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Association of *Phomopsis vexans* with Eggplant (*Solanum melongena*) Seeds, Seedlings and its Management

M. R. Islam[1*] and M. B. Meah[2]

[1]*Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka – 1207, Bangladesh*
[2]*Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh*

[*] *Corresponding author and Email: rafique6420032@yahoo.com*

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Abstract

Incidence of *Phomopsis vexans* on farmers' eggplant seeds collected from different areas of Bangladesh varied from 0.0 to 7.5%. The highest incidence of *P. vexans* (7.50 %) was recorded in cultivar Dohazari and Rupgonj L collected from Chandanish and Rupgonj, respectively. No incidence of *P. vexans* was observed in the cultivar Katabegun and Jessore-L collected from Pabna and Monirampur, respectively. Very low seed infection was recorded in the cultivar Shingnath, Bijoy, Ishurdi-Land Longla-long collected respectively from Chandina, Modhukhali, Ishurdi and Kulaura. Seeds collected from HRC of BARI had higher seed infection by *P. vexans*. Seed selection had a significant impact on the incidence of *P. vexans*. Use of apparently healthy seed was found effective in controlling damping off, tipover and seedling blight of eggplant. The least incidence of *P. vexans* (1.25%) and the highest germination (86.75%) were recorded in apparently healthy seed as against 6.5% seed infection and 60% seed germination recorded in farmer's seed. In the net house, the least incidence of damping off, tipover and seedling blight were recorded in case of apparently healthy seed. Seed treatment with hot water (56 ^{0}C for 15 minutes), garlic (*Allium cepa* L) bulb extract and Allamanda (*Allamanda cathertica* L) leaf extract, *Trichoderma harzianum* CP, *Trichoderma harzianum* T_{22} and Bavistin were found promising in controlling seedling diseases in the nursery and in increasing the seed germination. Combinations of apparently healthy seed (T_2), treated with garlic bulb extract (T_3) and soil treated with *T. harzianum* CP (T_{11}) completely controlled damping off, tipover and seedling blight in the nursery bed and increased seed germination by 48.83% over control.

Keywords: **Eggplant, incidence, seed, seedling, disease, *Phomopsis vexans*, management**

1. Introduction

Eggplant (*Solanum melongena* L.), is a popular and widely grown vegetable in Bangladesh and has got multifarious use as a dish item (Rashid, 1976; Bose and Som, 1986). It is thought to be originated in Indian sub-continent (Rashid, 1976; Zeven and Zhukovsky, 1975). Eggplant is the second most important vegetable crop in respect of total acreage (1, 15,113 acres) and production (3, 37,568 mt annually) in Bangladesh (BBS, 2009). It is available in the country throughout the year, especially during the lean period when the seasonal vegetables are in scarcity in the market. Eggplant is regarded as a cash crop.

However, the crop is known to suffer from 12 diseases and among them phomopsis blight and fruit rot caused by *Phomopsis vexans* has been treated as one of the major constraints to eggplant cultivation in the country (Khan, 1999; Das, 1998). This disease appears as damping off, tipover and seedling blight in the nursery and

fruit rot in the harvesting crop (Singh, 1992; Ashrafuzzaman, 2006).

Seed is the infection source of *P. vexans* and may serve as a substrate for pathogen survival (Pan *et al.*, 1995). The pathogens remain on the seed coat and the cotyledons of eggplant seeds causing various degrees of seed discoloration and minute black pycnidial bodies which is distinctly observed on the surface of the dry seed (Karuna *et al.*, 1994). This provides an opportunity to avoid the pathogens by discarding the infected, abnormal and discoloured seed. Therefore, selection of apparently healthy seed could be the easiest and economical practice for the growers to avoid the pathogen.

