



Sowing Time: A Crucial Factor for Mitigating *Agrillus acutus* (Buprestidae: Coleoptera) Infestation in *Hibiscus cannabinus* L. Cultivation

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Abstract: Kenaf (*Hibiscus cannabinus* L.) is one of the most important fibre crops next to cotton cultivated throughout the world for its core and bast fibres for industries with high economic value. Spiral borer, *Agrillus acutus* (Buprestidae: Coleoptera) is a serious pest of Kenaf. This experiment was undertaken with a view to find out the variation of infestation along with gall length of spiral borer in kenaf at different sowing dates. The experiment was conducted in two different locations namely Faridpur and Patuakhali jute research station at two kenaf growing seasons i.e. 2019 and 2018 following Randomized Complete Block Design with three replications. The highest infestation (49.78%) was found on 1st April 2018 in Patuakhali followed by 48.13%, 47.32% and 46.14%. The lowest infestation (13.33%) found on 20th May 2018 sown plot in Patuakhali followed by 13.65%, 13.97% and 14.91%. The highest gall length formation (46.21cm) was found in the plot that was sown on 1st April 2019, Faridpur followed by 45.65cm and 45.01cm. The lowest gall length (8.78cm) was recorded in 20th May 2019 sown plot in Faridpur. Correlation and regression study exhibited positive relationship between infestation (%) and gall length (cm). Here, it definitely showed that the gradual decrease in spiral borer infestation with the late sowing of kenaf. The lower the infestation, the lower the gall length of kenaf plant. Late sowing i.e. sowing after 13th to 20th May is the best option to avoid spiral borer infestation in kenaf cultivation.

Keywords: *Hibiscus cannabinus*, *Agrillus acutus*, Sowing Time, Percent Infestation, Gall Length

1. Introduction

The important fibre crop next to cotton is Kenaf (*Hibiscus cannabinus* L.). It is planted throughout the world for its core and bast fibres. kenaf fibre is obtained from vegetative part of plant. Growth and biomass production of kenaf is an important concern that should be taken into consideration for its fruitful profitable cultivation. Kenaf (*Hibiscus cannabinus* L.) has become nowadays a promising new fibre crop in Bangladesh. Around 0.08-0.09 million tons of kenaf is produced in the country from 0.04 million hectares of land [1].

Hibiscus cannabinus L. belongs to the family Malvaceae is a herbaceous, short-day and annual plant which is important for both its agricultural and financial value [2&3]. According to FAO [4], Kenaf is commercially cultivated in more than 20

countries in the world. Although, ninety percent of the sown area and more than 95% of total production belongs to China, India and Thailand [5], it is also commercially cultivated in Vietnam, Iran, Russia, Mozambique, Taiwan, El Salvador, Guatemala, Ivory Coast and Nigeria [2]. Kenaf is a fast growing crop of great interest as a source of natural fiber. It will be a valuable biomass crop of the future, which will provide raw material for industrial applications. In the past, kenaf used as a source of fibre for making ropes, sacks, canvas, and carpets [2]. Lately, it is being used as pulp and papermaking, oil/chemical absorbents [6] and bioremediation, paperboard products, a substitute for fibreglass, filtration media making, and food and bedding material for animals [7 & 8].

There are many insect pests of jute and allied fibre crops. Among them, spiral borer is the most destructive insect

pests of kenaf cultivation. With increasing cropping intensity incidence of insect pests increased, especially spiral borer, *Agrilus acutus* (Buprestidae: Coleoptera) in Bangladesh. The pest frequency in Kenaf (*Hibiscus cannabinus*) was progressively growing. Damage caused by spiral borer was three percent to five percent in 1975 and 1976.

It has recently been causing significant concern in the production of kenaf. Field infestation of spiral borer normally starts in mid-July or more precisely 70-80 days after planting. When plants are about 120-130 cm tall, initial infestation starts and it continues till harvest. The larval stage causes the damage. The nymphs and females feed on the apical parts of a plant which becomes stunted and shows bushy-top symptoms. The petiole becomes shortened, the lamina crumples and the internodal length is reduced, resulting in fibre deterioration and yield reduction. It holes skyward around the stem in a spiral fashion leading to the reed becoming wiry, brittle or remains attached to the stick during extraction of fibre, thus resulting deterioration of fibre quality. It has been detected that nearly 65 per cent of borer attacks occur within the lower 1 meter and 92 per cent within 2 meters above soil level. Spiral borer makes spiral shape gall at the basal part of the stem and infested portion become weak. As a result of gall formation, the stem cannot withstand at any sudden jerks caused by windy and rainy weather. Thus, it causes considerable yield loss. With increasing cropping intensity incidence of insect pests increased, especially Spiral borer (*Agrilus acutus*) in

Bangladesh. This experiment was undertaken with a view to find out the variation of infestation of spiral borer in kenaf according to different sowing date.

