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FEASIBILITY OF QUALITY IMPROVEMENT OF JUTE SEED BY PLANT EXTRACTS

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ABSTRACT

Five plant extracts *viz*. garlic tablet, allamanda tablet, neem leaf extract, bishkatali leaf extract and zinger rhizome extract were assessed as seed treating agents against seed-borne pathogens of jute. Farmers' seeds carry seed-borne fungi and their prevalence varies in varieties and locations. Garlic tablet was effective in controlling seed-borne fungal infection; consequently the seed germination was high. The effect of allamanda tablet was similar to that of garlic tablet. Neem leaf extract was able to reduce seed-borne fungi but the other three extracts were not effective in controlling seed-borne infection. The performance of garlic tablet was similar to that of Vitavax-200. A significant increase in seedling vigor was also observed over untreated control after garlic treatment.

Kay Words: Plant extract, Germination, Seed-borne fungi, Jute, Seed quality

INTRODUCTION

Jute (*Corchorus* spp.) is the principal fibre crop of Bangladesh. In Bangladesh, 5.1 million bales of fibre were produced from 0.42 million hectares of land with an average yield of 12.2 bales per hectare (BBS, 2010). Among the various factors related to good production, seed quality plays the pivotal role. Quality seed of an improved variety itself can provide 20% additional jute yield (Hossain *et al.*, 1994). Unfortunately the availability of good quality jute seed in our country is far below than the total requirement. Annual demand of jute seeds in Bangladesh is 3570 metric tons. Only 456 metric tons are supplied by public sector and 1350 metric tons by private sector. The gap between local production and demand for seed amounts to nearly 87% (BSGDMA, 2007). The contribution of private sector in seed supply is import based and they import jute seeds mostly from India. Nevertheless, the country has to largely rely on the farmers' seed and it faces acute scarcity of quality jute seed every year.

Seed-borne infection poses a serious threat to jute production. Jute crop suffers from 12 different diseases of which 10 are known to be seed-borne. Among the fungal pathogens *Botryodiplodia theobromae, Colletotrichum corchori* and *Macrophomina phaseolina* are predominant and *Curvularia lunata, Fusarium moniliforme, F. semitectum* and *Corynespora cassiicola* can also be associated with jute seeds (Islam *et al.*, 2007).

Proper disease control measure can substantially improve the quality of produce and significantly increase the yield. Among the practices seed treatment is probably the cheapest and safest way of plant disease control (Ahmed and Sultana, 1985). In many countries, regular practice of chemical seed treatment is considered as safeguard against the building up of inocula which help greatly in reducing yield loss, and also improve the quality of the produce. The eco-friendly botanical pesticides can be used for seed treatment instead of chemical fungicides. Therefore, this study was undertaken to assess the efficacy of different plant extracts on jute seed quality.

MATERIALS AND METHODS

Collection of seed samples

Twenty jute seed samples (10 for CVL-1 and 10 for O-9897) were collected from 10 different locations of Kaharul upazila of Dinajpur district. The samples were then kept in brown paper bags and stored in the refrigerator at 5-7^{o}C until subsequent studies.

Dry inspection

Seed samples were examined by naked eye and hand lens to separate out apparently healthy, diseased, shriveled and discoloured, and mechanically injured seeds. 400 seeds were tested form each sample and data were expressed in percentage.

Germination test

Four hundred seeds from each sample were tested for germination. Twenty five seeds were placed in each petri plate of 9 cm diameter containing three well-moistened blotter papers. Plates were then incubated at room temperature for five days. Seeds producing both plumule and radical were considered as germinated seeds. Data were expressed as percentage.

Blotter incubation test

Four hundred seeds from each sample were tested. Twenty five seeds were placed on three layers of moistened blotter papers in each plate. Seeds were then incubated at 22 ± 2^{o}C under alternating cycle of 12 hours of darkness and 12 hours under near ultraviolet (NUV) light for seven days. Seeds were then examined under dissecting microscope for the presence of associated seed-borne fungi, if needed was confirmed with the aid of compound microscope and pertinent literature. Total number of seeds infected by specific seed-borne fungus was scored to determine percentage of seed infection.

