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Efficacy of Plant Extracts on the Germination of Wheat Seeds

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Abstracts: *Seeds of wheat were treated with eight locally available indigenous plants namely. Allium sativum (Garlic), Datura stramonium (Datura), Azadirachta indica (Neem), Allium cepa var. aggregatum (Onion), Carica papaya (Papaya), Zingiber officinal (Ginger), Parthenium hysterophorvus (Parthenium), and Curcuma longa (Turmeric) were evaluated. I have been collected from farmer's storages of Varanasi U.P. India. The first aim was to characterize the antifungal activities of leaf extract with acetone, methanol and water as solvents on the most frequently occurring wheat pathogens of the loose smut (Ustilago tritici) in Varanasi. Among the treated wheat seeds, the highest germination was found in 95.58 Seeds were treated with solvents 'Water' plant extracts at 5.0, 7.5, and 10% of solutions in respective plant extracts, 93.95 Seeds were treated with solvents 'Methanol' at 5.0, 7.5, and 10% of solutions in respective plant extracts than 92.20 Seeds were treated with solvents 'Acetone' at 5.0, 7.5, and 10% of solutions in respective plant extracts. Growth promoting activities of leaf extract on wheat seedling vigour was reported. Interestingly, the inoculums on naturally infected wheat seeds could be reduced with plant extract as a seed dressing biofungicide, before sowing. In this study we demonstrated the efficacy and the high control potential of leaf extract against seed-borne wheat fungi.*
Key word*: Seed Germination, Seed treatment, Seed borne fungi, Wheat*

I. Introduction

Wheat (*Triticum aestivum L.*) is one of the first domesticated food crops and for 8,000 years has been the basic staple food in major part of Europe. West Asia and North Africa (CIMMYT, 2009). Wheat is one of the most important cereals for human diet and easily digested by nearly 99% of human population all over the world. It is one of the important cereal crops and major food grains in India. A considerable amount of wheat as well as other grains is lost every year in storage due to biotic and abiotic factors. Stored wheat grains are subjected to the attack of many pests and diseases in storage. There are approximately 200 species of insects and mites attacking stored grains and stored products (Maniruzzaman, 1981). Gentile and Trematerra (2004) reported that 20 insect pests infested stored wheat, while Chaudhury and Mahla observed 10 insect species of wheat in storage. Their attacks reduced both quantity and food value of stored seeds. In India, most of the farmers are poor and marginal and store small quantities of wheat grains in their houses for consumption and seed purpose.

Agricultural crops are exposed to approximately 70,000 species of pests, but of these only 10% are considered serious pests (Pimentel, 1997). After harvest, another 20% of the food is lost to another group of pests (Pimentel, 1997). Plant diseases caused by a variety of fungi may cause significant losses on agricultural crops. All plants are attacked by some kinds of fungi, and each of parasitic fungi can attack one or many kinds of plants. More than 10,000 species of fungi can cause disease in plants (Agrios, 2005).

Fungal diseases may be minimized by the reduction of the inoculums, inhibition of its virulence mechanisms and promotion of genetic diversity in the crop (Strange and Scott, 2005). Fungicides may also prevent the growth of fungi that produce toxins, such as aflatoxins. In 1997, worldwide, 5.7 billion pounds of pesticides were used, of which 0.5 billion were fungicides (Goldman, 2008). There are numerous classes of fungicides, with different modes of action as well as different potential for adverse effect on health and environment. Milne (2004) indicated 311 compounds are registered and used as fungicides to control various plant fungal diseases. Of these, seven agents are antagonistic microorganisms and only one agent is derived from plant extract, i.e., extract of Reynoutria sachalinensis (Giant Knotweed).

Different kinds of preventive and curative control measures are practiced to protect these pests. Among those, chemical pesticides have been used for a long time, but have serious drawbacks (Sharaby, 1988), such as direct toxicity to beneficial insects, fishes, and human (Pimental, I981), pesticides resistance (Brown, 1968), health hazard (Bhaduri et al., 1989) and increased environmental and social costs (Pimental et al., 1980). In many countries, efforts are being made to minimize the use of harmful insecticides through the use of indigenous plant products, implementation of IPM approaches, use of bio-degradable products (Khattach and Hameed, 1986) and applying insect growth regulators (Metcalf, 1975) to protect stored grains. In many areas of the world, locally available plant materials are widely used to protect stored product against damage by insect infestation (Golob and Webley, 1980).

