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Transmission Behavior of *Colletotrichum corchori* from Seed to Plant to Seed in CVL-1 Jute under Different Field Condition

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Abstract: Six hundred seed samples were collected from different sources and were subjected to investigate the transmission behavior of *Colletotrichum corchori.* Seed samples were categorized on the basis of presence of *Colletotrichum corchori* as 0%, 5%, 10%, 15%, 20% and 25%. Germination of the collected seed samples found to be varied significantly. Incidence of anthracnose increased with the increase of time. Seeds having higher level of seed infection with pathogens caused higher reduction of seed germination. Lower germination was recorded at higher prevalence of initial seed borne infection by *C. corchori.* Negative relationships between initial seed borne infection of *C. corchori* and seed yield parameters of harvested seeds were observed. Relationships between % seed germination and % total presence of pathogens in the seed was negative. Germination of the harvested seeds lowered with the increase of initial seed borne infections of *C. corchori.* Seed borne infection by *C. corchori* in harvested seeds increased with the increase of initial seed borne infection of *C. corchori.* Seed yield decreased with the increase of initial seed borne infection of *C. corchori*. Positive relationship between initial seed borne infection by *C. corchori* and seed borne infection in harvested seeds under field conditions proved the transmission of *C. corchori* from seed to plant to seed as a seed borne pathogen.

Key words: Initial seed borne infection · Transmission · Biotic stress · Seed health test · Seedling symptom test · *Colletotrichum* · Incidence

INTRODUCTION

Jute (*Corchorus capsularis* L. and *Corchorus olitorius* L.) is one of the cash crops of Bangladesh. In respect of production, Bangladesh ranks second (14,52,044 metric tons annually) among the jute growing countries of the world [1]. In Bangladesh, about 7,60,427 hectares of land were under jute cultivation, where produced 14,52,044 tons at 1.91 t ha^{-1} [2]. Jute is a natural fibre belongs to Tiliaceae family and it has two species namely, *Corchorus olitarius* L. (Tossa Jute) and *Corchorus capsularis* L. (White Jute). According to Bangladesh Bureau of Statistics (BBS) during the fiscal year 2013-14 farmers cultivated jute in 6.66 lakh hectares of land which was 8.33 lakh hectares in 2012 and 4.8 lakh hectares in 2010 and the raw jute export of Bangladesh during 2011-2012 was 411 thousand tones that earned $198.5 million and the export volume of raw jute has increased by 8.17% compared to previous year 2010-11 whereas the export price gone down by 28.06%. In 2012, raw jute price moved radically in domestic market [3].

Among the 12 different diseases of jute 10 are seed borne and except leaf mosaic all are caused by fungi [4]. The fungal pathogen *Colletotrichum corchori* causing anthracnose is one of the major diseases that transmitted through seed [5, 6, 7] *Macrophomina phaseolina*, *Botryodiplodia theobromae* and *Colletotrichum corchori* are transmitted from seed to plant to seed [2]. Study on transmission of seed borne infection of three major seed borne fungal pathogens in jute revealed that higher seed borne infection resulted in higher disease development in the field. Transmission of *C. corchori* from infected seeds to the harvested seeds through the growing plants is a great threat for jute cultivation [2].

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Few works regarding the seed health status of jute seeds of different tires and the transmission nature of *C. corchori* from seed to seedlings have been conducted by Fakir, *et al.* as Begum and Fakir in laboratory condition [8, 2]. However, no detail study on the transmission rate of *C. corchori* from seed to plant to seed has been reported. Keeping the view of the above facts and findings the present study was undertaken to determine the rate of transmission of *C. corchori* from seed to plant to seed under field condition.

MATERIALS AND METHODS

Experimental Site: The experiments were conducted in the fields of Jute Agriculture Experiment Station (JAES), Manikgonj and Chandina Regional Station (CRS), Comilla of Bangladesh Jute Research Institute, under the Department of Plant Pathology, Bangladesh Jute Research Institute.

Experimental Materials: The variety CVL-1 belonging to deshi pat (*Corchorus capsularis* L.) of different seed tires was used for conducting the experiments.

Collection of Seed Sample from Different Sources: Altogether 600 seed samples were collected from different locations of Bangladesh of which there were 15 breeders, 5 foundation seeds, 7 certified seeds and 573 farmers' seeds.

