

## EVALUATING LEAF PROPERTY-BASED RESISTANCE TO JUTE HAIRY CATERPILLAR *Spilosoma obliqua* IN SELECTED JUTE VARIETIES

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### ABSTRACT

The present study was conducted in the experimental field of the Department of Entomology, Gazipur Agricultural University, Bangladesh during April to August 2023 using jute varieties. The experiment aimed to explore the host plant resistance against *Spilosoma obliqua* (Walker, 1855) jute hairy caterpillar based on leaf biochemical parameters of the selected BJRI Tossa jute varieties and to evaluate the yield performance of these varieties. The selected jute varieties were O-9897, OM-1, BJRI Tossa pat-4, BJRI Tossa pat-6, BJRI Tossa pat-7 and BJRI Tossa pat-8. Biochemical parameters, namely chlorophyll content, carotenoids, phenolic content, 2,2-diphenyl-1-picryl hydrazyl (DPPH) and flavonoids were estimated from the leaves of these varieties. Among these biochemical contents, total chlorophyll content and flavonoids showed a positive influence on the infestation of jute hairy caterpillar. In contrast, carotenoids, phenolic content and DPPH showed a negative influence on its infestation. Data analysis revealed that the highest infestation at 60 and 90 days after sowing (DAS) was found in OM-1 (22.8±0.8% and 42.0±5.5%, respectively) while at 120 DAS, the highest infestation was recorded in BJRI Tossa pat-6 (28.3±3.8%). On the other hand, the lowest infestation at 60 DAS, 90 DAS and 120 DAS was observed in BJRI Tossa pat-8 (15.5±0.2%, 29.8±6.4% and 19.4±1.2%, respectively). The maximum fibre and stick yields were obtained from BJRI Tossa pat-8 (2.3±0.2 t/ha and 5.8±0.7 t/ha, respectively). Among the six evaluated varieties, BJRI Tossa pat-8 exhibited the lowest levels of jute hairy caterpillar abundance and infestation, along with the highest fibre and stick yields, indicating its greater suitability for cultivation.

**Keywords:** Host plant resistance; leaf biochemical properties; *Spilarctia obliqua*; varietal screening

## ABSTRAK

Kajian ini dijalankan di ladang eksperimen Jabatan Entomologi, Universiti Pertanian Gazipur, Bangladesh dari April hingga Ogos 2023 menggunakan varieti jut. Kajian ini bertujuan untuk mengkaji rintangan tanaman perumah terhadap ulat berbulu jut *Spilarctia obliqua* berdasarkan parameter biokimia daun bagi varieti jut Tossa BJRI terpilih serta menilai prestasi hasil varieti tersebut. Varieti jut yang dipilih ialah O-9897, OM-1, BJRI Tossa pat-4, BJRI Tossa pat-6, BJRI Tossa pat-7 dan BJRI Tossa pat-8. Parameter biokimia yang dikaji, iaitu kandungan klorofil, karotenoid, kandungan fenolik, 2,2-difenil-1-pikril hidrazil (DPPH) dan flavonoid, dianggarkan daripada daun varieti-varieti ini. Dalam kalangan kandungan biokimia tersebut, jumlah kandungan klorofil dan flavonoid menunjukkan pengaruh positif terhadap infestasi ulat berbulu jut. Sebaliknya, karotenoid, kandungan fenolik dan DPPH menunjukkan pengaruh negatif terhadap infestasi. Analisis data menunjukkan bahawa infestasi tertinggi pada 60 dan 90 hari selepas menyemai (DAS) didapati pada OM-1 (masing-masing  $22.8 \pm 0.8\%$  dan  $42.0 \pm 5.5\%$ ), manakala pada 120 DAS, infestasi tertinggi direkodkan pada BJRI Tossa pat-6 ( $28.3 \pm 3.8\%$ ). Sebaliknya, infestasi terendah pada 60 DAS, 90 DAS dan 120 DAS diperhatikan pada BJRI Tossa pat-8 (masing-masing  $15.5 \pm 0.2\%$ ,  $29.8 \pm 6.4\%$  dan  $19.4 \pm 1.2\%$ ). Hasil gantian dan batang tertinggi diperoleh daripada varieti BJRI Tossa pat-8 (masing-masing  $2.3 \pm 0.2$  t/ha dan  $5.8 \pm 0.7$  t/ha). Antara enam varieti yang dinilai, BJRI Tossa pat-8 menunjukkan tahap kehadiran dan infestasi ulat berbulu jut yang paling rendah, serta menghasilkan gantian dan batang yang tertinggi menunjukkan kesesuaiannya yang lebih baik untuk penanaman.

**Kata kunci:** Rintangan tanaman perumah; sifat biokimia daun; *Spilarctia obliqua*; saringan varieti

## INTRODUCTION

Jute, a fibre crop under the family of Malvaceae is one of the most important cash crops as well as the biggest foreign exchange earners of Bangladesh. It is a crucial natural fiber crop predominantly cultivated in tropical and subtropical regions. There are more than 40 species of jute available in Bangladesh out of them *Corchorus capsularis* which originated in India and Myanmar and *Corchorus olitorius* originated in Africa are commercially cultivated for fiber production. Because of its significance and golden color, jute is referred to as "golden fiber" in Bangladesh (Hassan et al. 2018). Bangladesh and India are major jute growing countries of the world (Rahman et al. 2017). Bangladesh now accounts for 58% of global jute production and 53% of jute, kenaf and fiber products. In Bangladesh, four million farmers are involved in jute production (Shahin 2023). The cultivation area in the fiscal year 2021-2022 is 727382.00 ha which is higher than 6.628% that of fiscal year 2020-2021. Yield rate has been estimated at 2.484 ton per ha in fiscal year 2021-2022 that is higher than that of previous year. Total production of jute is about 1806977.92 tons that is 9.156% higher than previous year (BBS 2022). The contribution of this sector to the national economy is on an upward trend. Bangladesh exported jute and jute goods worth 1.3 billion dollars in the fiscal year 2021-2022. Jute contributes 3% of Bangladesh total foreign exchange earnings and 3% to the country's GDP (Gross Domestic Product) (Al-Mamun 2023).