The identified seed borne fungi diseases of Wheat were antifungal activity against plant pathogenic fungi such as loose smut (*Ustilago tritici*) was determined in vivo by observing the inhibition of plant disease development. Seeds of Wheat were treated with 8 locally available indigenous plants namely. *Allium sativum* (Garlic), *Datura stramonium* (Datura), *Azadirachta indica* (Neem), *Allium cepa var. aggregatum* (Onion), *Carica papaya* (Papaya), *Zingiber officinal* (Ginger), *Parthenium hysterophorvus* (Parthenium), and *Curcuma longa* (Turmeric) may be grown by farmers with minimum cost and extracted by indigenous methods. And I have been investigated for their compatibility in the IPM programmed by determining their toxic (Mamun et al., 2009), repellent (Mamun et al., 2008), residual and grain protectant (Mamun et al., 2008b). So, it is important to know the effect of such indigenous plant extracts on the germination of wheat seeds but a few studies have been done on this. Therefore, the present study was undertaken to determine the effect of these botanicals on the germination of Wheat seed.

II. Materials and Methods

Plant Material

The present study was conducted in the Bhargawa Agricultural botany laboratory, of the Department of Botany, University of Allahabad, Allahabad, during the period from October 2013 to March 2014.Wheat seeds of the variety 'Sonalika' were collected from District Varanasi (U.P.) India.

Preparation of plant extracts

The various parts were collected to fresh leaves of Garlic, Datura, Neem, Onion, Papaya, Ginger, Parthenium, and Turmeric grass were collected from the surroundings of District Varanasi (U.P.). Afterwards, they were washed in running water. The plants were kept in shade for air-drying and then they were dried in the oven at 45^0C to gain constant weight. Dusts were prepared by pulverizing the dried leaves with the help of a grinder. Then the dusts were passed through a 25-mesh diameter sieve to obtain fine and uniform dint. The dusts were preserved in airtight condition in polythene bags till their use in extract preparation. The powder from all the samples was carefully stored a -20 °C. Water-soluble extracts were prepared as described by Rivillas-Acevedo and Soriano-García (2007), with some modifications.

The prepared leaf dusts were used for preparation of plant extracts. Each category dust (15gm) was taken in a 500 ml beaker and mixed separately with 100 ml of different solvents (acetone, methanol, and distilled water). Then the mixture was stirred for 30 minutes by a magnetic stirrer at (5000 rpm) and left to stand for next 24 hours. The mixture was then filtered through a fine cloth and again through filter paper (Whatman No. I). The filtrated materials were taken in a round bottom flask and condensed by evaporation of solvent in a water bath at 40^0C, 50^0C, and 60^0C temperature for acetone, methanol, and water extracts, respectively. Evaporation was done to make the volume 10 ml. After the evaporation of solvent, the condensed extracts were preserved in tightly corked labeled bottles and stored in a refrigerator until their use. Different concentrations of plant extracts were prepared by dissolving the stock solutions in the respective solvent prior to germination test of wheat seeds. The resulting aqueous solution was used for the fungal growth inhibition assay.

The germination of the treated wheat seed was evaluated by the process described by Qi and Burkholder (1981). The seeds were treated with different plant extracts at 5.0, 7.5, and 10.0% of respective plant extracts. The treated seeds were then dried under shade and kept for 3 months in the plastic container to prevent infestation. The seeds were then taken to test their germination by using blotting paper method (Agrawal, 1980). 100 seeds from each treatment were placed on petridishe of 9.0 cm diameter containing water soaked blotting paper. Each treatment was replicated thrice. The well germinated seeds in each petridish were counted after 7 days of treatment and expressed in number of seed germination.