2. Materials and Methods

The experiment was carried out to observe the incidence of spiral borer in kenaf at different sowing times. The experiment was conducted in two different locations (Faridpur: 23°17' and 23°40' north latitudes and in between 89°29' and 90°11' east longitudes; Patuakhali: 21°48' and 22°36' north latitudes and in between 90°08' and 90°41' east longitudes) at two kenaf growing seasons i.e 2019 and 2028. HC-95 kenaf variety was sown on eight different sowing times at two kenaf growing seasons. Date of sowing was as follows: i) 1st April, ii) 8th April, iii) 15th April iv) 22nd April v) 29th April vi) 6th May vii) 13th May and viii) 20th May. The unit plot size was 2.1m x 2m, row-to-row distance was 30 cm and plot-to-plot distance was 1m. The experiment was followed Randomized Complete Block Design (Gomez and Gomez, 1984) with three replications. It was encouraged to build up natural infestation of insect and mite pests in the field. Normal agronomical practices and recommended dosage of fertilizer were applied for kenaf cultivation. No plant protection measure was taken from sowing to harvest. Data on spiral borer infestation and gall length were taken when sufficient infestation was noticed in the field. Observation regarding percent of plant infestation (PPI) was recorded during the infestation period from the plots as per following Pradhan's [9] formula.

$$PPI = \frac{\text{No. of plant damaged}}{\text{No. of plant observed}} \times 100 \quad (1)$$

For gall length calculation of kenaf plant after spiral borer infestation, infested ten plants were randomly selected and measured its gall length by tape. Then their average length was taken as gall length of respective plot.

Gall length /plant were calculated as follows:

$$\text{Gall length /plant} = \frac{\text{Gall length of randomly selected ten plants}}{10} \quad (2)$$

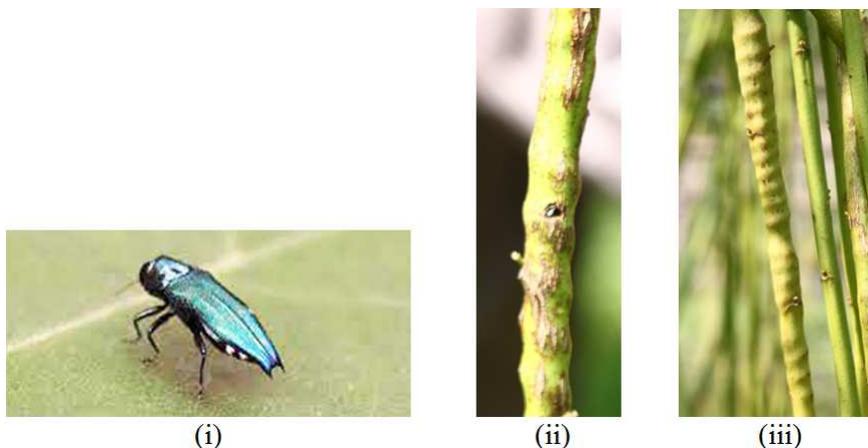


Figure 1. (i) Spiral borer (ii) Spiral borer infested kenaf plant (iii) Gall/spiral formation.

All data were inserted in MS excel sheet and then analyzed by statistix 10 software (Gomez and Gomez) [10] and mean

comparison was done by LSD.

3. Results

3.1. Effect of Date of Sowing on Spiral Borer Infestation in *Hibiscus cannabinus* Cultivation Irrespective of Locations

In spiral borer infestation of kenaf cultivation, the highest infestation (48.55%) was found on 1st April, 2018 followed

by 47.14% (1st April, 2019), 44.77% (8th April, 2018) and 42.66% (8th April, 2019) (Figure 2). The lowest infestation (13.65%) found on 20th May sown plot in 2018 followed by 14.28% (20th May, 2019), 17.70% (13th May, 2019) and 18.88% (13th May, 2018). The linear curve slopes downward. It means that the gradual decrease in spiral borer infestation with the late sowing of kenaf (Figure 2).

