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Field Evaluation of Kenaf Cultivars and Their Hybrids for Their Reactions to Spiral Borer

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Abstract: Out of eight kenaf (*Hibiscus cannabinus* L.) cultivars assessed under field conditions against spiral borer (*Agrilus acutus* Thumb.), two were rated resistant, one was moderately resistant, three were moderately susceptible and two were susceptible. Among the hybrids progenies one was rated resistant, two were moderately resistant, one was moderately susceptible, two were susceptible and one was highly susceptible. Among resistant cultivars and hybrids, differences in mean gall length were insignificant, however, in percent infestation and mean percent damage (APD), the differences were significant.

Key words: Kenaf, resistance, susceptible, *A. acutus*

Introduction

Kenaf, a jute substitute, is now grown as raw materials for paper-pulp in many countries (Andrew and Pieters, 1980; Jianguang *et al*., 2000; Nieschlag *et al*., 1960). The paper and pulp mills of Bangladesh have introduced kenaf as raw materials along with jute stems (Ahmad, 1997; Anonymous, 1993). Besides, the farmers have been using kenaf stick or whole stem in the vegetable, betel leave plantations and as fuel. This has created interest in cultivating kenaf. Increased cultivation has resulted in an increased incidence of pests, especially spiral borer, *Agrilus acutus* Thumb. (Bhuiyan and Kabir, 1985; Anonymous, 1995, 2000a). It is also a major pest of kenaf in India (Chatterji and Singh, 1983).

The pest appears during mid of the crop season when the plants are 90-100 days of age and about 90-110cm tall (Kabir, 1995; Ahmad and Faruquzzaman, 2000). A portion of the infected region swells up considerably to form an elongated gall and 1-3 such galls may be formed per plant (Kabir, 1995). The gall is usually found at the basal portion of the stem (Bhuiyan and Kabir, 1985). The region of the stem at the level of galls becomes very weak due to formation of thin walled parenchymatous cells and less lignification of the cell wall of xylem tissue (Dutt and Mitra, 1954; Dutta, 1971). Due to this weak formation of the gall region, the stem cannot withstand any sudden jerks resulting from the windy rainy season and cause considerable loss of yield. Attempts to control the spiral borer through use of the biocides are made in India without much success (Anonymous, 2000b). Use of biocides/pesticides is also costly and hazardous to human health and environment. Chatterji and Singh (1983) also opined that control of *A. acutus* with pesticide was difficult because the insect remained concealed most of its life cycle inside the stem of the host plant. Thus the development of kenaf varieties with resistance to *A. acutus* was thought to be a practical and environment friendly means of controlling this pest. Therefore, screening programmes of kenaf cultivars of diverse geographic origin (Africa, Australia, China, USA and Central Asia) against spiral borer were being conducted (Anonymous, 1995, 1996, 2000a) and few exotic kenaf cultivars were isolated as resistant (Ahmad and Faruquzzaman, 2000; Anonymous, 2000a). The agronomic performances of those cultivars (e.g. DS/002H, X/062H) are poor and not suitable for direct introduction in the field. As such, a hybridization program was undertaken to incorporate the resistant characters into commercial cultivars. The present experiment deals with assessment of field resistance of kenaf cultivars and their F_1s to *A. acutus*.

Materials and Methods

Experiments were conducted in the field of central station of Bangladesh Jute Research Institute (BJRI) during 1998-2000. Eight cultivars of kenaf (two recommended HC-95 and HC-2 and six exotic) and seven F_1 hybrids were used. Untreated seeds were sown during 15-30 March in different years in plots (3 X 1.2m^2) established in a randomized complete block design having 5 rows. Each row was 3 m with 30 cm spacing. Each treatment was replicated 3 times. Recommended doses of fertilizer (N-P-K = 40-50-20kg/ha) were applied and standard cultural practices were followed but no pesticides were used. About 260 plants from the middle three rows in each plot were checked monthly to record the percent infestation. Percent of plant damage due to gall formation were also recorded from the same plants. Based on the amount of plant damage (mean damage %), the tested materials were rated (Table 1) for their reactions to the pest for use in identifying levels of resistance following Ahmad and Faruquzzaman (2000).