Numerous pests target the crop from the seedling stage until harvest, which occurs during the summer. Insect infestation is one of the barriers for the productivity of jute that plays

an important role in the economy while exporting jute and jute products. About 40 insects and mite species are considered as jute pests in Bangladesh (Islam et al. 2022). Due to their attack the yield is greatly reduced every year (Rahman & Khan 2006). Among them, the jute hairy caterpillar, *Spilarctia obliqua* (Walker) is the most common as well as very destructive (Islam et al. 2020). It is one of the major insect pests and highly polyphagous infesting many economically important crops such as mulberry, sun hemp, ramie, roselle, turmeric, cereals, vegetables and jute often causing severe economic damage (Gupta & Bhattacharya 2008). It infests 126 plant species under 24 families (Rahman et al. 2020). The caterpillars feed on the whole leaf tissues leaving only the midrib. It can also feed on top shoots which reduce yields through defoliation and stunted growth (Islam et al. 2022). In jute, the hairy caterpillar causes yield loss up to 30% (Bandyopadhyay et al. 2014). Previously thought to be an occasional and irregular jute pest, outbreaks of this insect have been documented from jute-growing regions in recent years, resulting in significant fiber loss (Selvaraj et al. 2015). If not controlled in a timely manner, it can cause severe defoliation of jute plants (Satpathy et al. 2014).

Various crop protection strategies utilizing chemicals, parasites, predators and entomopathogens are needed to control insect pests to reduce yield loss. The plant itself, however, has a variety of defense systems to prevent, lessen, or withstand the consequences of pest infestations (Sarfranz et al. 2006). The defense mechanism is mediated by the external appearance and chemical constituents of jute varieties (Gotyal et al. 2015). The morphological characteristics and chemical constituents of the host plant may influence the nutrition of the insect by limiting the access to the epidermis which results in lower amount of feeding and ingestion of the nutritive materials (Agrawal et al. 2009; Amin et al. 2015). Screening of jute varieties/genotypes showed that different jute varieties/genotypes had different levels of susceptibility to jute hairy caterpillar infestation (Bhosale & Hole 2020). Therefore, understanding how the leaf chemical properties of jute influence the population dynamics and infestation of the jute hairy caterpillar might play a significant role in pest management strategies. This study was conducted to determine the level of infestation of the jute hairy caterpillar on the selected jute varieties and to assess the relationship of morphological and chemical properties of the jute varieties with the infestation of the caterpillar.

## MATERIALS AND METHODS

### Study Location and Duration

The study was carried out in the research field and laboratory of the Department of Entomology, Gazipur Agricultural University, Gazipur, Bangladesh from April to August 2023.

### Jute Varieties

The selected jute varieties for this study were O-9897, OM-1, BJRI Tossa pat-4, BJRI Tossa pat-6, BJRI Tossa pat-7 and BJRI Tossa pat-8. The seeds of the varieties were collected from Jute Agriculture Experimental Station, Manikganj, Bangladesh.

### Experimental Design and Crop Cultivation

A randomized-complete-block-design (RCBD) was used, with every plot measuring  $4.0 \times 3.0$  m<sup>2</sup> and replicated 3 times (Figure 1). A total of eighteen plots were arranged across 3 replications. The spacing maintained between plots and blocks were 0.5m and 1.0m, respectively, while the line-to-line and plant-to-plant distances were set at 30 cm and 5 cm. Seeds were sown on April 6, 2023, in 11 lines per plot, maintaining the specified line spacing.