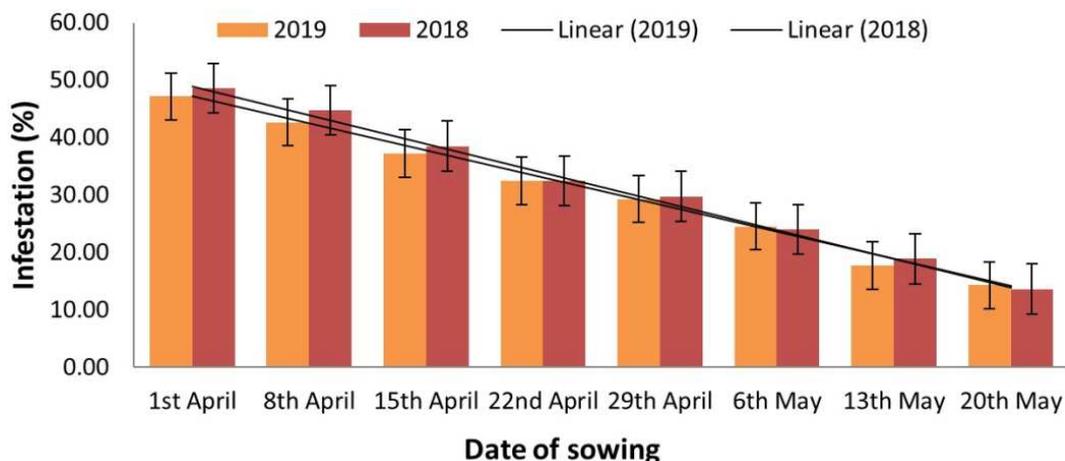


Figure 2. Percent spiral borer infestation at different date of sowing of kenaf irrespective of locations.

3.2. Effect of Date of Sowing on Spiral Borer Infestation in *Hibiscus cannabinus* Cultivation Irrespective of Years

In spiral borer infestation of kenaf cultivation, the highest infestation (47.96%) was found on 1st April, Patuakhali followed by 47.73% (1st April, Faridpur), 43.81% (8th April, Patuakhali) and 43.62% (8th April, Faridpur) (Figure 3). The

lowest infestation (13.81%) found on 20th May sown plot in Faridpur followed by 14.12% (20th May, Patuakhali), 17.44% (13th May, Patuakhali) and 19.13% (13th May, Faridpur). The linear curve slopes downward. It means that the gradual decrease in spiral borer infestation with the late sowing of kenaf.

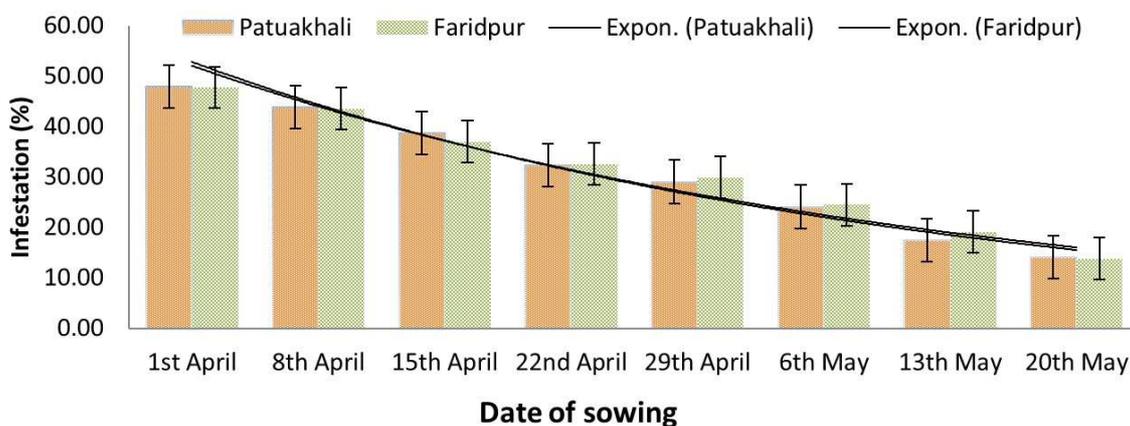


Figure 3. Percent spiral borer infestation at different date of sowing of kenaf irrespective of years.

