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Management of Leaf Blight Disease of Medicinal Plants with Bio-agents and Chemical Fungicides

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Leaf blight affecting medicinal plants like *Piper longum*, *Tylophora indica*, and *Hibiscus subdariffa* is a major issue in West Bengal, causing significant damage year-round. Effective management of this disease is crucial. Several chemical fungicides and Trichoderma isolates were evaluated against the disease of these plants under field condition. Carbendazim and mancozeb were found to be effective in Piper longum in terms of higher disease control (47.50 & 41.47%) with lower per

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cent disease incidence (49.87 & 51.47%) and per cent disease index (25.34 & 28.25%) over the control. Although all the Trichoderma isolates were not effective as chemical fungicides but Trichoderma isolate-3 was found to have more efficiency in disease control (35.23%) compared to other two isolates. Mancozeb was treated as the most effective fungicide in *T. indica* to control the disease (45.07%) with lower disease incidence (54.87%) and disease severity (27.34%) compared to other treatment and control plot. In contrary in *H. subdariffa* carbendazim was found the most effective fungicide with lowest disease incidence (47.89%) and disease severity (23.37%) resulting higher disease control (47.81%) compared to control. It was followed by cupper oxychloride and mancozeb comparatively with higher disease incidence (49.79 & 51.43%) and disease severity (25.89 & 31.78%). Whether all the Trichoderma isolates did not show significant efficacy as fungicides but Trichoderma isolate-3 showed comparatively good result in disease control (34.32%) over other two isolates and control plot. So, the aforementioned respective fungicides could be used in the control of leaf blight disease of respective medicinal plant. But to control the disease with bio agents more efficient Trichoderma culture need to be investigated.

Keywords: Hibiscus subdariffa; leaf blight; management; Piper longum; trichoderma isolate; Tylophora indica.

1. INTRODUCTION

India has a rich culture of medicinal herbs and spices, which includes about more than 2000 species and has a vast geographical area with high potential abilities for Ayurvedic, Unani, Siddha traditional medicines but only very few have been studied chemically and pharmacologically for their potential medicinal value (Gupta et al., 2005).

Human beings have used plants for the treatment of diverse ailments for thousands of years. According to the World Health Organization, most populations still rely on traditional medicines for their psychological and physical health requirements (Rabe and Van Stoden, 2000), since they cannot afford the products of Western pharmaceutical industries, together with their side effects and lack of healthcare facilities. Rural areas of many developing countries still rely on traditional medicine for their primary health care needs and have found a place in day-to-day life. These medicines are relatively safer and cheaper than synthetic or modern medicine. People living in rural areas from their personal experience know that these traditional remedies are valuable source of natural products to maintain human health, but they may not understand the science behind these medicines, but knew that some medicinal plants are highly effective only when used at therapeutic doses.

Herbal medicines are in great demand in both developed and developing countries as a source of primary health care owing to their attributes having wide biological and medicinal activities, high safety margins and lesser costs. Herbal molecules are safe and would overcome the resistance produced by the pathogens as they exist in a combined form or in a pooled form of more than one molecule in the protoplasm of the plant cell (Tapsell *et al.,* 2006). Even with the advent of modern or allopathic medicine, Hosseinzadeh *et al*. in 2015 have noted that a number of important modern drugs have been derived from plants used by indigenous people.

In India, West Bengal government has recommended some medicinal plants like Aswagandha, Sarpagandha, Senna, Tulsi, Pipul etc for commercial cultivation in different zones. But several biotic and abiotic factors limit the production of these crops. Those pathogenic disease cause significant damage of the crops as well as reduce the quality of the produces and acceptability to the market. The disease may reduce the active chemicals components in the plant parts used for medicinal purpose (Sarkar and Dasgupta, 2021). There are few important diseases (Root rots, cankers, wilts, leaf spots, scabs, blights, anthracnose, rusts, mildews, smuts, mosaics, yellows, root knots, etc) which reduce the quality of the product of the medicinal plants. The production of Pipul *(Piper longum),* Antomul (*Tylophora indica*) and Tak bhendi (*Hibiscus subdariffa*) is drastically reduced every year due to the leaf blight disease. The management of this disease is very crucial for better production.

So, our experiment is major concerned with the finding of effective molecules of chemical fungicides and bio control agents for successful management of this disease in these medicinal plants.

2. MATERIALS AND METHODS

A field trail was conducted at 'C' Block farm, Kalyani. The chemicals and bioagents were sprayed at 15 days interval for three times.