Table: 1 List of plants used for antifungal properties

Sl. No.	Common Name	Family	Botanical Name	Part used
1	Garlic	Amaryllidaceae	*Allium sativum*	Leaf
2	Datura	Solanaceae	*Datura stramonium*	Leaf
3	Neem	Meliaceae	*Azadirachta indica*	Leaf
4	Onion	Amaryllidaceae	*Allium cepa var. aggregatum*	Leaf
5	Papaya	Caricaceae	*Carica papaya*	Leaf
6	Ginger	Zingiberaceae	*Zingiber officinal*	Leaf
7	Parthenium	Asteraceae	*Parthenium hysterophorvus*	Leaf
8	Turmeric	Zingiberaceae	*Curcuma longa*	Leaf

Table: 2 Different concentrations of plant extracts were prepared by dissolving the stock solutions in the respective solvent prior to germination test of wheat seeds.

Leaf Extract of Plant	Leaf extract + Water in (Dilute)		Leaf extract + Acetone in (Dilute)		Leaf extract + Methanol in (Dilute)	
Allium sativum	15gm	100 ml	15gm	100 ml	15gm	100 ml
Datura stramonium	15gm	100 ml	15gm	100 ml	15gm	100 ml
Azadirachta indica	15gm	100 ml	15gm	100 ml	15gm	100 ml
Allium cepa var. aggregatum	15gm	100 ml	15gm	100 ml	15gm	100 ml
Carica papaya	15gm	100 ml	15gm	100 ml	15gm	100 ml
Zingiber officinal	15gm	100 ml	15gm	100 ml	15gm	100 ml
Parthenium hysterophorvus	15gm	100 ml	15gm	100 ml	15gm	100 ml
Curcuma longa	15gm	100 ml	15gm	100 ml	15gm	100 ml

III. Results and discussion

The present study tested the antifungal activity of leaf extracts and their respective dilutions from plants extract belonging to eight plant families against *Ustilago tritici*. These plants extract were chosen based on either traditional usage (Table:1), suggestive of antimicrobial activity, or previous studies that have demonstrated antifungal properties using different kinds of extracts (Guo et al., 1997; Wilson et al., 1997; Zhu et al., 2005).

Table: 3 the seeds were treated with solvents 'Water' plant extracts at 5.0, 7.5, and 10% of solutions in respective plant extracts.

Leaf Extract of Plant	5.0% (Water)	7.5% (Water)	10.0 % (Water)	Average
Allium sativum	95	97	98	96.66
Datura stramonium	94	96	97	95.66
Azadirachta indica	95	98	96	96.33
Allium cepa var. aggregatum	97	96	99	97.33
Carica papaya	93	95	98	95.33
Zingiber officinal	92	94	96	94.00
Parthenium hysterophorvus	96	93	94	94.33
Curcuma longa	94	96	95	95.00
			Total Average	

Note – Number of seeds germination rate in table: 3

764.64/8 = 95.58 Seeds.

I have taken 100 seeds, the study were tested the antifungal activity of plant extracts and their effect of respective dilutions from plant extract with different plant extracts at 5.0, 7.5, and 10% of solutions in respective leaf extracts. I found different resulted.

Table: 4 the seeds were treated with solvents 'Acetone' at 5.0, 7.5, and 10% of solutions in respective plant extracts.

Leaf Extract of Plant	5.0 % (Acetone)	7.5%(Acetone)	10.0 % (Acetone)	Average
Allium sativum	92	94	93	93.00
Datura stramonium	94	93	95	94.00
Azadirachta indica	91	94	92	92.33
Allium cepa var. aggregatum	93	95	94	94.00
Carica papaya	93	92	94	93.00
Zingiber officinal	90	87	88	88.33
Parthenium hysterophorvus	92	93	94	93.00
Curcuma longa	89	90	91	90.00
			Total Average	

Note – Number of seeds germination rate in table:4

737.66/8 = 92.20 Seeds.

Table: 5 the seeds were treated with solvents 'Methanol' at 5.0, 7.5, and 10% of solutions in respective plant extracts.