3.3. Pattern of Gall Length (cm) of Spiral Borer Infested Kenaf Plant at Different Date of Sowing Irrespective of Locations

In gall formation, the highest gall length formation (45.33cm) was found in the plot that was sown on 1st April, 2018 followed by 44.48cm (1st April, 2019). The lowest gall

length (9.24cm) was recorded in 20th May, 2019 sown plot (Figure 4) that was statistically similar to 9.87cm (13th May, 2018). The linear curve slopes downward. It indicates the gradual decrease in gall length formation with the late sowing of kenaf/ decreased spiral borer infestation (Figure 4).

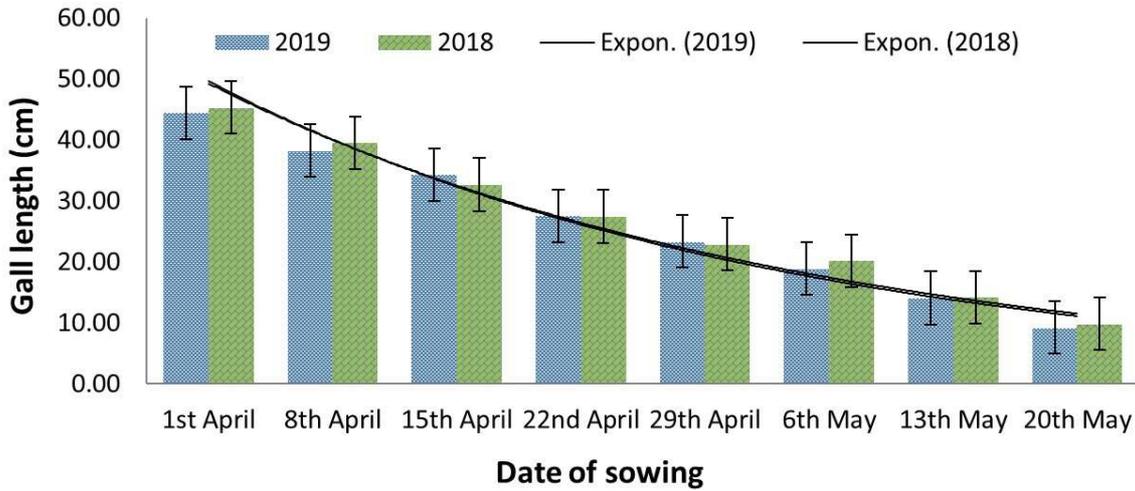


Figure 4. Pattern of gall length (cm) of spiral borer infested kenaf plant at different date of sowing irrespective of locations.

3.4. Pattern of Gall Length (cm) of Spiral Borer Infested Kenaf Plant at Different Date of Sowing Irrespective of Years

In gall formation, the highest gall length formation (45.93cm) was found in the plot that was sown on 1st April, Faridpur followed by 43.88 cm (1st April, Patuakhali). The

lowest gall length (9.01cm) was recorded in 20th May, Faridpur sown plot (Figure 5) that was statistically similar to 10.10cm (13th May, Patuakhali). The linear curve slopes downward. It hints that the gradual decrease in gall length formation with the late sowing of kenaf/ decreased spiral borer infestation (Figure 5).

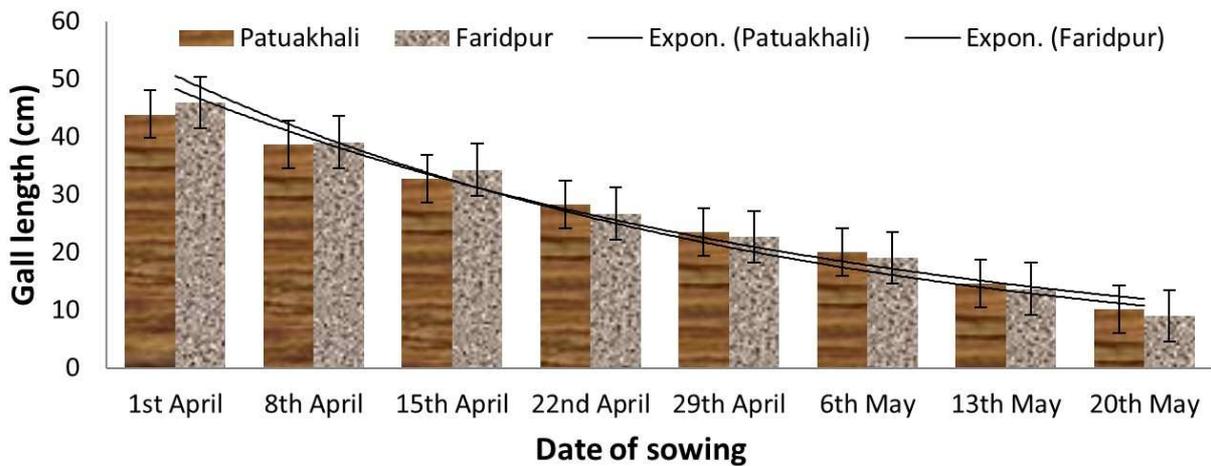


Figure 5. Pattern of gall length (cm) of spiral borer infested kenaf plant at different date of sowing irrespective of years.