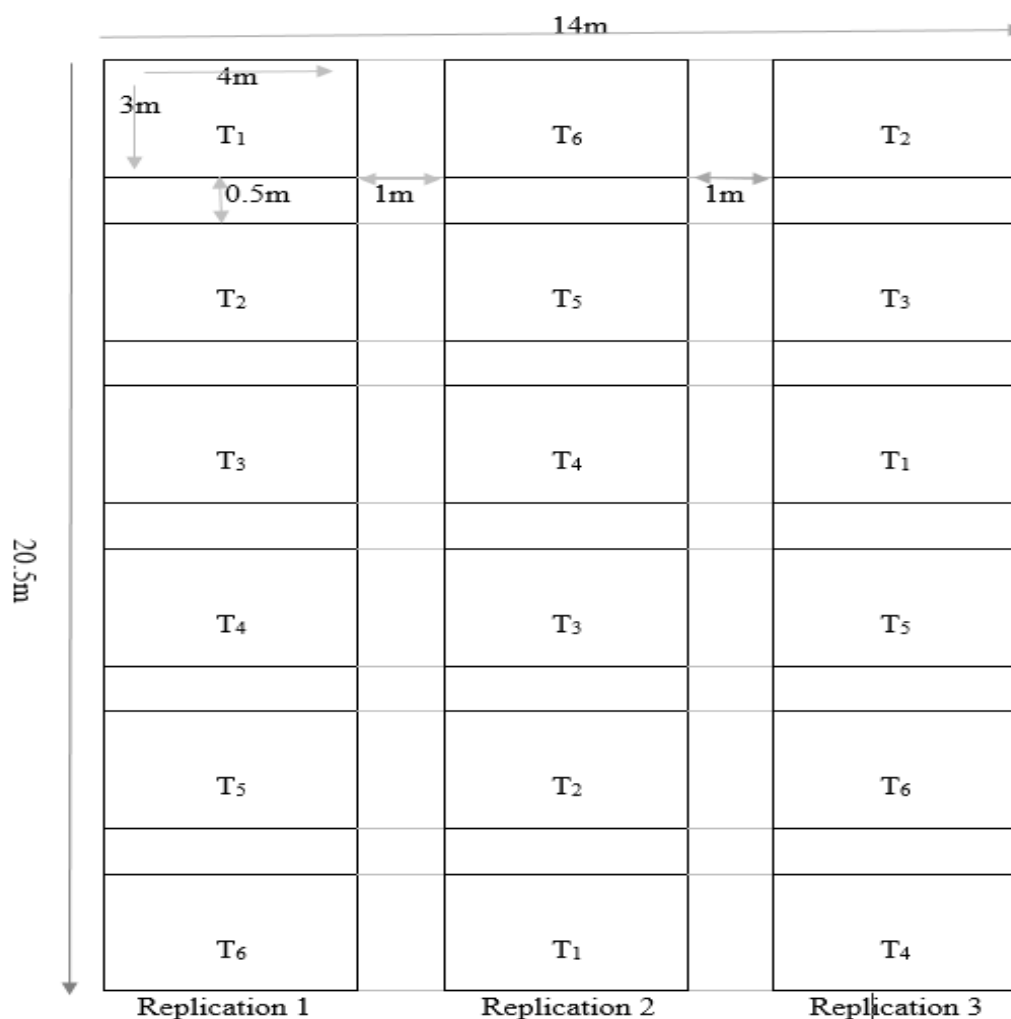


Figure 1. Layout of the experiment with distance and spacing

Fertilizer application followed the guidelines of the Fertilizer Recommendation Guide (BARC 2018), with the following rates: cow dung at 10 t/ha, urea at 200 kg/ha, MoP at 50 kg/ha, TSP at 60 kg/ha, and gypsum at 120 kg/ha. Cow dung, MoP, TSP, gypsum, and one-third of the urea were incorporated during land preparation and sowing, while the remaining urea was applied in two equal portions—30 and 45 days after sowing. Routine agronomic practices, including weeding, irrigation, thinning, and other intercultural operations, were carried out as needed and no insecticide was applied (Rahman & Khan 2010).

### Observation of Plant Morphological Attributes and Insect Pest Incidence

Weekly observations were carried out to monitor insect pest infestation and assess plant morphological traits such as plant height, number of leaves, leaf area, and various yield-related parameters. Measurements of plant height and leaf count were taken at 30, 60, 90, and 120 days after sowing (DAS), while leaf-area data was recorded at 60 DAS. Yield-related traits, including plant weight with and without leaves, bark thickness, fiber yield, and stick yield, were collected at harvest. The plots were left open to allow natural pest, *Spilosoma obliqua* to infest jute crops throughout the year. Initial signs of infestation typically appear in April when the plants reach a height of two to three feet. However, peak infestation generally occurs during June and July (Islam et al. 2022). The population of jute hairy caterpillar was observed visually and counted at 60 days, 90 days and 120 days after sowing. The mean number of jute hairy

caterpillar occurrence was calculated for the entire crop growing season. To determine the rate of caterpillar-infested leaves, both healthy and infested leaves were counted from 10 selected sample plants at 60, 90, and 120 days after sowing (DAS), the caterpillar identified visually and the results were expressed as percentages.

### Biochemical Analysis of Jute Leaf

#### *Data on Leaf SPAD*

The fresh leaves of jute were collected for biochemical analysis, with 10 replications tested for each variety. Chlorophyll content, which is a sign of plant healthiness and photosynthetic activity, was measured using the SPAD (Soil Plant Analysis Development) meter. Prior to measurement, the SPAD meter was carefully calibrated. The sensor head was positioned on selected leaves, ensuring full coverage of the sensor on the leaf surface. To ensure accuracy, readings were taken from ten leaves located at various parts of each plant.

#### *Estimation of Leaf Chlorophyll and Carotenoids*

Chlorophyll pigments (Chl-a, Chl-b, and total-Chl) along with carotenoids in leaf samples were measured using the method described by Khan et al. (2017). The analysis was performed with a UV visible spectrophotometer (Ultrospec-3000, Pharmacia-Biotech and Cambridge-United Kingdom). Specific equations were applied to calculate the concentrations of Chl-a, Chl-b, total-chlorophyll and carotenoids.

$$Chl - a = [12.7 (A663) - 2.69 (A645)] \left[ \frac{V}{1000 \times W} \right]$$

$$Chl - b = [22.9 (A645) - 4.68 (A663)] \left[ \frac{V}{1000 \times W} \right]$$

$$Total\ Chl = [20.21 (A645) - 8.02 (A663)] \left[ \frac{V}{1000 \times W} \right]$$

$$Carotenoids = \frac{[1000 (A470) - 2.270 \times Chl - a - 81.4 \times Chl - b]}{227}$$

Here, A (663; 645; 470) refers to absorbance values of Chl extract measured at wavelengths of 663, 645 and 470 nano meter, respectively. V represents the final volume. (in milliliter) of acetone used for extraction and W denotes the weight (in grams) of the garden-fresh leaf sample. The results were expressed in units of mg per gram of leaf fresh weight (FW).