The percentage of plant infestation (PPI) and amount of plant damage (APD) were computed according to the formula used by Pradhan (1988) with slight modification. Instead of considering the term percent of plant damage (PPD) as used by Pradhan, percent plant infestation (PPI) and instead of amount of damage (AD), amount of plant damage (APD) were used.

$$PPI = \frac{\text{Number of plants infested}}{\text{Number of plants observed}} \times 100$$

$$APD = \frac{\text{Extent X Intensity}}{100}$$

Where, extent = PPI, intensity = mean gall length.

Results and Discussion

Significant differences were observed among kenaf cultivars and their hybrids with regard to mean percent infestation, mean gall length and mean amount of plant damage (APD). None of these cultivars and hybrids were free from borer infestation. However, the results indicated variable host reaction among kenaf cultivars and their hybrids. Of eight cultivars screened, two (cult. X /062H and CPI 72126) were recorded resistant (7.47-14.57% infestation and 0.48-0.71% APD), one (cult. DS/002H) was moderately resistant (54.99%

infestation and 6.06% APD), three (cult DS/024H, PI 329192 and HC-95) were moderately susceptible (38.51-69.44% infestation and 7.45-10.03% APD) and two (cult FJ/017H and HC-2) were susceptible (53.68-77.83% infestation and 11.67-17.18% APD). Of seven single cross combinations studied, one combination (X /062H X CPI 72126) was recorded resistant (70.77% infestation and 2.31% APD), two (HC-95 X /062H and DS/024H X x/062H) were moderately resistant (69.68-96.46% infestation and 3.94-4.75% APD), one hybrid (HC-2 X X062H) was moderately susceptible (54.69% infestation and 7.95% APD), two hybrids (DS/002H X CPI 72126 and FJ/017H X HC-95) were susceptible (86.85-91.20% infestation and 13.92-15.12% APD) and one (PI 329192 X CPI 72126) was highly susceptible (91.40% infestation and 27.02% APD). Differential response of different varieties of kenaf and mesta (*Hibiscus sabdariffa* L.) to *A. acutus* were also observed by Dutt and Bhattacherjee (1960).

Among resistant cultivars and hybrids, differences in mean gall length were insignificant, however, in percent infestation (PPI) and mean percent damage (APD), the differences were significant. In few cultivars (PI 329192, HC-95 and HC-2) and F_1 hybrids (HC-2 X X/062H) percent infestation was between 38.5 and 53.68, and were ranked moderately susceptible to susceptible. Whereas, in one resistant hybrid combination (X/062H X CPI 72126) although percent infestation was high as 70.77, was ranked resistant. Due to minimum gall length (3.27 cm) the calculation for APD ranked this hybrids as resistant. Thus gall length was found to be an important factor in determining level of resistance to *A. acutus*. This observation was in accordance with Ahmad and Faruquzzaman (2000). In the tested materials infestation ranged from 7.47 to 96.46%, while mean gall length ranged from 3.27 to 29.56 cm and amount of plant damage (mean damage percent) ranged from 0.48 to 27.02%. This is in accordance with Kabir (1995) and Bhuiyan and Kabir (1985) where they recorded that frequency of upward occurrence of larval tunnel (infestation) in kenaf plants was about 100 percent while extent of damage (APD) usually accounts to 3 to 5 percent, but occasionally may be much higher. It was observed from the table 2 that all the tested materials were infested by the borer but the mean percent damage (APD) of the resistant materials was negligible. The infestation thus, by itself is not fully responsible for damage, but it is gall length which determines APD. However, infestation by itself results in the deterioration of fibre quality. Kabir (1995) reported that fibers of the infested portion of the seed become wiry, brittle or remain attached to the stick during extraction after retting. Thus causing deterioration of fibre quality.

Although the present study deals with field performance of kenaf cultivars and their F_1 hybrids against spiral borer, it would be worthwhile to discuss some points on their mode of inheritance. Resistant accession X/062H when crossed with susceptible cultivar HC-2, the F_1s showed moderately susceptible reactions and when X/062H was crossed with moderately cultivar HC-95, the F_1s showed moderately resistant reaction. The resistance of X/062H expressed differently with different recipient parents. The other resistant accession CPI 72126 when crossed with moderately susceptible accession PJ 329192, the F_1s showed highly susceptible reaction and when the former was crossed with moderately resistant accession DS/002H, the F_1s showed susceptible reaction. Here, the resistant parent CPI 72126 failed express its resistance in the F_1s. The resistant accession X/062H when crossed with resistant CPI 72126, the F_1s showed resistant reaction but, the percent infestation (PPI) and mean percent damage (APD) was high than either of the parents. As mentioned earlier that infestation by itself although not fully responsible for damage, to results deterioration of fibre quality (Kabir, 1995). Moreover, mean percent infestation (PPI) and mean percent damage (APD) were high in the F_1s than those of parents (cultivars). This may be explained by the vigorous growth of the hybrid progenies (Ahmad *et al.*, 1998). This observation is an accordance with Bhuiyan and Kabir (1985) who observed that the insect prefers to lay eggs on the plant with thick stems than those with this stems.