3.5. Effect of Different Date of Sowing on Spiral Borer Infestation (%) and Gall Length (cm) in Hibiscus cannabinus Cultivation Irrespective of Locations and Years

Spiral borer infestation in kenaf cultivation, the highest infestation (47.84%) was found in the plot that was sown on 1st April which was statistically similar to 8th April (43.72%) sown plot (Table 1). The lowest infestation (13.96%) found on 20th May sown plot followed by 18.29% (13th May). In case of gall formation, the highest gall length formation (49.90cm) was found in the plot that was sown on 1st April. The lowest gall length (9.95cm) was recorded in 20th May sown plot (Table 1) that was statistically different to others.

Table 1. Effect of different date of sowing on spiral borer infestation (%) and gall length (cm) in Hibiscus cannabinus irrespective of locations and years.

Date of Sowing/Treatment	Infestation (%)	Gall length (cm)
1 st April	47.84 a	44.90 a
8 th April	43.72 ab	38.89 b
15 th April	37.87 bc	33.51 c
22 nd April	32.46 cd	27.49 d
29 th April	29.51 de	23.11 e
6 th May	24.29 ef	19.55 e
13 th May	18.29 fg	14.15 f
20 th May	13.96 g	9.55 g
LSD (5%)	6.81	3.95
Standard Error	3.41	1.98

3.6. Interaction Effect (Location*Treatment*Year) on Spiral Borer Infestation (%) and Gall Length (cm) in Hibiscus cannabinus Cultivation

Spiral borer infestation in *Hibiscus cannabinus* cultivation, the highest infestation (49.78%) was found on 1st April 2018 in Patuakhali followed by 48.13% (1st April 2019, Faridpur), 47.32% (1st April 2018, Faridpur) and 46.14% (1st April 2019, Patuakhali) (Table 2). The lowest infestation (13.33%) found on 20th May 2018 sown plot in Patuakhali followed by 13.65% (20th May 2019, Faridpur), 13.97% (20th May 2018, Faridpur) and 14.91% (20th May 2019, Patuakhali) (Table 2). Other

treatments indicated different level of infestations. In case of gall formation, the highest gall length formation (46.21cm) was found in the plot that was sown on 1st April 2019, Faridpur followed by 45.65cm (1st April 2018, Faridpur), 45.01cm (1st April 2018, Patuakhali). The lowest gall length (8.78cm) was recorded in 20th May 2019, Faridpur sown plot (Table 2) that was statistically similar to 9.23cm (20th May 2018, Faridpur), 9.70cm (20th May 2019, Patuakhali) and 10.50cm (20th May 2018, Patuakhali). Other date of sowing showed various level of gall formation with various level of spiral borer infestation (Table 2).

Table 2. Interaction effect (Location*Treatment*Year) on spiral borer infestation (%) and gall length (cm) in *Hibiscus cannabinus*.

Location	Treatment	Infestation (%)			Gall length (cm)				
		2019		2018	2019		2018		
Patuakhali	1 st April	46.14	ab	49.78	a	42.75	abc	45.01	ab
	8 th April	41.97	abcdef	45.66	abc	38.25	bcde	39.10	abcde
	15 th April	37.98	abcdefg	39.39	abcdef	33.72	defg	31.72	efgh
	22 nd April	31.83	defghi	32.89	bcdefgh	28.05	fghi	28.50	fghi
	29 th April	28.63	fghij	29.54	fghij	24.12	hijk	23.03	ijk
	6 th May	24.46	ghijk	23.67	hijk	19.40	jklm	20.72	ijklm
	13 th May	16.30	jk	18.59	ijk	14.59	mn	14.74	lmn
Faridpur	20 th May	14.91	k	13.33	k	9.70	n	10.50	n
	1 st April	48.13	a	47.32	a	46.21	a	45.65	ab
	8 th April	43.35	abcde	43.89	abcd	38.25	bcde	39.96	abcd
	15 th April	36.49	abcdefgh	37.61	abcdefg	34.96	cdef	33.64	defg
	22 nd April	33.06	bcdefgh	32.05	cdefghi	27.01	ghij	26.39	ghij
	29 th April	29.94	efghi	29.93	efghi	22.55	ijkl	22.75	ijk
	6 th May	24.62	ghijk	24.41	ghijk	18.45	klm	19.63	ijklm
13 th May	19.10	ijk	19.17	ijk	13.64	mn	13.64	mn	
20 th May	13.65	k	13.97	k	8.78	n	9.23	n	
LSD (5%)		13.63				7.91			
Standard Error		6.82				3.95			

