SEED YIELD LOSS ASSESSMENT FOR PURPLE BLOTCH COMPLEX OF ONION

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JUNE, 2013

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Registration No. 06-01990

A Thesis
Submitted to the Faculty of Agriculture,
Sher-e-Bangla Agricultural University, Dhaka,
In partial fulfillment of the requirements
For the degree of

MASTER OF SCIENCE
IN
PLANT PATHOLOGY
SEMESTER: JANUARY-JUNE, 2013

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I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

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Place: Dhaka, Bangladesh

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ACKNOWLEDGEMENTS

All praises to Almighty and Kindfull “Allah Rabbul Al-Amin” who enabled the author to pursue his higher study and to complete the research work and submit the thesis for the degree of Master of Science (M.S.) in Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh.

The author wishes to express his profound sense of appreciation and heartiest gratitude to his Supervisor, **Dr. Md. Rafiqul Islam**, Professor, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka for his help, scholastic supervision, continuous encouragement and constructive suggestion throughout the period of research and for taking immense care in preparing this manuscript.

The author like to expresses his immense gratitude to his Co-supervisor, **Professor Mrs. Nasim Akhtar**, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka for his valuable advices and constructive criticism during the period of research work.

Cordial thanks and honor to **Dr. F. M. Aminuzzaman,** Associate Professor and Chairman, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka for his valuable advices and cooperation during the period of research work.

The author would like to extend his appreciation to all teachers of the Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka for their co-operation and encouragement during the study period.

Thanks are extended to Pritilata, Rehena Akhter and Khorshed Al Alam, Laboratory staff, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh for their help and assistance during the research work.

This is not enough to express his profound gratitude and deepest appreciation to his father Gonjer Ali, mother Momena Khatun, Brothers Rashed, Rakib and nephews Shimu, Sumon for their ever ending prayer, encouragement, sacrifices and dedication for the higher education of the author.

The author would like to thank to his wife (Bobita Aktari) who has inspired him with mental support to conduct the research and prepare this thesis.

The author feels proud to express his sincere appreciation and gratitude to all of his friends especially Tuhin, Rony, Shamim, Mitu, Masud, Ibrahim for their help and encouragement.

The author is really grateful to his senior brothers and sisters, Abdul Motin, Gaziul Haque, and Mosammat Afroza Daisy for their co-operation to complete the research work.

The Author

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ABSTRACT

Experiments were conducted in the farm of Sher-e-Bangla Agricultural University and in the Seed Health Laboratory, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka 1207 during the Rabi season from November 2011 to March 2012 with a view to study on the seed yield loss assessment for purple blotch complex of onion. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 4 (four) replications. Multiple treatments viz. T_0 (Control) , T_1 (One field spraying with Rovral 50 WP @ 0.2%), T_2 (Two field spraying with Rovral 50 WP @ 0.2%) , T_3 (Three field spraying with Rovral 50 WP @ 0.2%), T_4 (Four field spraying with Rovral 50 WP @ 0.2%), T_5 (Five field spraying with Rovral 50 WP @ 0.2%), T_6 (Six field spraying with Rovral 50 WP @ 0.2%), T_7 (Seven field spraying with Rovral 50 WP @ 0.2%), T_8 (Eight field spraying with Rovral 50 WP @ 0.2%), T_9 (Nine field spraying with Rovral 50 WP @ 0.2%) and T_{10} (Ten field spraying with Rovral 50 WP @ 0.2%) were explored in the experiments to make variation in the disease severity and respective yield of treated plot. Remarkable variations were observed in the disease severity of purple blotch on seed yield and yield contributing characters of onion. The lowest (0.0%) Percent Disease Index (PDI) and the highest seed yield (649.40 kg/ha) was recorded in case of treatment T_{10} where 10 spraying were applied with Rovral 50 WP @ 0.2%. The highest PDI (78%) and the lowest seed yield (365.26 kg/ha) was counted in case of treatment T_0 (control).Using the variation of seed yield loss with corresponding disease severity, the yield loss assessment was made by the regression equation $\hat{Y} = 0.04 + 0.56Xi$. It indicates that each percent increase of disease severity decreased 0.56 % yield.

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CHAPTER I

INTRODUCTION

The onion (*Allium cepa*), is the most widely cultivated species of the genus *Allium*. Onion is an important spice crop in Bangladesh. It ranks first in production among the spices crop cultivated in Bangladesh. Based on yield potential of the major onion producing countries, 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 too lower than the other onion producing countries. Onion bulb provides quite vitamin C 19.7%, fiber 10.8%, molybdenum 10.6%, manganese 10.5%, vitamin B 69.5%, potassium 6.6 %, and tryptophan 6.2%. Onions are very low in calories (just 40 cal per 100 g) and fats; but rich in soluble dietary fiber. It is used as important and popular vegetables in Australia, Belgium, India, Japan, United Kingdom, USA and many other countries. Spices are important constituents of food items in Bangladesh. A good number of spices crops are grown in Bangladesh. The major ones are Onion, Garlic, Zinger, Turmeric, Coriander, Chili, etc. The onion suffers from different diseases and incurs substantial losses every year in Bangladesh. This lower yield of onion 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 disorders may be present at the same time.

The local varieties namely Faridpuri and Taherpuri are commonly grown in Bangladesh. The demand of bulb onion as well as the onion seeds are increasing every year in Bangladesh and the price of the true seed remains fairly high in the country.

In the world, onion is attacked by 66 diseases including 10 bacterial, 38 fungal, 6 nemic, 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 like 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 even up to 100% (Brewster, 2008).

Purple blotch of onion is noted as a major disease throughout the world including Bangladesh (Ahmed and Hossain, 1985; Meah and Khan, 1987; Bose and Som, 1986 and Castellanos *et al*., 1988). In India purple blotch of onion is a devastating including the latest work and widespread disease causing serious yield reduction (Ahmed and Goyal, 1988). The disease is also a great threat for seed production of onion (Gupta *et al*., 1986; Rahman *et al*. 1988 and Yazawa, 1993).

The purple blotch disease is characterized with small water-soaked lesions initially produce on leaves and seed stalk that quickly develop white centers. As lesions enlarge, they become zonate, brown to purple, surrounded by a yellow zone and extend upward and downward for some distance. Under humid condition, the surface of the lesion may be covered with brown to dark gray structure of fungus. A few large lesions have been formed in a leaf or seed stalk which may coalesce and girdle the leaf or seed stalks.

Usually the affected leaves or seed stalks break down and die within 4 weeks if the environment favors the disease (Gupta *et al.*, 1991).

Now a day's *Stemphylium vesicarium*, the causal agent of white blotch of onion are being considered as an organism involved indirectly with the causation of purple blotch of onion. It is considered that *Stemphylium vesicarium* initiate the infection which facilitates subsequent infection of *Alternaria porri* causing purple blotch and hence the disease is designated as purple blotch complex.

