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HOT WATER THERMAL TREATMENT FOR CONTROLLING SEED-BORNE MYCOFLORA OF MAIZE

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ABSTRACTS

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An experiment was conducted to control seed-borne mycoflora of maize seeds using Barnali, Khai and Mohor variety. Efficacy of three different levels of hot water viz. 48^0C, 50^0C, 52^0C was evaluated against seven different fungi including three major pathogenic fungi- *Bipolaris maydis*, *Cuvularia lunata* and *Fusarium* . Seed treatment with hot water affects significantly to reduce seed-borne infection of maize. In an average of three varieties of maize, 60.47, 71.07 and 76.99 % reduction of total seed-borne infection occurred and 19.31, 29.37 and 4.01 % germination increased after the seed treatment with hot water of 48^0C, 50^0C and 52^0C respectively. Hot water treatment with 50^0C temperature for 15 minutes gave good result for controlling seed-borne fungi and maintaining better as well as safe germination of maize seeds.

Key words: Hot water treatment, seed-borne mycoflora, maize

INTRODUCTION

Maize is the third important cereal crop in the world as well as in Bangladesh, has a good potential, due to its low cost of production wide range of adaptability for both season cultivation and multipurpose use. The average yield of the crop in our country is lower in comparison with that of the world though its production area is increasing day by day. There are many causes of low maize yield of which diseases play a significant role. Moreover seed-borne diseases cause enormous losses both in storage as well as in the field. A total of 112 diseases are known to occur maize crops (USDA, 1960) and among them more than 70 are seed-borne. Important seed-borne diseases of maize are leaf spot, leaf blight, Collar rot, kernel rot, scutellum rot, seedling blight, anthracnose and head smut (Richardson, 1990). In Bangladesh Fakir (2001) listed 11 seed-borne diseases on the crop.

Seed health is a well recognized factor in the modern agricultural science for desired plant population and good harvest. Seed treatment by chemicals is the best way to keep good seed health condition. But chemicals cause health hazard and environment pollution (Chapman and Harris, 1981). In addition the seed treating chemicals are very expensive and are rot available to our resource poor farmers. Alternative means of seed treatment have drawn the attention of plant pathologist all over the world. In this context use of physical treatment i.e. solar heat hot water treatment, moisture control and seed treatment in vacuum may become an easy and less costly way in controlling seed-borne mycoflora. So, the study was taken to evaluate the effectiveness of hot water treatment for controlling seed-borne mycoflora of maize with maintaining better germination of maize.

MATERIALS AND METHODS

Collection of seed samples

Seed samples of 500gm of three maize varities viz Barnali Khai and Shuvra were collected from five shops of Local Market at Rangpur. After collection seeds were mixed together to make a composite sample. Then the seeds were kept for further studies in clothe bag and stored in refrigerator at Plant Pathology Division of Bangladesh Agricultural Research Institute, Gazipur. From the composite sample, working sample was done and when required.

Seed treatment with hot water

The hot water treatment of three varieties of seed was done with the help of vegetable seed treating device developed from IMP laboratory, Bangladesh Agricultural University, Mymensingh (Meah, 2004). At first seeds were soaked in normal water for 3-4 hrs. in a cotton fabric bag. Then 2 litters poured in the device below the red marking of the device. Six different level viz. 46 ^{0}c, 48 ^{0}c, 50 ^{0}c, 52 ^{0}c, 54 ^{0}c and 56 ^{0}c for were pre-studied for selecting the effective range of the seed treatment of maize using a composite sample of three varieties. From that trail three levels of hot water temperature were selected for the study on the basis of effective control of seed-borne pathogen as well as on higher and safe germination percentages. Two hundred seeds for each sample of Maize were treated with three different level of hot water treatment viz. 48 ^{0}c, 50 ^{0}c and 52 ^{0}c as physical control by hot water treating box for 10 minutes.

Seed incubation

The thermostat bulb was then regulated to fix the desired temperature. After the desired temperature obtained, the seeds were dipped in the water of the seed treating device for 15 min. Desired time was recorded through stopwatch. During the dipping the bag with the seeds was frequently stirred for uniform exposure of seeds to hot water and also to maintain uniform heat all over the tank. At the end of the treatment, seeds were taken out of the tank, drained off and spread on a piece of brown paper and shade dried. Then the seeds were plated for test. For testing, the seeds were plated by using Blotter technique following the ISTA rules (ISTA, 2001). Four hundred seeds were taken from working sample for each treatment. Hundred seeds were taken for each of four replications.

