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Effect of Chemicals and Environment Friendly Components on Growth Parameters and Yield Contributing Character of Onion (*Allium cepa*)

Md. Harun Or Rashid[1], Md. Maksudul Haque[2,*], Dr. Md. Abu Bakr[3] and Dr. Md. Rafiqul Islam[4]

[1]Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh
[2]Plant Breeding Division, Bangladesh Rice Research Institute, Gazipur 1701, Bangladesh
[3]Ex- Chief Scientific Officer, Division of Plant Pathology, Bangladesh Agricultural Research Institute, Gazipur 107, Bangladesh
[4]Professor, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh

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ABSTRACT

Field experiment was conducted at spices Research Centre, BARI, Shibgonj, Bogra to determine the integrated approach for the management of purple blotch of onion for seed production. The treatment of the expeirment were Rovral wp @ 0.2% (T_1), Rovral wp @ 0.1% + Provax 0.25% (T_2); Trichoderma 5x10^6 spore/ml @ 100 ml/plant (T_3); Rovral wp @ 0.1% + Bavistin 0.5% (T_4); Neem leaf extract 1:6 (w/v) (T_5); Rovaral wp @ 0.1% +Evaral @ 0.1% (T_6); Rovaral wp @ 0.1% +Ridomil gold MZ-72 @ 0.1% (T_7); Rovaral wp @ 0.1% +Secure @ 0.05% (T_8) and control (T_9). Different treatment has effect on inhibition of mycelial growth of the fungus. The lowest mycelial growth was recorded in case of T_7 followed by T_2 where the highest mycelial growth was recorded in case of control (T_9). The highest plant height (81.40cm) and the yield (1.24 ton/ha) were recorded in treatment T_7 where as the lowest plant height (61.20cm) and seed yield (0.82. ton/ha) were recorded in control (T_9).

KEY WORDS: Chemicals, Environment, Isolation, yield, Onion (*Allium cepa*)

INTRODUCTION

Onion (*Allium cepa*) is an important spices crop, commercially grown in many countries of the world. It ranks first in production among the spices crop cultivated in Bangladesh. The major onion producing countries like Korea Republic tops the list with 65.25t/ha followed by USA 53.91t/ha, Spain 52.06t/ha, Japan 47.55t/ha (FAO, 2008), where as the productivity of onion in Bangladesh is 8.95t/ha (AIS, 2011) which is very lower than the other onion producing countries. This variation of yield may be due to several constraints that affect onion yield adversely in our country, which may includes the use of low quality seed, imbalanced fertilizers, uneven irrigations; and attack of various insect-pests and diseases. A variety of diseases and disorders affect onion. Most of the diseases are caused by fungi or bacteria where as disorders may be caused by adverse weather, air pollutants, soil conditions, nutritional imbalances and pesticidal affect. Sometimes several diseases and/or disorders may be present at the same time.

In the world, onion is attacked by 66 diseases including 10 bacterial, 38 fungal, 6 nematode, 3 viral, 1 mycoplasmal, 1 parasitic plant and 7 miscellaneous diseases and disorders (Schwartz and Mohan, 2008, Schwartz, 2010). In Bangladesh, several diseases have become widespread and serious enough to limit the production. The common diseases such as purple leaf blotch (*Alternaria porri*), *Stemphylum* blight (*Stemphylium vesicarium)* downy mildew (*Peronospora destructor*) and basal/stem rot (*Fusarium* sp., *Sclerotium* sp., *Rhizoctonia* sp.), damping off etc, are the most destructive diseases that damage the crop and reduce the seed yield up to 100% (Brewster, 2008).
Bulb and seed yields of onions cv. "Nasik Red" were significantly reduced as a result of purple blotch caused by *Alternaria porri* (Gupta and Pathak, 1988). About 20 to 25% losses in seed yield have been recorded in India and 41-44% in Bangladesh (Hossain and Islam, 1993; Fakir, 2002). In Bangladesh the cultivars Faridpuri and Taherpuri are susceptible to the disease (Rahman *et al*., 1988).