#### *DPPH Photometric Assay*

The antioxidant-activity of jute leaves was assessed using the 2,2-diphenyl -1-picryl hydrazyl (DPPH) radical foraging assay, following the technique of Mensor et al. (2001) with minor modification. Initially, one ml of methanolic jute leaf extract was mixed with 3 ml of 0.2 mmol DPPH solution in a microplate. The reaction mix was incubated at 25°C for five minutes, after which the absorbance was recorded at 517 nm. The DPPH solution without any extract was used as the control. The radical foraging activity of leaf extract was determined by calculating the percentage of inhibition using the following equation:

$$\% \text{ Inhibition of DPPH radical activity} = \frac{[(A \text{ control} - A \text{ sample}) \times 100]}{A \text{ control}}$$

### *Estimation of Total Phenolic Content*

The total phenolic content of jute leaves was determined spectrophotometrically using the Folin Ciocalteu method following the procedure by Ainsworth & Gillespie (2007), with minor modifications. In this procedure, 1 ml of methanolic jute leaf extract was placed in a test-tube, followed by the addition of 0.5 ml of 10% Folin Ciocalteu reagent (prepared in water, v/v) to the sample and standard tubes. The mixtures were vortexed for 10 seconds, then covered and allowed to incubate at room temperature for thirty minutes. Next, 2.5 ml of 700 mM sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) solution was added to each tube, vortexed and incubated at room temperature for two hours. Absorbance was recorded at 765 nm using a spectrophotometer, with all samples analyzed in triplicate against a reagent blank. The results were compared with a standard calibration curve prepared using gallic acid solutions at concentrations of 5, 10, 25, 40, 100, and 200  $\mu\text{g mL}^{-1}$ , and expressed as gallic acid equivalents ( $\mu\text{g g}^{-1}$  FW GAE).

### *Estimation of Total Flavonoids*

The flavonoid concentration in jute leaves was quantified following the procedure of Zhishen et al. (1999), with minor adjustments. One ml of methanolic leaf extract was mixed with one ml of deionized water in a test-tube. Then 0.4 ml of  $\text{NaNO}_2$  solution was added. After a 5-minute incubation, 0.6 ml of 10%  $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$  was introduced, and, one minute later, 2.5 ml of 1 Mol NaOH was mixed. The admixture was then brought to a final volume of 10 ml with deionized water, thoroughly mixed and its absorbance was assessed at 510 nm against a blank using a UV visible spectrophotometer. A standard curve (catechin) was generated and flavonoid content was showed as catechin equivalent ( $\mu\text{g g}^{-1}$  FW CE).

### **Data Analysis**

Data on plant growth, agronomic traits, physio-morphological and biochemical characteristics, as well as caterpillar infestation rates, were investigated using one-way ANOVA. Pearson's correlation, standard error (SE) and Tukey HSD post hoc test were also applied using IBM SPSS version 25.0 (Georgia, USA) software.

## **RESULTS**

SPAD (Soil Plant Analysis Development) value and the amount of chlorophyll content were estimated from the leaves of different jute varieties. Statistically significant variation was observed in SPAD values of the selected jute varieties at 30 DAS and 60 DAS and SPAD values were increased over the time (Table 1). Significantly the highest SPAD values at 30 DAS ( $38.5 \pm 1.5 \text{ mg g}^{-1}$ ) and 60 DAS ( $41.3 \pm 1.4 \text{ mg g}^{-1}$ ) were found in BJRI Tossa pat-7 while the lowest SPAD values at 30 DAS and 60 DAS were observed in BJRI Tossa pat-6 ( $34.8 \pm 1.2$  and  $35.4 \pm 1.0$ ) respectively. In the case of chlorophyll contents (Chlorophyll a, Chlorophyll b and Total Chlorophyll), statistically significant differences were observed. The highest chlorophyll a ( $1.7 \pm 0.1 \text{ mg g}^{-1}$  fresh weight) were found in OM-1 and BJRI Tossa pat-4 and the lowest chlorophyll a ( $1.5 \pm 0.0 \text{ mg g}^{-1}$  fresh weight) was found in BJRI Tossa pat-7. The highest chlorophyll b ( $3.6 \pm 0.2 \text{ mg g}^{-1}$  fresh weight) was found in BJRI Tossa pat-7 and the lowest chlorophyll b ( $2.6 \pm 0.1 \text{ mg g}^{-1}$  fresh weight) was found in BJRI Tossa pat-4 and the highest total chlorophyll ( $5.2 \pm 0.1 \text{ mg g}^{-1}$  fresh weight) was found in BJRI Tossa pat-6 and the lowest total chlorophyll ( $4.4 \pm 0.1 \text{ mg g}^{-1}$  fresh weight) was found in BJRI Tossa pat-4. There were statistically significant variations found in antioxidant contents (carotenoid, phenol, DPPH and flavonoid) of different jute varieties (Table 2). The highest ( $6.9 \pm 0.0 \text{ mg g}^{-1}$  fresh weight) carotenoid content was observed in BJRI Tossa pat-6 and the lowest ( $6.0 \pm 0.2 \text{ mg g}^{-1}$  fresh weight) carotenoid content was found in BJRI Tossa pat-4. BJRI Tossa pat-7 had the highest ( $255.8 \pm 1.9 \mu\text{g g}^{-1}$  FW GAE) amount of phenolic content however it is not significantly different

from BJRI Tossa pat-8 ( $254.5 \pm 0.7 \mu\text{g g}^{-1}$  FW GAE) and OM-1 had the lowest ( $224.1 \pm 13.8 \mu\text{g g}^{-1}$  FW GAE) amount of phenolic content. The highest and lowest DPPH inhibition ( $70.0 \pm 1.7 \text{ mg g}^{-1}$  fresh weight and  $59.3 \pm 1.4 \text{ mg g}^{-1}$  fresh weight) were found in BJRI Tossa pat-4 and BJRI Tossa pat-6, respectively. In the case of flavonoid content, the maximum and minimum flavonoids were found in BJRI Tossa pat-6 ( $2500.5 \pm 35.9 \mu\text{g g}^{-1}$  FW CE) and BJRI Tossa pat-4 ( $2176.9 \pm 82 \mu\text{g g}^{-1}$  FW CE), respectively.