It is clear from the observation that resistance against spiral borer in kenaf did not follow simple Mendelion rule and the levels of resistance are also weak. Moreover, the more vigorous the growth of plants the more intensity of attack by the pest irrespective of cultivars and F_1s. Ahmad and Faruquzzaman (2000) mentioned that the levels of resistance in other species such as *H. sabdariffa, H. radiatus* and *H. acetosella* are sufficient to encourage their use as donors in

Table 1: Rating scale of kenaf cultivars for identifying levels of resistance to *A. acutus*

Score group	Mean damage (% APD)	Description	Rank
1	0	No infestation	HR
2	0.1-3	Gall formation not visible, low pest attack caused slight effect on fibre quality but no plant loss or yield loss.	R
3	3.1-7 MR	Gall formed but no lodging of stem i.e., no yield loss, Fibre quality slightly deteriorates	
4	7.1-10 MS	Gall formed. No plant loss through lodging but the fibre quality deteriorates through sticking of fibers with the stick at the gall site	
5	10.1-20	Gall formed. Most of the infected plants lodged causing loss in yield as well as in quality	S
6	20.1-above	Severe gall formation. Infested plants get lost through lodging thereby causing total loss in yield	HS

HR = Highly resistant; R = Resistant; MR = Moderately resistant; MS = Moderately susceptible; S = Susceptible. HS = Highly susceptible.

Table 2: Effect of *A. acutus* infestation on Kenaf under field condition

CGR Acc./Cultivar/	Source	Mean infection (% ppm)	Mean gall length (cm)	Mean damage (% APD)	Rank
DS/002H	Kenya	54.99d	11.02b	6.06ef	MR
DS/024H	Kenya	69.44e	10.73b	7.45fg	MS
X/062H	Tanzania	14.57b	4.87a	0.71ab	R
PI 329192	El-Salvador	38.51c	21.31d	8.21g	MS
FJ/017H	China	77.83f	22.08d	17.18j	S
HC-95	Bangladesh	50.55d	19.86d	10.03h	MS
HC-2	Bangladesh	53.68d	21.74d	11.67h	S
CPI 72126	Australia	7.47a	6.38a	0.48a	R
F_1(X/062HxCPI 72126		70.77e	3.27a	2.31bc	R
F_1(HC-2 x X/062H)		54.69d	14.53c	7.95g	MS
F_1(HC-95 x X/062H)		69.68e	5.65a	3.94cd	MR
F_1(PI 329192xCPI 72126		91.40g	29.56e	27.02k	HS
F_1(DS/002H x CPI 72126)		91.20g	16.58c	15.12i	SS
F_1(DS/024Hx X/062H)		96.46h	4.92a	4.75de	MR
F_1(FJ/017H x HC-95)		86.85g	16.03c	13.92i	S
CV%		4.5	12.1	11.4	

Means followed by a common letter are not significantly different at 5% level. HR = Highly resistant; R = Resistant; MR = Moderately resistant; MS = Moderately susceptible; S = Susceptible. HS = Highly susceptible.

breeding for resistance to *A. acutus*. They also mentioned that fertile hybrids between *H. cannabinus* and *H. acetosella* were obtained using *H. radiatus* as a bridging species and advanced generations were raised (Ahmad *et al.,* 1996). It may be concluded that a two fold approaches should be made : (a) Further screening of wide genetic resources of the genus *Hibiscus* especially *H. cannabinus,* preserved in gene bank should be made and a wide crossing programme may be undertaken and (b) the interspecific hybrids thus obtained should be studied, back crossed and selection should be practiced for getting commercial varieties of kenaf having resistance to *A. acutus*.

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