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EFFICACY OF ESSENTIAL OILS AS JUTE SEED PROTECTANT

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ABSTRACT

Essential oils obtained from the leaves of *Eucalyptus citriodora, E. camaldulensis,* and whole plants of *Ocimum gratissimum* and *O. americanum* were tested for their efficiency to protect seed of jute (var.D-154) from seed-borne fungal pathogens. A total of 9 fungi were detected. Among the 9 deteced seed borne pathogenic fungi, the highest percentage of fungal occurrence was recorded with *Macrophomina phaseolina* (37.71%). This was followed by *Botryodiplodia theobromae* (30.10%) and *Colletotrichum corchori* (19.72%). The jute seeds dressed with the oil of *Eucalyptus citriodora* and *Ocimum gratissimum* exibited complete elimination of seed fungi, increased seed germination and reduced seedling mortality as compared to that of *E. camaldulensis* and *O. americanum*.

Key words: Jute, essential oils, seed protectant, antifungal.

INTRODUCTION

Disease free seeds play a vital role in crop production. But it is known to us that storage fungi degrade the nutritional components of seeds and also produce mycotoxins which cause reduced seed germination and increase seedling mortality while and more house 1977, 1978. Due to the growing concern about the toxicity of seed dressing organo-mercurials and development of resistance in the pathogens against such fungicides, search for various naturally occurring compounds with antifungal activity has become quite intense. It is advocated that these seed protecting fungicides should ideally be safe and non polluting (Fawcet and Spencer 1970, Khosoo 1986). Many essential oils have been found to possess varied degree of toxicity against different fungal pathogens (Rao and Nigam 1978, Thind and Suri 1979, Sinha and Gulati 1990, Begum *et al.* 1997, 1999, 2007, Chowdhury *et al*. 2003). Jute suffers from more than 12 different diseases. Of them, 10 are known to be seed borne (Hoque *et al*. 2005). Control of seed-borne fungi by various plant extracts were well documented (Ahmed and Sultana 1984, Khan and Fakir 1995). The present study was undertaken to evalute the

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seed protectant efficacy of essential oils collected from *Eucalyptus citriodora* Hook, *E. camaldulensis* Dehnh, *Ocimum gratissimum* L. and *O. americanum* L.. It should be ponted out that these plants are the important source of essential oils which are extensively used in perfumery and medicine (Guenther 1972, Yusuf *et al.*1994).

MATERIALS AND METHODS

Extraction of essential oils

Essential oils were extracted from fresh leaves of *E. camaldulensis, E. citriodora* and whole plants of *Ocimum gratissimum* and *O. americanum* by hydrodistillation through Clevenger's apparatus. *E. camaldulensis* and *E. citriodora* were collected from Chittagong University Campus, Bangladesh and *O. gratissimum* and *O. americanum* were collected from BCSIR Laboratories, Chittagong and Chittagong plantation area, Bangladesh. The essential oils thus collected were dried over anhydrous sodium sulfate and stored in sterile bottles for experimentation. Four voucher specimens of the plant have been preserved in the Herbarium of BCSIR Laboratories, Chittagong, Bangladesh.

Collection of seed sample

Jute seeds(var. D-154) were collected from Bangladesh Jute Research Institute, Dhaka. Seeds were brought to the laboratory, kept in paper bags and stored in desiccators until they were used for investigation.

Detection of mycoflora and testing of seed health

Jute seeds were analyzed for the detection of seed associated fungi, % germination and seedling mortality were determined by blotter method as recommended by International Seed Testing Association (ISTA 1966). Fungi were identified by steriobinocular microscopic observation (Agarwall *et al*. 1972). Individual fungus was isolated and purified by repeated streak method on PDA.

Seed treatment with oils

Seeds of jute (var. D-154) were taken in a sterile container. For each treatment 400 seeds were taken. The seeds were treated with 1%, 2% and 3% (W/V) oil separately. The container was closed tightly and shaken well to mix the seeds with oil. A control set without oil was also maintained for each treatment. The prevalence of associated fungi, seed germination and seedling mortality of treated and control seeds were examined after 30, 60 and 90 days of storing at room temperature (27 ± 2^0C).