Table 1. Leaf SPAD values and leaf chlorophyll contents of the selected jute varieties in Gazipur region during Kharif-1 season 2023

Variety	SPAD Value		Chlorophyll a ( $\text{mg g}^{-1}$ FW)	Chlorophyll b ( $\text{mg g}^{-1}$ FW)	Total Chlorophyll ( $\text{mg g}^{-1}$ FW)
	30 DAS	60 DAS			
O-9897	$38.3 \pm 0.7^b$	$40.1 \pm 0.6^b$	$1.7 \pm 0.0^b$	$2.8 \pm 0.0^d$	$4.6 \pm 0.0^c$
OM-1	$35.0 \pm 2.4^d$	$36.1 \pm 2.1^d$	$1.7 \pm 0.1^a$	$2.9 \pm 0.1^c$	$4.6 \pm 0.0^d$
BJRI Tossa pat-4	$35.0 \pm 0.7^c$	$37.1 \pm 0.6^e$	$1.7 \pm 0.1^a$	$2.6 \pm 0.1^d$	$4.4 \pm 0.1^f$
BJRI Tossa pat-6	$34.8 \pm 1.2^f$	$35.4 \pm 1.0^f$	$1.7 \pm 0.0^b$	$3.5 \pm 0.0^b$	$5.2 \pm 0.1^a$
BJRI Tossa pat-7	$38.5 \pm 1.5^a$	$41.3 \pm 1.4^a$	$1.5 \pm 0.0^c$	$3.6 \pm 0.2^a$	$5.1 \pm 0.2^b$
BJRI Tossa pat-8	$36.1 \pm 1.1^c$	$37.3 \pm 1.0^c$	$1.7 \pm 0.0^b$	$2.9 \pm 0.1^c$	$4.7 \pm 0.1^c$

DAS= Days after sowing

FW= Fresh weight

Means within a column followed by same letter(s) are not significantly different by Tukey HSD post hoc statistic at  $<0.05$

Table 2. Performance of jute varieties based on antioxidant contents grown in Gazipur region during kharif-1 season 2023

Variety	Carotenoid Content ( $\text{mg g}^{-1}$ FW)	Phenolic Content ( $\mu\text{g g}^{-1}$ FW GAE)	DPPH Inhibition ( $\text{mg mol}^{-1}$ )	Flavonoid Content ( $\mu\text{g g}^{-1}$ FW CE)
O-9897	$6.3 \pm 0.0^c$	$228.5 \pm 20.5^d$	$67.9 \pm 0.2^b$	$2280.1 \pm 22.0^d$
OM-1	$6.2 \pm 0.3^c$	$224.1 \pm 13.8^e$	$67.4 \pm 2.6^c$	$2239.9 \pm 135.0^c$
BJRI Tossa pat-4	$6.0 \pm 0.2^d$	$227.4 \pm 13.1^c$	$70.0 \pm 1.7^a$	$2176.9 \pm 82.4^e$
BJRI Tossa pat-6	$6.9 \pm 0.0^a$	$240.5 \pm 9.2^b$	$59.3 \pm 1.4^c$	$2500.5 \pm 35.9^a$
BJRI Tossa pat-7	$6.6 \pm 0.2^b$	$255.8 \pm 1.9^a$	$62.8 \pm 3.5^d$	$2382.8 \pm 94.5^b$
BJRI Tossa pat-8	$6.3 \pm 0.1^c$	$254.5 \pm 0.7^a$	$67.7 \pm 1.6^c$	$2256.6 \pm 65.7^c$

DAS= Days after sowing

FW= Fresh weight

Means within a column followed by same letter(s) are not significantly different by Tukey HSD post hoc statistic at  $<0.05$

In the case of abundance of the jute hairy caterpillar per plot and the rate of leaf infestation (%), there were statistically significant variations found on the different jute varieties over the time at 60 DAS, 90 DAS and 120 DAS (Table 3). At 60, 90 and 120 DAS BJRI Tossa pat-4 ( $13.2 \pm 1.6$ ), BJRI Tossa pat-7 ( $6.6 \pm 1.4$ ) and BJRI Tossa pat-8 ( $7.2 \pm 0.8$ ) showed the highest number of caterpillars per plot. At 60 and 120 DAS O-9897 ( $6.6 \pm 0.8$  and  $4.0 \pm 0.0$ ), respectively, showed the lowest number of caterpillars per plot followed by BJRI Tossa pat-8 ( $4.6 \pm 0.3$ ) at 90 DAS.

Table 3. Abundance and rate of infestation of jute hairy caterpillar on different jute varieties grown in Gazipur region during kharif-1 season 2023

Variety	No. of Caterpillar/Plot			Rate of Leaf Infestation (%)		
	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS
O-9897	6.6±0.8 <sup>f</sup>	6.0±1.0 <sup>b</sup>	4.0±0.0 <sup>f</sup>	17.1±4.2 <sup>e</sup>	30.9±7.1 <sup>e</sup>	22.2±4.9 <sup>e</sup>
OM-1	8.6±1.6 <sup>d</sup>	5.1±0.6 <sup>c</sup>	6.6±0.3 <sup>b</sup>	22.8±0.8 <sup>a</sup>	42.0±5.5 <sup>a</sup>	27.3±2.0 <sup>b</sup>
BJRI Tossa pat-4	13.2±1.6 <sup>a</sup>	5.1±1.4 <sup>c</sup>	6.0±0.0 <sup>c</sup>	21.2±1.7 <sup>b</sup>	38.3±4.3 <sup>b</sup>	25.4±6.7 <sup>c</sup>
BJRI Tossa pat-6	7.2±1.2 <sup>e</sup>	5.1±1.4 <sup>c</sup>	5.2±0.6 <sup>d</sup>	20.6±4.1 <sup>c</sup>	34.9±12.5 <sup>d</sup>	28.3±3.8 <sup>a</sup>
BJRI Tossa pat-7	9.2±0.8 <sup>c</sup>	6.6±1.4 <sup>a</sup>	4.6±0.3 <sup>c</sup>	19.9±2.5 <sup>d</sup>	38.0±2.9 <sup>c</sup>	23.7±5.9 <sup>d</sup>
BJRI Tossa pat-8	10.0±1.5 <sup>b</sup>	4.6±0.3 <sup>d</sup>	7.2±0.8 <sup>a</sup>	15.5±0.2 <sup>f</sup>	29.8±6.4 <sup>f</sup>	19.4±1.2 <sup>f</sup>