Vigor test

Vigor index of jute seeds was examined following sand tray method. Only one treatment (garlic tablet 1:2) was employed for the vigor test. One hundred seeds were sowed in each tray and four trays were maintained for each variety. Data on germination, root length and shoot length were recorded after eight days of sowing. Seedling vigor was calculated following the formula of Baki and Anderson (1972):

Vigor Index = (Mean root length + Mean shoot length) × % Germination

Seed treatment

Five botanical extracts were used for the experimentation (Table 1). Garlic and allamanda tablets were collected from the IPM Laboratory, Department of Plant Pathology, Bangladesh Agricultural University (BAU) and other plant species were collected from different areas of BAU. For garlic and allamanda tablets, one part of tablet (ground and powdered) was added to one and two parts of distilled water (weight/volume) to prepare 1:1 and 1:2 dilutions, respectively. For other extracts, respective plant parts were chopped and crushed in a blender without water followed by squeezing through three folds of fine cloths. The filtrates were used as plant extracts and required dilutions were made by adding distilled water. For treatment, seeds were dipped into the dilution dozes for twenty minutes followed by proper drying. As positive control, seeds were treated with Vitavax 200 @ 0.25% of seed weight.

Table 1. Botanicals used in the experiment

Common name	Scientific name	Plant part/product used
Garlic	*Allium sativum*	Tablet
Allamanda	*Allamanda cathartica*	Tablet
Neem	*Azadirachta indica*	Leaf
Bishkatali	*Polygonum hydropiper*	Leaf
Zinger	*Zingiber officinale*	Rhizome

Data analysis

Data were analyzed by ANOVA following completely randomized design (CRD) using a statistical package MSTATC. Treatment means were compared by Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Seed samples were subjected to dry inspection to sort out the apparently healthy, diseased, shriveled and discoloured, and mechanically injured seeds (Table 2). In case of CVL-1, seeds collected from Mirjapur appeared to be the best followed by Kakor. Seeds from Mirjapur had 83% apparently healthy seed; diseased, discoloured and injured seeds were comparatively low. Seeds from Sundol were of poor quality having 66.25% apparently healthy seed, 3.5% diseased seed, 27% shriveled and discoloured seed and 3.25% seed with mechanical injury. For O-9897, the scenario was also similar. Mirjapur seeds seemed to be the best with 78.75% healthy seeds. Diseased, shriveled and discoloured seeds were the least though mechanical injury was comparatively higher. Seeds collected from Sundol and Malihata were of worst quality having 66.25% and 66.50% healthy seed, respectively. Among CVL-1 samples, seeds from Joynanda (6.00%)

and in case of O-9897, seeds from Malihata (5.25%) showed the highest amount of diseased seed, respectively.

Table 2. Dry inspection of jute seed samples collected from different locations of Kaharul upazila of Dinajpur district

Variety	Location	% of seed			
		Apparently healthy	Diseased	Shriveled and discoloured	Mechanically injured
Deshi (CVL-1)	Kamore	73.25	3.75	22.00	1.00
	Malihata	69.75	5.00	22.75	2.50
	Mirjapur	83.00	2.50	13.00	1.50
	Bergaon	77.25	1.75	19.50	1.50
	Sundol	66.25	3.50	27.00	3.25
	Voronda	70.25	1.75	26.00	2.00
	Kakor	81.50	2.25	13.75	2.50
	Badlipara	70.75	2.75	22.75	3.75
	Rukunpur	76.00	4.75	16.25	3.00
	Joynonda	72.75	6.00	19.25	2.00
Mean		74.07	3.40	20.23	2.30
Standard deviation		28.51	1.97	22.95	0.74
Tossa (O-9897)	Kamore	71.50	4.75	22.50	1.25
	Malihata	66.50	5.25	25.75	2.50
	Mirjapur	78.75	2.75	16.25	2.25
	Bergaon	74.25	3.50	21.25	1.00
	Sundol	66.25	3.50	27.00	3.25
	Voronda	73.25	4.00	19.75	3.00
	Kakor	73.50	2.50	21.00	3.00
	Badlipara	75.25	3.75	18.25	2.75
	Rukunpur	73.00	3.00	22.25	1.75
	Joynonda	72.25	3.25	23.25	1.25
Mean		72.45	3.63	21.93	2.30
Standard deviation		14.09	0.95	8.70	0.80

400 seeds were inspected for each sample

Seed germination varied location to location irrespective of varieties (Table 3). Average germination of deshi seeds was higher than that of tossa seeds. In case of CVL-1, seeds collected from Mirjapur had the highest (81.00%) germination followed by Kakor (78.75%). The lowest germination was recorded from the seeds of Sundol (61.75%). For O-9897, the highest germination was observed in case of Badlipara seeds (68.25%). Germination was statistically similar between the seeds of Kakor and Voronda. Seeds from Bergaon showed the lowest germination (57%). It is likely that seed germination varies depending on variety and location. Rashid *et al*. (2007) also reported the variation in jute seed

germination based on seed source. However, the differences in germination status might also be due to differences in storage and handling. The prevalence of seed-borne infection is also responsible for lower germination (Fakir, 1998 and Islam *et al*., 2003).