Many plants extracts, bioagents and hot water are reported to be antimicrobials against plant pathogenic fungi (Bowers *et al.*, 2000; Lawson *et al.*, 1998; Hossain, 2004; Hassan, 2000; Cook, 1993; Harman, 1989). Those components may address against *P. vexans*. Besides, seed dressing fungicide Bavistin and Vitavax may be assayed against the pathogen *Phomopsis vexans.* The present experiment was designed to determine the prevalence of *Phomopsis vexans* in eggplant seeds and seedlings and to identify the pathogen inhibitory components for management of seed infection and seedling diseases of eggplant.

2. Materials and Methods

The experiments were conducted in the IPM Laboratory and Net house of the Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh during 2004-2005. Seed samples of eggplant were collected randomly from the selected farmers of eighteen upazillas of 15 districts as well as from HRC, BARI and IPM Lab, BAU (Table 1).

For studying the incidence of *P. vexans* and seed germination, four hundred seeds of each sample were plated (25 seeds /plate) and incubated at room temperature (25^0 C ± 2) for 10-15 days following Blotter method (ISTA, 2001). Each seed was observed under stereomicroscope to detect the seed infection. The presence of *P. vexans* was confirmed by observing the prepared slide under compound microscope. Germination percentage of seed samples was recorded by counting. For assessing the seedling infection caused by *P. vexans*, nine treatments viz. Hot water treatment, Bavistin (0.1 %), Vitavax-200 (0.2%), Garlic extracts (1:1), Allamanda extracts (1:1), *Trichoderma harzianum* CP., *Trichoderma harzianum* $T_{22,}$ *Trichoderma SP. (EP),* and control were evaluated in the net house. For hot water treatment, two hundred seeds of eggplant cv, Dohazari were treated at 56°C temperature for 15 min using Vegetable Seed Treating Plant, developed at IPM Lab, BAU. The treated seeds were then drained off and dried in shade for sowing in the tray. In case of fungicidal treatment, required amount of fungicides for a fixed quantity of seeds were taken in a 250 ml conical flask (1:1, V/W) and were shaken for proper coating of seeds with the fungicide. For treating seeds with plant extracts, the seeds were dipped in the extract (Seed: extract, W/V 1: 1.5) for 30 minutes. The liquid was drained off and seeds were shade dried before sowing in the tray.

For treating seeds with bioagent the selected strains *Trichoderma harzianum* were mass multiplied in PDA media inoculated at 25^0C for 7-10 days (Shamarao *et al.*, 2002). Then these were rolled with 10 days old PDA culture of *Trichoderma* strains, air dried and sown in the sterilized soil in the net house (Biswas and Sen, 2000).

2.1. Categorization of seeds

Eggplant seeds of cultivars Dohajari categorized (manually) into three groups viz. Farmers' seed (seeds collected from farmers and used as it were), Apparently healthy seed (seeds sorted from the farmer's seed sample having normal shape, size and shiny colour**)** and Diseased seed (spotted, discoloured, shrivelled seeds appeared to be infected) for evaluation of the incidence of *P. vexans***.**

Table1. Incidence of *Phomopsis vexans* on eggplant seeds collected from farmers of different regions of Bangladesh