To prepare a spore suspension of *Trichoderma* spp., eight days old culture plates were used, which were grown on PDA at 28± ºC. The plates were rinsed by brush with sterilized distilled water. The suspension was then filtered by muslin cloth to separate the spores from the mycelia. The concentration was adjusted to 3.7×10^8 spores ml^{-1} (Kangjam *et al*., 2023) with the help of haemocytometer. This spore suspension of *Trichoderma* spp. was applied at 6ml $L^{-1}$of water. Among the fungicides, mancozeb and copper oxychloride at 2.5gm L^{-1}lit and carbendazim at 1gm L^{-1} of water were applied to control the disease.

To assess the incidence and severity of leaf blight disease in these medicinal plants, observations were taken at 15 days interval from May to June 2012 & 2013. For calculating the per cent disease incidence, the number of infected leaves and the total number of leaves (both infected and healthy) per plant in a plot were counted. The percent disease index was determined by measuring the percentage of infected area on each leaf per plant through visual assessments in each plot. Each leaf of tagged plant was rated on a scale from 0 to 5, where 0 represents healthy leaves, 1 indicates 1-10% infection, 2 corresponds to 11-20% infection, 3 signifies 21-40% infection, 4 denotes 41-60% infection and 5 indicates over 61% infection. The calculations for disease incidence and severity were performed using the following formulas:

$$\text{Percent disease incidence} = \frac{\text{No.of infected leaves per plant}}{\text{Total no.of leaves per plant}} \times 100$$

$$\text{Disease index} = \frac{\sum \text{Numerical ratings}}{\text{Total No.of units observed} \times \text{highest rating}} \times 100$$

3. RESULTS AND DISCUSSION

3.1 Crop Loss Assessment in *P. Longum* Due to Diseases

The experiment of the evaluation of chemical fungicides and Trichoderma isolates against leaf blight disease of *P. longum* revealed that the carbendazim was the best fungicide to control the disease. It is significantly superior in disease control (47.50%) with lower disease incidence (49.87%) and disease severity (25.34%) compared to other treatments and control plot. Mancozeb was the next fungicide with percent disease control (41.47%) and disease incidence (51.47%) and disease severity (28.25%). But Trichoderma isolates showed comparatively less disease control over control. Trichoderma isolates-3 was better than other two isolates in terms of lower disease incidence (53.41%) and disease severity (31.26%) resulting higher disease control (35.23%). The least disease control (19.61%) was achieved by Trichoderma isolate-2.

The findings of the experiment are similar with the result obtained by Patil et al (2009) where carbendazim + mancozeb was most effective with higher disease control (33.38%) followed by carbendazim (0.1%), copper oxychloride (0.3%) and *Trichoderma viride* (6 x 10^7 CFU/ml) with 30.95%, 30.10% and 28.46% disease control.

3.2 Crop Loss Assessment in *T. Indica* Due to Diseases

The result of evaluation of several chemical fungicides and Trichoderma isolates against leaf blight of *T. indica* was presented in the Table 2. Here mancozeb was considered as the best fungicide to control the disease. It showed higher disease control (45.07%) with lower disease incidence (54.87%) and disease severity (27.34%) over the control. Other two fungicides cupper oxychloride and carbendazim were treated as moderate effective with less disease control (39.23 & 29.16%) and disease incidence (56.49% & 58.43%) and disease severity (30.25% & 35.26%) compared to untreated plot. But all the Trichoderma isolates did not show more efficacy like chemical fungicides due to less disease control. Trichoderma isolate-3 was better than two isolates-1 & 2 in terms of disease control (29.02%) with lower disease incidence (60.41%) and disease severity (35.33%) over control. This result is also similar with Choudhury et al, (2015) where carbendazim and mancozeb were the best fungicides with higher disease control of leaf spot of Thankuni and target leaf spot of Sarpagandha in comparison with the bio control agents.

