polyphagotarsonemus latus* Banks	Tarsonemidae	Acarina
Natural enemies				
1	Lady bird beetle	*Micraspis discolor*	Coccinellidae	Coleoptera
	Lady bird beetle	*Coccinella septempunctata*	Coccinellidae	Coleoptera
2	Ground beetle	*Ophionea nigrofasciata*	Carabidae	Coleoptera
3	Damselfly	Unidentified	Coenagrionidae	Odonata
4	Dragonfly	Unidentified	Ashnidae	Odonata
5	Wasp	Unidentified	Vespidae	Hymenoptera
6	Spiders	*Oxyopes* spp.	Lycosidae	Araneae
7	Assasin bug	*Zelus longipes* L.	Reduvidae	Hemiptera
8	Rove beetle	*Holobus kashmiricus*	Staphylinidae	Coleoptera

Percentage of jute plant infested by hairy caterpillar: The percentage of jute plants per 5 rows infested by jute hairy caterpillar on different mutants is presented in Table 2. Significantly the highest per cent plant infestation per 5 rows (30.77) was found in mutant VM-1 followed by 0 - 9897 (30.37) which was statistically similar to 0 - 72 (30.22) and HC-95 (29.91) followed by CVL-1 (22.32). Significantly the lowest per cent plant infestation was recorded in mutant BJC-214 (14.37%) followed by BJC-7370 (14.81) and HC-3 (14.86). However, no significant difference was observed on plant infestation among mutant HC-2 (17.71%), BJC-83 (16.09%) and 0-795 (15.65%). The rank order of plant infestation per 5 rows was VM-1 > 0-9897 > 0-72 > HC-95 > CVL-1 > CVE-3 > HC-2 > BJC-83 > 0-795 > HC-3 > BJC-7370 > BJC-214.

Table 2. Percentage of jute plants infested by jute hairy caterpillar on different mutants.

Mutants	Total number of plants checked/5 rows	Number of infested plants	Number of healthy plants	% infested plants/ 5 rows
0-9897	135	41	94	30.37ab
0-72	278	84	194	30.22ab
0-795	115	18	97	15.65d
HC-2	96	17	79	17.71d
HC-3	148	22	126	14.86de
HC-95	107	32	75	29.91ab
BJC-83	230	37	193	16.09d
BJC-214	174	25	149	14.37e
BJC-7370	135	20	115	14.81de
CVL-1	112	25	87	22.32bc
CVE-3	394	82	312	20.81cd
VM-1	169	52	117	30.77a
CV (%)				17.64
CD (5%)				6.403

Values are averages of three replications.

Percentage of infested leaves per plant: Percentage of jute leaves infested by jute hairy caterpillar on different mutants is presented in Table 3. Significantly the highest per cent leaf infestation per plant was recorded on mutant BJC-83 (46.30%). The lowest per cent leaf infestation was in mutant HC-3 (25.40) followed by HC-95 (31.08) which was statistically similar to BJC-214 (34.48), 0-795 (35.19). Statistically identical results were found in CVL-1 (36.54%) and BJC-7370 (36.54%). However, no significant differences were observed among mutants VM-1, CVE-3, HC-2, 0-72 and 0-9897 (Plate 1 and 2). The rank order of per cent leaf infestation per plant was BJC-83 > 0-9897 > 0-72 > HC-2 > CVE-3 > VM-1 > BJC-7370 ≥ CVL-1< 0-795 > BJC-214 > HC-95 > HC-3.

Table 3. Percentage of jute leaves infested by jute hairy caterpillar in different mutants.

Mutants	Total number of leaves/ plant	Number of infested leaves/plant	% infested leaves/plant
0-9897	10.6	4.6	43.40ab
0-72	10.2	4.2	41.18ab
0-795	10.8	3.8	35.19ab
HC-2	13.8	5.6	40.58ab
HC-3	12.6	3.2	25.40b
HC-95	14.8	4.6	31.08ab
BJC-83	10.8	5.0	46.30a
BJC-214	11.6	4.0	34.48ab
BJC-7370	10.4	3.8	36.54ab
CVL-1	10.4	3.8	36.54ab
CVE-3	12.0	4.8	40.00ab
VM-1 (715)	8.2	3.2	39.02ab
CV (%)			21.30
CD (5%)			5.501

Values are averages of 5 observations.

Percentage of leaf area damaged by hairy caterpillar: Fig. 1 revealed that the highest per cent leaf area damaged was observed in mutant CVE-3 (45) followed by mutant 0-72 (30) which was statistically identical to BJC-7370 (30) and the lowest was in mutant HC-3 (9) followed by CVL-1 (10), HC-95 (12) and BJC-83 (15). The intermediate higher level of leaf area damage was found in mutant 0-795 (17%) followed by BJC-214 (18%), HC-2 (22%) and 0-9897 (25%) which was statistically identical to VM-1 (715) (25%). The rank order of leaf area damage was CVE-3 > BJC-7370 ≥ 0-72 > 0-9897 ≥ VM-1(715) > HC-2 > BJC-214 > 0-795 > BJC-83 > HC-95 > CVL-1 > HC-3.