Table 3. Germination status of jute seed samples collected from different locations

Variety	Location	Germination (%)	Variety	Location	Germination (%)
Deshi (CVL-1)	Kamore	70.75cd	Tossa (O-9897)	Kamore	61.50b
	Malihata	65.00f		Malihata	66.00a
	Mirjapur	81.00a		Mirjapur	63.00b
	Bergaon	72.00c		Bergaon	57.00c
	Sundol	61.75g		Sundol	62.25b
	Voronda	67.25c		Voronda	65.75a
	Kakor	78.75b		Kakor	67.25a
	Badlipara	65.00f		Badlipara	68.25a
	Rukunpur	70.75cd		Rukunpur	62.00b
	Joynonda	70.25d		Joynonda	62.50b
Mean		70.25			63.55
Standard deviation		0.90			1.70

400 seeds were inspected for each sample; Values within the same column having common letter(s) do not differ significantly (P≥0.05)

Colletotrichum corchori, *Macrophomina phaseolina*, *Botryodiplodia theobromae*, *Fusarium* sp., *Curvularia lunata*, *Penicillium* sp. and *Cercospora corchori* were associated with jute seeds (Table 4 and 5). Several studies also reported the association of these seed-bore fungi with jute (Mathur *et al.*, 1989; Khan and Fakir, 1993 and Rashid *et al.*, 2007). For CVL-1, the highest seed-borne infection was recorded from the seeds of Joynonda and the lowest from the seeds of Kamore. In contrast, for O-9897, the highest and the lowest fungal infections were recorded from the seeds collected from Malihata and Mirjapur, respectively (Fig. 1).

Plant extracts had significant effect in controlling seed-borne fungal infection and improved germination. Both varieties had improved performance following seed treatment (Table 6 and 7). Garlic and allamanda tablet performed the best among the treatments. It is apparent that garlic and allamanda tablets have broad spectrum antifungal activity offering good control against most of the seed-borne fungi encountered. The performance of T_1 was similar to T_0. However, T_2, T_3 and T_4 had statistically similar effect to T_1 in controlling seed-borne fungi, but the germination was lower in those treatments. Allamanda tablet was next to garlic tablet in terms of fungal control and germination percentage. Efficacy of garlic and allamanda extracts in controlling seed-borne fungal infection in different crops has also been reported by Dubey and Dwivedi (1991), Rahman *et al.* (1999), Meah *et al.* (2004) and Rashid *et al.* (2007). Neem leaf extract was moderately effective while bishkatali and zinger extracts were not effective in controlling seed-borne fungi. Rahman *et al.* (1999) also found moderate effect of neem extract against fungi associated with wheat seeds.

Table 4. Prevalence of different seed-borne fungi recorded on farmers' saved jute seeds (CVL-1)

Location	Percent seed-borne fungal infection						
	Colletotrichum corchori	*Macrophomina phaseolina*	*Botryodiplodia theobromae*	*Fusarium* spp.	*Curvularia lunata*	*Penicillium* sp.	*Cercospora corchori*
Kamore	0.25d	0.00d	0.00e	5.50e	2.75c	13.25b	0.00b
Malihata	3.25ab	1.25c	0.00e	10.25bc	0.00d	12.25c	0.00b
Mirjapur	0.00d	2.50bc	3.25c	9.25de	0.25d	10.00e	0.00b
Bergaon	2.25bc	1.75bc	7.00a	11.50a	0.00d	10.75de	0.25b
Sundol	1.25cd	0.00d	3.50c	8.75d	5.25a	15.00a	0.00b
Voronda	0.75d	2.00bc	0.00e	11.75a	0.00d	13.25b	0.25b
Kakor	1.00cd	1.75bc	2.00d	10.25bc	0.00d	10.50de	0.00b
Badlipara	3.25ab	2.75ab	2.00d	8.25d	4.25b	11.25d	0.00b
Rukunpur	2.25bc	1.50bc	1.00de	10.50b	2.50c	7.50f	0.00b
Joynonda	4.00a	3.75a	5.75b	11.75a	5.50a	8.25f	1.75a

Values within the same column having common letter(s) do not differ significantly (P≥0.05); Data were analyzed after transformation (Arcsin)