Sl. No.	Locations (Village, Upazilla, District)	Sources	Cultivars	Germination of seeds (%)	Seed infection *P. vexans* (%)
1	Dohazari, Chandanish, Chittagong	Md. Yunus S/O- Kalu Mia	Dohazari	53.75 k	7.50 (2.75) a
2	Hazishawri, Mirreshawri, Chittagong	Md.Zero Mia S/O- Abul Hashem	Talbegun	55.75 jk	7.25 (2.65) a
3	Srimantapur, Chandina, Comilla	Md.Tayab Ali S/O- Md.Nowab Ali	Shingnath	68.75 c	0.00 (0.75) h
4	Purbagram, Rupgonj, Narayangonj	Md.Ali Ahmad S/O- Jamir Uddin	Rupgonj-L	55.00 k	7.50 (2.73) a
5	Srirampur, Dhamri, Dhaka	Md. Kalu Mia S/O- Md. Lal Mia	Shingnath	66.00 d	1.25 (1.10) fg
6	Ramdia, Manikgonj sadar, Manikgonj	Md. Afzal Hossain S/O- Bahadur Ali	Irate	64.50 de	1.50 (1.20) f
7	Gondhardia, Modhukhali, Faridpur	Md. Hadiur Rahman S/O-Sohrab Uddin	Bijoy	66.25 d	1.25 (1.10) fg
8	Horergati, Monirampur, Jessore	Siddiqur Rahman S/O-Md. Ijjat Ali	Jessore-L	71.50 b	0.00 (0.70) h
9	Charkamalpur, Ishurdi, Pabna	Md. Salamat Pramanik S/O-Md. Hares Uddin	Ishurdi-L	70.00 bc	0.50 (0.85) gh
10	Sarutia, Gabtali, Bogra	Md.Mubarok Ali Chan S/O- Khush Mahmud	Manter	62.00 fg	4.50 (2.10) cd
11	Birasthal,Paba, Rajshahi	Md. Lutfur Rahman S/O- Abdur Rahim Mondal	Katabegun	74.75 a	0.00 (0.70) h
12	Khatkhatia, Rangpur sadar, Rangpur	Sri Kamal Kumar Roy S/O- Sri Bipin Chandra Roy	Khatkhatia	57.75 ij	5.75 (2.39) bc
13	Lakkhirchar, Nandina, Jamalpur	Md. Iqbql Hossain S/O- Azir Uddin Mondal	Zhumki	54.75 k	6.50 (2.54) ab
14	Satpaika, Sherpur sadar, Sherpur	Noashed Ali S/O- Tofazzal Hossain	Laffa-S	60.50 gh	4.50 (2.11) cd
15	Maricharchar,Ishargonj, Mymensingh	Md. Hashim Uddin S/O- Md. Hamed Ali	Thamba	59.25 hi	4.25 (2.05) d
16	Charkamaria, Gaffargaon, Mymensingh	Md. Suhrab Uddin S/O- Kamar Ali Akon	Laffa-G	54.50 k	6.75 (2.29) ab
17	Chargobindapur, Sadar, Mymensingh	Abdul Hannan (Shapan) S/O- Md. Samsuddin	Volanath	61.25 gh	4.00 (1.99) d
18	Nartan, Kulaura, Moulovibazar	Md. Abdul Khaleque S/O- Md. Abdur Rahman	Longlalong	64.00 d-f	1.25 (1.10) fg
19	HRC, BARI, Gazipur	BARI, Joydebpur Gazipur-1701	Kazla	59.50 hi	5.00 (2.23) cd
20	IPM Lab, BAU,Mymensingh	IPM Lab, Dept. Pl. Path., BAU	Laffa-BAU	62.25 e-g	2.50 (1.57) e
CV(%)				12.62	21.96

Values in a column with same letter(s) do not differ significantly ($p \leq 0.05$)
Figures in the parentheses are the mean of square transformed values

2.2. Sowing seed in trays

Tray substratum was prepared by mixing soil, sand and decomposed cow dung in the proportion of 2:1:1 and sterilized with 5 ml formalin (40%) diluted with 20 ml water for 4 kg soil (Dashgupta, 1988). After 4 days of treatment, surface sterilized plastic tray (35 x 25 $cm^{2)}$ was filled with the sterilized soil. Seeds of eggplant cv Dohazari treated with different components were sown in line and labelled. Untreated farmers' seeds were sown as control. Two hundred seeds were sown in one tray (35 cm X 25 cm) and four replications were maintained in each treatment. Observations were recorded on seed germination, damping off, seedling blight and tip over caused by Phomopsis vexans.