3.7. Correlation and Regression Study

The degree of statistical relationship between infestation (%) and gall length (cm) in both locations and years (average value used) has been found significant relationship at 5% level of probability. The positive slopes exhibited positive relationship.

The degree of relationship between infestation (%) and gall

length (cm) was studied (Figure 6). The result revealed that infestation (%) and gall length (cm) have a direct significant positive relationship at 5% level of significance which has been confirmed with correlation co-efficient $r=0.9931$ (Figure 6). The relationship was more evident by the equation $Y=1.0177x - 5.1451$ and sowing gradual $Y=1.0177x - 5.1451$ increase in gall length (cm) with the increase of infestation (%)

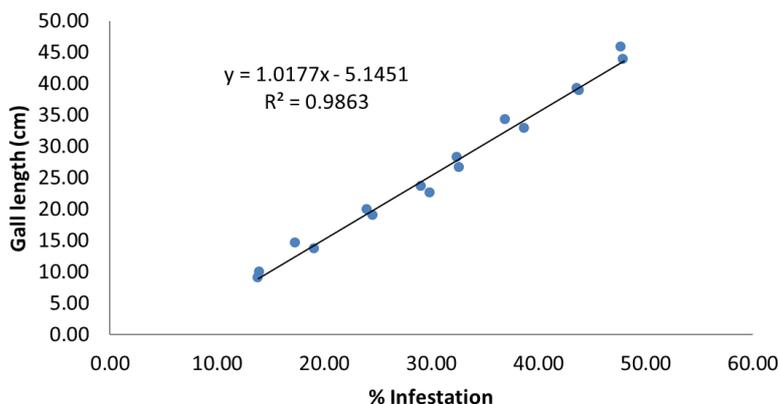


Figure 6. Relationship between infestation (%) and gall length (cm)

4. Discussion

Dutt and Bhattacharjee [11] reported that *Agrilus acutus*

showed different level of infestation to *Hibiscus cannabinus*. In the experiment infestation ranged from 13.33%-49.78% and gall length ranged from 8.78cm to 46.21cm. This result is accordance with Kabir [12] and Bhuiyan and Kabir [13].

Ahmad *et al.* [14] reported the more or less or similar result when they evaluated kenaf cultivars and their hybrids for their reaction to spiral borer. Kabir [12] stated that fibres of the infested portion of stem become lean, stiff or keep on attached to the stick during extraction after retting which causes deterioration of the fibre. At the level of galls formation, the section of the stem becomes very feeble due to formation of thin walled parenchymatous cells and fewer lignification of the cell wall of the xylem tissue [15 & 16]. Due to this fragile development of the gall region, the stem cannot resist any sudden jerks resulting from the windy rainy season and ultimately cause substantial loss of yield. Spiral borer infestation and gall length results are also agreed to Ahmad and Faruquzzaman [17]. In their study, they found different variation of gall length and spiral borer infestation when they tested kenaf, mesta and related genera for their reaction to spiral borer in field condition.

5. Conclusion

The highest infestation (49.78%) was found on 1st April 2018 in Patuakhali. The lowest infestation (13.33%) found on 20th May 2018 sown plot in Patuakhali. The highest gall length formation (46.21cm) was found in the plot that was sown on 1st April 2019, Faridpur. The lowest gall length (8.78cm) was recorded in 20th May 2019 sown plot in Faridpur. The degree of statistical relationship between infestation (%) and gall length (cm) exhibited positive relationship. It showed that the gradual decrease in spiral borer infestation with the late sowing of kenaf. The lower the infestation, the lower is the gall length formation. It can be recommended late sowing i.e. sowing after 13th May to 20th May for the avoidance of spiral borer infestation in kenaf cultivation.

Conflict of Interest

The authors declare that they have no competing interests.

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