Onion seed production is severely affected by purple blotch complex of onion because the disease causes breaking of floral stalks (Munoz *et al*., 1984). Damage of foliage and breaking of floral stalks results failure of seed production of onion (Munoz *et al*., 1984; Ashrafuzzaman and Ahmed, 1976). The infected seed stalks break down at the point where the blotch lesion is developed (Singh, 1987).

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 (Thind and Jhooty, 1982) 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; Islam *et al* ; 2001).

Temperature and humidity are the most predominant factors for the development of purple blotch disease. The disease is favored by moderate temperature (24-30 ^{0}C) and high relative humidity (Gupta and Pathak, 1986; Evert and Locy, 1990 and Rodriguez *et al*., 1994).

Now a day's farmers are less interested for onion cultivation that affect the national yield which make the country for importing enormous amount of

onion bulb every year at the cost of huge foreign exchange. Unstable price of onion in the local market, especially in the month of Ramadan is mainly due to the shortage of onion production and lack of information about the total national yield losses for purple blotch complex. But no initiatives had yet been taken to estimate the crop loss assessment of the disease. The Government need to have the picture about national yield status of onion prior to harvesting the crops to take necessary step to meet up the national demand.

Keeping these facts in mind, the present study was undertaken with the following objectives:

i. To make variation in the disease severity of purple blotch complex of onion by applying multiple treatment.
ii. To estimate the seed yield loss using regression equation

CHAPTER II

REVIEW OF LITERATURE

Onion (*Allium cepa L*) is one of the most important and widely used vegetable and spices crops in Bangladesh as well as many countries all over the world . Researcher all over the world has been carrying out their investigations on the purple blotch complex of onion, its epidemiology and the management of the disease. In Bangladesh very few works have been done in this respect. The available information in this connection over the world has been reviewed in this chapter.

2.1. Varietal Resistance

Alves *et al,* (1983) studied the incidence of purple spot (*Alternaria porri* EII.Cif.) on onion cultivars and hybrids in Manaus, Amazonia. Plants were divided into five classes on the basis of natural infection in the field. Incidence was 30-50% (class II) in most cases ; only the hybrids Px76 having plants in class I (0-10%).

Bhonde *et al,* (1992) conducted a field trial during 1987-1988 on 8 onion cultivars (Agrifound Light red, Arka Niketan, L-102-1, Nasik Red and Pusa Red, Agrifound Dark Red, Arka Kalyan and Kharif Local). Agrifound Light Red had a good yield and had the highest DM content.

Das (2010) reported that at seedling stage in net house no disease incidence of white blotch of onion (*Stemphylium vesicarium*) were recorded in case of BARI piaz-3, Indian big and Indian small. The lowest disease incidence and highest yield also recorded in BARI piaz-3, Indian big and Indian small among nine onion cultivars viz. BARI piaz-1, BARI piaz-2, BARI piaz-3, Thakurgong local, Foridpur local, Manikgong local, Indian big, Indian small and Taherpuri. BARI piaz-1 showed lower performance in respect of all parameters.

Gupta and Pathak (1988) studied 21 indigenous and exotic cultivars screened at 2 locations in India under artificial condition. All the exotic lines except 2 from the Sudan were highly resistant to *Alternaria porri* while all the indigenous lines were found susceptible. It is suggested that susceptible cultivars should be replaced by the resistant Pusa Red.

Kibria (2010) reported that BARI piaz-3 gave lowest disease incidence and highest yield (12.67 t/ha) against purple blotch of onion (*Alternaria porri*) among nine onion cultivars viz. BARI piaz-1, BARI piaz-2, BARI piaz-3, Thakurgong local, Foridpur local, Manikgong local, Indian big, Indian small and Taherpuri. In case of disease reaction 8.00% observed in BARI piaz-3 and was graded as resistant.

Sandhu *et al*. (1982) reported that none of 102 genotypes they screened was resistant to *Alternaria porri.* However, they could locate 12 genotypes which showed moderate resistance reaction. The genotypes that had flat erect leaves showed moderately resistance reaction whereas all those with curved, drooping leaves were susceptible.

Sharma (1997) studied onion genotypes grown in Himachal Pradesh, India, for resistance to *Alternaria porri* during 1991-92. The lines IC48059, IC48179, IC39887, IC48025 and ALR found resistant.

Thirumalachar *et al.* (1953) reported about the existence of some varietal resistance and they stated that the fungus *Alternaria porri* (purple blotch) caused severe scorching of some onion varieties at the College of Agriculture, Sabour; but the indigenous red variety had remained uninfected.

2.2 Epidemiology and management

Ahmed *et al*. (1999) conducted an experiment to evaluate the efficacy of six fungicides against the purple blotch of onion caused *Alternaria porri* viz. Rovral 50WP (0.2%), Ridomil MZ -72 (0.2%), Folicur 250EC (0.1%), Dithane

M-45 (0.2%) and Tilt 250EC (0.1%). Among the fungicides, Rovral 50WP and Ridomil MZ -72 found to be effective in controlling the disease incidence and disease severity with corresponding increase in seed yield by 100% when they were used alone or in combination of 1:1.

Akter (2007) conducted a field experiment at the research farm of Sher-e-Bangla Agricultural University, Dhaka during the rabi season of 2006-2007 to study the management of purple blotch of onion through chemicals and plant extracts. Eleven treatments comprising Dithane M-45, Rovral 50WP, Bavistin 50WP, Cupravit 50WP, Proud 250EC, Champion, Tilt 250EC, Ridomill Gold, Neem leaf extract, Allamanda leaf extract and Control were explored in the experiment. The highest bulb yield (8.767 t/ha) was obtained with Rovral 50WP treated plot. The percent plant infection, percent leaf infection, percent Leaf Area Diseased (% LAD) and Percent Disease Index (PDI) were the lowest in foliar spray with Rovral 50WP and the highest in control treatment. Neem extract performed better than Allamanda extract.

Ali (2008) reported that Rovral 50WP @ 0.2% reduced the highest mycelial growth of *Alternaria porri* and *Stemphylium vesicarium* followed by Ridomill Gold MZ-72 @ 0.2% and Dithane M-45 @ 0.45% compared to control. In the field experiment, the treatments showed significant effect in respect of disease incidence, disease severity, seed yield and yield contributing characters. The lowest disease incidence and disease severity were observed in Rovral 50WP @ 0.2% + micronutrients followed by Rovral 50WP @ 0.2% alone, Dithane M-45 @ 0.45% + micronutrients and Dithane M-45 @ 0.45% alone. The highest disease incidence and disease severity were recorded in control treatment.

Datar (1996) tested eight fungicides, viz. Carbendazim, Copper oxychloride, Zineb, Mancozeb, Iprodione, Thiophanate methyl, Dithianon and Ziram at 100, 250 and 500 ppm which significantly reduced the conidial germination of *Alternaria porri* on onion cv. N-53-1 over control.