2.3. Integrated effect of selected components

The components found promising against *P. vexans* were further evaluated for their integrated effect on seedling diseases in the nursery in the net house. The treatments combination were
1. T_1+ T_3+ $T_{10,}$ 2. T_1+ T_3+ $T_{11,}$ 3. T_1+ T_3+ $T_{12,}$ 4. T_1+ T_4+ $T_{10,}$ 5. T_1+ T_4+ $T_{11,}$ 6. T_1+ T_4+ $T_{12,}$ 7. T_1+ T_5+ $T_{10,}$ 8. T_1+ T_5+ $T_{11,}$ 9. T_1+ T_5+ $T_{12,}$ 10. T_1+ T_6+ $T_{10,}$ 11. T_1+ T_6+ $T_{11,}$ 12. T_1+ T_6+ $T_{12,}$ 13. T_1+ T_7+ $T_{10,}$ 14. T_1+ T_8+ $T_{11,}$ 15. T_1+ T_9+ $T_{12,}$ 16. T_2+ T_3 +$T_{10,}$ 17. T_2+ T_3+$T_{11,}$ 18. T_2+ T_3+$T_{12,}$ 19. T_2+ T_4+$T_{10,}$ 20. T_2+ T_4+$T_{11,}$ 21. T_2+ T_4+$T_{12,}$ 22. T_2+ T_5+$T_{10,}$ 23. T_2+ T_5+$T_{11,}$ 24. T_2+ T_5+$T_{12,}$ 25. T_2+ T_6+ $T_{10,}$ 26. T_2+ T_6+ $T_{11,}$ 27. T_2+ T_6+ $T_{12,}$ 28. T_2+ T_7+ $T_{10,}$ 29. T_2+ T_7+ $T_{11,}$ 30. T_2+ T_7+ T_{12} and 31. Control.

Where T_1 = Farmer's seed, T_2 = Selected apparently healthy seed, T_3 = Seed treatment with garlic bulb extract, T_4 = Seed treatment with allamanda leaf extract, T_5 = Seed treatment with Bavistin, T_6 = Seed treatment with hot water (56 ^{0} C), T_7 = Seed treatment with *Trichoderma sp.* (EP), T_8 = Seed treatment with *Trichoderma harzianum* (CP), T_9 = Seed treatment with *Trichoderma harzianum* (T-22), T_{10} = Soil treatment with *Trichoderma* sp (EP), T_{11} = Soil treatment with *Trichoderma harzianum* (CP), T_{12} = Soil treatment with *Trichoderma harzianum* (T-22). Observations were made on seed germination, damping off, seedling blight and tip over caused by *P. vexans*.

3. Results and Discussion

3.1. Incidence of Phomopsis vexans in eggplant seeds collected from farmers of different eggplant growing areas of Bangladesh

Seed samples varied greatly in terms of seed infection by *P. vexans* and seed germination (Table 1). The highest incidence of *P. vexans* (7.50 %) was recorded in cultivar Dohazari and Rupgonj L collected from Chandanish and Rupgonj, respectively. The seed infection by *P. vexans* in cultivar Talbegun (7.25 %) and Zhumki (6.50 %) collected from Mirreshawri and Nandina were statistically similar to that of the cultivars Dohazari and Rupgonj L. No incidence of *P. vexans* was observed in the cultivar Katabegun and Jessore L collected from Paba and Monirampur, respectively. Very low seed infection was recorded in the cultivar Shingnath, Bijoy, Ishurdi L and Longla-long collected, respectively from Chandina, Modhukhali, Ishurdi and Kulaura. Seeds collected from HRC, BARI had higher infection by *P. vexans* than those from IPM Lab. The findings are in agreement with those of Khan (1999), who found seed infection of 0.5 - 7.0% by *P. vexans* in 22 seed samples of eggplant collected from different regions of Bangladesh. Further support of the present findings comes from Gangadharaswamy *et al*. (1997) who reported 13.0% seed infection by *P. vexans* in var. Erenagere and no infection in Pusa purple. Variation in seed infection by *P. vexans* revealed the existence of variation in distribution of the pathogen in respect of growing areas in Bangladesh. Variation in geographical distribution of *P. vexans* has been reported by Punithalingam and Holliday (1972). Reasons for variation may be due to weather conditions, extent of eggplant cultivation, variability in cultivars, growers' action toward collection and preservation of seeds and other factors.