3.3 Crop Loss Assessment in *H. Subdariffa* Due to Diseases

The result of the experiment (Table 3) suggested that chemical fungicides are more effective compared to biocontrol agents in the management of leaf blight disease of

Table 1. Management of *P. longum* blight caused by *C. gloeosporioides*

Treatments	Percent disease incidence (%)				Percent disease index				Percent disease control over control (%)
	Before 1st spray	After 1st spray	After 2nd spray	After 3rd spray	Before 1st spray	After 1st spray	After 2nd spray	After 3rd spray	
1. Spraying of Blitox (0.25%)	42.51 (40.69)	46.79 (43.16)	49.79 (44.88)	55.39 (48.09)	23.11 (28.73)	26.78 (31.16)	30.59 (33.58)	33.33 (35.26)	30.95
2. Spraying of Bavistin (0.1%)	40.79 (39.69)	42.25 (40.54)	45.74 (42.56)	49.87 (44.93)	19.48 (26.19)	21.49 (27.62)	23.43 (28.95)	25.34 (30.22)	47.50
3. Spraying of Dithane M-45 (0.25%)	39.12 (38.72)	43.29 (41.14)	46.19 (42.81)	51.47 (45.84)	21.17 (27.39)	23.59 (29.06)	25.81 (30.53)	28.25 (32.11)	41.47
4. Spraying of Trichoderma-1	42.18 (40.50)	48.41 (44.09)	51.97 (46.13)	57.19 (49.13)	21.91 (27.91)	28.79 (32.45)	33.79 (35.54)	38.58 (38.40)	20.07
5. Spraying of Trichoderma-2	41.37 (40.03)	48.97 (44.41)	53.79 (47.17)	59.78 (50.64)	23.98 (29.32)	29.91 (33.15)	35.11 (36.34)	38.8 (38.53)	19.61
6. Spraying of Trichoderma-3	43.25 (41.12)	44.17 (41.65)	47.28 (43.44)	53.41 (46.96)	22.69 (28.45)	25.89 (30.59)	29.85 (33.12)	31.26 (33.99)	35.23
7. Control	41.29 (39.98)	57.81 (49.49)	63.79 (53.00)	69.47 (56.46)	23.79 (29.19)	33.78 (35.54)	41.97 (40.38)	48.27 (44.01)	0
C.D.	1.698	1.161	1.209	1.283	0.828	0.893	0.944	0.99	
SE(m)	0.5512	0.373	0.388	0.412	0.266	0.287	0.303	0.318	
SE(d)	0.499	0.527	0.549	0.583	0.376	0.405	0.429	0.45	
C.V.	1.555	1.564	1.58	1.609	1.437	1.458	1.472	1.493	

Table 2. Management of *T.indica* blight caused by *S.rolfsii*

Treatments	Percent disease incidence (%)				Percent disease index				Percent disease control over control (%)
	Before 1st spray	After 1st spray	After 2nd spray	After 3rd spray	Before 1st spray	After 1st spray	After 2nd spray	After 3rd spray	
1. Spraying of Blitox (0.25%)	45.13 (42.21)	49.28 (44.59)	52.2 (46.26)	56.49 (48.73)	22.17 (28.09)	25.57 (30.38)	27.83 (31.84)	30.25 (33.37)	39.23
2. Spraying of Bavistin (0.1%)	49.23 (44.56)	50.16 (45.09)	53.28 (46.88)	58.43 (49.85)	23.69 (29.13)	27.87 (31.87)	31.86 (34.36)	35.26 (36.43)	29.16
3. Spraying of Dithane M-45 (0.25%)	46.77 (43.15)	48.24 (43.99)	51.76 (46.01)	54.87 (47.79)	20.48 (26.91)	23.46 (28.97)	25.44 (30.29)	27.34 (31.53)	45.07
4. Spraying of Trichoderma-1	48.16 (43.95)	54.4 (47.52)	57.94 (49.57)	62.21 (52.07)	22.91 (28.60)	30.78 (33.70)	35.74 (36.71)	40.58 (39.57)	18.48
5. Spraying of Trichoderma-2	47.35 (43.48)	54.96 (47.85)	59.74 (50.62)	64.76 (53.58)	23.98 (29.32)	31.63 (34.22)	37.19 (37.58)	39.97 (39.21)	19.70
6. Spraying of Trichoderma-3	48.5 (44.14)	52.77 (46.59)	55.78 (48.32)	60.41 (51.01)	24.11 (29.41)	28.79 (32.45)	32.61 (34.82)	35.33 (36.47)	29.02
7. Control	47.27 (43.44)	58.96 (50.16)	67.79 (55.42)	73.13 (58.78)	23.79 (29.19)	34.81 (36.16)	42.97 (40.96)	49.78 (44.87)	0
C.D.	2.687	0.936	0.983	1.032	0.642	0.69	0.722	0.752	
SE(m)	0.872	0.3	0.315	0.331	0.206	0.221	0.232	0.241	
SE(d)	0.407	0.425	0.446	0.468	0.292	0.313	0.328	0.341	
C.V.	1.207	1.21	1.23	1.248	1.104	1.103	1.104	1.11	

Table 3. Management of *H.subdariffa* blight caused by *Fusarium* sp.