Seed Collection Procedure: Seed samples were obtained from the seed lots of each tier. Primary seed sample of 50g were randomly taken from 10 different positions of the seed lot. All the primary seed samples were mixed thoroughly to make a composite sample. Thus each composite sample was 500 g of seeds. As the size of each composite sample was 500 g, so it was regarded as submitted sample. The submitted seed samples were kept in plastic container. All the seed samples were labeled properly and preserved in Gene Bank of BJRI at 5°C till the samples were used for conducting respective research. Working seed samples were taken from the preserved seed samples as per requirement. Total procedure was maintained following the Rules of ISTA [9].

Detection of *C. corchori* in Jute Seeds: Seed health analysis was conducted by blotter method following the International Rules for Seed Health Testing [9]. In this method 9 cm diameter plastic petridish and Whatman no. 1 filter paper were used. Two hundred seeds were taken randomly and placed on the moist filter paper in eight replicate petridishes. The petridishes with seeds were then incubated at 22±2°C for seven days in the laboratory. After incubation the seeds were examined under stereomicroscope and the pathogen *C. corchori* were identified by following the key of Sutton [10]. Collected seed samples from all seed tires were categorized on the basis of presence of *Colletotrichum corchori* as 0, 5, 10, 15, 20 and 25% infection with *C. corchori*.

Field Experiments: Previously categorized seeds were used for conducting the field experiments. The size of the unit plot was kept 4m X 3m and the distance between plots and replications both were kept 1m. Fertilizers such as Urea, Triple Super Phosphate and Muriate of Potash ware applied at the rate of 60 kg, 50 kg and 25 kg respectively during the final land preparation [11-14]. First Top dressing was done at 15 days after germination and second top dressing was done at 30 days after germination with Urea at the rate of 60 kg ha^{-1} each time. Gypsum and Zinc oxide @ 45 kg ha^{-1} and 5 kg ha^{-1} was applied to meet up sulphur and zinc deficiency [11-14]. Seeds were sown in line. Row to row and plant to plant distance ware kept 20 cm x 10 cm [15]. Dhaincha (*Sesbania* spp.) were grown between the plots as barrier crop to avoid pathogen transmission from one plot to another. Germination, emergence of normal seedlings and incidence of anthracnose were recorded in the field with close observation. Incidences of other diseases were also recorded along with Anthracnose. The disease incidence data for seed borne infection caused by *C. corchori* was calculated as:

$$\text{Disease incidence (seed borne infection)} \frac{\text{Number of infected seeds caused by } C.\ corchori}{\text{Total number of seeds}} \times 100$$

Seed yield was recorded in kg ha^{-1}. Quality of the harvested seeds from each plot was judged by the two parameters viz. germination and health.

Statistical Analysis: Field experimental data were analysed by using Randomized Completely Block Design (RCBD) with three replications. Mean comparisons among the treatments were compared by Duncan's Multiple Range Test (DMRT).

RESULTS

Effect of Initial Seed Borne Infection of *Colletotrichum corchori* on Germination of CVL-1 under Field Condition: Percent germination of seeds under field condition with initial seed borne infection of 0.00%, 5.0%,

Table 1: Effect of initial seed borne infection of *Colletotrichum corchori* on germination of CVL-1 under field condition

	JAES		CRS	
% Initial seed borne infection of *C. corchori*	Germination Percentage	Germination Percentage reduction	Germination Percentage	Germination Percentage reduction
0.0%	98.00 a	-	96.00 a	-
5%	91.86 b	6.27	87.00 b	9.38
10%	86.12 c	12.12	81.33 c	15.28
15%	80.53 d	17.83	76.33 d	20.49
20%	76.50 e	25.00	70.00 e	27.08
25%	70.53 f	28.03	65.33 f	32.00
Level of significance	0.05	-	0.05	-

Values in column having common letter(s) do not differ significantly.

Table 2: Effect of initial seed borne infection of *Colletotrichum corchori* on seed yield of CVL-1 under field condition

	JAES		CRS	
% Initial seed borne infection of *C. corchori*	Seed Yield (kg ha^{-1})	Percentage of seed yield reduction	Seed Yield (kg ha^{-1})	Percentage of seed yield reduction
0.0%	814.67 a		801.33 a	
5%	790.33 b	2.98	774.98 b	3.41
10%	730.00 c	10.39	698.33 c	12.85
15%	705.33 d	13.42	653.00 d	18.51
20%	657.67 e	19.27	625.00 e	22.00
25%	625.00 f	23.28	575.67 f	28.16
Level of significance	0.05		0.05	

Values in column having common letter(s) do not differ significantly

10.00%, 15.00%, 20.00% and 25.00% of *C. corchori* varied significantly. The highest germination (98.00%) was recorded at Jute Agricultural Experimental Station (JAES) followed by germination (96.00%) at Chandina Regional Station (CRS) of BJRI for 0.0% initial seed borne infection of *C. corchori.* The lowest germination (65.33%) was recorded at Chandina Regional Station of BJRI, preceded by germination (70.53%) at JAES for 25.00% initial seed borne infection of *C. corchori*.