Several workers tried to find out suitable control measures, like cultivation of resistant variety, manipulation of the date of planting, management of fertilizers, bulb size, protective spray of fungicides, etc. (Suheri and Price, 2000; Sherf and Macnab, 1986; Srivastava *et al*., 1991; Mishra, 1989; and Mondal *et al*., 1989;). Use of healthy seeds for planting and crop rotation for 2-3 years with cereal crops can check the disease. Schedule and alternate spraying of Mancozeb (0.25%) or Iprodione (0.25%) at first appearance of disease symptoms can reduce the disease. It is reported that, spraying of Rovral (0.2%) + Antracol + Dithane M-45 combinedly can reduce the purple blotch

***Correspondents Author:** Md. Maksudul Haque, Plant Breeding Division, Bangladesh Rice Research Institute, Gazipur 1701 Bangladesh

disease severity (Anon., 2010; and Rahman *et al*., 2010) and that Secure + Rovral showed the best performance in reducing the purple blotch disease of summer onion. Use of plant extracts is however a recent approach to plant diseases management and it has drawn special attention of the plant pathologist all over the world. Many researchers reported plant extracts having antifungal properties and thus having potential to be used against plant diseases (Ayub and Sultana, 2004; and Hossain, 2008; Peters, 1990).

Keeping these facts in mind, the present study was undertaken with the following objectives: Isolation and identification of the causal pathogen and to integrate the selected components for management of the disease.

MATERIALS AND METHODS

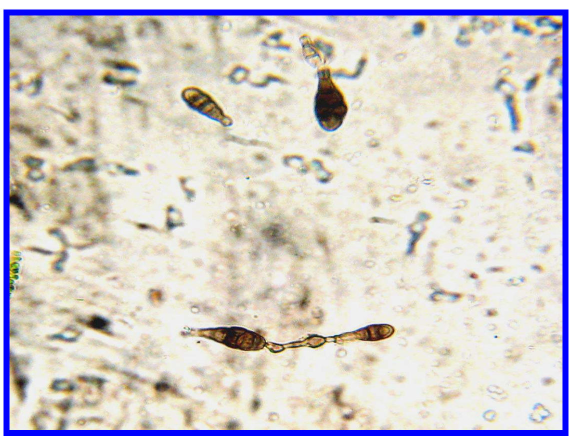
The materials used and methodologies adopted for the research works are elaborately described in this chapter. It included a description of both *in-vitro* screening of fungicide and *in-vivo* efficacy of the fungicides and botanical extracts under field conditions. These comprised isolation of causal pathogens from infected onion plant and bioassay of fungicides, plant extract & bioagent against the test pathogen (*Alternaria porri*) under laboratory condition.

Particulars of the chemicals (fungicides) used in this study

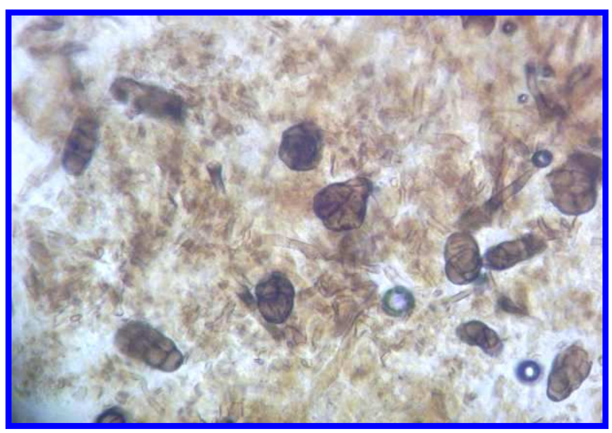
Fungicides	Active ingredient
Rovral 50 WP	Iprodione 50%
Provax	Carboxin+Thiram (37.5+37.5)%
Ridomil Gold (MZ-72)	Metalaxyl 67% + Mancozeb 6%
Evaral	Iprodione50%
Bavistin	Carbendazim 50%
Secure	Fenamidone+Mancozeb(10%+50%)

Isolation of *Alternaria porri* and *Stemphylium vesicarium*

The diseased leaves were cut into pieces (4 mm diameter) and surface sterilized with $HgCl_2$ (1:1000) for 30 seconds. Then the cut pieces were washed in water thrice and were placed on to acidified PDA in Petri dish. The plates containing leaf pieces were placed at room temperature for seven days. When the fungus grew well and sporulated, then slides were prepared and was observed under microscope and identified with the help of relevant literature (CMI Description Vol. No. 338).



Conidia of *Alternaria porri* (X 40)



Conidia of *Stemphylium vesicarium* (X 40)

Treatments of experiment

Altogether there were 09 different treatments as stated bellow. The treatments were applied into the assigned plots as per design of the experiment.