DAS= Days after sowing

Means within a column followed by same letter(s) are not significantly different by Tukey HSD post hoc statistic at &lt;0.05

For the rate of leaf infestation, all varieties have shown significant difference at each 60, 90 and 120DAS. At 60 and 90 DAS, OM-1 (22.8±0.8 and 42.0±5.5), respectively showed the highest rate of infestation per plot followed by BJRI Tossa pat-6 (28.3±3.8) at 120 DAS. At 60, 90 and 120 DAS, BJRI Tossa pat-8 (15.5±0.2, 29.8±6.4 and 19.4±1.2), respectively showed the lowest rate of infestation per plot.

The studied varieties of jute showed significant variations in morpho-physiological characters (Table 4). The tallest (338.3±17.7 cm) plant was recorded from O-9897 followed by BJRI Tossa pat-7 (333.4±8.3 cm) and the shortest (300.7±13.9 cm) plant was found in BJRI Tossa pat-6. At 60 DAS the leaf area was measured where the highest leaf area was found in O-9897 (79.3±2.9 cm<sup>2</sup>) and the lowest leaf area was measured on OM-1 (61.0±3.6 cm<sup>2</sup>). BJRI Tossa pat-6 had the highest (1.25±0.07 mm) bark thickness whereas the lowest bark thickness was found on O-9897 (1.13±0.07 mm). For base diameter, BJRI Tossa pat-8 had the highest (7.30±0.10 cm) base diameter whereas the lowest base diameter was observed on BJRI Tossa pat-6 (6.10±0.15 cm).

Table 4. Performance of different jute varieties based on morpho-physiological characters grown in Gazipur region during kharif-1 season 2023

Variety	Plant Height (cm)	Leaf Area (cm <sup>2</sup> ) at 60 DAS	Bark Thickness (mm)/Plant	Base Diameter (cm)/Plant
O-9897	338.3±17.7 <sup>a</sup>	79.3±2.9 <sup>a</sup>	1.13±0.07 <sup>e</sup>	6.80±0.25 <sup>b</sup>
OM-1	328.8±17.6 <sup>b</sup>	61.0±3.6 <sup>f</sup>	1.21±0.07 <sup>c</sup>	6.53±0.46 <sup>c</sup>
BJRI Tossa pat-4	303.1±21.1 <sup>d</sup>	70.6±4.3 <sup>b</sup>	1.17±0.05 <sup>d</sup>	6.53±0.39 <sup>c</sup>
BJRI Tossa pat-6	300.7±13.9 <sup>c</sup>	67.3±1.4 <sup>d</sup>	1.25±0.07 <sup>a</sup>	6.10±0.15 <sup>d</sup>
BJRI Tossa pat-7	333.4±8.3 <sup>a</sup>	63.6±2.4 <sup>e</sup>	1.23±0.07 <sup>b</sup>	6.73±0.42 <sup>b</sup>
BJRI Tossa pat-8	321.9±12.0 <sup>b</sup>	67.3±5.4 <sup>c</sup>	1.23±0.07 <sup>b</sup>	7.30±0.10 <sup>a</sup>

DAS= Days after sowing

Means within a column followed by same letter(s) are not significantly different by Tukey HSD post hoc statistic at &lt;0.05

The studied varieties showed statistically significant variations in yield and yield contributing parameters (Table 5). BJRI Tossa pat-8 showed the highest yield and yield contributing parameters. The highest amount of green weight with leaves and without leaves was found in BJRI Tossa pat-8 (19.65±1.03 and 16.74±.63 kg, respectively) whereas BJRI

Tossa pat-4 showed the lowest ( $12.25 \pm 2.58$  and  $9.91 \pm 2.20$  kg, respectively) performance. From the Table 5, the highest fibre yield per plot ( $1.4 \pm 0.0$  kg) and per hectare ( $2.3 \pm 0.2$  tons) were recorded from BJRI Tossa pat-8 whereas the lowest fibre yield per plot ( $0.9 \pm 0.1$  kg) and per hectare ( $1.5 \pm 0.3$  tons) were recorded from BJRI Tossa pat-4. Similarly, the highest stick yield/plot and stick yield/ha were found from BJRI Tossa pat-8 ( $3.5 \pm 0.1$  kg and  $5.8 \pm 0.7$  tons, respectively) and the lowest stick yield/plot and stick yield/ha were found from BJRI Tossa pat-4 ( $1.5 \pm 0.3$  kg and  $3.3 \pm 0.6$  tons, respectively).