3.2. Seed treatment with hot water, plant extract, bioagents and fungicides in controlling seedling diseases of eggplant caused by Phomopsis vexans

All the selected components showed significant effect on controlling the seedling diseases and in increasing seed germination (Table 2). The highest seed germination was recorded in garlic extract that was statistically identical with hot water treatment, Bavistin, allamanda extract, *T. harzianum* CP and *T. harzinum*-$T_{22.}$ The lowest seed germination but far better than control was recorded in *Trichoderma sp*. EP proceeded by Vitavax-200. The damping off disease of seedlings was completely controlled by garlic extract that was statistically similar to the effect of hot water, allamanda extract and *T. harzinum* CP. The rest of the tratments also performed better in comparison with control. In controlling tipover and seedling blight, the performance of the treatments were in similar trend of damping off to some extent. Earlier studies support the present findings (Hossain, 2004; Meah, 2003; Meah *et al.*, 2004; Harman *et al.*, 1989; Islam, 2004 and Islam *et al*.,1989). Hossain (2004) obtained 100% control of *Phomopsis vexans* and 87.0% seed germination by treating seeds at 55^{o}C for 15 minutes. Meah (2003) found that *T. harzianum* CP significantly controlled the nursery diseases caused by *Phomopsis vexans* and increased seed germination by 49 % over control. Meah *et al*, (2004) reported that formulated *T. harzianum* CP and *T. harzianum* T_{22} grown on peat soil based substrate was found effective in controlling nursery diseases like damping off, tipover and seedling blight of eggplant and promoted seed germination. Harman *et al*. (1989) reported that the strains of *T. harzianum* acted as strong competitors to other pathogenic micro-organisms in the rhizosphere colonizing the root zone. Meah (2003) reported that garlic bulb extract controlled the nursery diseases in the net house and reduced the fruit infection of eggplant by 71 – 75 % in the field. Islam (2004) found 76 – 100 % inhibition of mycelial growth of *P. vexans* by garlic bulb and allamanda leaf extracts. Inhibition of pathogenic fungi by garlic bulb extract might be due to the presence of antimicrobial compounds in the extract. It has been reported that the antibiotic substance present in garlic is the allyl compound of allyl thiosulphate (Cavallito *et al.*, 1944). Garlic contains an amino acid alliin which on crush is transferred into allicin by the action of allicinase enzymes and this allicin is toxic to the micro-organisms. Islam *et al*. (1989) reported Bavistin (Carbendazim) as an effective fungicide against *P. vexans*.

Table 2. Effect of seed treatment with selected agents in controlling *Phomopsis vexans* of eggplant seedlings in net house

Sl. No.	Treatments	Germination (%) *	Damping off (%)**	Tip over (%)**	Seedling blight (%)**
1	Hot water (56 ^{0} C – 15 mins.)	85.50 (67.62) ab	0.62 (0.78) cd	1.00 (1.00) fg	0.62 (0.78) ef
2	Bavistin	87.00 (68.91) a	1.50 (1.20) b	1.25(1.10)e-g	1.25 (1.10) cd
3	Vitavax - 200	82.50 (65.27) b	2.00 (1.39) b	3.50 (1.86) b	3.75 (1.92) b
4	Garlic extract (1:1)	87.50 (69.41) a	0.00 (0.70) d	0.87 (0.92) g	0.00 (0.70) f
5	Allamanda extract (1:1)	85.00 (67.20) ab	1.12 (1.03) b-d	1.50(1.20) d-f	0.87(0.92) d-f
6	*Trichoderma harzianum* CP	84.00 (66.48) ab	1.12 (1.03) b-d	1.75(1.31) c-e	1.25 (1.10) cd
7	*Trichoderma harzianum* T_{22}	83.50 (66.09) ab	1.25 (1.10) bc	2.00 (1.41) cd	1.00(1.00) c-e
8	*Trichoderma sp.* EP	82.00 (64.90) b	1.50 (1.20) b	2.25 (1.49) c	1.50 (1.20) c
9	Control	56.00 (48.72) c	12.25 (3.49) a	13.75 (3.70) a	14.50 (3.80) a
CV		3.19%	17.74%	11.03%	12.50%