Detection of seed borne fungi

Treated seeds were taken randomly and placed on the moist filter paper in 10 replicated Petri dishes setting 10 seeds per plate. The seeds were then kept at 22 ±2ºC for seven days. After incubation the fungi grown on the seeds were identified under the stereo-microscope following the key of Mathur and Kongsdal (2003). The treated and untreated control seeds were analyzed for detection of seed-borne fungi. The means for all treatments were calculated and analyses of variance of all the characters were performed by Duncan's New Multiple Range Test.

RESULTS AND DISCUSSION

In the present study, effect of hot water treatment on the incidence of seed-borne fungi of maize was studied. Considering three varieties of maize, hot water affect significantly for controlling seed-borne infection compared to control. Seven different fungi were isolated from the study among them *Bpolaris maydis*, *Curunlaria lunata* and *Fusarium moniliforme* were pathogenic to the crop.

In Barnali variety, major pathogenic fungi *Bipolaris maydis*, *Curularia lunata* and *Fusarium moniliforme* including other storage fungi were significantly decreased over control after hot water treatment of three different levels. Lower fungi incidences of pathogenic fungi as well as storage fungi were observed in Barnali variety at 52^{o}C temperature level where as higher incidence at the control. In maximum cases of fungal incidences of results variety showed statistically similar at 50^{o}C and level of temperature.

In case of the variety Khai bhutta, highest incidences of pathogenic fungi like *Bipolaris maydis* (3%), *Curvularia lunata* (6.33%) and *Fusarium moniliforme* (10%) were observed at control. Lowest incidences of *Bipolaris maydis* (0%) *Curvularia lunata* (1%) and *Fusarium moniliforme* (4%) were found at 50^{o}C and 52^{o}C showed statistically similar effect on reducing the incidences of fungi viz. *Aspergillus niger, Bipolaris maydis*, *Curvularia lunata* and *Fusarium moniliforme*.

Similarly in Mohor variety the highest incidences of *Bipolaris maydis* (4.66%), *Curvularia lunata* (2.66%) and *Fusarium mniliformae* (13.33%) were found at control. Lowest incidences of the three pathogenic fungi were observed 52^{o}C temperature level of hot water. Fungal incidences of *Aspergillus niger*, *Bipolaris maydis*, *Curvularia lunata*, *Fursarium moniliforme* and *Penicillium* spp. gave statistically similar results after the seed treatment with hot water of 48^{o}C and 50^{o}C temperature. In maximum cases out of three level of hot water treatment, 52^{o}C level reduced more seed-borne infection compared to that of 48^{o}C and 50^{o}C as well as control (Table 1).

After treatment with hot water total fungal incidence counted from the seeds of three varieties of maize were lower compared to that of seeds in control. In case of Barnali variety, total seed-borne infection was highest (199.98) at control and lowest (40.99) at 52^{o}C temperature level. For germination percentage highest germination (71%) was observed and lowest (54.33%) at 52^{o}C. Germination failure was highest at 52^{o}C temperature level followed by control. In Khai Bhutta, total seed-borne infection was highest (96.67) at control and lower (25.67) at 52^{o}C hot water temperature. Highest germination (69.66%) and lowest germination failure were recorded at 48^{o}C followed by 50^{o}C and 52^{o}C. Total seed-borne infection was highest (125.00) at control followed by 48^{o}C, 50^{o}C and 52^{o}C of hot water treatment in Mohor variety. Statistically similar germination was observed at 48^{o}C and 52^{o}C temperature where as highest at 50^{o}C. Temperature level 48^{o}C, 52^{o}C and control gave lower germination compared to 50^{o}C level excepting khai variety (Table 2).

Considering three varieties of maize, on an average 60.47, 71.07 and 76.99 % reduction of total seed-borne infection occurred and 19.31, 29.37 and 4.01 % germination increased after the seed treatment with hot water of 48^{0}C, 50^{0}C and 52^{0}C respectively (Table 3).

Seed treatment with hot water reduced seed-borne pathogens viz. fungi, bacteria even viruses of different crops that was observed by many workers in home and abroad (Meah, 2004; Napoles *et al.,* 1991; Jindal *et al*., 1991; Nega *et al.,* 2003 and Muniz, 2001). These findings supported the present study. The possible phenomenon of decreasing the

seed-borne pathogen may be due to hot water treatment, firstly the temperature acted upon the fungal contaminants and with increasing the temperature it penetrated within the seed and killed pathogen embedded deeper and deeper in the seeds. Though hot water seed treatment reduced seed-borne infection in certain cases decreased germination percentages of the seeds. Similar results were also obtained from different crops by Winter *et al.* (1994) and Verzignasis *et al.* (1997). In the present study, considering both fungal incidence and germination parentages of the seeds 50^{o}C temperature was effective for controlling seed borne mycoflora of maize. This result closely agreed with the report of Nega *et al.* (2003), Muniz (2001), Suryanarayana *et al.* (1963) and Raychoudhuri (1967).

