MANAGEMENT OF DAMPING-OFF DISEASE IN BOTTLE GOURD SEEDLINGS UNDER FLOATING AGRICULTURE

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ABSTRACT

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Damping-off caused by common fungi *Pythium* spp., *Fusarium* spp., *Sclerotium rolfsii, Phytophthora sp.* and *Rhizoctonia solani,* etc. is the most prevalent disease in Bangladesh. Four available commercial fungicides viz. Ridomil gold MZ 68 WG (Mancozeb + Metalexyl) @ 0.2%, Topzim super 75 WDG (Imidachloropid + Thiram +Carbendazim) @ 0.1%, Timseen Tm (n –alkyl dimethyl benzyl) @ 0.1%, Provax-200 (Carboxin + Thiram) @ 0.2% were evaluated in ten different combinations, as seed treatment and tema/ball soaking to control damping-off disease and to increase percent emergence, seedling vigor during 2016-17 and 2017-18 cropping seasons at floating agriculture under pond condition. In 2016-17, the maximum percent disease incidence was15.55% and the lowest seedling survival was 84.44% under control treatment. The disease incidence was reduced from 51.83 to100% and seedling survival was 92.51to 100% due to different fungicidal treatments. In 2017-18 crop seasons, the disease incidence was 17.42% and seedling survival was 82.58% under control treatment. Due to fungicidal treatment the disease incidence was reduced to 53.73-88.92% and seedlings survival was calculated to 91.94-98.06%. The most effective fungicide was Provax-200 followed by Topzim super 75 WDG, Timseen Tm and Ridomil gold MZ 68 WG to control the damping-off disease and to increase vigour of bottle gourd seedlings. Maximum disease reduction of (100% and 98.92%) and seedlings survival (100% and 98.06%) was obtained when seeds and tema/ball treated with Provax-200 and Topzim super 75 WDG. Based on results of the present investigation Provax-200 @ 0.2%, Topzim super 75 WDG @ 0.1%, and Timseen Tm @ 0.1%, might be recommended against damping-off of bottle gourd seedlings under floating agriculture.

Key words: Damping-off, bottle gourd, floating agriculture, fungicides

INTRODUCTION

Floating agriculture is an old practice in the waterlogged villages of Barishal, Pirojpur, Satkhira and Gopalgonj districts of Bangladesh and it is uncommon elsewhere in the country. According to local tradition, this indigenous system of ‘soilless cultivation’ has been used for growing different types of vegetables and seedlings for at least two centuries. This region is one of the main seedling supply zones of Bangladesh. The floating bed is built up with various types of local materials and the single most important component is water hyacinth, topapana, dulali lata, algae and dissected coconut fibres are also used (Islam and Atkins 2011). The floating bed is more fertile than the normal land (BARCIK 2004). It was also observed that the floating agriculture is a suitable adaptation option in considering the environmental as well as social aspects under submerged ecosystem. Various seedlings are grown on the floating beds such as okra, chili, water melon, musk melon, different beans, cauliflower, cabbage, radish, tomato, eggplant, bitter gourd, snake-gourd, cucumber, bottle gourd, sweet gourd and turnip. But this crop has been found to be affected by a number of serious fungal diseases viz. damping-off, foot and root rot, colar rot caused by *Pythium*, *Rhizoctonia, Fusarium, Sclerotium* and *Phytophthora*. Species of the soil organism *Pythium* are most often responsible for damping-off disease (Islam and Faruq 2008). There are different methods available for controlling damping-off disease. Control measures like host resistance has not yet become a viable measure. No resistant variety has yet been developed and released against this soil borne pathogens causing damping-off of vegetable at seedling stage in Bangladesh. In case of cultural methods such as soil solarization, soil amendment and bio-agent have been used to minimize the inoculum of *S. rolfsii, F. oxysporum* and *R. solani* in the soil. In many countries including the United States, Australia and France, pre-sowing fungicidal treatment is a routine practice (Agreste 2019, You *et al.* 2020). Systemic fungicides, such as carboxin and thiabendazole, which not only reduced seed-borne pathogens but also soil-borne pathogens, made them the choice for seed treatment. Systemic fungicide treatment of seed is an important strategy in disease management for many field and vegetable crops worldwide (Bhushan *et al.* 2013, Lamichhane *et al.* 2020). The damping-off disease is spreading very rapidly every year. No information is available on the management of damping off disease in floating agriculture. Therefore, present study was undertaken to find out a management package for damping-off disease and it effect on seed germination and seedling growth of bottle gourd seedlings under floating agriculture in Barishal, Pirojpur, Satkhira and Gopalgonj districts of Bangladesh.

