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Effect of Soil and Seed Treatments on Seedling Diseases of Wheat

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Abstract

The experiment was conducted at Plant Pathology Field, Bangladesh Agricultural Research Institute (BARI), Gazipur-1701 during the cropping season 2014-17. The effectiveness of different methods of seed and soil treatments were evaluated against seedling diseases of wheat under inoculated condition in the field. The lowest percentage of diseased seedlings, highest number of grain/head as well as the highest yield 4.0, 4.5 and 5.0%; 42, 40 and 39, and 3767, 3765 and 3764 kg/ha, respectively were obtained with seed treatment + soil drenching with Vitavax-200 followed by seed treatment + soil drenching with Bavistin in three consecutive years. The highest percentage of diseased seedlings, lowest number of grain/head as well as the lowest yield 12.2, 12.7 and 13.2%; 31, 29 and 28; and 2754, 2752 and 2751 kg/ha, respectively were obtained from the same treatment. The lowest number of grain/head, lowest yield with the highest percentage of diseased seedlings was recorded from the control treatment in all three cropping seasons.

Keywords: *Soil treatment, seed treatment, seedling disease, wheat, Bangladesh*

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1. INTRODUCTION

Wheat (*Triticum aestivum*) is the second most important staple food crop in Bangladesh. It suffers from a number of seed and soil borne diseases from seedling to ripening stage of the crop. Among the different seedling diseases, foot and root rot caused by, *Sclerotium rolfsii*, *Bipolaris sorokiniana* and *Fusarium oxysporum* and leaf blight caused by *Bipolaris sorokiniana* and *Alternaria triticini* are important.

Seedling diseases such as foot and root rot and seedling blight that attacks at seedling stages of wheat directly reduced plant population as well as yield of wheat. Chattopadhaya (1953) reported that within 15 days of germination in inoculated soil, seedling became infected and died gradually, there being some 50-60% death after 3 weeks. Tinline and Ledingham (1979) reported yield reduction of 2.5-5.6% depending on the cultivar, and Sallans (1948) estimated that common root rot can decrease yield as much as 17.8%. Hermann and Weise (1985) estimated 50% yield reduction of wheat due to foot and root rot. Goel *et al.* (2006) reported that due to the attack of spot blotch (*Bipolaris sorokiniana*) the grain yield loss ranged from 7.07 to 36.66%, while reduction in 1000-grain weight ranged from 7.07 to 43.65%. Ahmed and Meisner (1996) reported that soil – borne pathogens reduced the yield 8-16%. Both seed and soil-borne pathogens are responsible for seedling diseases of wheat (Cattopadhaya 1953, Mishra and Sinha1963 and Parashar and Chohan 1967). Saari (1985) reported that specialized pathogens are suppressed by flooding, rotation and certain tillage operations. Several scientists of the world worked on the effect of soil moisture (Khandar and Bhowmik 1995, Reddy and Patil Kulkarni 1972) and chemical fertilizer (Subrahmanyam and Tyagi 1968) on the occurrence of seedling diseases of wheat. Among the management practices, development of resistant/tolerant germplasm is an effective, durable and eco-friendly method for combating seedling diseases. Molan *et al*. (2001), Harlapur *et al.* (1993), Mishra *et al* (1992), Karaw and Singh (1975) and Agrawal and Singh (1969) worked on the development of resistant/tolerant germplasm against seedling diseases of wheat. Besides this a group of scientists used seed treating fungicides against seed and soil-borne diseases of wheat (Sawinska and Maecka 2007, Sarma *et al*. 2005, Kubiak 2004, Enikuomein *et al* 2002 and Neilson 2000). Comprehensive reports on the causes of reduction in plant populations of wheat due to seedling mortality are not available in Bangladesh. To maintain standard seedling

population with a view to increase plant stand and yield of wheat it is necessary to find out causes of seedling mortality under agro-ecological conditions of Bangladesh and attempt should be made to develop effective management practices against the diseases. The present study was undertaken to find out an effective method of seedling disease management of wheat.