Table 5. Prevalence of different seed-borne fungi recorded on farmers' saved jute seeds (O-9897)

Location	Percent seed-borne fungal infection						
	Colletotrichum corchori	*Macrophomina phaseolina*	*Botryodiplodia theobromae*	*Fusarium* spp.	*Curvularia lunata*	*Penicillium* sp.	*Cercospora corchori*
Kamore	1.25bc	1.00d	0.00e	15.25a	0.00d	9.25de	1.75a
Malihata	3.00a	3.25a	3.25ab	12.25c	3.25a	12.75a	0.25bc
Mirjapur	0.00d	0.75d	2.25bc	10.25d	1.75b	11.25bc	0.00c
Bergaon	0.25cd	2.25b	1.25cd	11.75c	2.25b	13.25a	0.75b
Sundol	1.25bc	0.00e	1.75cd	9.75d	2.25b	11.50b	0.00c
Voronda	2.75a	3.00a	3.50a	11.50c	3.75a	11.25bc	0.75b
Kakor	1.50b	2.00bc	1.25cd	14.25b	0.00d	9.25de	0.00c
Badlipara	0.25cd	1.25cd	0.00e	12.50c	3.75a	11.50b	0.25bc
Rukunpur	3.25a	2.00bc	2.00c	12.25c	1.00c	8.75e	0.00c
Joynonda	2.25ab	1.25cd	0.75de	12.00c	0.75c	10.25cd	0.25bc

Values within the same column having common letter(s) do not differ significantly (P≥0.05); Data were analyzed after transformation (Arcsin)

Table 6. Effect of botanical seed treatment on seed-borne fungi of farmers' saved jute seeds (CVL-1)

Treatment	Germination (%)	Percent seed-borne fungal infection					
		Colletotrichum corchori	*Macrophomina phaseolina*	*Botryodiplodia theobromae*	*Fusarium* sp.	*Curvularia lunata*	*Penicillium* sp.
T_0	88.00a	0.00d	0.00e	0.00d	0.75d	0.00g	1.00d
T_1	85.75b	0.00d	0.00e	0.00d	2.25c	0.25f	1.25c
T_2	83.25c	0.00d	0.25de	0.00d	3.00bc	1.00ef	1.25c
T_3	81.25d	0.00d	0.50cde	0.50cd	3.50bc	1.50de	2.25bc
T_4	80.00e	0.25d	0.50cde	0.50cd	3.25bc	1.75cde	2.50bc
T_5	78.50f	0.75cd	1.00b-e	0.75cd	3.75bc	1.75cde	3.00bc
T_6	75.25g	1.00bcd	0.75b-e	1.25bc	4.00bc	2.00cde	3.25b
T_7	74.25g	1.50abc	1.00b-e	1.25bc	3.75bc	2.50bc	3.00bc
T_8	71.00h	2.00abc	1.75abc	2.00a	4.75ab	3.00bc	3.75b
T_9	71.25h	2.25ab	2.00ab	2.25ab	5.00ab	3.50ab	4.00b
T_{10}	70.50h	2.50a	2.75a	3.00a	6.50a	4.50a	6.50a

Values within the same column having common letter(s) do not differ significantly ($P \geq 0.05$); Data (fungal infection) were analyzed after transformation (Arcsin)

T_0 = Vitavax 200 @ 0.25% (positive control), T_1 = Garlic tablet (1:1), T_2 = Garlic tablet (1:2), T_3 = Allamanda tablet (1:1), T_4 = Allamanda tablet (1:2), T_5 = Neem leaf extract (1:1), T_6 = Neem leaf extract (1:2), T_7 = Bishkatali leaf extract (1:1), T_8 = Bishkatali leaf extract (1:2), T_9 = Zinger rhizome extract (1:1), and T_{10} = Zinger rhizome extract (1:2)

Table 7. Effect of botanical seed treatment on seed-borne fungi of farmers' saved jute seeds (O-9897)