Gupta and Pathak (1988) reported that bulb and seed yields and 1000 seed weight of Nashik Red onion were significantly reduced by *Alternaria porri* infection. Disease severity was computed in terms of the co-efficient of disease index (Codex). A linear relationship was found between yield and Codex.

Gupta *et al*. (1996) reported that Purple blotch (*Alternaria porri*) and Stemphylium blight (*Stemphylium vesicarium*) are 2 rnajor diseases causing serious losses of onion crops in india. To determine effective control measures of the diseases, studies were undertaken in Karnal, Haryana, India, during kharif, 1993, 1994 and 1995. Three sprays each of iprodione (as Rovral), fosetyl (as Aliette), chlorothalonil, metalaxyl (as Ridomil), iprobenfos (as Kitazin) and benomyl and 4 sprays of mancozeb (as a control) were applied, after disease onset. Results from a 3-years study revealed that 3 sprays of chlorothalonil (0.2%) or iprodione (0.25%) were alternatives for controlling both *Alternaria porri* and *Stemphylium vesicarium*.

Islam (1995) evaluated seven fungicides against *Alternaria porri* causing purple blotch of onion. Score (Difenconazole) was found as the most effective fungicide followed by Rovral (Iprodione), Tilt 250 EC (Propiconazole) and Folicur (Tebuconazole). Percentage of reduction in disease index varied from 48.34 to 65.44 in score, 45.48 to 64.02 in Rovral, 34.90 to 47.24 in Tilt 250 EC and 32.93 to 46.34 in Folicur. Fungicidal treatments increased bulb yield by 10.53% to 95.53% over unsprayed control.

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Islam *et al.* (2001) conducted an experiment to evaluate the efficacy of eight fungicides viz. 'Score (Difenconazole), Tilt 250 EC (Propiconazole),Folicur (Tebuconazole), Rovral 50wp (Iprodione), Knowin (carbendazim), Macuprax.(Borcleaux mixture + curfanex), Bavistin 50WP(carbendazim), Ridornil MZ-72 (Metalaxial + Mancozeb) against the purple blotch of onion caused by *Alternaria porri* Among the fungicides, Rovral 50WP was the most effective fungicide next to score in reducing radial mycelial growth of *Alternaria porri* in in-vitro and disease incidence and severity of purple blotch of onion in field.

Islam *et al.* (2003) evaluated the relative efficacy of ten fungicides against *Alternaria porri* causing purple blotch of onion. Rovral and Ridomil reduced disease incidence and severity and incurring higher seed yield.

Khare and Nema (1982) also reported that the temperature ranged between 22^0 C to 25^0 C was not only suitable for growth and sporulation of *Alternaria porri* but also optimum for spore germination as well as for infection in onion. They also argued that spore germination on leaves decreased with the increase of nitrogen doses to the host. They also reported that temperature, humidity and nutrients seemed to play important roles for ensuing infection of *Alternaria porri* in onion. Cent percent (100%) spore germination occurred *in vitro* within 4 hrs at 22^0 C, while maximum germination was recorded within 6 hrs at 25^0 C on the host surface.

Khare and Nema (1984) conducted an experiment to determine the effect of temperature and humidity of developing the symptoms of purple blotch of onion incited by *Alternaria porri* and noted that temperature between 22^0 to 25^0 C and relative humidity 90% were favorable for the development of leaf blotch symptom.

Lakra (1999) conducted an experiment in at the India and found that numerous purple spots / blotchs were observed on older leaves and scapes when

fortnightly dew fall was >1.0 mm, relative humidity > 75% and temperature 20-30^{0} C with > 18 hr favourable temperature (10-30) duration. Exposure of leaf to wetness for 8 hr was a pre-requisite for conidial germination. Severe infection reduced the number of scapes/plant, the height of scape, the number of umblets/umbel, the number of seeds/umblet, 1000-grain weight, number of seeds/plant and the seed yield compared to healthy plants.

Miller (1983) reported that measurements of infected leaves were done from bulb initiation to bulb maturity. They observed that the leaf damage levels were significantly lowered on younger leaves than older leaves. Leaves emerging 9, 8, 7, 6 and 5 week before bulb maturity required $5^{1}/_{2,}$ 5, $4^{1}/_{2}$, $3^{1}/_{2}$ and $2^{1}/_{2}$ weeks, respectively to reach 50% damage.

Miura (1985) found that *Alternaria porri, A. alternata* and *Fusarium spp*. are predominated among the fungi isolated from onion seeds. *In vitro* products based on iprodione gave the best results resulting 97.4% control of the fungi with 81.4% germination against 54.8% germination of untreated seeds.

Nuchart Joglaekha *et al*. (1982) observed that most of the conidia produced germ tubes and penetrated leaves within 8 hrs. after inoculation. The conidia were club shaped with cross and longitudinal septa. This fungus produces spores when the temperature lies between 18^{0} C- 26^{0}C.

Prateung and Sangawonge (1991) conducted a field trial to determine the efficacy of nine (9) fungicides for controlling purple blotch of onion caused by *Alternaria porri* during January-April 1989. The first spray was made 40 days after transplanting the onion seedlings, and the second and third sprays at weekly intervals. The fourth spray was made 12 days after the third. The results after 2nd applications of fungicides indicated that rnyclobutanil, iprodione, and

imazalil gave the lowest percentage of disease infection. Triphenyl tin acetate and myclobutanil + mancozeb gave the second best result.

Perez- Moreno *et al*. (1992) observed that Iprodione gave the best control of purple spot and downy mildew followed by Fosetil. Fosetil gave the best control of the disease in the fresh market cultivars whereas; Iprodione gave the most effective disease control in the hybrids (USA origin). Iprodione gave the highest yield followed by Fosetil.

Prodhan (2005) evaluated thirteen fungicides to control purple blotch of onion. All the tested fungicides reduced the severity of the disease. The performance of Rovral, Controll, Contaf and Pharzeb were the best in reducing mean severity of the disease and increased bulb yield compared to control.

The efficacy of six fungicides was evaluated by Rahman *et al*. (1988) for controlling leaf blotch of onion (*Alternaria porri*). Rovral and Dithane M-45 were found to be the best both in laboratory and field conditions. Under field conditions, all the test fungicides gave significant reduction of disease severity but significant increase of onion yield was achieved with Rovral, Dithane M-45 and Bordeaux mixture that gave 61, 35 and 29% yield increases, respectively.

Rahman *et al.* (1989) evaluated six fungicides viz. Antracol (Propineb) 65 WP, Bordeaux mixture (copper sulphate and lime), Cupravit (copper oxychloride), Dithane M-45 (Mancozeb), Rovral (Iprodione) and Trimiltox forte (Cu-salts and Mancozeb) for their efficacy against leaf blotch (*Alternaria porri*) of onion in laboratory and field condition. All the fungicides gave significant reduction of mycelial growth and disease severity. Increase of onion yield was achieved with Rovral, Dithane M-45 and Bordeaux mixture. Maximum yield increase was achieved with Rovral (61%) followed by Dithane M-45 (36%) and Bordeaux mixture (29%).