2. MATERIALS AND METHODS

The experiment was conducted at Plant Pathology Field, Bangladesh Agricultural Research Institute (BARI), Gazipur-1701 during the cropping season 2014-17 with one wheat variety Kanchan. The soil of the experiment plot was well prepared with a tractor disc plough, rotavator and harrow. The land was levelled properly after final harrowing. The soil was mixed with well decomposed cowdung (10 t/ha) before 20 days of sowing. Urea, TSP, MP and gypsum were applied at the rate of 220-132-68-125 kg/ha (Ahmed and Meisner, 1996). Two third of urea and full doses of TSP, MP and gypsum were applied during final land preparation. The rest one-third of urea was top dressed at crown root initiation (CRI) stage.

Seven days before sowing the soil was artificially inoculated with the mixed inocula of *S. Rolfsii*, *Bipolaris sorokiniana* and *F. oxysporum*. Inocula of *S. Rolfsii*, *Bipolaris sorokiniana* and *F. oxysporum* were prepared on barley grains. The barley grains were soaked in water for 24 hours, excess water was decanted from the grains and poured into 500 ml conical flasks (about half of the flask). The mouth of conical flask was wrapped with aluminium foil and autoclaved for sterilization at 121^0C for 15 minutes under 0.7kg/cm^2 pressure. After proper cooling the sterilized barley grains were inoculated with 10 mycelial blocks (5 mm diameter) cut from 5 days old PDA culture in petridishes. The inoculated flasks were incubated at 28 plus minus 2^0 C for 3 weeks for growth of the fungus. For uniform colonization, the flasks were shaken with and every alternate day. The colonized barley grains were air dried on paper trays at room temperature (28 plus minus 2^0 C) and stored at 4^0C in a refrigerator.

The experiment was laid out with RCB design wit 4 replications. Nine different treatments were used in the trial which were T_1= Seed treatment with Vitavax-200, T_2= Seed treatment with Bavistin. T_3= Soil drenching with Vitavax, T_4= Soil drenching with Bavistin, T_5= Seed solarization, T_6= Hot water seed treatment, T_7= Seed treatment + soil drenching with Vitavax, T_8= Seed treatment + soil drenching with Bavistin and T_9 = Control (Untreated).

Seeds were sown in the unit plot maintaining line to line spacing of 20 cm. Intercultural operations were done as and when necessary. Untreated and fungicidal treated (Vitavax-200, 3g /kg) seeds of one wheat variety namely Kanchan was used in the experiment.

After emergence, the number of healthy and diseased seedlings/m^2 were recorded from each plot at an interval of 3 days and continued for 30 days. The severity of diseased was expressed in percentage based on total number of seedlings. The length of shoot and root of seedlings were recorded at 3 leaf stage. The plant population/m^2 were also recorded. Yield (kg/ha) and 1000-grain weight were recorded after harvest. The recorded data were analyzed statistically to find out the level of significance and the variance was analyzed following Duncans New Multiple Range Test(DMRT).

3. RESULTS AND DISCUSSION

Results revealed that plant population/m^2 and incidence of diseased seedling (%) were influenced significantly by 8 different methods of seed and soil treatments (Table 1). The highest plant population/m^2 was recorded (282, 280 and 279) from the treatment T_8 where seeds were treated with Bavistin and soil drenching with the same chemical before sowing in the consecutive three years. Second highest plant population/m^2 was recorded (268, 266 and 265) from the treatment T_7 where seeds were treated with Vitavax-200 and soil drenched with the same chemical in the all three cropping seasons. But the lowest plant population/m^2 was recorded (154, 152 and 151) from the control treatment (T_9) during three cropping seasons. The lowest percentage of disease seedlings was recorded (4, 4.5 and 5) from the treatment T_7 followed by T_8 and T_1 in three consecutive years and they were statistically similar (Table 1, 2 and 3). Diseased seedlings were recorded as 6.0, 6.5 and 7%, and 6.5, 7.0 and 7.5%, respectively, from the treatment T_6 (hot water treatment) and T_2 (seed treatment with Bavistin) and they were also statistically similar in 2014-15, 2015-16 and 2016-17 cropping seasons (Table 1, 2 and 3). The highest percentage of diseased seedling was recorded (12.2, 12.7 and 13.2 %) from the control treatment (T_9 (Table 1, 2 and 3)). Shoot and root growth were influenced significantly by 8 different methods of seed and soil treatments in all the three cropping season. The highest length of shoot and root were recorded from the treatment T_7 followed by T_1, while the lowest length of them were recorded from the control treatment (T_9) (Table 1, 2 and 3). Grain yield (kg/ha) and number of grain/head were also influenced significantly by 8 different methods of seed and soil treatments. The highest yield was obtained (3767, 3765 and 3764 kg/ha) from the treatment T_7 followed by T_8 (Table 1, 2 and 3). Yield were recorded as 3562, 3560 and 3559 kg/ha , and 3374, 3372 and 3371 kg/ha, respectively form the treatment T_1 and T_3.