Treatment	Germination (%)	Percent seed-borne fungal infection					
		Colletotrichum corchori	*Macrophomina phaseolina*	*Botryodiplodia theobromae*	*Fusarium* sp.	*Curvularia lunata*	*Penicillium* sp.
T_0	82.50a	0.00f	0.00f	0.00f	1.00f	0.00f	0.75g
T_1	81.00b	0.00f	0.00f	0.00f	2.50f	0.75f	1.50f
T_2	79.50c	0.00f	0.00f	0.25ef	3.00ef	1.00f	2.00ef
T_3	79.00cd	0.00f	0.25f	0.25ef	3.00ef	1.25f	2.25ef
T_4	78.25d	0.50ef	0.75ef	0.75ef	3.50ef	1.50f	2.75ef
T_5	77.00e	1.00de	1.25de	1.50de	4.00e	2.50e	3.25ef
T_6	75.50f	1.50d	2.00cd	2.50cd	5.25d	3.00de	3.50ef
T_7	74.00g	0.75e	2.50c	3.00c	5.75cd	3.75cd	4.25d
T_8	72.00h	2.25c	3.75b	4.50b	6.50b	4.50c	5.75bc
T_9	70.25i	3.00b	4.25b	5.00ab	7.25b	5.50b	6.25ab
T_{10}	66.00j	3.75a	5.75a	5.75a	8.50a	6.75a	7.25a

Values within the same column having common letter(s) do not differ significantly (P≥0.05); Data (fungal infection) were analyzed after transformation (Arcsin)

T_0 = Vitavax 200 @ 0.25% (positive control), T_1 = Garlic tablet (1:1), T_2 = Garlic tablet (1:2), T_3 = Allamanda tablet (1:1), T_4 = Allamanda tablet (1:2), T_5 = Neem leaf extract (1:1), T_6 = Neem leaf extract (1:2), T_7 = Bishkatali leaf extract (1:1), T_8 = Bishkatali leaf extract (1:2), T_9 = Zinger rhizome extract (1:1), and T_{10} = Zinger rhizome extract (1:2)

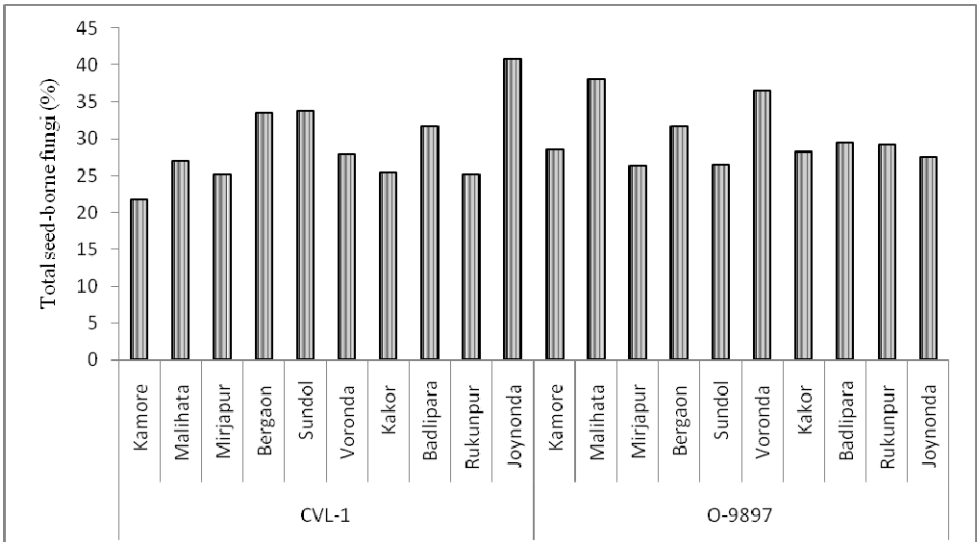

Fig. 1. Total seed-borne infection recorded from the farmers' jute seeds

the present investigation, T_1 appeared to be the best as it had the best control against seed-borne infection and higher germination (85.75% in deshi and 81.00% in tossa). But T_2 had almost similar effect to T_1. A significant increase in vigor and 27% increase in germination were observed with garlic treatment (T_2) in both the varieties (Table 8). Ahmed *et al*. (2002) and Hasan *et al*. (2005) also reported increased seedling vigor in rice and wheat, respectively after seed treatment with garlic extract.

Table 8. Vigor test of jute seeds collected from farmers' of Kaharul upazila of Dinajpur district

Variety	Treatment	Germination (%)	Mean shoot length (cm)	Mean root length (cm)	Vigor index (VI)
Deshi (CVL-1)	Untreated	56.00	3.15	2.15	296.80
	Garlic tablet (1:2)	83.00	3.40	2.29	472.27
Tossa (O-9897)	Untreated	5100	2.28	1.50	192.78
	Garlic tablet (1:2)	78.00	2.53	1.71	330.72

Garlic and allamanda tablets had the best potential in controlling seed-borne fungi and in increasing germination. Garlic tablet @ 1:2 can be used as seed treatment for controlling seed-borne infection, getting higher germination and seedling vigor.

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