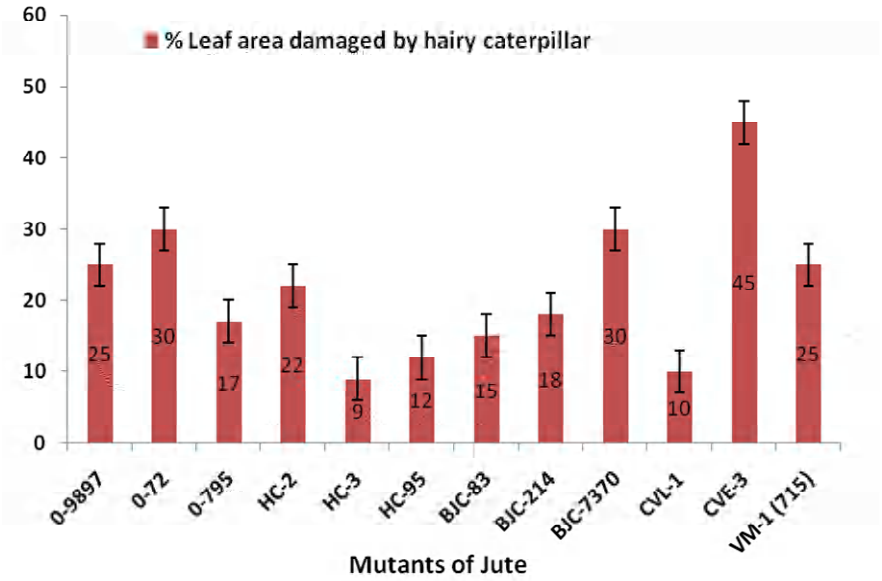

Fig. 1. Percentage of leaf area damaged by jute hairy caterpillar on jute mutants.

Fig. 2. Different immature stages of jute hairy caterpillar.

Fig. 3. Damaged leaves of different mutants caused by jute hairy caterpillar.

Damage symptoms of yellow mite (*Polyphagotarsonemus latus* Banks): The damage of yellow mite is generally known as "Telenga" or Telchita". The infestation usually appears on the apical leaves of jute plant (Fig. 4). Rahman and Khan (2012) observed that yellow mite incidence was started in the last week of May and attained its peak with 29.33% plant infestation and 35.87 mites/leaf in the last week of June, 2004 and 27.60% plant infestation with 18.66 mites/leaf in the 3rd week of June 2005.

Yellow mite, *Polyphagotarsonemus latus* is destructive for jute production (Das and Rouchaudhori 1979). They suck sap from younger leaves results in foliage discoloration; natural green colour of leaves turn into brown with change of shape due to curling (Das and Sing 1985). Loss of nutrition in young plant due to sucking, height of the plant becomes stunted and significant yield loss occurs (Nair 1986, Pradhan and Saha 1997).

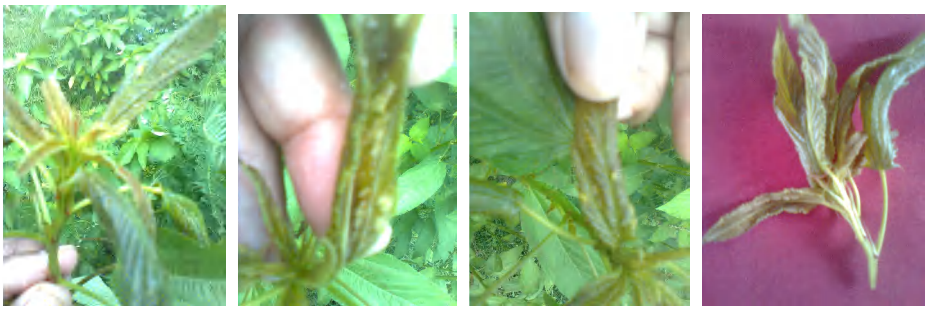

Fig. 4. Damage symptoms due to yellow mite infestation in jute.

Rahman and Khan (2012) reported that *S. obliqua* infestation was noticed in the second week of June with 5.63% plant infestation and reached its peak infestation with 21.6% in the 2nd week of July and declined thereafter to cause 2.96% plant infestation in the last week of July in 2004. No hairy caterpillar larvae were found during harvest of the jute. Rahman and Khan (2010) reported from a pest complex of *olitorius* jute var. JRO-524 that incidence of *S. obliqua*, *A. sabulifera*, *M. discolor*, *A. corchori* and *P. latus* causing a minimum of 4.68, 6.10, 12.38, 5.09 and 10.47% plant infestation, respectively. Mahapatra (1996) found that yellow mite incidence started in the last week of May and continued up to July with 9.01 - 49.71% plant infestation and number of mites/leaf varied from 37.6 to 91.3. Das and Pathak (1999) reported a maximum of 77.39 yellow mites/leaf in *C. olitorius* jute and 16.00 mites/leaf in *C. capsularis* jute varieties.

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