Leaf Extract of Plant	5.0 %(Methanol)	7.5 % (Methanol)	10.0 % (Methanol)	Average
Allium sativum	93	95	94	94.00
Datura stramonium	95	94	96	95.00
Azadirachta indica	93	95	94	94.00
Allium cepa var. aggregatum	94	94	94	94.00
Carica papaya	93	94	95	94.00
Zingiber officinal	95	93	92	93.33
Parthenium hysterophorvus	95	94	96	95.00
Curcuma longa	92	93	92	92.33
			Total Average	

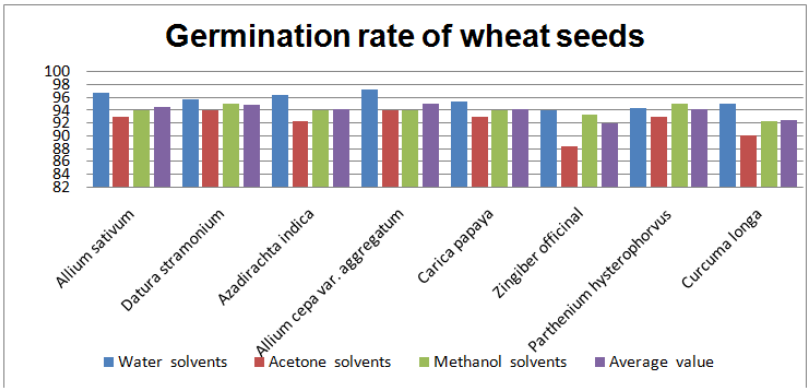
Note – Number of seeds germination rate in table:5

751.66/8 = 93.95 Seeds.

Table: 6 Germination rate of wheat seeds treated with different plant extracts of different solvents.

Plant extract	Water solvents	Acetone solvents	Methanol solvents	Average value
Allium sativum	96.66	93.00	94.00	94.55
Datura stramonium	95.66	94.00	95.00	94.88
Azadirachta indica	96.33	92.33	94.00	94.22
Allium cepa var. aggregatum	97.33	94.00	94.00	95.11
Carica papaya	95.33	93.00	94.00	94.11
Zingiber officinal	94.00	88.33	93.33	91.88
Parthenium hysterophorvus	94.33	93.00	95.00	94.11
Curcuma longa	95.00	90.00	92.33	92.44

Note – Number of seeds germination rate of average value with different plant extracts and different solvents in table 6.



Results on the effect of different plant and plant part extracts had significant effect on germination of wheat seeds in Table 3-5. Interaction of different plant parts at different dose level had significant effect on germination of wheat seeds and the highest germination seeds were recorded in leaf extracts. Among the solvents, the highest germination 95.58 per seeds (table 3) was found in wheat seeds treated with water extracts followed by methanol 93.95 per seeds (table 4) and acetone 92.20 per seeds (table 5) extracts. Number of seeds germination rate of average value with different plant extracts of different solvents in table 6. The interaction effects of different doses and different plant extracts showed that the average germination was the highest and the lowest dose level. Germination of wheat seeds decreases gradually with the increase of doses (Table 3-5).

Among the treated wheat seeds, the highest germination was found in *Allium cepa var. aggregatum* (Onion) treated wheat seeds and the lowest in *Zingiber officinal* (Ginger) treated wheat seeds. Number of seeds germination was always higher in wheat seed treated with leaf extract. There are solvent methanol extracts, the highest germination was observed in *Parthenium hysterophorvus* (Parthenium), and *Datura stramonium* (Datura) and the lowest in *Curcuma longa* (Turmeric). And number of seeds germination was higher in *Allium cepa var. aggregatum* (Onion) and *Datura stramonium* (Datura), the lowest germination was observed in *Zingiber officinal* (Ginger) to wheat seeds treated from acetone extract. Germination of wheat seeds decreased gradually with increase of doses. All the tested plants did not show any adverse effect on germination of seeds up to 8 days of treatments. The present findings are almost in agreement with those of Islam (2001); Khaire et al (1992), Gupta et al. (1988), where they reported that seeds treated with plant materials did not adversely affect the seed germination. Farmers may use these plant extracts in their storage structure for management of stored grain pests without any adverse effect on germination of treated seeds.

IV. Conclusions

The study has shown that 12 locally available indigenous plants namely. *Allium sativum* (Garlic), *Datura stramonium* (Datura), *Azadirachta indica* (Neem), *Allium cepa var. aggregatum* (Onion), *Carica papaya* (Papaya), *Zingiber officinal* (Ginger), *Parthenium hysterophorvus* (Parthenium), and *Curcuma longa* (Turmeric) are very effective in inhibiting the fungal growth of *Ustilago tritici*. Therefore, it may be concluded that plant extract can successfully be used for controlling seed borne fungal pathogens of wheat instead environment hazardous chemicals for treating seeds of wheat in India.

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