Table 5. Performance of different jute varieties based on yield and yield attributing characters grown in Gazipur region during kharif-1 season 2023

Variety	Green Weight with Leaves (kg/plot)	Green Weight Without Leaves (kg/plot)	Fibre Yield/Plot (kg)	Stick Yield/Plot (kg)	Fibre Yield (t/ha)	Stick Yield (t/ha)
O-9897	$19.19 \pm 5.32^b$	$16.23 \pm 4.61^b$	$1.3 \pm 0.2^b$	$3.3 \pm 0.7^b$	$2.1 \pm 0.4^b$	$5.5 \pm 0.7^b$
OM-1	$18.80 \pm 3.14^c$	$15.98 \pm 2.31^c$	$1.2 \pm 0.1^b$	$3.1 \pm 0.3^c$	$2.0 \pm 0.3^b$	$5.1 \pm 0.4^c$
BJRI Tossa pat-4	$12.25 \pm 2.58^f$	$9.91 \pm 2.20^f$	$0.9 \pm 0.1^d$	$2.0 \pm 0.3^f$	$1.5 \pm 0.3^d$	$3.3 \pm 0.6^f$
BJRI Tossa pat-6	$14.65 \pm 3.67^c$	$11.67 \pm 2.71^c$	$1.1 \pm 0.1^c$	$2.4 \pm 0.4^c$	$1.8 \pm 0.4^c$	$4.0 \pm 0.8^c$
BJRI Tossa pat-7	$16.84 \pm 2.20^d$	$13.96 \pm 2.04^d$	$0.9 \pm 0.2^d$	$2.7 \pm 0.3^d$	$1.5 \pm 0.4^d$	$4.5 \pm 0.7^d$
BJRI Tossa pat-8	$19.65 \pm 1.03^a$	$16.74 \pm .63^a$	$1.4 \pm 0.0^a$	$3.5 \pm 0.1^a$	$2.3 \pm 0.2^a$	$5.8 \pm 0.7^a$

Means within a column followed by same letter(s) are not significantly different by Tukey HSD post hoc statistic at  $<0.05$

The correlation matrix of jute infestation by jute hairy caterpillar with the biochemical contents of leaves of different varieties is shown in Table 6. By analyzing the correlation of jute infestation by jute hairy caterpillar with biochemical contents it was found that there was a positive insignificant correlation between the numbers of jute hairy caterpillars present in the field and the rate of leaf infestation. Among the biochemical properties of leaves it was observed that only total chlorophyll and flavonoids showed a positive influence on jute hairy caterpillar infestation. On the other hand, other properties namely chlorophyll a, chlorophyll b, carotenoids, phenol and DPPH showed negative relationship with jute hairy caterpillar infestation.

Table 6. Correlation matrix of the rate of infestation by jute hairy caterpillar with the bio-chemical contents of leaves of different jute varieties

	<b>Rate of Infestation</b>	<b>No. of JHC</b>	<b>SPAD Value</b>	<b>Chl a</b>	<b>Chl b</b>	<b>Total Chl</b>	<b>Carotenoid</b>	<b>Phenol</b>	<b>DPHH</b>
<b>No. of JHC</b>	0.177 <sup>NS</sup>								
<b>SPAD Value</b>	-0.367 <sup>NS</sup>	-0.122 <sup>NS</sup>							
<b>Chl a</b>	-0.369 <sup>NS</sup>	-0.014 <sup>NS</sup>	-0.722 <sup>NS</sup>						
<b>Chl b</b>	-0.119 <sup>NS</sup>	-0.438 <sup>NS</sup>	0.195 <sup>NS</sup>	-0.667 <sup>NS</sup>					
<b>Total Chl</b>	0.024 <sup>NS</sup>	-0.501 <sup>NS</sup>	0.087 <sup>NS</sup>	-0.520 <sup>NS</sup>	0.978 <sup>**</sup>				
<b>Carotenoid</b>	-0.016 <sup>NS</sup>	-0.614 <sup>NS</sup>	-0.014 <sup>NS</sup>	-0.333 <sup>NS</sup>	0.909 <sup>**</sup>	0.972 <sup>**</sup>			
<b>Phenol</b>	-0.509 <sup>NS</sup>	-0.006 <sup>NS</sup>	0.349 <sup>NS</sup>	-0.604 <sup>NS</sup>	0.622 <sup>NS</sup>	0.620 <sup>NS</sup>	0.498 <sup>NS</sup>		
<b>DPHH</b>	-0.158 <sup>NS</sup>	0.531 <sup>NS</sup>	0.071 <sup>NS</sup>	0.375 <sup>NS</sup>	-0.934 <sup>**</sup>	-0.974 <sup>**</sup>	-0.983 <sup>**</sup>	-0.446 <sup>NS</sup>	
<b>Flavonoid</b>	0.042 <sup>NS</sup>	-0.367 <sup>NS</sup>	-0.022 <sup>NS</sup>	-0.322 <sup>NS</sup>	0.900 <sup>**</sup>	0.961 <sup>**</sup>	0.996 <sup>**</sup>	-0.436 <sup>NS</sup>	-0.986 <sup>**</sup>

NS= Non-significant

\*= Significant

\*\*= Highly significant, P&lt;0.05

JHC= Jute hairy caterpillar

## DISCUSSION

Significant differences were found across all of the jute varieties employed in this experiment, according to analyses of variances for morphological and yield contributing data. The highest plant height from this study was obtained from BJRI Tossa jute O-9897 ( $338.3 \pm 17.7$  cm), maximum base diameter was obtained from BJRI Tossa pat-8 ( $7.30 \pm 0.10$  cm) and maximum green weights with and without leaves were recorded from BJRI Tossa pat-8 ( $19.65 \pm 1.03$  and  $16.74 \pm 0.63$  kg, respectively). This study also discovered that BJRI Tossa pat-8 produced the maximum fiber and stick yields ( $2.3 \pm 0.2$  and  $5.8 \pm 0.7$  kg, respectively) after examining all the variables. The findings of this study showed closed conformity with the findings of Rafiq et al. (2020) who showed that the highest plant height (3.65m), the maximum base diameter (14.87mm), green weights with leaves (79.42 t/ha) and without leaves (67.93 t/ha), fibre weight (4.97 t/ha) and stick weight (10.57 t/ha) were recorded in the variety of tossa jute BJRI Tossa pat-8. The increased biomass observed in this variety is probably due to effective nutrient absorption and optimal physiological processes, which in turn enhances their high yield production.