MATERIALS AND METHODS

The experiment was conducted on the water hyacinth made floating bed under pond condition in the Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Rahmatpur, Barishal during two early Rabi seasons of 2016-2017 and 2017-18 cropping years. The experiment was conducted under natural infection conditions. The experiment was carried out in randomized complete block design with three replications. The unit floating bed size was 10 m long × 1.2 m wide. Variety of bottle gourd was BARI Lau-4. The eleven treatments including control were (1) seed treatment with Ridomil gold MZ 68 WG (Mancozeb + Metalexyl) @ 0.2%, (2) seed treatment with Provax-200 (Carboxin + Thiram) @ 0.2%, (3) seed treatment with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim) @ 0.1%, (4) seed treatment with Timseen Tm (n –alkyl dimethyl benzyl) @ 0.1%, (5) tema/ball soaking with Ridomil gold MZ 68 WG (Mancozeb + Metalexyl) @ 0.2%, (6) tema/ball soaking with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim) @ 0.1%, (7) tema/ball soaking with Timseen Tm (n –alkyl dimethyl benzyl) @ 0.1%, (8) seed treatment with Provax-200 (Carboxin + Thiram) @ 0.2% and tema/ball soaking with Provax-200 (Carboxin + Thiram) @ 0.2%, (9) seed treatment with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim)@ 0.1% and tema/ball soaking with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim) @ 0.1%, (10) seed treatment with Timseen Tm (n –alkyl dimethyl benzyl) @ 0.1% and tema/ ball soaking with Timseen Tm (n –alkyl dimethyl benzyl) @ 0.1% and (11) for control only distilled water was used. The seeds of bottle gourd was treated before inserting into the tema/ball. After that the sprouted seeds of bottle gourd were placed into small ball prepared with decomposed water hyacinth or topapana which was treated with different fungicides as mentioned before. Then they were shifted to the water hyacinth made main floating bed. No fertilizer and manure were applied to the bed during seedling production. The seedlings were harvested at 30 Days after sowing (DAS) when they attained the suitable stages for transplanting. Data were collected on different parameters such as seedling emergence (%), dead seed (%), damping-off incidence (%), seedling survival (%), shoot length, root length, stem girth and biomass (%). Percent biomass was computed on the basis of the following formula:

$$\text{Biomass }\% = \frac{\text{Dry biomass weight}}{\text{Wet biomass weight}} \times 100$$

Data analyses were done using SAS (Version 9.4) and Microsoft Office Excel 2021. Treatment means were compared via ANOVA using the least significant differences test (LSD) at 5% level.

RESULTS AND DISCUSSION

The effects of different fungicidal treatments on percent emergence of bottle gourd seedlings differed significantly in comparison to control (Table 1). The percent emergence of bottle gourd seedlings in 2016-2017 and 2017-2018 cropping seasons ranged from 84.22-100% and 82.22-97.78%, respectively. In both the year emergence percentage was the lowest in control treatment. All treatments with fungicides significantly (P=0.05) increased emergence percentage of seedling compared to control in two crop seasons. The lowest disease incidence was recorded under combination of seed treatment and tema/ball soaking with Provax-200. The highest disease reduction of damping-off was achieved with Provax-200 fungicide followed by Topzim super 75 WDG, Timseen Tm in both years. The reduction in disease incidence was 51.83-100% during 2016-2017 and 53.73-88.92% during 2017-2018 (Table 1). At 30 DAS, the highest survival (100 & 98.06%) of bottle gourd seedlings were recorded in combination of seed treatment and tema/ball soaking with provax-200 (T_8) that was statistically similar with combination of seed treatment and tema/ball soaking with Topzim super 75 WDG (T_9). The lowest percent seedling survival of bottle gourd was recorded in control treatment (T_{11}) followed by tema/ball soaking with Ridomil gold MZ 68 WG (T_5).