[N. B. Values in a column with same letter(s) do not differ significantly ($P \leq 0.05$), * Figures in the parentheses are the mean of arcsine-transformed values, ** Figures in the parentheses are the mean of square root transformed values]

3.3. Effect of seed selection on the incidence of Phomopsis vexans of eggplant in the laboratory and net house

The categorized seed showed significant ($P \leq 0.05$) impact on the incidence of *Phomopsis vexans* both in the laboratory and in the net house (Table 3). The least percent of *P. vexans* was recorded in case of apparently healthy seed followed by farmers' seed and diseased seed *in vitro* condition. Similarly, the incidence of damping off, tipover and seedling blight were the least in case of apparently healthy seed followed by farmers' seed and diseased seed in the nursery bed. Seed germination was 66.0 and 55.0 %, respectively in the laboratory and in the nursery in case of original farmers' seed. Diseased seed yielded very poor seed germination and higher incidence of *P. vexans* causing nursery diseases (Table 3). The findings corroborate with the findings of Meah (2003) who reported that seed germination of eggplant could be upgraded to 100% and seed rotting could be minimized through selection of apparently healthy seed. Meah (2003) obtained 91% seed germination and eliminated seedling diseases in the net house by sowing apparently healthy seeds. The present findings also do agree with the report of Toole *et al*. (1941). Promising effect of seed sorting in other crops has also been reported. Substantial increases of seed germination by seed selection were achieved in mustard (Chowdhury, 1999 and Sultana *et al*., 1992), wheat (Hossain and Doullah, 1998) and in jute (Fakir *et al*., 1990). Hossain and Doullah (1998) obtained 83% higher plant population in the field through sorting farmers' seeds of rice.

3.4. Integrated effect of selected promising components for management of seedling diseases of eggplant caused by Phomopsis vexans

The integrated effect of IPM components in controlling damping off, tipover and seedling blight of eggplant were found promising. All the treatment combinations showed significantly ($P \leq 0.05$) better performance against *P. vexans* in controlling seedling diseases over control (Table 4 and Fig 1). The treatment combination 17 ($T_2+T_3+T_{11}$) was noted as the best treatment, where apparently healthy seed (T_2), seeds treated with garlic extract (T_3) and soil treated with *T. harzianum* CP (T_{11}) were combined.

Statistically similar effects were observed among the treatment combinations 18 ($T_2+T_3+T_{12}$), 20 ($T_2+T_4+T_{11}$), 21 ($T_2+T_4+T_{12}$), 26 ($T_2+T_6+T_{11}$) and 27 ($T_2+T_6+T_{12}$). The lowest performance against *P. vexans* was recorded in the treatment combination 13 ($T_1+T_7+T_{10}$). Reports on the effect of apparently healthy seed, plants extracts, hot water seed treatment, bioagents and fungicides that were found effective against *P. vexans* in the present investigation were supported by the previous workers (Hossain, 2004; Meah, 2003; Meah *et al.*, 2004; Harman *et al.*, 1989 and Islam, 2004; Islam *et al*.,1989). Meah *et al*., (2004) carried out an integrated experiment for the management of *Phomopsis vexans* and found garlic and allamanda extracts in combination with soil treatment with the isolates of *T. harzianum* effective against *P. vexans* in the nursery.

