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Full Length Research Paper

Determination of effective dose of garlic for controlling seedborne fungal disease of tomato

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Tomato seeds collected from farmer's were treated with garlic tablet at concentration 1:3 w/v, 1:4 w/v, 1:5 w/v and 1:6 w/v for controlling seedborne fungal diseases. Seed health status of treated seeds was evaluated following blotter incubation method. Three different fungal pathogens viz., *Aspergillus* spp., *Fusarium* spp. and *Penicillium* spp. were identified from seed samples by blotter incubation method. Garlic tablet at 1:3 w/v dose showed better performance in increasing seed germination and reducing prevalance of fungal pathogens over control treatment. The highest germination recorded was 71.25% at 1:3 w/v dose of garlic tablet which represents an increase of 11.25% over control. Germination percentage was increased 18.75% over control when treated seeds were sown in tray soil. Substantial importance in seed quality was noticed in reducing hard seed, damping off, blighted seedlings and tip over. In pot experiment, 1:3 w/v dose also performed best to yield the lowest percentage of hard seed, damping off, blighted seedlings, tip over and seedlings with highest seed germination.

Key words: Garlic, tomato, seed treatment, germination, seedborne pathogens, *Aspergillus*, *Fusarium*, *Penicillium*.

INTRODUCTION

Tomato *(Lycopersicon esculentum,* Mill) a member of the family Solanaceae, is the most important and popular vegetable in the world because of its taste and high nutritive value and also for its diversified use (Bose et al., 1986). It is widely grown in almost all countries of the world due to its adaptability to a wide range of soils and climate (Ahmad, 1976). The yield of the crop is very low in Bangladesh compared to those of other countries. Recent statistics show that in Bangladesh tomato was grown in 15,789 ha of land and the production was approximately 102,000 metric tons in 2002 to 2003, the average yield was 4.4 tons/ha compared to 6.67 ton/ha in India, 16.657 tons/ha in China, 20.00 ton/ha in Egypt, 60.00 ton/ha in Japan, and 14.54 ton/ha in USA (FAO, 2003). Now-a-days, the average yield of tomato is 2.8 tons per acre (Monthly Statistical Bulletin, 2006).

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Diseases of tomato are among the main factors limiting its production. Over 200 diseases have been reported to affect the tomato plants in the world (Watterson, 1986). Among them the seedborne pathogens play a vital role in disease development (Fakir and Khan, 1992). Six seed-borne fungal diseases of tomato viz. early blight (*Alternaria solani*), germination reduction (*Aspergillus flavus*, *Penicillium* spp.), seed discoloration (*A. fumigatus*), Fusarium wilt (*Fusarium oxisporum*), and late blight (*Phytophthora infestans*) have been detected in Bangladesh (Fakir, 2001).

Seedborne diseases create a great loss to the production of crops in Bangladesh. In order to reduce the loss, farmers use to treat seeds with chemicals. Chemicals are quite effective in reducing seedborne infection. Indiscriminate use of chemicals for controlling diseases of crop plants resulted environmental pollution, health hazards etc., all over the world. Moreover, the costly chemicals are being imported from overseas and farmers have to purchase with high price. As an alternate means of avoiding these problems, use of organic/plant

extract as control agents is now being considered in many developed countries for combating the disease with the aim of increasing food production. Effective and efficient use of garlic tablet can control seed-borne disease and subsequently crop yield can be increased using healthy seeds and seedlings. Incorporating garlic tablets in the existing IPM system of Bangladesh can save huge foreign currency and reduce pollution of the environment. Moreover, garlic tablets are easily available and low cost compare to chemical fungicides. Garlic tablet have been formulated in the IPM laboratory of Department of Plant Pathology and found effective against various diseases and pathogens. The present research was undertaken to achieve the following objectives:

1. To identify the fungal pathogens associated with tomato seeds.
2. To determine the effective dose of garlic tablet against seed germination and seedborne fungal pathogens of tomato.

MATERIALS AND METHODS

The experiments (in Laboratory and pot) were conducted between July, 2005 to September, 2006 in the Integrated Pest Management (IPM) laboratory and in the net house of the Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh. Seed samples of tomato were collected from local market of Mymensingh. Four hundred seeds of tomato were randomly taken from seed sample for each treatment so that maximum incidence of seed-borne infection may be available. To prepare 1:3 solution, one part tablet (ground and powdered) was added into three parts distilled water (weight/volume). Prepared suspensions were used instantly. In the same way, 1:4 w/v, 1:5 w/v and 1:6 w/v suspensions were prepared. Four hundred seeds were treated in each dilution of garlic tablets for fifteen minutes. In case of control treatment seeds were soaked in distilled water and no tablets were used to know the actual status of the pathogen.

Plating the treated seeds

After washing the plastic petridish, surface sterilization was done by 70% alcohol and allowed to open for sometimes for volatilization. Two filter papers soaked in sterile water were set at the bottom of the petridish. Then, twenty five seeds were plated in each petridish. For one treatment sixteen petridishes were required. Each petridish with the seeds was considered as a replicate. The petridishes were incubated at room temperature (25±2°C) for one week. After one week of incubation period, percentage of germination, abnormal germination, hard seeds, rotten seeds and infected seeds were recorded from each petridish.