The effect of different treatments on growth characters of bottle gourd seedlings differed significantly (Table 2). The highest shoot length (43.29 cm) was recorded in case of seed treatment with provax-200 and tema/ball soaking with provax-200 (T8) followed by seed treatment with Topzim super 75 WDG and tema/ball soaking with Topzim super 75 WDG (T_9) and seed treatment with Timseen Tm and tema/ ball soaking with Timseen Tm (T_{10}). Provax-200 increased shoot length, root length and stem girth up to 18.83%, 27.03%, and 12.48%, respectively over control treatment. The highest biomass (7.54%) was recorded in case of seed treatment and tema/ball soaking with Provax-200 followed by Topzim super 75 WDG (7.43%) and Timseen Tm (7.24%) at 30 DAS.

The relationship of average disease reduction of damping-off and average percent biomass of bottle gourd seedlings due to fungicidal treatment was linear, positive and significant (r=0.977*) and expressed by the regression equations of $y = -5.9072 + 0.5774x$. The coefficient of determination (R^2) indicated that biomass increase due to reduction in disease incidence might be attributed to 95.47% in cropping seasons (Fig. 1).

Chemical seed treatments still represent a major practice in agriculture to manage damping-off disease (Dorrance *et al*. 2009, Rothrock *et al*. 2012, Kandel *et al*. 2016). Results of the present investigations revealed that seed treatment as well as tema/ball soaking with Provax-200, Topzim super 75 WDG, Timseen Tm, and Ridomil gold MZ 68 WG effectively reduced the damping-off disease incidence and substantially increased percent biomass of bottle gourd seedlings. The findings were in agreement with the findings of Bhushan *et al*. 2013, Devi *et al*. 2015, Kandel *et al*. 2016, Singh *et al*. 2016, Zeun *et al*. 2013 and many other workers who reported that the fungicides carbendazim, mancozab, triazoles, phenylpyrroles, phenylamides, benzimidazoles and strobilurines, used for seed treatment significantly ($P<0.05$) reduced the disease incidence of damping-off compared to untreated control (Ayesha *et al*. 2021). Bhushan *et al*. (2013) attributed that methyl benzimidazole carbamate (MBC) group of fungicides provided excellent control of damping-off diseases on apple, bean, brinjal, barley, mango, cucurbit, cotton, grape, groundnut, jute, pea, paddy, rose, sugar beet, wheat, walnut and tapioca. Weems *et al*. (2015) tested several fungicides as seed treatments, including azoxystrobin, *Bacillus pumilus* GB34, fludioxonil, mefenoxam or metalaxyl, prothioconazole, thiophanate-methyl, and thiophanate-methyl + pyraclostrobin, trifloxystrobin + metalaxyl in multiple combinations. Haghanifa (2018) recorded carboxin + thiram as the best fungicide to storability, seed germination, vigour and gave the highest percentage of seed germination of maize. Lamichhane *et al*. (2020) attributed that seed treatment with systemic fungicides was a routine integrated crop management practice for crops. Despite the benefits realized by fungicide seed treatment including improved seed emergence, plant height, plant vigour, plant and root biomass through protection from seed- and soil-borne fungal pathogens (da Silva *et al*. 2017, Dorrance and McClure 2001).