The highest germination percentage reduction (32.00%) was recorded at CRS followed by germination (28.03%) at JAES for 25.00% initial seed borne infection of *C. corchori*. The lowest germination reduction (6.27%) was recorded at JAES, preceded by germination (9.38%) at CRS for 5.00% initial seed borne infection of *C. corchori* (Table 1).

Effect of Initial Seed Borne Infection of *Colletotrichum corchori* on Seed Yield of CVL-1 under Field Condition: Seed yield under field condition with initial seed borne infection of 0, 5, 10, 15, 20 and 25% of *C. corchori* varied significantly. Seed yield decreased with the increase of initial seed borne infection of *C. corchori*. The highest seed yield (814.67 kg ha^{-1}) recorded at JAES followed by seed yield (801.33 kg ha^{-1}) at CRS for 0.0% initial seed borne infection of *C. corchori.* The lowest seed yield (575.67 kg ha^{-1}) was recorded at CRS, preceded by seed yield (625.00 kg ha^{-1}) at JAES for 25.00% initial seed borne infection of *C. corchori*.

The highest percentage of seed yield reduction (28.16%) was estimated in CRS followed by seed yield reduction (23.28%) in JAES by 25.00% initial seed borne infection of *C. corchori.* The lowest percentage of seed yield reduction (2.98%) was recorded at JAES, preceded by % seed yield reduction (3.41%) at CRS in case of 5.00% initial seed borne infection of *C. corchori* (Table 2).

Percent Seed Borne Infections with *C. corchori* in Harvested Seeds of CVL-1 of Different Locations: Percent seed borne infection in harvested seeds under field condition varied significantly with initial seed borne infection of 0, 5, 10, 15, 20 and 25% of *C. corchori* varied significantly.

The highest percentage of seed borne infection (30.00%) with *C. corchori* in harvested seeds was recorded at CRS followed by seed borne infection (24.00%) at JAES for 25.00% initial seed borne infection of *C. corchori*. The lowest seed borne infection (3.33%) with *C. corchori* in harvested seeds was recorded at JAES, preceded by seed borne infection (5.00%) at CRS for 5.00% initial seed borne infection of *C. corchori*. No seed borne infection of *C. corchori* was recorded in seeds harvested with 0.00% initial seed borne infection of *C. corchori*.

Table 3: Percent seed borne infections with *C. corchori* in harvested seeds of CVL-1 of different locations

% Initial seed borne infection of *C. corchori*	JAES		CRS	
	% *C. corchori*	% Total pathogens	% *C. corchori*	% Total pathogens
0.0%	0.00 e	2.50 e	0.00 e	2.67 e
5%	3.33 d	5.00 d	5.00 d	12.00 d
10%	8.67 c	14.00 c	10.50 c	17.33 c
15%	14.63 c	19.50 c	17.00 c	24.50 c
20%	19.50 b	24.00 b	26.50 b	26.00 b
25%	24.00 a	29.17 a	30.00 a	36.17 a
Level of significance	0.05	0.05	0.05	0.05

Values in column having common letter(s) do not differ significantly

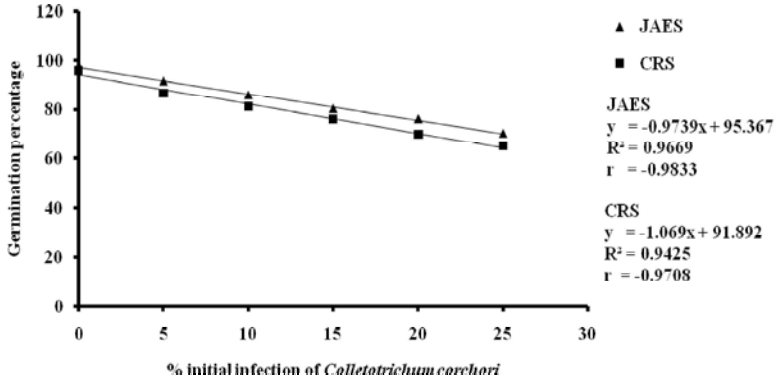

Fig. 1: Regression Equation and lines for % germination and % initial infection of *C.corchori* under field condition