Table 3. Effect of seed selection on the incidence of *Phomopsis vexans* of eggplant cultivars Dohazari

Treatment	*In vitro*		Net house			
	Germination (%) *	*P. vexans* (%) **	Germination (%) *	Damping off (%)**	Tip over (%)**	(%) Seedling blight **
Farmer's seed	60.00 (50.75) b	6.50 (2.54) b	55.00 (47.85) b	12.00 (3.45) b	14.00 (3.73) b	14.75 (3.83) b
Apparently healthy seed	86.75 (68.66) a	1.25 (1.10) c	84.75 (67.10) a	1.75 (1.31) c	3.75 (1.93) c	3.50 (1.86) c
Diseased seed	32.25 (34.57) c	21.25 (4.60) a	28.00 (31.90) c	30.25 (5.49) a	25.00 (5.00) a	26.25 (5.12) a
CV (%)	4.01	15.61	3.03	13.92	10.66	11.12

[N. B. Values in a column with same letter(s) do not differ significantly ($P \leq 0.05$), * Figures in the parentheses are the mean of arcsine-transformed values, ** Figures in the parentheses are the mean of square root transformed values]

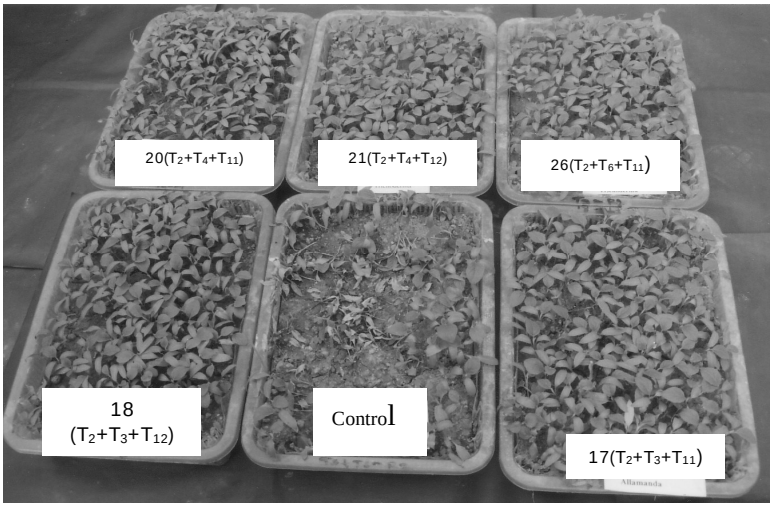

Fig. 1. Integrated effect of IPM components in controlling seedling diseases in the nursery

Table 4. Integrated effect of selected IPM components against *Phomopsis vexans* of eggplant in net house

Sl. No	Treatment combinations	% Germination	% Damping off	% Tip over	% Seedling blight
1	$T_1+T_3+T_{10}$	87.00 (9.32) h-k	0.50 (0.85) d	0.75 (0.92) de	0.50 (0.85) d
2	$T_1+T_3+T_{11}$	89.75 (9.47) d-h	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
3	$T_1+T_3+T_{12}$	89.25 (9.44) d-i	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
4	$T_1+T_4+T_{10}$	85.75 (9.26) i-l	1.00 (1.03) d	1.25 (1.10) cd	0.75 (0.92) d
5	$T_1+T_4+T_{11}$	89.00 (9.43) e-i	0.25 (0.78) d	0.25 (0.78) e	0.25 (0.78) d
6	$T_1+T_4+T_{12}$	87.25 (9.34) g-k	0.25 (0.78) d	0.25 (0.78) e	0.25 (0.78) d
7	$T_1+T_5+T_{10}$	85.00 (9.21) j-l	1.00 (1.03) d	1.25 (1.10) cd	1.00 (1.00) d
8	$T_1+T_5+T_{11}$	89.25 (9.44) d-i	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
9	$T_1+T_5+T_{12}$	87.25 (9.34) g-k	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
10	$T_1+T_6+T_{10}$	84.00 (9.16) kl	1.00 (1.03) d	0.75 (0.95) de	0.75 (0.95) d

