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 gill 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 stalk or whole stem in the vegetable, betel leaf plantation 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 50-110 cm 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, 1995). The region of the stem at the level of gall becomes very weak due to formation of thin walled parenchymatous cells and less lignification of the cell wall of xylem tissue (Dutt and Mitre, 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 F₃ to A. acutus.

Materials and Methods
Experiments were conducted in the field of central station of Bangladesh Jute Research Institute (BJRI) during 1999-2000. Eight cultivars of kenaf (two recommended HC-95 and HC-2 and six exotic) and seven F₁ hybrids were used. Untreated seeds were sown during 15-30 March in different years in plots (3 x 1.2 m²) 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 = 40-50-20 g/ha) were applied and standard cultural practices were followed but no pesticides were used. About 280 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.

\[
PPI = \frac{\text{Number of plants infested X 100}}{\text{Number of plants observed}}
\]

\[
APD = \frac{\text{Extant X Intensity}}{100}
\]

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 7.46-10.03% 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 PI 72126) was 
recorded resistant (70.77% infestation and 2.31% APD), two 
(PI 95 X /062H and DS/024H X X/062H) were moderately 
resistant (69.68-96.46% infestation and 3.94-4.76% APD), 
one hybrid (HC-2 X X/062H) was moderately susceptible 
(54.69% infestation and 7.56% APD), two hybrids (DS/002H 
X CPI 72126 and FJ/017H X HC-95) were susceptible 
(60.85-91.20% 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 (Peltophorum 
sabdariffa L) to A. acutus were also observed by Dutt and 
Bhattacharjee (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 
F1 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 96.48%, while mean gall length ranged 
from 3.27 to 29.6 cm and amount of plant damage (mean 
damage percent) ranged from 0.48 to 27.02%. This is in 
agreement 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 
deterioration of fibre quality. Kabir (1995) reported that 
fibres of the infested portion of the seed become wavy, brittle 
or remain attached to the stock during extraction after retting. 
Thus causing deterioration of fibre quality.

Although the present study deals with field performance 
of kenaf cultivars and their F1 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 F1s showed moderately 
susceptible reactions and when X/062H was crossed with 
moderately cultivar HC-95, the F1s showed moderately 
recessive 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 F1s showed highly 
susceptible reaction and when the former was crossed with 
moderately resistant accession DS/002H, the F1s showed 
susceptible reaction. Here, the resistant parent CPI 72126 
failed express its resistance in the F1s. The resistant accession 
X/062H when crossed with resistant parent CPI 72126, the F1s 
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 F1s 
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 Mendelian rule and the 
levels of resistance are also weak. Moreover, the more 
vigorous the growth of the plants the more intensity of attack by 
the pest irrespective of cultivars and F1s. 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>
<thead>
<tr>
<th>Score</th>
<th>Mean damage</th>
<th>Description</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2.1</td>
<td>No infestation</td>
<td>HR 1</td>
</tr>
<tr>
<td>3</td>
<td>1.1</td>
<td>Gall formation not visible, low pest attack caused slight effect on fibre quality but no plant loss or yield loss</td>
<td>R</td>
</tr>
<tr>
<td>2</td>
<td>0.1-3</td>
<td>Gall formed but no lodging of</td>
<td>MR</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>stem i.e., no yield loss, fibre quality slightly deteriorates</td>
<td>MS</td>
</tr>
</tbody>
</table>

Table 2: Rating scale of kenaf cultivars for identifying levels of resistance to A. acutus

<table>
<thead>
<tr>
<th>CGP Association / Cultivar</th>
<th>Source</th>
<th>Mean infestation (% ppm)</th>
<th>Mean gall length (cm)</th>
<th>Mean damage (% APD)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS/024H</td>
<td>Kenya</td>
<td>64.50d</td>
<td>11.00d</td>
<td>0.02f</td>
<td>MR</td>
</tr>
<tr>
<td>DS/024H</td>
<td>Kenya</td>
<td>69.66d</td>
<td>10.73b</td>
<td>3.48f</td>
<td>MS</td>
</tr>
<tr>
<td>X/062H</td>
<td>Tanzania</td>
<td>14.67b</td>
<td>4.87a</td>
<td>0.71a</td>
<td>R</td>
</tr>
<tr>
<td>PI 329192</td>
<td>Bolivia</td>
<td>38.81c</td>
<td>21.31b</td>
<td>9.21g</td>
<td>MS</td>
</tr>
<tr>
<td>FJ/017H</td>
<td>China</td>
<td>77.83f</td>
<td>22.08d</td>
<td>17.18i</td>
<td>S</td>
</tr>
<tr>
<td>JC/0126</td>
<td>Bangladesh</td>
<td>46.06d</td>
<td>19.86d</td>
<td>10.03h</td>
<td>MS</td>
</tr>
<tr>
<td>CH/72126</td>
<td>Australia</td>
<td>63.65d</td>
<td>21.74d</td>
<td>11.67g</td>
<td>S</td>
</tr>
<tr>
<td>F1 (X/062H X PI 72126)</td>
<td>70.77a</td>
<td>2.37a</td>
<td>0.41f</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>F1 (HC-2 X X/062H)</td>
<td>84.69d</td>
<td>14.63c</td>
<td>7.95f</td>
<td>MS</td>
<td></td>
</tr>
<tr>
<td>F2 (HC-2 X X/062H)</td>
<td>69.66d</td>
<td>9.65a</td>
<td>3.46d</td>
<td>MR</td>
<td></td>
</tr>
<tr>
<td>F1 (PI 329192 x CPI 72126)</td>
<td>91.40g</td>
<td>26.66c</td>
<td>27.02c</td>
<td>HS</td>
<td></td>
</tr>
<tr>
<td>F1 (DS/002H x CPI 72126)</td>
<td>91.20g</td>
<td>16.60d</td>
<td>16.12h</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>F1 (DS/024H X X/062H)</td>
<td>90.45h</td>
<td>4.92a</td>
<td>7.46e</td>
<td>MR</td>
<td></td>
</tr>
<tr>
<td>F1 (PJ/017H X HC-95)</td>
<td>86.95g</td>
<td>16.03i</td>
<td>15.95h</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>CV%</td>
<td>4.6</td>
<td>12.1</td>
<td>11.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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. radicus* 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*.

References