The duration of this study was from April 2023 to August 2023. The data of jute hairy caterpillar infestation were recorded at 60 DAS (mid-June 2023), 90 DAS (mid July 2023) and 120 DAS (1<sup>st</sup> week of August 2023). The findings of the study showed the varietal effect of leaf infestation by jute hairy caterpillar at 60 DAS, 90 DAS and 120 DAS and the highest mean infestation was recorded at 90 DAS (mid July 2023). Rahman & Khan (2012) also observed that the infestation of jute hairy caterpillar started in June and reached the peak at the second week of July with 21.6% infestation thereafter infestation declined in the last week of July. The results of the present study demonstrated a close conformance with the findings of Alam et al. (2017) who reported that among the 30 DAS, 60 DAS and 90 DAS the highest jute hairy caterpillar infestation was recorded at 90 DAS (49.14%). This concurrence indicates that the environmental conditions during this time particularly temperature and relative humidity are probably favorable for larval growth and feeding behavior.

Another finding of the present study revealed that the highest infestation of jute hairy caterpillar at 60 DAS and 90 DAS on OM-1 were  $22.8 \pm 0.8\%$  and  $42.0 \pm 5.5\%$ , respectively and at 120 DAS the highest infestation was observed on BJRI Tossa pat-6 ( $28.3 \pm 3.8\%$ ) whereas the lowest infestation at 60 DAS ( $15.5 \pm 0.2\%$ ), 90 DAS ( $29.8 \pm 6.4\%$ ) and 120 DAS ( $19.4 \pm 1.2\%$ ) were recorded in BJRI Tossa pat-8. Rafiq et al. (2020) found that the insect infestation was lowest in BJRI Tossa pat-8 (50.15%) and the highest in O-4 (61.07%). Although O-4 was not chosen for examination in this study, the outcomes of the current investigation somewhat corroborated these findings. The reason behind this result is probably that BJRI Tossa pat-8 shows the relative resistance to the jute hairy caterpillar infestation across all growth stages and O-4 shows the higher relative susceptibility to the jute hairy caterpillar.

In the present study, it was observed that the rate of infestation was positively correlated with the number of jute hairy caterpillar, total chlorophyll and flavonoids present in the leaves and negatively correlated with carotenoids, phenol and DPPH present in the leaves. Rahman et al. (2023) found that the infestation of aphids and sawflies in mustard was higher in the varieties having the high chlorophyll content. Another research on correlation of pest infestation with the biochemical composition of different mulberry genotypes by Prabhakar et al. (2013) reported the positive correlation of chlorophyll content and pest attack in susceptible genotypes. The favorable link between chlorophyll levels and infestations can be understood through the lens of nutritional ecology. Leaves that have higher chlorophyll concentrations tend

to be richer in nitrogen and protein, which improves their taste and nutritional value for herbivores. Elevated chlorophyll content may inadvertently promote feeding by *S. obliqua* due to enhanced food quality. Riddick (2024) revealed that lepidopteron insects like butterflies had a positive correlation with flavonoids. Female butterflies oviposited on host leaves in the presence of flavonoids and other compounds such as adenosine. The positive relationship with flavonoids may seem paradoxical, given that flavonoids typically serve as defensive compounds. Nonetheless, various Lepidopteran species, including butterflies, utilize specific flavonoids as cues for oviposition. Varieties that contain higher flavonoid levels may inadvertently encourage oviposition by *S. obliqua*, leading to a greater initial larval population and subsequent leaf damage.

On the other hand, Bi & Felton (1995) observed that the level of antioxidants in soybean such as carotenoids, ascorbic acid decreased the feeding activities of herbivores. Leiss et al. (2009) showed that the phenolics compounds in some plant species acted as feeding deterrents to insects. The inverse relationship of phenols, carotenoids, and DPPH activity with infestation underscores their protective functions. Phenolic compounds are well-known for their abilities to deter feeding and interfere with digestion in insects. Carotenoids and antioxidants (like those evaluated through DPPH activity) aid in oxidative defense, creating reactive substances that make the plant less palatable or hinder larval digestion. Therefore, varieties high in these compounds have more robust biochemical defenses that discourage feeding or impair larval growth.

## CONCLUSION

The comprehensive assessment of biochemical, morphological, and agricultural traits in six jute varieties strongly indicates that the resistance of these varieties to the jute hairy caterpillar is primarily influenced by the chemical composition of their leaves. The research revealed that increased levels of phenolic, carotenoids, and antioxidant activity function as effective biochemical defenses that reduce the infestation of *Spilosoma obliqua*. In contrast, elevated amounts of chlorophyll and flavonoids, despite their significance for plant health might inadvertently heighten vulnerability by improving leaf quality and appealing to the pest. Among the varieties studied, BJRI Tossa pat-8 stood out as the most advantageous, showing lower pest presence along with higher fiber and stick yields. Its resistance seems to arise from a favorable interplay of defensive biochemicals and strong morphological traits. Thus, BJRI Tossa pat-8 is recommended as a dependable cultivar for regions in Bangladesh where *S. obliqua* consistently threatens production.

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### **Conflict of Interest**

All authors declare that there is no conflict of interest among them.

### **Ethics Declarations**

Ethics declarations are not applicable for this research.

### **Data Availability Statement**

This manuscript has no associated data.

### **Authors' Contributions**

S.A. Urmi: Conducting research, data analysis and writing the draft manuscript; M.R. Amin: Reviewing and editing the manuscript, M.M. Rahman: Reviewing and editing the manuscript, M.R. Talukder: Reviewing and editing the manuscript; M. Ahmed: Reviewing and editing the manuscript; M.K. Mazed: Reviewing and editing the manuscript; A. Islam: Reviewing and editing the manuscript; A. Samiha: Reviewing and editing the manuscript; M.S. Hossain: Designing the experiment, research supervision, reviewing and editing the manuscript.

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