The lowest yield was recorded from the control treatment (T_9). The highest and lowest number of grain/head was recorded from the treatment T_7 and T_9 (Control), respectively (Table 1, 2 and 3).

Table 1. Effect of seed and soil treatments on diseased seedlings (%), yield and yield contributing characters of wheat during 2014-15

Treatment	Plant Population/m^2	Diseased seedlings (%)	Shoot length (cm)	Root length (cm)	Grain/head (no)	1000 G.W (g)	Yield (kg/a)
T_1	241 bc	5.5 def	20.5 ab	15.2 ab	40 ab	43.0 a	3562 c
T_2	198 de	6.5 cde	19.5 abc	13.5 abc	34 cde	45.5 a	3045 g
T_3	228 c	8.0 bc	16.4 cd	10.7 cde	39 abc	44.0 a	3374 d
T_4	215 cd	9.0 b	15.7 cd	9.5 de	35 b-e	42.0 a	3182 f
T_5	256 ab	7.0 cd	17.1 bcd	12.2 bcd	37 a-d	41.0 a	3276 e
T_6	177 ef	6.0 de	18.2 abc	13.0 a-d	33 de	40.0 a	2978 h
T_7	268 ab	4.0 f	21.2 a	16.5 a	42 a	46.0 a	3767 a
T_8	282 a	4.7 f	19.2 abc	14.5 ab	41 a	47.0 a	3671 b
T_9	154 f	12.2 a	14.1d	8.5 e	31 e	39.0 a	2754 i
LSD (0.05)	27.39	1.82	3.79	3.63	5.40	ns	39.47

Table 2. Effect of seed and soil treatments on diseased seedlings (%), yield and yield contributing characters of wheat during 2015-16

Treatment	Plant Population/m^2	Diseased seedlings (%)	Shoot length (cm)	Root length (cm)	Grain/head (no)	1000 G.W (g)	Yield (kg/a)
T_1	239 bc	6.0 def	20.3 ab	15.0 ab	38 ab	41.0 a	3560 c
T_2	196 de	7.0 cde	19.5 abc	13.3 abc	32 cde	43.5 a	3043 g
T_3	226 c	8.5 bc	16.2 cd	10.5 cde	37abc	42.0 a	3372 d
T_4	213 cd	9.5 b	15.5 cd	9.3 de	33 b-e	40.0 a	3180 f
T_5	254 ab	7.5 cd	16.9 bcd	12.0 bcd	35 a-d	39.0 a	3274 e
T_6	175 ef	6.5 de	18.0 abc	12.8 a-d	31 de	38.0 a	2976 h
T_7	266 ab	4.5 f	21.0 a	16.3 a	40 a	44.0 a	3765 a
T_8	280 a	5.2 f	19.0 abc	14.3 ab	39 a	45.0 a	3669 b
T_9	152 f	12.7 a	13.9d	8.3 e	29 e	37.0 a	2752 i
LSD (0.05)	27.14	1.94	3.68	3.58	5.32	ns	39.13

Table 3. Effect of seed and soil treatments on diseased seedlings (%), yield and yield contributing characters of wheat during 2016-17