T_1 = Rovral 0.2% (Recommended), T_2 =Rovral + Provax (0.1% + 0.25%), T_3 = Trichoderma (5x10^6 spore/ml), T_4 =Rovra l+ Bavistin (0.1% + 0.5%), T_5 = Neem leaf extract (1:6 w/v), T_6 =Rovral + Evaral (0.1% + 0.1%), T_7 =Rovral + Ridomil (0.1% + 0.1%), T_8 =Rovral + Secure (0.1% + 0.05%) and T_9 = Control

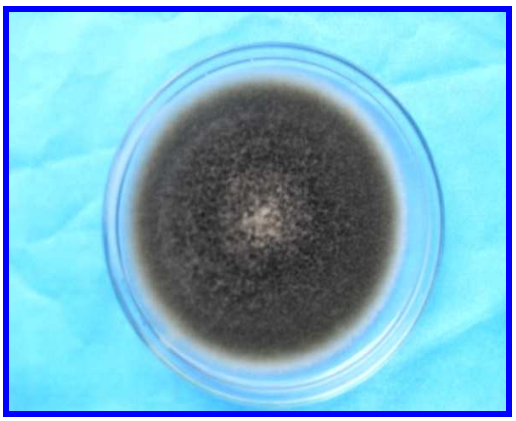
Fungicides	Doses rate	Fungicides	Doses rate
Rovral 50 wp	0.2% Recommended)	Rovral+Bavistin	(0.1%+ 0.5%)
Rovral+Provax	(0.1% + 0.25%)	Rovral+Evaral	(0.1% + 0.1%)
Ridomil gold MZ-72+Rovral	(0.1% + 0.1%)	Rovral+Secure	(0.1% + 0.05%)

Preparation of spray solution:

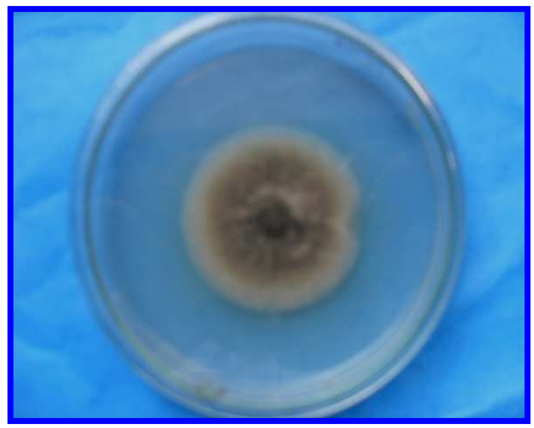
At recommended doses suspension/solution of fungicides were prepared by mixing thoroughly with requisite quantity of normal clean water. Spray was given at seven days interval in the assigned plots. The spray solution of fungicides used in the experiment were presented below with their doses.

Isolation and identification of pathogens from leaf tissue

The diseased leaves were cut into pieces (4 mm diameter) and surface sterilized with $HgCl_2$ (1:1000) for 30 seconds. Then the cut pieces were washed in sterile water thrice and were dried keeping in untreated blotting paper then placed on to acidified PDA in petridish. The plates containing leaf pieces were placed at room temperature for seven days. When the fungus grew well, and sporulated, then the pathogen slide was prepared and was identified under microscope with the help of relevant literature. After incubation the mycelial growth of the fungus from each concentration of the fungicide was recorded.



Pure culture of *Alternaria porri*



Pure culture of *Stemphylium vesicarium*

Analysis of Data/Statistical Analysis

Data were analyzed statistically using MSTAT Computer Program. Data were transformed, whenever necessary, following Arcsine transformation. Means of treatment were separated using Duncan's Multiple Range Test (DMRT), (Gomez and Gomez, 1984).

RESULT

Plant height

Statistically significant variation was recorded in terms of plant height for the effectiveness of different chemicals and environmental friendly components against purple blotch of onion (Table 1). The maximum plant height (81.40 cm) was recorded in the treatment T_7 (Rovral 50 WP @ 0.1% + Ridomil gold MZ-72 @ 0.1%) which was statistically identical (81.00 cm and 78.50 cm) with T_2 (Rovral WP @ 0.1% + Provax 0.25%) and T_8 (Rovral WP @ 0.1% + Secure @ 0.05%). On the other hand, the minimum plant (61.20 cm) was recorded in T_9 (control) which was followed (67.40 cm) by T_3 (Trichoderma 5×10^6 spore/ml @ 100 ml/plant).