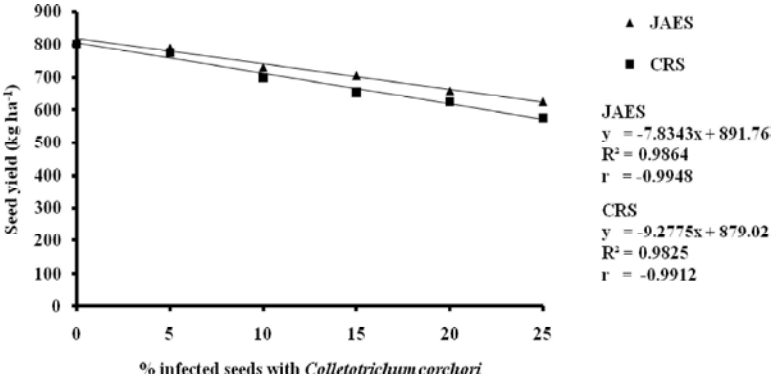

Fig. 2: Regression lines and equations Initial infection of *C. Corchori* and Seed at JAES and CRS

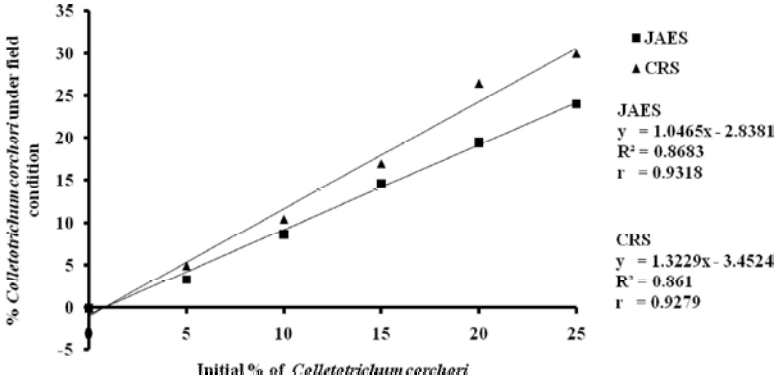

Fig. 3: Regression equations and lines transmission of *C. corchori* from seed to seed

The highest % total pathogen (36.17%) was recorded at CRS followed by total pathogen (29.17%) at JAES for 25.00% initial seed borne infection of *C. corchori*. The lowest % total pathogen (2.50%) was recorded at JAES, preceded by % total pathogen (2.67%) at CRS for 0.00% initial seed borne infection of *C. corchori* (Table 3).

Relationship of Initial Seed Borne Infection of *C. corchori* on Seed Yield Parameters of the Harvested Seeds of CVL-1 Produced at Different Locations: Regression lines of Figure 1 showed that the relationship between initial seed borne infection of *Colletotrichum corchori* with % germination were negative. The regression coefficients for % germination of harvested seeds produced at JAES and CRS were -0.98 and -1.07, respectively indicating % germination of harvested seeds decreased by 0.97% at JAES and 1.07% at Chandina for each % increase of initial seed borne infection of *C. corchori* (Figure 1).

Regression lines of Figure 2 showed that the relationship between initial seed borne infection of *Colletotrichum corchori* with seed yield (kg ha^{-1}) were negative. The regression coefficients for seed yield of harvested seeds produced at JAES and CRS were -7.83 (kg ha^{-1}) and -9.28 (kg ha^{-1}), respectively which indicates that rate of decrease of seed yield of harvested seeds decreased by 7.83% at JAES and 9.28% at CRS for each % increase of initial seed borne infection of *C. corchori* (Figure 2).

Transmission of *Colletotrichum corchori* from Seed to Seed under Field Condition: Regression lines of Figure 3 indicate that the relationship between initial seed borne infection of *Colletotrichum corchori* with % infection of *C. corchori* in harvested seeds at JAES and CRS were positive. The regression coefficients for % infection of *C. corchori* in harvested seeds were 1.05% and 1.32% for JAES and CRS, respectively. Findings evident that the rate of transmission of % infection of *C. corchori* in harvested seeds at JAES and CRS were 1.05% and 1.32%, respectively for each % increase of initial seed borne infection of *C. corchori* (Figure 3).