Rahman (2004) observed the effect of three fungicides viz., Ridomil, Rovral and Tilt 250 EC (0.2%) comprising 13 treatments in field experiment. Eight

sprays of Rovral or Ridomil at 7 days interval minimized disease incidence and increased yield. Rovral 0.2% sprayed at 7 days interval was the best, which gave the highest reduction in disease incidence and severity of leaf blotch and eventually increased the yield of onion.

Srivastava *et al.* (1994) made a five years survey (1988-93) in both the kharif and robi onions and reported the high incidence (2.5 - 87.8%) of purple blotch was observed when high humidity prevailed in the environment.

Sugha (1995) conducted a field trial on the management of purple blotch of garlic caused by *Alternaria porri* during winter season of 1989-90, 1990-91 and 1991-92 and reported that three foliar sprays of Iprodione @ 0.1% alone or in combination with Copper oxychloride 0.1% and Mancozeb 0.1% at 15- days intervals resulted in 53.5 to 62% protection to the crop. Clove dip in Iprodione 0.25% for 1 hr before sowing followed by 2 sprays of Metalaxyl + Mancozeb (Ridomil MZ @ 0.25%) or Iprodione @ 0.2% proved highly effective, giving 79.6-84.9% control of the disease. Iprodione and Metalaxyl + Mancozeb were superior to Chlorothalonil, Copper oxychloride, Mancozeb and Zineb improving protection to garlic crop from purple blotch.

During 1992-93 and 1993-94 in Haryana, India, total failure of onion seed crop occurred due to Stemphylium blight (*Stemphylium vesicarium*) and purple blotch (*Alternaria porri*). To overcome this alarming situation Srivastava *et al.* (1995) conducted trials with Iprobenfos (Kitazin), Iprodione (Rovral), Fosetyl (Aliette), Kavatch, Thiophanate-methyl (Topsin M), Benomyl, Metalaxyl (Ridomil) and Mancozeb. Observation on disease intensity/PDI was recorded at fortnightly intervals, just before each spray, and a total of 5 sprays were applied. They recommended that seed growers in North India should apply fortnightly sprays of 0.25% Mancozeb or 0.25% Iprodione to control onion seed diseases caused by *Stemphylium vesicarium* and *Alternaria porri*.

Uddin (2005) reported bulb treatment followed by six foliar spraying at 10 days interval starting from 20 days after bulb sowing with Dithane M-45 (0.45%) or Rovral (0.2%) minimized disease incidence and severity and increased seed yield. The least seed infection by *Alternaria porri* and the highest seed germination was recorded in the seed sample picked up from Dithane M-45 and Rovral 50WP treated plot in a post harvest seed health test.

2.3 Crop loss assessment

Ahmed and Hossain (1985) recorded purple blotch of onion from all onion growing regions of Bangladesh. Ashrafuzzaman and Ahmed (1976) also reported that the damage of foliage and breaking of floral stalks due to the disease resulting in failure of seed production are common.

Hossain *et al.*, (1993) reported that 41-44% loss of seed crop in Bangladesh due to purple blotch of onion. Under favorable environmental conditions of the disease, complete failure of onion seed crop was observed (Sharma, 1986). The disease causes 20-25% loss in seed yield in India. (Thind and Jhooty, 1982).

Sultana *et al.* (2008) conducted an experiment in the field of Plant Pathology Division, BARI, Joydebpur to assess yield loss of onion bulb due to purple blotch disease. The design was paired plot technique having 5 replications using variety Taherpuri. Result indicate, 71.95% disease reduce in the fungicide spraying plot over control. Weight of l0 bulb (g) and yield/plot (kg) also increased 10.6% and 50.9% in fungicide sprayed plot over control.

CHAPTER III

MATERIALS AND METHODS

The details of the materials and methods of this research work were described in this chapter under the following headings and sub-headings:

3.1 Experimental sites

The experiment was conducted in the farm of Sher-e-Bangla Agricultural University, Dhaka. The experimental field is located at the 23^0 74 N latitude and 90^o 35 E longitude with an elevation of 8.2 meter from sea level.

3.2 Experimental period

The experiment was carried out during the Rabi season from November 2011 and to March 2012. Seeds were sown on 15th November, 2011 and were harvested on 21-25, March 2012.

3.3 Soil type

The soil of the experimental site belongs to the Agro-ecological region of "Madhupur Tract" (AEZ No.: 28). It was Deep Red brown Terrace soil and belongs to "Nodda" cultivated series. The top soil is clay loam in texture. Organic matter content was very low (0.82%) and soil pH varied from 5.47-5.63. The information about AEZ 28 is given (Appendix-II)

3.4 Weather

The monthly mean of daily maximum, minimum and average temperature, relative humidity, monthly total rainfall and sunshine hours received at the experimental site during the period of the study have been collected from Bangladesh Meteorological Department, Agargaon, Dhaka (Appendix-III)

3.5 Land Preparation

The experimental field was ploughed with power tiller drawn rotovator. After ploughing the field it was left to nature for 10 days for sun and nature to work upon. Subsequent cross ploughing was done followed by laddering to make the land level. Then the soil clods were broken by a wooden hammer and all weeds, stubbles and residues were removed from the field. Later, Cowdung @ 10 ton/ha and chemical fertilizer like Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MP) was mixed with soil during final land preparation. Finally the land was properly leveled before seed sowing. and plots were prepared as per the Experimental design.

3. 6 Application of Fertilizers

The experimental field was fertilized with Nitrogen (in the form of Urea), Phosphorus (in the form of Triple Super Phosphate -TSP), Potassium (in the form of Muriate of Potash -MP), Gypsum, ZnO and Boric powder. As per the treatment, whole quantity of TSP, MP, Gypsum, ZnO, Boric powder and one fourth of Urea were applied at final plot preparation. The rest third fourth Urea was applied later in three installments on (40, 60 and 80 days after planting). Fertilizer was applied as per recommended doses (BARC,1997). Applied doses were as follows:

Doses of chemical fertilizers

Name of	Name of	Fertilizer	Fertilizer applied during	Rest installments

the nutrient element	the Fertilizer	dose (kg/ha)	final land preparation (kg/182 m^2 land)	(Urea)(kg/182m^2 land)		
				1^{st}	2^{nd}	3^{rd}
N	Urea	320	1.45	1.45	1.45	1.45
P	TSP	415	7.55	-	-	-
K	MP	168	3.05	-	-	-
S	Gypsum	100	1.82	-	-	-
Zn	ZnO	5	0.09	-	-	-
B	Boric powder	5	0.09	-	-	-
	Manure	10000	182			

3.7 Experimental design and layout

The experimental plots were arranged in Randomized Complete Block Design (RCBD) with four (4) replications (Appendix-IV). The experiment details were given bellow:

- Total plot area : 182 m^2
- Number of plot : 40
- Plot size : 3 m^2
- Block to block distance : 1.0 m
- Plot to boundary distance : 0.5 m
- Plot to plot distance(Lengthwise) : 1 m
- Plot to plot distance(breath wise) : 0.5 m
- Plant to plant spacing : 15 cm
- Row to row spacing : 30 cm

3.8 Multiple treatment experiments

Multiple treatments were applied in the experiments. Altogether 11 treatments were applied comprising different number of sprays as follows.

