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Preservation of seeds with some antifungal volatile compounds

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Allyl-iso-thiocyanate present in mustard seed proved to be nore effective as seed preservative, even at 0.2%, against fungal infection of a number of seeds in natural storage than propionic acid. These two compounds at the rate of 0.2%, 0.4%, and 0.6% (v/w) were tested on the seeds of maize, groundnut and soybean. No phytotoxicity was recorded in allyl-iso-thiocyanate treated seed at the lowest concentration (0.2%) whereas phytotoxicity was fairly high in propionic acid treated seed even at the lowest concentration (0.2%).

Key words : Seed, storage fungi, deteriorative change, antifungal activity, allyl-iso-thiocyanate, propionic acid

INTRODUCTION

In recent years, preservation of seeds with different volatile seed preservatives has been successfully undertaken (Nandi, 1990) to control seed deterioration caused by different microbial agents under storage conditions (Nandi *et al.*, 1988; Mukherjee *et al.*, 1992). The present investigation, studied the efficacies of allyl-iso-thiocynate and propionic acid as preservatives of some economic seeds in storage.

MATERIALS AND METHODS

The maize (*Zea mays* cv. Ganga), groundnut (*Arachis hypogaea* cv. Nizam) and soybean (*Glycine max* cv. Bragg) were collected from the local market and were used in the present study. The volatile compounds allyl-iso-thiocynate and propionic acid were tested at concentration of 0.2, 0.4 and 0.6% (v/w) on heavily infected one year old seeds to determine their antifungal properties and on freshly harvested healthy seeds to determine their phytotoxic properties. The initial fungal infection in all seeds was found to be more than 70% in one year old seeds. The moisture content of the seeds of maize, groundnut and soybean in one year old seeds and in freshly harvested seeds were 14, 7, 10 and 13.5, 6.7, 9.5% respectively. *Aspergillus flavus*, *A. niger* and *A. candidus* were the predominant fungal species in these seeds. Ten g of each seed sample was placed in the polyethylene bags and the required amount of the appropriate chemical was added using a micropipette. The polyethylene bags were closed immediately but not sealed hermatically, thus permitting an exchange of oxygen for fungal growth. The seeds were shaken thoroughly and incubated at room temperature (30±2°C) for 30, 60 and 90 days in natural condition.

Untreated seeds kept in identical condition served as control set. At the end of the incubation period, fungi were recorded by placing surface sterilized seeds on salt-malt-agar (Nandi and Fries, 1976). Germination was recorded by placing seeds in Petridishes containing sterilized moist filter papers (ISTA, 1966) and incubating them at 30±2°C for seven days.

RESULT

Seed infection - In the control set, fungal infection was more than 70% in one year old seeds of all species after 30 days and increased thereafter (Table 1). When treated with allyl-iso-thiocyanate (0.2%) these seed lots showed only limited infection by *A. candidus* and became entirely free from fungal infection after 30 days. Propionic acid (0.2%) on the other hand reduced the growth of fungal species in seeds after 30 days and eliminated the fungi completely after 60 days of storage. At the higher concentration (0.4 and 0.6%) propionic acid eliminated fungi in seeds more quickly.

Seed germination - The germination (%) of freshly harvested seeds remained more or less unaffected by allyl-iso-thiocyanate (0.2%), 90 days after treatment (Table 2). Some reduction in germination (%) occurred in seed treated with 0.4% and 0.6% allyl-iso-thiocyanate. With propionic acid at 0.2% concentration germination was affected after 90 days in all seeds. Propionic acid at 0.4% and 0.6% severely reduced germination.

DISCUSSION

A number of earlier investigators reported propionic acid to be an efficient fungistat in seeds (Herting and Drury, 1974; Jones, 1970; Nandi, 1990; Paster, 1979). Mahapatra (1973) reported strong fungicidal activities of the vapour of allyl-iso-thiocyanate. Mondal *et al.* (1985) applied it as a seed preservative. The present study indicated that allyl-iso-thiocyanate at 0.2% concentration was more efficient than propionic acid (0.2%) as a fungitoxic compound against mycoflora present on seeds stored under the experimental conditions. The phytotoxic properties of this compound were less pronounced than those of propionic acid as was evident from the higher retention of germination.

Some of the storage fungi such as *A. flavus, A. niger and A. candidus* species predominantly present in untreated control seeds are capable of producing mycotoxins under Indian storage conditions. This necessitates the treatment of seeds with a suitable fungistat to inhibit fungal growth and reduce the possibility of mycotoxin contamination.

From this study, it can be concluded that allyl-iso-thiocyanate is more effective than propionic acid as a preservative of seeds, because of its fungitoxic property and low phytotoxicity. Allyl-iso-thiocyanate is known to be present (0.4%) in mustard seed, though mainly in an inactive form (Mahapatra, 1973). Nevertheless, it provides the seed with more resistance against fungal infection, than other oil yielding seeds, where this compound is absent (Mondal *et al.* 1985). Since the compound is an endogenous natural volatile compound, its toxicity in general, particularly at lower

Table 1. Effect of volatile compounds on fungal infection in one year old seeds under natural condition

Seeds	Incubation (days)	Seed germination (%)*												
		Control			Volatile compounds (Conc.)									
					0.2%			0.4%			0.6%			
		30	60	90		30	60	90	30	60	90	30	60	90
Maize		81	87	92	AITC	15	0	0	0	0	0	0	0	0
					PA	28	17	0	11	5	0	0	0	0
Groundnut		87	91	95	AITC	21	2	0	0	0	0	0	0	0
					PA	29	18	0	19	10	0	0	0	0
Soybean		74	79	84	AITC	12	0	0	0	0	0	0	0	0
					PA	17	9	0	9	0	0	0	0	0

* Mean of 500 seeds; AITC = Allyl-iso-thiocyanate; PA = Propionic acid

Table 2. Effect of volatile compounds on the germination of healthy seeds stored under natural condition

Seeds	Incubation (days)	Seed germination (%)*												
		Control			Volatile compounds (Conc.)									
					0.2%			0.4%			0.6%			
		30	60	90		30	60	90	30	60	90	30	60	90
Maize		90	90	87	AITC	89	88	86	88	85	99	80	79	72
					PA	81	79	74	78	75	70	74	72	61
Groundnut		86	85	83	AITC	86	83	82	76	70	69	67	65	54
					PA	74	71	64	71	68	59	67	64	57
Soybean		69	66	62	AITC	67	64	60	60	59	52	58	54	42
					PA	59	55	49	54	50	47	50	47	41

* Mean of 500 seeds; AITC = Allyl-iso-thiocyanate; PA = Propionic acid

concentration is expected to be fairly harmless to animal.

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