11	T_1+ T_6+ T_{11}	87.00 (9.32) h-k	0.50 (0.85) d	0.25 (0.75) e	0.25 (0.78) d
12	T_1+ T_6+ T_{12}	86.50 (9.30) h-l	0.50 (0.85) d	0.25 (0.78) e	0.50 (0.88) d
13	T_1+ T_7+ T_{10}	83.00 (9.11) l	7.50 (2.73) b	3.50 (1.86) b	4.75 (2.17) b
14	T_1+ T_8+ T_{11}	85.00 (9.21) j-l	4.00 (1.99) c	0.75 (0.92) de	2.50 (1.57) c
15	T_1+ T_9+ T_{12}	83.75 (9.15) kl	4.25 (2.05) c	1.25 (1.10) cd	2.75 (1.65) c
16	T_2+ T_3 +T_{10}	90.75 (9.52) c-g	0.50 (0.85) d	0.50 (0.85) de	0.50 (0.85) d
17	T_2+ T_3+T_{11}	96.00 (9.79) a	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
18	T_2+ T_3+T_{12}	94.75 (9.73) ab	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
19	T_2+ T_4+T_{10}	89.75 (9.47) dh	0.75 (0.92) d	0.50 (0.85) de	0.50 (0.85) d
20	T_2+ T_4+T_{11}	93.75 (9.68) ac	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
21	T_2+ T_4+T_{12}	92.75 (9.63) ad	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
22	T_2+ T_5+T_{10}	88.75 (9.42) e-i	1.00 (1.03) d	0.75 (0.92) de	1.00 (1.00) d
23	T_2+ T_5+T_{11}	92.00 (9.59) b-e	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
24	T_2+ T_5+T_{12}	91.25 (9.55) b-f	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
25	T_2+ T_6+ T_{10}	86.50 (9.30) h-l	0.75 (0.95) d	0.50 (0.85) de	0.50 (0.88) d
26	T_2+ T_6+ T_{11}	92.25 (9.60) e-j	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
27	T_2+ T_6+ T_{12}	92.75 (9.63) f-j	0.00 (0.70) d	0.00 (0.70) e	0.00 (0.70) d
28	T_2+ T_7+ T_{10}	85.00 (9.21) j-l	3.25 (1.78) c	1.75 (1.28) c	2.25 (1.57) e
29	T_2+ T_7+ T_{11}	86.25 (9.28) h-l	0.75 (0.95) d	0.50 (0.85) de	0.50 (0.88) d
30	T_2+ T_7+ T_{12}	85.50 (9.24) i-l	0.75 (0.95) d	0.25 (0.78) e	0.50 (0.88) d
31	Control	64.50 (8.03) m	27.25 (5.21) a	17.75 (4.20) a	14.25 (3.77) a
CV		12.96%	18.23%	13.12%	11.08%

[N. B.

T_1 = Farmer's seed
T_2 = Selected apparently healthy seed
T_3 = Seed treatment with garlic bulb extract
T_4 = Seed treatment with allamanda leaf extract
T_5= Seed treatment with Bavistin
T_6 = Seed treatment with hot water (56^0 C)
T_7 = Seed treatment with *Trichoderma sp*. (EP)
T_8 = Seed treatment with *Trichoderma harzianum* (CP)
T_9 = Seed treatment with *Trichoderma harzianum* (T-22)
T_{10} = Soil treatment with *Trichoderma* sp (EP)
T_{11} = Soil treatment with *Trichoderma harzianum* (CP)
T_{12} = Soil treatment with *Trichoderma harzianum* (T-22)

Values in a column with same letter(s) do not differ significantly ($P \leq 0.05$), Figures in the parentheses are the mean of square root transformed values]

4. Conclusions

Incidence of *Phomopsis vexans* on the farmers' seed varied in respect of different eggplant growing regions of the country. Seed selection had a significant impact on the incidence of *P. vexans*. The least incidence of *P. vexans* and the highest germination were recorded in apparently healthy seed in comparison to farmer's seed. Apparently healthy seed treated with hot water (56 ^{0}C for 15 minutes), garlic (*Allium cepa* L) bulb extract and allamanda (*Allamanda cathertica* L) leaf extract, *Trichoderma harzianum* CP, *Trichoderma harzianum* T_{22} and Bavistin were found promising in controlling seedling diseases individually and in combinations.

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