T_0 = No field spraying with fungicide

T_1 = One field spraying with Rovral 50 WP @ 0.2%

T_2 = Two field spraying with Rovral 50 WP @ 0.2%

T_3 = Three field spraying with Rovral 50 WP @ 0.2%

T_4 = Four field spraying with Rovral 50 WP @ 0.2%

T_5 = Five field spraying with Rovral 50 WP @ 0.2%

T_6 = Six field spraying with Rovral 50 WP @ 0.2%

T_7 = Seven field spraying with Rovral 50 WP @ 0.2%

T_8 = Eight field spraying with Rovral 50 WP @ 0.2%

T_9 = Nine field spraying with Rovral 50 WP @ 0.2%

T_{10} = Ten field spraying with Rovral 50 WP @ 0.2%

3.9 Variety Selection:

The experiment was conducted with a local onion variety "Taherpuri". This onion variety is most popular in Bangladesh and its quality is more standard than other local or high yielding variety.

3.10 Collection of onion bulb

Bulb of onion were collected from Gourango bazar, Manikgonj.

3.11 Planting date of onion bulb

Uniform seed (mother) bulbs were planted in the experimental plot in 15th November 2011.

3.12 Planting procedure:

The healthy bulbs were selected for planting in experimental plots. The bulbs were planted maintaining row to row distance 30 cm and plant to plant distance

15 cm. Before plantation, the neck of bulbs were cut with a sharp knife, the prepared bulb was planted, as per design and spacing.

3.13 Intercultural operation

3.13.1 Irrigation

Irrigation was given as per requirement of the land with regular intervals. First irrigation was given after 7days of sowing of bulbs and continued up to harvesting of crop. Water cane with perforated mouth piece was used for soft discharged of water. Irrigation was generally followed the each weeding of the crops.

3.13.2 Weeding and mulching

Weeding and mulching were done when required to keep the crop free from weeds, for better soil aeration and conserve soil moisture. The common weeds were *Cynodon dactylon* L. (Durba grass), *Cyperus rotundus* L. (Mutha) etc. Weeding was done carefully keeping the delicate plants undisturbed.

3.14 Preparation and application of spray solution

The fungicidal solution was prepared by mixing with required amount of fungicide (Rovral 50 WP @ 0.2%) with tap water. The number of sprays varied with the treatment applied. The lowest number of spray was 1 and the highest number of sprays was 10. The first spray was done at 30 days after sowing and others were sprayed will 7 days interval. The last spray was done at 100 days after sowing. Every time the fungicide was freshly prepared prior to application and the spray tank was thoroughly cleaned before filling with new materials. The insecticide (Ektara) was applied to control thrips but not in the same days

of fungicide sprays. Adequate precaution was taken to avoid drifting of spray materials from one plot to neighboring ones by polythine barrier.

Table 1: Details of Fungicide

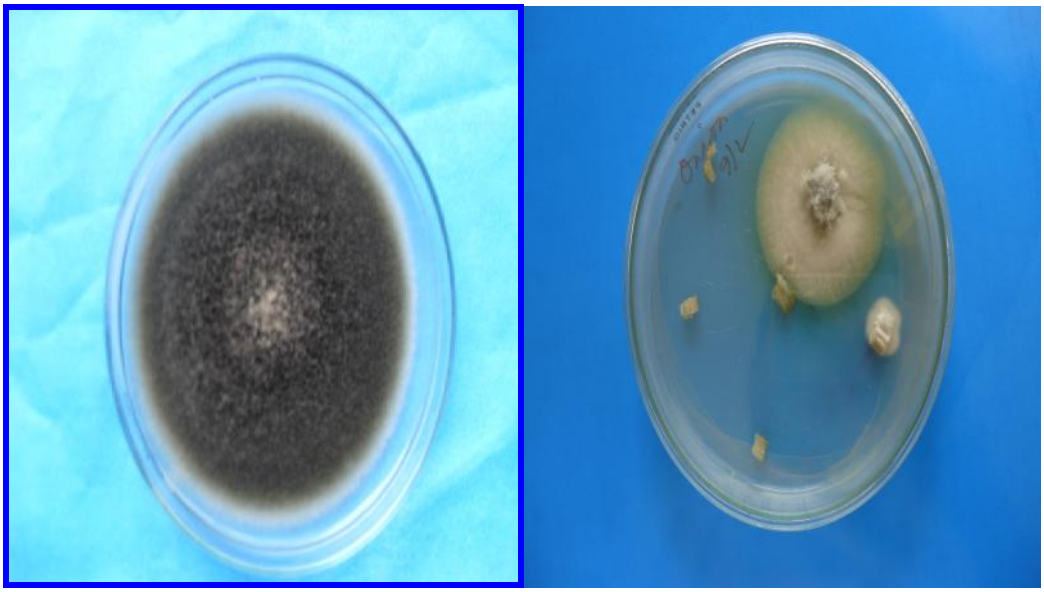
Common name	Chemical name	Active ingredients	Doses used
Rovral 50 WP	3- (3, 5 dichlorophenyl)- N-(Imethylethyl)-2,4 dioxoimidazolidene carboxamide$(C_3H_{13})_3N_3C_{l2}$	Iprodione (50%)	0.2%

3.15 Tagging and data collection:

Randomly ten (10) plants were selected from each plot and tagged for data collection and mean values were determined to get rating score of each treatment.

3.16 Isolation and identification of pathogens

Diseased leaves of onion were collected and cut into pieces (4 diameter) and surface sterilized with H_gCl_2 (1:1000) for 30 seconds. Then the cut pieces were washed in sterile water thrice and then placed into 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 the slide was prepared from the PDA under microscope observed with the help of relevant literature.



A B

Photograph: 1. Pure culture of (A) *Alternaria porri* (B) *Stemphylium vesicarium*

3.17 Collection of data

The following parameters were considered for data collection.