RESULTS AND DISCUSSION

The total number of fungi associated and their occurrence (jute seeds var. D-154), per cent germination and seedling mortality are shown in Table-1. A total of 9 fungi including eight fungal genera (*Macrophomina phaseolina, Botryodiplodia theobromae, Colletotrichum corchori, Chaetomium* sp., *Rhizopus* sp., *Aspergillus* sp., *Penicillum* sp., *Fusarium* sp.) and *Mycelia sterilia* were detected during investigation (Table.1). The highest percentage of fungal occurrence were recorded with *Macrophomina phaseolina* (37.71%) followed by *B. theobromae* (30.10%) and *C. corchori* (19.72%). Table.1- revealed that among 1800 seeds 289 were infected with fungi, germination percentage was 91.0 and seedling mortality was 11.7%. The efficacy of four essential oils at three different doses and with three different working periods on three major and other minor seed borne fungal pathogens of jute along with the percent seed germination and percent seedling mortality are shown in Table 2. It was observed that all the fungal pathogens showed susceptibility towards the four essential oils tested. The degree of susceptibility varied depending on the species as well as the dose given. The oil (1%) of *E. citriodora* and *O. gratissimum* were superior in eliminating the seed fungi (except *M. phaseolina*,) reducing seedling mortality and enhancing seed germination compared to that of *E. camaldulensis and O. americanum*. But at 2% and 3% dose of these two oils, completely eliminated seed fungi and seedling mortality, also caused increase in seed germination percentage (Table 2). Seed protectant property of essential oils of *Zingiber officinale* was reported earlier (Mishra 1990). Al-Mousawi and Al-Maib (1976) reported that *Eucalyptus* oil inhibits germination of seed, but in this study this oil was found to enhance germination of jute seeds. Jute is the major cash crop of Bangladesh. So, protection of seeds from fungi during storage is of utmost importance for growing healthy plants. This finding suggests that the oils of *E. citriodora* and *O. gratissimum* may be utilized as indigenous seed protectants to control seed borne fungal pathogens of jute seeds. These essential oils have no gross toxicity on white strain rats during oral dose (Sinha and Gulati 1990, Begum *et al.*1997). Besides, these oils appear to be non toxic to human beings because they have been already used medicinally(Guenther 1972, Yusuf *et al*. 1994).

Variations in reductions of seedling mortality due to various treatments (types of oils, doses of oils, and treatment interactions) of this study were found to be significant at 1% and 5% levels as per ANOVA.

TABLE 1**:** OCCURRENCE OF SEED BORNE FUNGI, PERCENT SEED GERMINATION AND MORTALITY OF SEEDLING OF JUTE (VAR.D-154).

Fungal species	Total number of fungi	% fungi	% infected seeds	% seed germination	% seedlings mortality
Macrophomina phaseolina	109	37.71	6.05		
Botryodiplodia theobromae	87	30.10	4.83		
Colletotricum corchori	57	19.72	3.16		
Chaetomium sp.	10	3.46	0.55		
Rhizopus sp	7	2.42	0.38	90.80	11.70
Aspergillus sp.	10	3.46	0.55		
Penicillium sp	5	1.72	0.27		
Fusarium sp.	3	1.03	0.16		
Mycelia sterilia	1	0.34	0.05		
Total	289	99.96	16.00		

* Percent of fungi was calculated on the basis of total number of fungi associated with seeds i.e. 289.
* Percent of seed germination was calculated on the basis of total no. of seeds i. e. 1800 seeds

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TABLE 2: EFFICACY OF ESSENTIAL OILS TO PROTECT JUTE SEEDS FROM MAJOR AND OTHER SEED- BORNE FUNGAL PATHOGENS.

Source of Essential oils	Dose (% seed wt)	% seed-borne fungus									% other associated fungi			% seed germination			% seedling mortality		
		Macrophomina phaseolina			*Botryodiplodia thobromae*			*Colletotrichum cochori*											
		30 *	60 *	90*	30	60	90	30	60	90	30	60	90	30	60	90	30	60	90
Eucalyptus	1																		
citriodora	2	2.0	2.0	2.0	00	00	00	00	00	00	00	00	00	94.0	95.0	93.3	1.41	1.0	1.4
	3	00	00	00	0.0	00	00	00	00	00	00	00	00	95.3	96.0	94.0	00	00	00
		00	00	00	00	00	00	00	00	00	00	00	00	96.0	96.0	95.3	00	00	00
Eucalyptus camaldulensis	1	6.0	8.0	8.0	6.0	4.0	6.0	4.0	4.0	4.0	2.0	2.0	2.0	91.0	90.0	90.0	4.52	4.40	4.40
	2	6.0	6.0	6.0	4.0	4.0	4.0	2.0	4.0	4.0	2.0	2.0	2.0	91.5	91.0	91.0	2.97	4.18	4.18
	3	4.0	4.0	6.0	4.0	2.0	4.0	2.0	2.0	2.0	1.0	2.0	2.0	92.2	92.0	92.0	2.86	00	00
Ocimum gratissimum	1	2.0	2.0	2.0	00	00	00	00	00	00	00	00	00	93.3	90.6	90.0	0.6	1.43	1.4
	2	00	00	00	00	00	00	00	00	00	00	00	00	95.3	94.6	90.6	00	00	00
	3	00	00	00	00	00	00	00	00	00	00	00	00	96.0	94.6	92.0	00	00	00
Ocimum americanum	1	6.0	6.0	6.0	6.0	6.0	6.0	4.0	4.0	4.0	2.0	2.0	2.0	91.3	91.02	91.02	5.82	8.60	8.60
	2	6.0	6.0	5.0	4.0	4.0	4.0	4.0	2.0	3.0	1.0	1.0	1.0	94.0	92.01	91.08	6.38	7.90	7.00
	3	4.0	4.0	4.0	4.0	4.0	4.0	2.0	2.0	2.0	1.0	1.0	1.0	94.0	93.01	92.0	6.13	6.50	6.00
Control		8.0	8.0	8.0	6.0	6.0	6.0	4.0	4.0	4.0	4.0	4.0	4.0	91.0	91.0	91.0	11.7	11.7	11.0

Note : % of 1800 seeds *Durations of storage of seeds.

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