Net house experiment

The doses of garlic tablet which showed the best performance were further investigated through pot experiment in the net house. For both 1:3 w/v dose and control treatment, eight hundred seeds were sown in surface sterilized tray filled up with sterilized soil. One hundred seeds per tray were sown for treated and untreated conditions. Observations were made for seed germination and other parameters.

Collected data were analyzed using ANOVA following completely randomized design (CRD) using MSTAT-C computer program. Differences in means of different treatments were evaluated for significance following Duncan's Multiple Range Test (Gomez and Gomez, 1984).

RESULTS

Fresh garlic tablets were used in the present study to find out the effect on different parameters of seed quality, both in the blotter and in the pot experiment. The seed quality investigated were seed germination, abnormal seed germination, rotten seeds, hard seeds, seed infection and seedling diseases, such as damping off and tip over were recorded.

Effect of garlic tablet treatment on seed germination and other parameters seed germination

Germination percentage at different doses varied significantly. All doses of garlic tablet increased germination over control. The highest (80.0%) germination percentage was recorded at 1:3 w/v doses which were 18.0% higher than control. Statistically similar germination percentage was recorded at 1:4 (75%) and 1:5 (73%) w/v dose of garlic tablets. The lowest (68.0%) germination percentage was recorded in the control (Table 1).

Abnormal seed germination

Statistically significant abnormal seed germination was recorded in different treatments. Abnormal seed germination recorded the lowest (6.0%) in 1:3 w/v doses and highest abnormal seed germination (15.0%) was recorded in 1:6 w/v dose and control. All doses of garlic tablet decrease abnormal seed germination. At 1:3 w/v dose 60.0% lower abnormal seed germination was recorded (Table 1).

Dead seed

Significantly different hard seeds were recorded in different doses of garlic tablets. Highest (33.0%) percentage of hard seeds was found in the 1:6 w/v doses and in the control (32.0%). The lowest (20.0%) hard seeds were found at 1:3 w/v dose of garlic tablet. At 1:3 w/v dose 38.0% lower hard seeds were found compared to the control (Table 1).

Rotten seed

Percentage of rotten seeds was recorded highest (32.0%) in the control and lowest (2.0%) at 1:3 w/v

Table 1. Effect of different doses of garlic tablet on the quality of cucumber seeds.

Treatment	%Germinated seed	%Abnormal Germinated seed	%Dead seed	%Rotten seed	%Infected seed
1:3	80.0 a	6.0 d	20.0 d	2.0 e	5.0 e
1:4	75.0 b	8.0 c	25.0 c	7.0 d	10.0 d
1:5	73.0 b	14.0 b	27.0 b	11.0 c	29.0 c
1:6	67.0 c	15.0 a	33.0 a	22.0 b	47.0 b
Control	68.0 c	15.0 a	32.0 a	32.0 a	73.0 a
LSD (P≥0.05)	1.63	0.4	0.53	1.09	2.56
CV (%)	5.71	11.44	8.62	8.01	15.65

Figures in a column with common letter (s) do not differ significantly at P ≥ 0.05. Data were analyzed after transformation.

Table 2. Effect of different doses of garlic in controlling the seed-borne fungi.

Treatment	% Seed-borne infection					
	***Aspergillus* spp.**	**Decreased over control**	***Fusarium* spp.**	**Decreased over control**	***Penicillium* sp.**	**Decreased over control**
1:3	3.0 c	90.7	2.0 c	89.7	1.25 c	84.5
1:4	4.0 c	87.7	2.5 c	87.2	1.25 c	87.5
1:5	17.5 b	46.2	10.25 b	47.4	7.5 b	25.0
1:6	30.5 a	6.2	18.75 a	3.8	8.75 ab	12.5
control	32.5 a	-	19.5 a	-	10 a	-
LSD (P≥0.05)	2.71		2.81		2.48	
CV	17.18		13.28		17.85	

Values within the same common with a common letter (s) do not differ significantly (P = 0.05). Data were analyzed after transformation.

doses. Lower rotten seeds (7.0%) were also observed at 1:4 w/v doses. Compared to control treatment 94.0% lower rotten seeds were recorded at 1:3 w/v dose (Table 1).

Seed infection

Highest percentage of seed infection was recorded (62.0%) among control seeds. Seed infection was obtained lowest (5.0 %) in 1:3 w/v doses. The percentage of seed infection increased with the decrease of the garlic tablet concentration. At 1:3 w/v dose 93.0% lower seed infection were observed over control (Table 1).

Effect of garlic tablet on the prevalence of seed-borne fungi

Aspergillus spp.

Prevalence of *Aspergillus* spp. was significantly different in different treatments. The lowest seed infection (3.0%) was recorded at 1:3 w/v doses statistically similar seed infection was found at 1:4 w/v doses (4.0%). The highest seed infection (32.5%) was recorded in the control. Percentage of seed infection observed at 1:6 w/v doses was statistically similar to that of the control. Prevalence of *Aspergillus* increased with the increase of dilution. At 1:3 w/v doses, 90.7% reduction of *Aspergillus* spp. was observed over control. 87.7% reduction of *Aspergillus* spp. was also observed at 1:4 w/v dose (Table 2).