Table 1. Effect of chemicals and environment friendly components on growth parameters of onion

Treatment	Plant height (cm)	Number of leaves per plant	Number of flower stalk per hill	Height of onion seed stalk (cm)	Umbel diameter (cm)
T1	77.80 ab	18.10 ab	4.90 bc	60.60 ab	6.03 abc
T2	81.00 a	19.50 a	5.10 ab	61.90 a	6.26 ab
T3	67.40 d	16.13 bc	3.40 e	54.30 cd	5.46 d
T4	71.90 cd	17.00 ab	4.10 d	56.90 abc	5.72 cd
T5	70.10 cd	16.70 abc	3.80 d	55.50 bcd	5.61 cd
T6	74.50 bc	17.60 ab	4.60 c	58.70 abc	5.84 bcd
T7	81.40 a	19.50 a	5.30 a	62.20 a	6.32 a
T8	78.50 ab	18.30 ab	5.00 ab	60.50 ab	6.02 abc
T9	61.20 e	14.20 c	2.50 f	51.20 d	5.02 e
LSD(0.05)	5.038	2.492	0.367	5.194	0.424
CV(%)	10.95	8.25	4.93	5.18	8.23

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

Number of leaves per plant

Number of leaves per plant for the effectiveness of different chemicals and environmental friendly components against purple blotch of onion showed statistically significant variation (Table 1). The maximum number of leaves per plant was recorded in the treatment T_7 and T_2 (19.50) which was statistically identical with T_8 (18.30), T_1 (18.10), T_6 (17.60), T_4 (17.00) and T_5 (16.70), and the minimum number (14.20) was recorded in T_9 preceded by T_3 (16.13).

Number of flower stalk per hill

Statistically significant variation was recorded in terms of number of flower stalk per hill for the effectiveness of different chemicals and environmental friendly components against purple blotch of onion under the present trial (Table 1). The maximum number of flower stalk per hill was recorded in the treatment T_7 (5.30) which was statistically identical with T_2 (5.10) and T_8 (5.00), and the minimum number (2.50) was recorded in T_9 preceded by T_3 (3.40).

Height of onion seed stalk

Different chemicals and environmental friendly components against purple blotch of onion varied significantly in terms of height of onion seed stalk for the effectiveness of (Table 1). The longest seed stalk was recorded in the treatment T_7 (62.20 cm) which was statistically identical with T_2 (61.90 cm), T_8 (60.50 cm), T_1 (60.60 cm), T_6 (58.70 cm) and T_4 (56.90 cm).The shortest seed stalk (51.20 cm) was recorded in T_9 preceded by T_3 (54.30 cm) and T_5 (55.50 cm).

Umbel diameter

Statistically significant variation was recorded in terms of umbel diameter for the effectiveness of different chemicals and environmental friendly components against purple blotch of onion (Table 1). The highest diameter of umbel was recorded in the treatment T_7 (6.32 cm) which was statistically identical with T_2 (6.26 cm), T_8 (6.02 cm), T_1 (6.03 cm), while the lowest diameter (5.02 cm) was recorded in T_9 preceded by T_3 (5.46 cm) and T_5 (5.61 cm).

Yield Contributing Characters

Number of florets per umbel

Significant difference was recorded in terms of number of florets per umbel for the effectiveness of different chemicals and environmental friendly components against purple blotch of onion (Table 2). The maximum number of florets per umbel was recorded in the treatment T_7 (310) which was statistically identical which was followed with T_2 (308) and T_8 (301), and the minimum number (224) was recorded in T_9 preceded by T_3 (263).

Number of effective florets per umbel for the effectiveness of different chemicals and environmental friendly components against purple blotch of onion showed statistically significant differences (Table 2). The maximum number of effective florets per umbel was recorded in the treatment T_7 (286) which was statistically identical with T_2 (284) and T_8 (271), and the minimum number (193) was recorded in T_9 preceded by T_3 (223).

Table 2. Effect of chemicals and environment friendly components on yield and yield contributing characters

Treatment	Number of florets per umbel	Number of effective florets per umbel	Number of seeds per umbel	Weight of 1000 seeds (g)	Seed yield (t/ha)
T_1	294 abc	262 abc	936 ab	3.43 ab	1.17 abc
T_2	308 a	284 a	953 a	3.55 a	1.21 ab
T_3	263 c	223 d	872 c	3.11 c	1.05 c
T_4	279 abc	245 bcd	902 bc	3.32 abc	1.11 bc
T_5	271 bc	234 cd	886 c	3.24 bc	1.09 bc
T_6	288 abc	258 abc	912 bc	3.38 abc	1.14 abc
T_7	310 a	286 a	954 a	3.56 a	1.24 a
T_8	301 ab	271 ab	943 ab	3.51 ab	1.18 ab
T_9	224 d	193 e	754.00 d	2.76 d	0.82 d
$LSD_{(0.05)}$	28.66	28.01	38.12	0.257	0.110
CV(%)	5.87	6.46	5.44	7.52	5.59

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

Number of seeds per umbel

Statistically significant difference was recorded in terms of number of seeds per umbel for the effectiveness of different chemicals and environmental friendly components against onion purple blotch (Table 2). The maximum number of seeds per umbel was recorded in the treatment T_7 (954) which was statistically identical with T_2 (953) and T_8 (943), and the minimum number (754) was recorded in T_9 preceded by T_3 (872) and T_5 (886).