Treatments	Percent disease incidence (%)				Percent disease index				Percent disease control over control (%)
	Before 1st spray	After 1st spray	After 2nd spray	After 3rd spray	Before 1st spray	After 1st spray	After 2nd spray	After 3rd spray	
1. Spraying of Blitox (0.25%)	35.13 (36.35)	42.28 (40.56)	46.67 (43.09)	49.79 (44.88)	17.98 (25.09)	22.58 (28.37)	23.78 (29.19)	25.89 (30.59)	42.18
2. Spraying of Bavistin (0.1%)	34.77 (36.13)	41.24 (39.95)	46.76 (43.14)	47.89 (43.79)	17.91 (25.04)	20.49 (26.91)	21.98 (27.96)	23.37 (28.91)	47.81
3. Spraying of Dithane M-45 (0.25%)	41.23 (39.95)	43.16 (41.07)	47.28 (43.44)	51.43 (45.82)	19.11 (25.92)	25.79 (30.52)	28.79 (32.45)	31.78 (34.31)	29.03
4. Spraying of Trichoderma-1	38.16 (38.15)	47.33 (43.47)	51.95 (46.12)	55.24 (48.01)	18.21 (25.26)	27.75 (31.79)	31.75 (34.30)	34.97 (36.25)	21.90
5. Spraying of Trichoderma-2	37.35 (37.67)	47.96 (43.83)	53.54 (47.03)	57.71 (49.44)	16.98 (24.33)	28.78 (32.44)	33.24 (35.21)	36.47 (37.15)	18.55
6. Spraying of Trichoderma-3	38.47 (38.33)	45.77 (42.57)	49.78 (44.87)	53.39 (46.94)	19.58 (26.26)	24.79 (29.86)	27.84 (31.85)	29.41 (32.84)	34.32
7. Control	37.27 (37.63)	51.97 (46.13)	61.47 (51.63)	67.81 (55.43)	18.97 (25.82)	32.89 (34.99)	37.45 (37.73)	44.78 (42.00)	0
C.D.	0.815	0.872	0.923	0.967	0.606	0.679	0.708	0.739	
SE(m)	0.261	0.28	0.296	0.31	0.195	0.218	0.227	0.237	
SE(d)	0.37	0.396	0.419	0.439	0.275	0.308	0.321	0.335	
C.V.	1.195	1.191	1.208	1.23	1.114	1.123	1.13	1.142	

H. subdariffa. Carbendazim was treated as the most effective fungicide compared to other two chemical fungicides and Trichoderma isolates in terms of disease control (47.81%) and disease incidence (47.89%) as well as disease severity (23.37%) over the untreated plot. Copper oxychloride was also considered as the good fungicide with moderately effect in disease control (42.18%) over the control. Another fungicide Mancozeb was the least effective with higher disease incidence (51.43%) and disease severity (31.78%) showing very less disease control (29.03%). Among the Trichoderma isolates, only Trichoderma isolate-3 showed the higher efficacy compared to other two isolates in terms of disease control (34.32%) with lower disease incidence (53.39%) as well as disease severity (29.41%) over the control. Isolate- 1 and 2 were the very weak in the disease control (21.90 & 18.55%).

Sarkar *et al.* (2016) conducted an experiment to evaluate the fungicides and bio agents against the leaf blight disease of *H. subdariffa* where carbendazim was superior in the control of the disease compared to other fungicides (mancozeb and copper oxychloride) and bioagents.

4. CONCLUSION

Our current research elaborated those chemical fungicides specially carbendazim and mancozeb showed remarkable effect on reduction of disease incidence and disease severity over the studied plant. Even though Trichoderma isolates tested did not showed that expected level of effectiveness compared to chemical fungicides. But Trichoderma isolate-3 exhibited nearly promising effectiveness among the Trichoderma isolate. From this it is clear that chemical fungicides have better result. Due to hazardous effect of chemical fungicide we need to investigate further for more effective strain of Trichoderma to control diseases or we need to improve their effectiveness by various ways like radiation.

5. FUTURE SCOPE

We need to focus on chemical fungicide along with bio-agents to develop integrated management strategies for disease control ensuring healthy and sustainable world.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT or other AI generating tools… etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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