Fusarium spp.

In the case of *Fusarium* spp., lowest seed infection (2.0%) was recorded at 1:3 w/v dose followed by 1:4 w/v dose (2.5%). The highest prevalence (19.5%) was recorded in the control, while similar prevalence (18.75%) was also recorded at 1:6 w/v dose (Table 2).

Penicillium sp.

Prevalence of *Penicillium* sp. was significantly different among the treatments. The highest percentage of prevalence was observed in the control (10.0%). The lowest (1.25%) prevalence was observed at 1:3 w/v and 1:4 w/v doses. The prevalence was recorded 87.5% at

Table 3. Comparative performance of garlic (1:3 w/v doses) and control in tray soil.

Treatment	Seed germination (%)	Abnormal seed germination (%)	Hard seed (%)	Rotten seed %	Damping off (%)	Seedling blight (%)	Tip over (%)
1:3	71.25	3	28.75	13.25	1.25	1.0	0.75
Control	60.0	9.0	40.0	9.0	17.0	8.0	5.25
LSD (P≥0.05)	2.26	1.16	2.26	0.88	2.98	1.41	0.96
CV (%)	3.56	13.61	6.80	9.53	7.42	15.95	16.15

Values within the same common with a common letter (s) do not differ significantly (P=0.05). Data were analyzed after transformation.

1:3 w/v dose compared to control treatment (Table 2). Among three different fungi associated with tomato seeds, prevalence of *Aspergillus* spp. was higher followed by *Fusarium* sp. and *Penicillium* sp.

Net house experiment

In the net house, an experiment was conducted with the treatment that showed the best seed quality results in blotter incubation test. In general, seeds treated with 1:3 w/v dose garlic tablets gave luxuriant growth of seedlings in tray soil whereas in the control poor growth of seedling was observed.

In tray soil seed germination was recorded 71.25% at 1:3 w/v doses which was 18.75% over control and 60.0% at control treatment (Table 3). At 1:3 w/v dose, percentage of hard seed, damping off, seedling blight and tip over were significantly different from the control and they were 28.75, 1.25, 1.0 and 0.75 respectively (Table 3). On the other hand percentage of hard seed, damping off, seedling blight and tip over were 40.0, 17.0, 8.0 and 5.25 respectively in control treatment (Table 3).

Hard seed percentage was significantly lower in 1:3 w/v doses. 28.13% less hard seeds were observed in the tray experiment. Seed treatment with 1:3 w/v doses of garlic tablet showed significant influence on damping off disease in tray experiment. Percentage of damping off diseases were recorded 1.25% in 1:3 w/v dose of garlic tablet which was 92.64% lower than control treatment.

Percentage of seedling blight was recorded 1.0% in 1:3 dose of garlic tablet. It was estimated that 87.5% lower seedling blight was observed in treated seed over control treatment.

Tip over affected plants were recorded 0.75% in treated seeds which was significantly different from untreated control. 85.71% lower tip over affected seedlings was observed in treated seeds over control (Table 3).

DISCUSSION

The experiment was conducted to determine the effective dose of garlic tablet against seedborne fungi associated with tomato seeds. To achieve this objective, garlic tablet of different concentrations were applied to tomato seeds collected from local market. In the experiment with tomato seeds it was found that percentage of seed germination was highest in seeds treated with garlic tablet at 1:3 w/v doses both in the blotter and in the pot experiment. Garlic tablet at 1:3 w/v dose reduced damping off, Seedling blight and tip over very significantly. Garlic tablet at 1:3 concentrations also enhanced seed germination over control treatment. The findings are in agreement with Awal (2005) where 30 days old garlic tablet showed similar effect at 1:3 w/v doses on seed germination and vigor index. Khan and Kumar (1992) also found that garlic extract inhibited spore germination of *Bipolaris sorokiniana* at concentration 1:3. Kuprashvile (1996) reported that extracts of garlic disinfected the seeds of Capsicum, Aubergine, Tomato, Cabbage, Carrot and Onion by *Peronospora destructor, Phomopsis vexans, Fusarium oxysporum*. The result showed that the plant extracts disinfected seeds. Alice and Rao (1987) also observed that seeds treated with garlic extract produced seedlings of higher shoots and roots than those of the untreated Checks. All these findings are limitedly in agreement with only concentration of extracts of garlic. Seed infection also decreased significantly at different concentration of solution especially 1:3 w/v doses. The findings are in agreement with Hawlader (2003) who reported that garlic bulb extract (1:1 w/v dose) effectively increased germination of egg plant seeds and significantly reduced damping off, seedling blight and tip over. In the net house experiment it was found that garlic tablet at 1:3 w/v dose showed significant improvement in seed germination. Seed infection, damping off, tip over and seedling blight decreased significantly in comparison with control seeds. Arun et al. (1995) reported that the extract of garlic bulbs was effective in suppressing redial growth of *Fusarium* and *Sclerotium* and was more effective when added after sterilization.

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