Treatment	Plant Population/m^2	Diseased seedlings (%)	Shoot length (cm)	Root length (cm)	Grain/head (no)	1000 G.W (g)	Yield (kg/a)
T_1	238 bc	6.5 def	20.1 ab	14.8 ab	37 ab	40.0 a	3559 c
T_2	195 de	7.5 cde	19.1 abc	13.1 abc	31 cde	42.5 a	3042 g
T_3	225 c	9.0 bc	16.0 cd	10.3 cde	36 abc	41.0 a	3371 d
T_4	212 cd	10.0 b	15.3 cd	9.1 de	32 b-e	39.0 a	3179 f
T_5	253 ab	8.0 cd	16.7 bcd	11.8 bcd	34 a-d	38.0 a	3273 e
T_6	174 ef	7.0 de	17.8 abc	12.6 a-d	30 de	37.0 a	2975 h
T_7	265 ab	5.0 f	20.8 a	16.1 a	39 a	43.0 a	3764 a
T_8	279 a	5.7 f	18.8 abc	14.1 ab	38 a	44.0 a	3668 b
T_9	151 f	13.2 a	13.7d	8.1 e	28 e	36.0 a	2751 i
LSD (0.05)	26.29	2.10	3.45	3.30	4.96	ns	39.10

A field experiment was conducted to find out the effect of six seed and soil – borne fungal pathogens causing seedling diseases of wheat. Seven days before seed sowing the soil was artificially inoculated with the mixed inocula of *S. rolfsii*, *B. sorokiniana* and *F. oxysporum*. For foliar infection, the inoculums suspension of *B. sorokiniana* was sprayed on wheat seedlings at 10 days after emergence. The varieties of wheat namely Kanchan was included in the study. Vitavax-200 and Bavistin were used as seed and soil treating fungicide. The seeds of Kancan variety were treated with Vitavax-200 and Bavistin at the rate of 3g /kg of seeds before sowing. Results of the present study indicated that the highest plant population was recorded from the plots where seed and soil were treated with seed treatment + soil drenching with Vitavax before sowing. Pre-sowing seed and soil with seed treatment + soil drenching with Vitavax reduced the incidence of seed and soil borne diseases resulting maximum plant population. This is in conformity with the findings of Bakr (2007), Neilson (2000) and Gongalez and Trevatan (2000). According to Bakr (2007) seed treatment with fungicide gave significantly higher emergence as compared to control (untreated) and the highest plant population was recorded from the Vitavx treated seeds.

Results also showed that the maximum of 12.2, 12.7 and 13 % diseased seedling was recorded under control (untreated) treatment, while the minimum of 4.0, 4.5 and 5.0 % diseased seedling was achieved with seed treatment + soil drenching with Vitavax followed by seed treatment with Bavistin , and Seed treatment + soil drenching with Bavistin. This is in line with the findings of Kilpatric and Merkle (1967) and Bakr (2007). Kilpatric and Merkle (1967) observed that seed treatment improved emergence and offered greater protection from post emergence killing.

The effects of seed and soil treatments on the incidence of seedling mortality and yield of wheat were assessed by the scientist of BARI during 2011-12, 2012-13 and 2013-14. It was observed that different methods of seed and soil treatments was performed better in reducing seedling mortality, increasing plant growth as well as yield of wheat over control treatment. The results revealed that seed and soil treatments had a significant influence on the incidence of seedling diseases of wheat. It might be inferred that the disease incidence might be minimized by sowing wheat seeds with soil and seed treatment (BARI, 2013, BARI, 2014 and BARI, 2015). It might be due to the effect of active ingredients of the seed and soil treating chemicals.

Results of three years' study indicated that plant population/m^2 was well as yield as of all the treatments was increased where seed and soil were treated with Vitavax-200 and Bavistin. Grain yield ranged 2754 - 3767kg/ha, 2769 – 3765kg/ha and 2751- 3764 kg/ha, respectively in 1st, 2nd and 3nd year. The yield is significantly lower in case of untreated seed and soil as compared to treated seed and soil which is corroborates with results of BARI, 2013, BARI, 2014 and BARI, 2015

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