Disease incidence and severity

a. Percent leaf infection

b. Percent leaf area diseased (% LAD)

c. Percent stalk infection

d. Percent stalk area diseased (% SAD)

Yield and yield contributing characters

a. Seed stalk height

b. Number of stalk/hill

c. Number of umbel/plot

d. 1000-seed weight (g)

e. Yield (kg/ha)

Harvested seed

a. Percent seed germination

b. Percent seed infection

3.18 Procedure of data collection

3.18.1 Percent leaf infection

Ten plants per plot were selected and tagged for collection of data. Data on percent leaf infection were recorded at 80 days after planting by visual observation of symptoms. Percent leaf infection was calculated by the following formula.

$$\% \text{ Leaf infection} = \frac{\text{Number of infected leaf}}{\text{Number of total inspected leaf}} \times 100$$

3.18.2 Percent leaf area diseased

Data on percent leaf area diseased (LAD) were recorded at 80 days after planting by visual observation of symptoms. Percent leaf area diseased was calculated by the following formula.

$$\% \text{ Leaf area diseased} = \frac{\text{Leaf area infected}}{\text{Total leaf area inspected}} \times 100$$

3.18.3 Percent stalk infection

Data on percent stalk infection were recorded at 110 days after planting by visual observation of symptoms. Percent stalk infection was calculated by the following formula.

$$\% \text{ Stalk infection} = \frac{\text{Number of infected stalk}}{\text{Number of total inspected stalk}} \times 100$$

3.18.4 Percent stalk area diseased

Data on percent stalk area diseased were recorded at 110 days after planting by visual observation of symptoms. Percent stalk area diseased was calculated by the following formula.

$$\% \text{ Stalk area diseased} = \frac{\text{Stalk area infected}}{\text{Total stalk area inspected}} \times 100$$

3.18.5 Stalk height

Stalk height was measured by a meter scale. Data were also recorded as the average of randomly selected ten (10) stalk from each plot. The mean height was expressed in cm.

3.18.6 Number of stalk per hill

Number of stalk per hill was recorded as the average of randomly selected ten (10) hill from each plot.

3.18.7 Number of umbel per plot

Total number of umbel per plot was recorded.

3.18.8 1000-seed weight (g)

One thousand grains were randomly counted and selected from the stock seed and weighed by digital electric balance. It was expressed as 1000-seed weight in gram (g).

3.18.9 Seed Yield (kg/ha)

Seed yield was recorded from each plot. After harvesting, the umbels were sun-dried and threshed. Seeds were properly sun-dried and weighed. Seed yield was then converted to kg/ha.

3.18.10 Estimation of percent disease index (PDI)

Percent disease index (PDI) was measured by the following formula-

$$\text{Percent Disease Index (PDI)} = \frac{\text{Sum of total disease ratting}}{\text{Total no. of observation X Maximum grade in the scale}} \times 100$$

Disease severity scale:

Using "0-5" scale (Horsfall and Barratt, 1945) we calculated the disease severity. "0-5" scale is given bellow-

% Leaf Area Diseased (LAD)	Grade / rating
0	0
0.1 - 5.0	1
5.1 - 12.0	2
12.1 - 25.0	3
25.1 - 50.0	4
>50.0	5
Total	

Regression equation:

For simulation of mathematical point model for estimation of yield loss, regression equation was used as shown bellow

Y = a +bX

$\hat{Y} = \bar{Y} + b\ (Xi - \bar{X})$ (working formula)

Here, $\hat{Y}$ = Predicted yield loss (%)

$\bar{Y}$ = Estimated yield loss (%)

Xi = Disease severity (i = 1,2,3,……n)

b = Regression co-efficient

$\bar{X} = \frac{\sum X}{N}$ (N= No. of observation).

$\bar{Y}$ = $\frac{\sum Y}{N}$ (N= No. of observation)

$$b = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sum (Xi - \bar{X})^2}$$

3.19 Seed health testing

For germination and seed health test the presence of *Alternaria porri*. and *Stemphylum vesicarium* in the harvested seed, 400 seeds randomly drawn from each sample and were tested by the standard technique (ISTA, 2000). Seeds were placed on three layers of moist blotting paper (Whatman no. 1) contained in petridishes. In each petridish, 25 seeds were placed in equidistace. All the plates with seeds were incubated at room tempareture (25+/-2^{0}C) under 12 hours cycle of alternate Near Ultra Violet (NUV) light and darkness. Watering was done as and when required. Germination of seedling and seed infection by *Alternaria porri*. and *Stemphylum vesicarium* were recorded. Results were expressed as percent seed germination. After 7-10 days of incubation, each seed was observed under sterio-binocular microscope to detect the presence of *Alernaria porri*. and *Stemphylum vesicarium.*

3.20 Experimental Design and Statistical analysis

The collected data for different parameters were compiled and tabulated in proper form. Appropriate statistical analysis was made by MSTAT computer package program. The treatment means were compared by Duncan's Multiple Range Test (DMRT). ANOVA table was presented in appendix-IV.

CHAPTER IV

RESULTS

The present experiment was conducted for the Seed yield loss assessment for Purple blotch complex of Onion" through multiple treatment experiment with Rovral 50 WP @ 0.2% application. Data were recorded on % infected leaf, disease severity (leaf), % infected stalk, disease severity (stalk), yield contributing characters and yield of onion seed in field condition, the analyses of variance (ANOVA) of the data on different characters were done (Appendix III-X). The results have been presented and discussed, and possible interpretations have been drawn under the following headings:

4.1 Percent leaf infection

The effect of different treatments on leaf infection of onion at 80 days after planting (DAP) summarized and presented in Table 2. Different treatments had significant influence on percent leaf infection of onion (Taherpuri) at 80 days after planting (DAP). At 80 days after planting (DAP), the highest percent leaf infection (74.03%) was found in T_0 (control) and no leaf infection (0.00%) was recorded in treatment T_{10} where Ten spraying were done with Rovral 50 WP (0.2%). The inhibition of leaf infection was 100% in case of T_{10} where 10 sprays were applied. The inhibition of leaf infection gradually decreased with the decrease of number of sprays. (Table 2)

4.2 Percent leaf area diseased

The effect of different treatments on leaf area diseased (LAD) of onion at 80 days after planting (DAP) summarized and presented in Table 3. Different number of sprays had significant influence on percent leaf area diseased of onion (Taherpuri) at 80 days after planting (DAP). At 80 days after Planting (DAP), the highest percent leaf area diseased (63.85 %) was found in T_0 (control) and the lowest percent leaf area diseased (0.00%) was recorded in treatment T_{10} where ten field spraying were applied with Rovral 50 WP (0.2%). The reduction of leaf area diseased (LAD) was stood cent percent while 10 sprays with Rovral 50 WP (0.2%) were done and the LAD was found to be decreased gradually with the increase of number of sprays (Table 3)

Table 2. Effect of different treatments on percent leaf infection of onion at 80 days after planting (DAP)

Treatments	% Leaf Infection at 80 DAP	% Inhibition of leaf infection over control at 80 DAP

T_0	74.03 a	0
T_1	63.47 b	14.26
T_2	50.13 c	32.28
T_3	46.01 d	37.85
T_4	37.01 e	50.01
T_5	32.01 f	56.76
T_6	27.65 g	62.65
T_7	20.50 h	72.31
T_8	13.07 i	82.34
T_9	10.44 j	85.90
T_{10}	0.0000 k	100
LSD	1.627	
% CV	3.31	

In a column means having same letter(s) do not differed significantly at 5% level.