DISCUSSION

Six hundred collected seed samples were categorized on the basis of seed borne infection of *Colletotrichum corchori* as 0, 5, 10, 15, 20 and 25% in addition; seed to plant to seed transmission of *C. corchori* was studied.

Percent germination of harvested seeds produced with different initial seed borne infection of *C. corchori* varied significantly. The highest germination was recorded at JAES followed by germination at CRS for 0.0% initial seed borne infection of *C. corchori.* The lowest germination was recorded at CRS, preceded by germination at JAES for 25.00% initial seed borne infection of *C. corchori* (Table 1). Haque *et. al.*, Kubiak and Korbas, Dawson and Bateman, Javaid *et. al.,* Akranuchat *et. al.*, Islam *et. al.* and Alemu reported that negative relationship between % germination and % total pathogens were observed and the % germination decreased with the increase of initial seed borne fungal infections [16-22].

Percent seed borne infection in produced seeds under field condition with different initial seed borne infection of *C. corchori* varied significantly. The highest seed borne infection with *C. corchori* in harvested seeds was recorded at CRS followed by seed borne infection at JAES for 25.00% initial seed borne infection of *C. corchori*. The lowest seed borne infection with *C. corchori* in harvested seeds was recorded at JAES. The highest total pathogen was recorded at CRS followed by total pathogen at JAES for 25.00% initial seed borne infection of *C. corchori*. The lowest total pathogen was recorded at JAES. (Table 3). Higher the initial seed-borne infection of the pathogens, higher the disease development in the field. Mathews, Fakir, *et al.*, Kabeere *et al.*, Wu *et al.*, Coles and Wicks, Hampton, Islam *et al.*, Farrag and Moharam and Siddique *et al.* reported that initial seed borne infection of fungal pathogens viz. 0, 5, 10, 15 and 20% infected seeds cause less seedling emergence in the field which is also in agreement with the present findings [23, 2, 24, 25, 26, 27, 28, 29, 30].

Seed yields under field condition produced with different initial seed borne infection of *C. corchori* were negatively related and varied significantly. The highest seed yield was recorded at JAES followed by seed yield at CRS for 0.0% initial seed borne infection of *C. corchori*. The lowest seed yield was recorded at CRS, preceded by seed yield at JAES for 25.00% initial seed borne infection of *C. corchori.* The higher the seed-borne infection of the pathogens, higher the disease development in the field. Fakir, *et al.* and Islam *et al.* reported that as the initial seed borne infections increases, disease development in the field also increases and consequently cause the reduction in yield of seed and fiber which is in agreement with the present study [2, 31].

Regression coefficients for % germination of harvested seeds produced with different initial seed borne infection of *C. corchori* at JAES CRS indicates that the rate of decrease of % germination of harvested seeds decreased by 0.97% and 1.069%, respectiely at JAES and CRS for each % increase of initial seed borne infection of *C. corchori* (Figure 1). The regression coefficients for seed yield of harvested seeds produced with different initial seed borne infection of *C. corchori* at JAES and CRS indicates that the rate of decrease of seed yield of harvested seeds decreased by 7.83% at JAES and 9.2775% at CRS for each % increase of initial seed borne infection of *C. corchori* (Figure 2). Fazli and Ahmad (1960) found that *Macrophomina phaseolina* and *Colletotrichum corchori* were responsible for the deterioration of quality and yield of jute seeds which support the present finding.

Transmission rate of *C. corchori* from seed to harvested seeds were 1.32% and 1.05%, respectively for JAES and CRS for each % increase of initial seed borne infection of *C. corchori*. Transmission of the major seed borne diseases including stem rot caused by *Macrophomina phaseolina*, black band caused by *Botryodiplodia. threobromae* and anthracnose caused by *Colletotrichum corchori,* from seed to plant to seed revealed that germination of the seeds were found to decrease with the increase of initial seed borne fungal infection and resulted significantly higher amount of disease development in the field [2].

CONCLUSION

Findings indicate that percent germination and seed yield decreased with increase of initial seed borne infection of *C. corchori*. Transmission rate of *C. corchori* from seed to harvested seeds was measured by regression coefficients. The regression co-efficient for % infection of *C.corchori* were 1.05 and 1.32, respectively for JAES and CRS. The transmission of rate of *C. corchori* from seed to harvested seeds were 1.05% and 1.2% for JAES and CRS, respectively for the increase of each 1 % initial seed borne infection of *C. corchori*.

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