Table 1: Effect of different levels of hot water treatment on seed borne mycoflora of three varieties of maize

Teatment	*Aspergillus flavus*	*Aspergillus niger*	*Bipolaris maydis*	*Curvularia lunata*	*Rhizopus stolonifer*	*Fusarium miniliformae*	*Penicillium* spp.
Barnali							
48 ^{0}c	14.67b (3.89) *	5.67b (2.48)	1.67b (1.46)	1.33b (1.29)	11.67b (3.48)	8.33a (2.95)	14.33c (3.85)
50 ^{0}c	12.00b (3.53)	4.33b (2.19)	0.33c (0.88)	0.33b (0.88)	8.66b (3.03)	7.33ab (2.78)	8.33d (2.97)
52 ^{0}c	3.67c (2.02)	4.33b (2.16)	0.00c (0.71)	0.00b (0.71)	8.67b (3.03)	4.00b (2.08)	20.00b (4.52)
Control	46.33a (6.84)	57.00a (7.58)	5.00a (2.34)	4.33a (2.19)	36.00a (6.04)	11.67a (3.48)	39.67a (6.33)
Khai							
48 ^{0}c	15.66b (4.02)	7.66b (2.86)	0.33b (1.17)	5.00ab (2.08)	5.33b (2.40)	6.66b (2.67)	12.66b (3.63)
50 ^{0}c	13.00c (3.67)	4.66c (2.27)	0.00b (0.71)	1.33b (1.18)	1.66c (1.46)	4.00c (2.13)	8.66b (3.00)
52 ^{0}c	10.66d (3.13)	4.00c (2.11)	0.33b (0.88)	1.00b (1.17)	0.33d (0.88)	4.33bc (2.18)	4.33c (2.16)
Control	35.66a (6.01)	52.00a (7.24)	3.00a (1.86)	6.33a (2.61)	29.00a (3.43)	10.00a (3.23)	33.33a (5.81)
Mohor							
48 ^{0}c	18.00b (4.29)	4.00b (2.13)	1.66b (1.39)	0.33a (0.88)	3.00c (1.47)	11.33a (3.43)	17.33ab (4.22)
50 ^{0}c	13.00c (3.66)	3.33bc (1.88)	0.00b (0.71)	0.00a (0.71)	8.33b (2.94)	10.66a (3.32)	15.00bc (3.92)
52 ^{0}c	11.00c (3.28)	1.00c (1.17)	0.00b (0.71)	0.00a (0.71)	1.00c (1.09)	6.33b (2.61)	11.00c (3.38)
Control	27.33a (5.27)	31.00a (5.61)	4.66a (2.24)	2.66a (1.61)	22.66a (4.81)	13.33a (3.72)	23.33a (4.88)

*Figure in the parenthesis represents square root transformed value

Table 2. Total seed borne infection and percent seed germination of three varieties of maize after different level of hot water treatment

Treatment	Total seed-borne infection	Germination (%)	Seeds failed to germinate
Barnali			
48 ^{0}c	57.67b	64.33b	35.67
50 ^{0}c	41.32c	71.00a	29.00
52 ^{0}c	40.99c	54.33d	45.67
Control	199.98a	60.00c	40.00
Khai			
48 ^{0}c	53.34b	69.66a	30.34
50 ^{0}c	30.34c	60.66b	39.34
52 ^{0}c	25.67d	54.66c	45.34
Control	96.67a	54.00c	46.00
Mohor			
48 ^{0}c	55.65b	63.67b	36.33
50 ^{0}c	50.33b	82.67a	17.33
52 ^{0}c	30.33c	63.33b	36.67
Control	125.00a	51.67c	48.33
Average of three varieties of maize			
48 ^{0}c	55.55	65.89	34.11
50 ^{0}c	40.66	71.44	28.56
52 ^{0}c	32.33	57.44	42.56
Control	140.55	55.22	44.78

Table 3. Percent reduction of total seed-borne infection and Percent increase of seed germination over control in an average of three maize varieties after the seed treated with different level of hot water.

Treatment	Percent reduction of total seed-borne infection	Percent increase of seed germination
48 ^{0}c	60.47	19.31
50 ^{0}c	71.07	29.37
52 ^{0}c	76.99	4.01
Control	-	-

From the above study it has been observed that seeds treated hot water of 50^{o}C gave good results for controlling seed borne fungal infections and germination of the seeds. So 50^{o}C temperature of hot water may be used effectively for controlling of the seed-borne pathogens and for maintaining rational germination percentage of maize seeds.

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