Based on results of the present investigation it might be concluded that combination of seed treatment and tema/ball soaking with Provax-200 (Carboxin + Thiram) @ 0.2%, Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim) @ 0.1%, Timsen Tm (n –alkyl dimethyl benzyl) @ 0.1%, and Ridomil gold MZ 68 WG (Mancozeb + Metalexyl) @ 0.2% were effective to control damping-off disease and thereby increased the vegetative growth of bottle gourd seedlings in floating agriculture under pond conditions.

Table 1. Effect of different treatments on emergence percentage, damping-off incidence, and plant survival percentage of bottle gourd seedlings at 30 days after sowing (DAS) on floating agriculture under pond condition at RARS, Rahmatpur, Barishal

Treatments	Emergence (%)		Dead Seed (%)		Damping-off incidence (%)		Damping-off reduction (%) over control		Seedling Survival (%)	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
T1	95.37 d	91.11 c	4.63 d	8.89 c	4.56 cde	5.65 de	70.67	67.57	95.44 def	94.34 de
T2	98.15 abc	95.55 ab	1.85 efg	4.45 de	3.18 ef	4.23 fg	79.54	75.72	96.81 cd	95.77 bc
T3	97.22 bcd	95.00 ab	2.78 def	5.00 de	3.22 ef	4.70 efg	79.29	73.02	96.78 cd	95.29 bcd
T4	96.29 cd	94.44 b	3.71 de	5.56 d	4.21 def	5.03 def	72.92	71.13	95.79 cde	94.97 cde
T5	98.88 f	86.11 d	11.12 b	13.89 b	7.49 b	8.06 b	51.83	53.73	92.51g	91.94 g
T6	91.67 e	88.89 cd	8.33 c	11.11 bc	5.54 cd	6.15 cd	64.37	64.69	94.45 ef	93.84 ef
T7	90.74 ef	87.78 d	9.26 bc	12.22 b	5.87 c	6.95 bc	62.25	60.10	94.12 f	93.04 fg
T8	100 a	97.78 a	0.00 g	2.22 e	0.00 h	1.93 h	100	88.92	100.00 a	98.06 a
T9	99.08 ab	97.78 a	0.92 fg	2.22 e	1.32 gh	3.73 g	91.51	78.59	98.67 ab	96.27 b
T10	99.07 ab	96.67 ab	0.93 fg	3.33 de	2.66 fg	4.00 fg	82.89	77.04	97.34 bc	96.00 bc
Control	84.22 g	82.22 e	15.78 a	17.78 a	15.55 a	17.42 a	-	-	84.44 h	82.58 h
LSD (0.05)	2.154	3.06	2.154	3.06	1.60	1.27	-	-	1.597	1.269
CV (%)	1.33	1.95	23.45	22.81	19.24	12.05	-	-	0.985	0.7941

Means within the same column with a common letter(s) are not significantly different at 5% level of probability

T_1 = Seed treatment with Ridomil gold MZ 68 WG (Mancozeb + Metalexyl) @ 0.2%,
T_2 =Seed treatment with Provax-200 (Carboxin + Thiram) @ 0.2%,
T_3 = Seed treatment with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim) @ 0.1%,
T_4 = Seed treatment with Timseen Tm (n –alkyl dimethyl benzyl) @ 0.1%,
T_5 = Tema/ball soaking with Ridomil gold MZ 68 WG (Mancozeb + Metalexyl) @ 0.2%,
T_6 = Tema/ball soaking with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim) @ 0.1%,
T_7 = Tema/ball soaking with Timseen Tm (n –alkyl dimethyl benzyl) @ 0.1%,
T_8 = Seed treatment with Provax-200 (Carboxin + Thiram) @ 0.2%, and Tema/ball soaking with Provax-200 (Carboxin + Thiram) @ 0.2%,
T_9 =Seed treatment with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim) @ 0.1% and Tema/ball soaking with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim)@ 0.1%,
T_{10} = Seed treated with Timseen Tm (n –alkyl dimethyl benzyl) @ 0.1% and Tema/ Ball soaking with Timsen@ 0.1%**.**
T_{11} = Control treatment