Weight of 1000 seeds

Different chemicals and environmental friendly components against onion purple blotch showed statistically significant variation in terms of weight of 1000 seeds for the effectiveness of (Table 2). The highest weight of 1000 seeds was recorded in the treatment T_7 (3.56 g) which was statistically identical with T_2 (3.55 g), and the lowest weight (2.76 g) in T_9 preceded by T_3 (3.11 g).

Seed yield

Statistically significant variation was recorded for weight of seed yield in the effectiveness of different chemicals and environmental friendly components against onion purple blotch (Table 2). The highest seed yield was recorded in the treatment T_7 (1.24 t/ha) which was statistically identical with T_2 (1.21 t/ha), T_8 (1.18 t/ha), T_1 (1.17 t/ha) and T_6 (1.14 t/ha), and the lowest seed yield (0.82 t/ha) was recorded in T_9 preceded by T_3 (1.05 t/ha), T_5 (1.09 t/ha) and T_4 (1.11 t/ha).

DISCUSSION

The present experiment was conducted to find out the effect of chemicals and environmental friendly components for the management of purple blotch of onion. Efficacy of the chemicals and environmental friendly components in controlling purple blotch of onion caused by *Alternaria porri* was assessed based on the mycelial growth against the test materials. Different treatments have effect on inhibition of mycelial growth of the fungus. The lowest mycelial growth was recorded in the treatment T_7 where Rovral 50 WP (0.1%) is used combinedly with Ridomil Gold (0.1%) followed by T_2 (Rovral 50 WP 0.1%+ Provax 0.25%), T_8 (Rovral 50WP 0.1% + Secure @ 0.05%) and T_1 (Rovral WP @ 0.2%). The highest mycelial growth was recorded in T_9 (control). Treatment T_3 (Trichoderma 5×10^6 spore/ml) and T_5 (Neem leaf extract 1:6 (w/v), showed significantly better performance than the control but less effective than the chemical alone or combined. The findings of the experiment revealed that Rovral 50 WP @ 0.2% or combination of Rovral with other fungicides was more effective for the inhibition of mycelial growth of the fungus. Rahman *et al.* (1989) evaluated six fungicides against *A. porri* in the laboratory and found Rovral as a promising fungicide in reducing the mycelial growth of the fungus. Islam *et al.* (2001) also found that Rovral 50 WP as the most effective fungicides in inhibition of mycelial growth of the fungus. Similar results also reported by BARI (2004-2005) and Datar (1996) from their earlier research.

Islam *et al.* (2003) reported the relative efficiencies of ten fungicides against *Alternaria porri* causing purple blotch of onion. The fungicides Rovral and Ridomil reduced all the disease parameters incurring higher seed yield. Prodhan (2005) observed that performance of Rovral was the best in reducing mean severity of the disease and increased bulb yield compared to control. Rahman *et al.* (1989) reported that increase of onion yield was achieved with Rovral, Dithane M-45 and Bordeaux mixture. Maximum yield increase (61%) was achieved with Rovral followed by Dithane M-45 (36%). Rahman (2004) reported that among 6 fungicides, Rovral 50 WP significantly reduced the disease severity of purple blotch of onion. Srivastava *et al.* (1996) observed that seedling dipped in Carbendazim and thiophanate methyl followed by 4 sprays of Rovral 50 WP was effective against purple blotch of onion. Islam, *et al.* (2001) reported that Rovral 50 WP gave promising effect in reducing the disease severity of purple blotch of onion. Hoque (2008) reported that the bulb treatment with Rovral 50 WP (0.2%) followed by foliar spraying with Rovral 50 WP at 7 days interval starting from onset of the disease minimized disease incidence and severity of purple blotch of onion. No report is available about the combined use of different fungicides against purple blotch of onion. In the present experiment the combined use of Rovral with other fungicide @ half of the recommended doses of each showed better performance than the use of Rovral 50WP (@ recommended dose) alone for the management of purple blotch of onion for seed production.

CONCLUSION

Field experiment with different fungicides alone and in combination of Neem extract (a botanical) and *Trichoderma* (a bioagent) was conducted. The performance of ecofriendly components Trichoiderma and Neem leaf extract against the disease were signicantly better than control but not up to the mark compared to the fungicide alone or in combination.

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