Treatment

T_0=Control

T_1= One field spraying with Rovral 50 WP

T_2 =Two field spraying with Rovral 50 WP

T_3=Three field spraying with Rovral 50WP

T_4=Four field spraying with Rovral 50 WP

T_5=Five field spraying with Rovral 50 WP

T_6=Six field spraying with Rovral 50 WP

T_7=Seven field spraying with Rovral 50WP

T_8=Eight field spraying with Rovral 50 WP

T_9=Nine field spraying with Rovral 50 WP

T_{10} = Ten field spraying with Rovral 50 WP

Table 3. Effect of different treatments on percent leaf area diseased (%LAD) of onion at 80 days after planting (DAP)

Treatments	% Leaf area diseased (LAD) at 80 DAP	% Inhibition of Leaf area diseased (LAD) over control at 80 DAP
T_0	63.85 a	0
T_1	57.88 b	9.35
T_2	53.24 c	16.62
T_3	44.92 d	29.64
T_4	39.07 e	38.81
T_5	32.99 f	48.33
T_6	28.24 g	55.77
T_7	23.80 h	62.73
T_8	19.58 i	69.33
T_9	10.57 j	83.44
T_{10}	0.0000 k	100
LSD	2.781	
% CV	5.66	

In a column means having same letter(s) do not differed significantly at 5% level.

Treatment

T_0=Control

T_1= One field spraying with Rovral 50 WP

T_2 =Two field spraying with Rovral 50 WP

T_3=Three field spraying with Rovral 50 WP

T_4=Four field spraying with Rovral 50 WP

T_5=Five field spraying with Rovral 50 WP

T_6=Six field spraying with Rovral 50 WP

T_7=Seven field spraying with Rovral 50 WP

T_8=Eight field spraying with Rovral 50 WP

T_9=Nine field spraying with Rovral 50 WP

T_{10} = Ten field spraying with Rovral 50 WP

4.3 Percent stalk infection

The effect of different treatments on stalk infection of onion at 110 days after planting (DAP) calculated and presented in Table 4. Different treatments had

remarkable influence on percent stalk infection of onion (Taherpuri) at 110 days after planting (DAP). At 110 days after planting (DAP), the highest percent stalk infection (72.94 %) was found in T_0 (control) and no stalk infection (0.0%) was recorded in treatment T_{10} where 10 field spraying were applied with Rovral 50 WP (0.2%). The stalk infection was completely controlled (100% inhibition) while 10 sprays were applied with Rovral (0.2%) and the inhibition of stalk infection were gradually increased with the increased of number of sprays (Table 4).

4.4 Percent stalk area diseased (SAD)

The effect of different treatments on stalk area diseased of onion at 110 days after planting (DAP) estimated and summarized in table 5. Different treatments had profound influence on percent stalk area diseased of Onion (Taherpuri) at 110 days after planting (DAP). At 110 days after planting (DAP), the highest percent stalk area diseased (39.18%) was found in T_0 (control) and the lowest percent stalk area diseased (0.0%) was recorded in treatment T_{10} where 10 field spraying were applied with Rovral 50 WP (0.2%). The inhibition of stalk area diseased (SAD) was recorded 100% over control while altogether 10 field sprays were done with Rovral 50 WP (0.2%) and the inhibition of SAD gradually decreased with the decrease of number of sprays (Table 5). The cent percent reduction of stalk area diseased was noticed in T_{10} followed by T_9, T_8, T_7 and so on.

Table. 4 . Effect of different treatments on percent stalk infection of onion at 110 days after planting(DAP)

Treatments	% Stalk Infection at 110 DAP	% Inhibition of stalk infection over control at 110 DAP

T_0	72.94 a	0
T_1	61.51 b	15.67
T_2	48.06 c	34.11
T_3	43.09 d	40.92
T_4	37.81 e	48.16
T_5	34.19 f	53.13
T_6	28.25 g	61.27
T_7	19.98 h	72.61
T_8	13.80 i	81.01
T_9	7.262 j	90.04
T_{10}	0.0000 k	100
LSD	1.809	
% CV	3.76	

In a column means having same letter(s) do not differed significantly at 5% level.

Treatment

T_0=Control

T_1= One field spraying with Rovral 50 WP

T_2 =Two field spraying with Rovral 50 WP

T_3=Three field spraying with Rovral 50WP

T_4=Four field spraying with Rovral 50 WP

T_5=Five field spraying with Rovral 50 WP

T_6=Six field spraying with Rovral 50 WP

T_7=Seven field spraying with Rovral 50WP

T_8=Eight field spraying with Rovral 50 WP

T_9=Nine field spraying with Rovral 50 WP

T_{10} = Ten field spraying with Rovral 50 WP

Table. 5 . Effect of different treatments on percent Stalk area diseased (%SAD) of

onion at 110 days after Planting (DAP)

Treatments	% Stalk Area Diseased (SAD) at 110 DAP	% Inhibition of stalk area diseased over control at 110 DAP
T_0	39.18 a	0
T_1	29.09 b	25.75
T_2	24.43 c	37.65
T_3	18.85 d	51.89
T_4	14.73 e	62.40
T_5	8.898 f	77.29
T_6	6.528 fg	83.34
T_7	4.568 gh	88.34
T_8	2.790 hi	92.88
T_9	2.063 hi	94.73
T_{10}	0.0000 i	100
LSD	2.946	
% CV	14.85	

In a column means having same letter(s) do not differed significantly at 5% level.

Treatment

T_0=Control

T_1= One field spraying with Rovral 50 WP

T_2 =Two field spraying with Rovral 50 WP

T_3=Three field spraying with Rovral 50WP

T_4=Four field spraying with Rovral 50 WP

T_5=Five field spraying with Rovral 50 WP

T_6=Six field spraying with Rovral 50 WP

T_7=Seven field spraying with Rovral 50WP

T_8=Eight field spraying with Rovral 50WP

T_9=Nine field spraying with Rovral 50WP T_{10} = Ten field spraying with Rovral 50 WP

4.5.1 Height of onion seed stalk (cm)

Different treatments had remarkable influence on height of onion seed stalk (cm). The height of seed stalk was obtained highest (64.46 cm) from T_{10} (ten field spraying with Rovral 50 WP with some extent) treated plot. The lowest seed stalk height (50.46 cm) was recorded in case of control plot (Table- 6).

4.5.2 Number of onion seed stalk / hill

Number of onion seed stalk / hill differed significantly due to the application of different treatments. The highest number of onion seed stalk / hill (1.67) was recorded in case of T_{10} (ten field spraying with Rovral 50 WP) treatment and the lowest number of onion seed stalk / hill (0.98) was obtained from T_0 (control) treatment (Table 6).

4.5.3 Number of umbel / plot

Number of umbels/plot was found to differed significantly due to the application of different treatments. The highest number of umbel/plot (107.8) was recorded in case of T_{10} (ten field spraying with Rovral 50 WP) treatment and the lowest number of umbel/plot (66.25) was obtained from T_0 (control) treatment (Table 6).