Table 2. Effect of different treatments on shoot length, root length, stem girth, seedling biomass percentage of bottle gourd seedlings at 30 days after sowing (DAS) on floating agriculture under pond condition at RARS, Rahmatpur, Barishal

Treatments	Shoot length (cm)	% Shoot length increased over control	Root length (cm)	% Root length increased over control	Stem girth (mm)	% Stem girth increased over control	Biomass (%)	% Biomass increased over control
T1	40.52 abc	11.22	19.03 a	19.08	5.68 ab	10.72	6.85 ab	33.79
T2	42.48 ab	16.61	19.50 a	22.02	5.73 a	11.70	7.16 ab	39.84
T3	41.85 abc	14.88	19.41 a	21.46	5.72 a	11.50	7.09 ab	38.48
T4	41.30 abc	13.37	19.05 a	19.21	5.68 ab	10.72	6.86 ab	33.98
T5	36.81 c	1.04	18.27 ab	14.33	5.59 b	8.97	6.48 b	26.56
T6	39.16 abc	7.49	18.66 a	16.77	5.67 ab	10.52	6.61 ab	29.10
T7	37.65 bc	3.35	18.39 ab	15.08	5.67 ab	10.52	6.58 ab	28.51
T8	43.29 a	18.83	20.30 a	27.03	5.77 a	12.48	7.54 a	47.27
T9	43.14 a	18.42	19.86 a	24.28	5.76 a	12.28	7.43 ab	45.18
T10	42.88 ab	17.71	19.73 a	23.46	5.74 a	11.89	7.24 ab	41.40
Control	36.43 c	-	15.98 b	-	5.13 c	-	5.12 c	-
LSD (0.05)	5.45	-	2.44	-	0.114	-	0.98	-
CV (%)	7.91	-	7.58	-	1.18	-	8.47	-

Means within the same column with a common letter(s) are not significantly different at 5% level of probability

T_2 =Seed treatment with Provax-200 (Carboxin + Thiram) @ 0.2%,
T_3 = Seed treatment with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim) @ 0.1%,
T_4 = Seed treatment with Timseen Tm (n –alkyl dimethyl benzyl) @ 0.1%,
T_5 = Tema/ball soaking with Ridomil gold MZ 68 WG (Mancozeb + Metalexyl) @ 0.2%,
T_6 = Tema/ball soaking with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim) @ 0.1%,
T_7 = Tema/ball soaking with Timseen Tm (n –alkyl dimethyl benzyl) @ 0.1%,
T_8 = Seed treatment with Provax-200 (Carboxin + Thiram) @ 0.2%, and Tema/ball soaking with Provax-200 (Carboxin + Thiram) @ 0.2%,
T_9 =Seed treatment with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim) @ 0.1% and Tema/ball soaking with Topzim super 75 WDG (Imidachloropid + Thiram + Carbendazim)@ 0.1%,
T_{10} = Seed treated with Timseen Tm (n –alkyl dimethyl benzyl) @ 0.1% and Tema/ Ball soaking with Timsen@ 0.1%.
T_{11} = Control treatment
T_1 = Seed treatment with Ridomil gold MZ 68 WG (Mancozeb + Metalexyl) @ 0.2%,

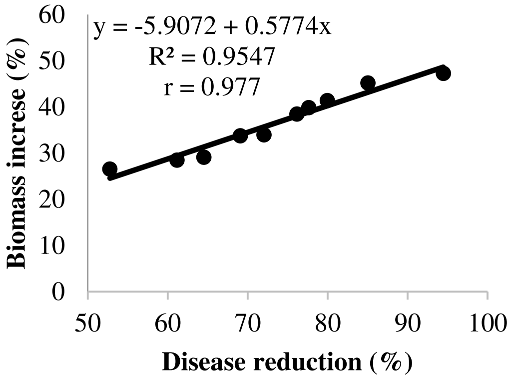

Figure 1. Relationship of average percent biomass increase of bottle gourd seedlings with average percent damping-off disease reduction during 2016-2017 and 2017-2018 cropping seasons

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