4.5.4 1000-Seed weight (g)

Thousand seed weight differed significantly due to the application of different treatments. The maximum 1000-seed weight (3.52g) was obtained from T_{10} (ten field spraying with Rovral 50 WP) treatment while T_0 (control) yielded the minimum 1000-seed weight (2.94g) (Table 6).

4.5.5 Seed Yield (kg/ha)

Significant variation of different treatments was found on seed yield (kg/ha). Maximum seed yield (649.40 kg/ha) was obtained from treatment T_{10} while ten

field spraying with Rovral 50 WP@0.2% was done. The lowest yield (365.26 kg/ha) was recorded from T_0 (control) (table 6). The highest yield increased (43.75%) was estimated from treatment T_{10} and followed by T_9 (41.45%), T_8 (40.41%), T_7 (37.43 %) and so on.

Table.6: Effect of different treatments on yield and yield contributing characters of onion.

Treatments	**Yield and yield contributing characters**					% Yield increased over control
	Height of Onion seed stalk(cm)	No. Of onion seed stalk/hill	No. of umbel /plot	Thousand (1000) seed weight(g)	Seed yield (kg/ha)	
T_0	50.46 g	0.98 d	66.25 d	2.943 f	365.26 j	0.00
T_1	51.90 g	1.05 cd	68.25 d	2.952 ef	394.40 i	7.37

T_2	52.11 g	1.08 cd	70.00 cd	2.967 def	430.83 h	15.20
T_3	52.72 fg	1.11 cd	74.00 cd	2.987 cdef	459.97 g	20.59
T_4	55.29 ef	1.13 cd	79.00 cd	3.223 bcde	489.11 f	25.31
T_5	57.59 de	1.22 bcd	82.00 bcd	3.235 bcd	521.90 e	30.01
T_6	58.19 cde	1.26 bcd	84.00 bcd	3.250 abc	551.04 d	33.70
T_7	59.01 cd	1.30 abcd	86.75 bcd	3.262 abc	583.83 c	37.43
T_8	60.89 bc	1.42 abc	90.50 abc	3.273 ab	612.98 b	40.41
T_9	62.87 ab	1.61 ab	101.8 ab	3.405 ab	623.90 b	41.45
T_{10}	64.46 a	1.67 a	107.8 a	3.523 a	649.40 a	43.75
LSD	2.92	0.37	19.18	0.25	12.59	
% CV	2.65	14.94	11.92	4.14	5.71	

In a column means having same letter(s) do not differed significantly at 5% level.

Treatment

T_0 = Control

T_1 = One field spraying with Rovral 50 WP

T_2 = Two field spraying with Rovral 50WP

T_3=Three field spraying with Rovral 50WP

T_4 =Four field spraying with Rovral 50 WP

T_5 = Five field spraying with Rovral 50 WP

T_6 = Six field spraying with Rovral 50 WP

T_7 =Seven field spraying with Rovral 50WP

T_8 =Eight field spraying with Rovral 50WP

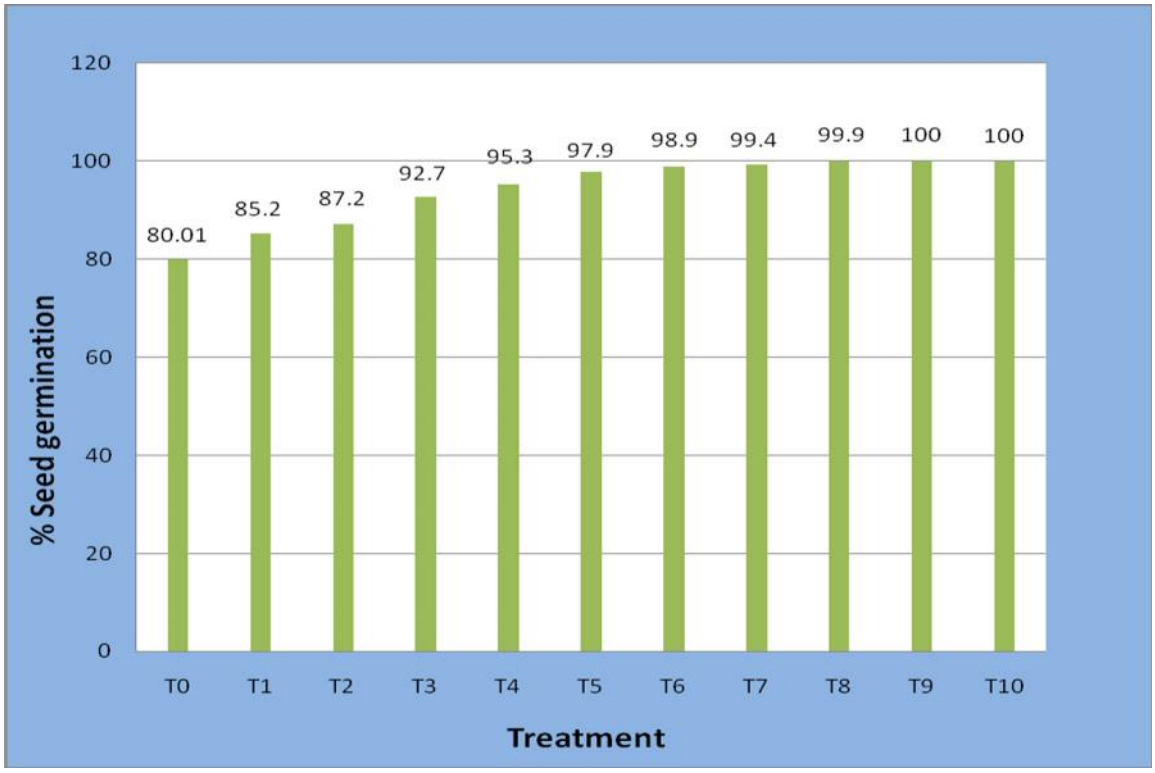
T_9 = Nine field spraying with Rovral 50 WP

T_{10} = Ten field spraying with Rovral 50 WP

4.6.1 Percent seed germination

Percent seed germination was found to be differed due to the application of different treatments. Seed obtained from T_{10} (ten field spraying with Rovral 50 WP@0.2%) treated plot showed the maximum percent seed germination (100%). Seed obtained from control plots showed the minimum germination

percentage (80.01%). Seed germination gradually decreased with the decrease of number of spraying.



Photograph 2: Effect of different treatments on percent seed germination of onion.

Treatment

T_0 = Control

T_1 = One field spraying with Rovral 50 WP

T_2 =Two field spraying with Rovral 50 WP

T_3=Three field spraying with Rovral 50WP

T_4 =Four field spraying with Rovral 50 WP

T_5 = Five field spraying with Rovral 50 WP

T_6 = Six field spraying with Rovral 50 WP

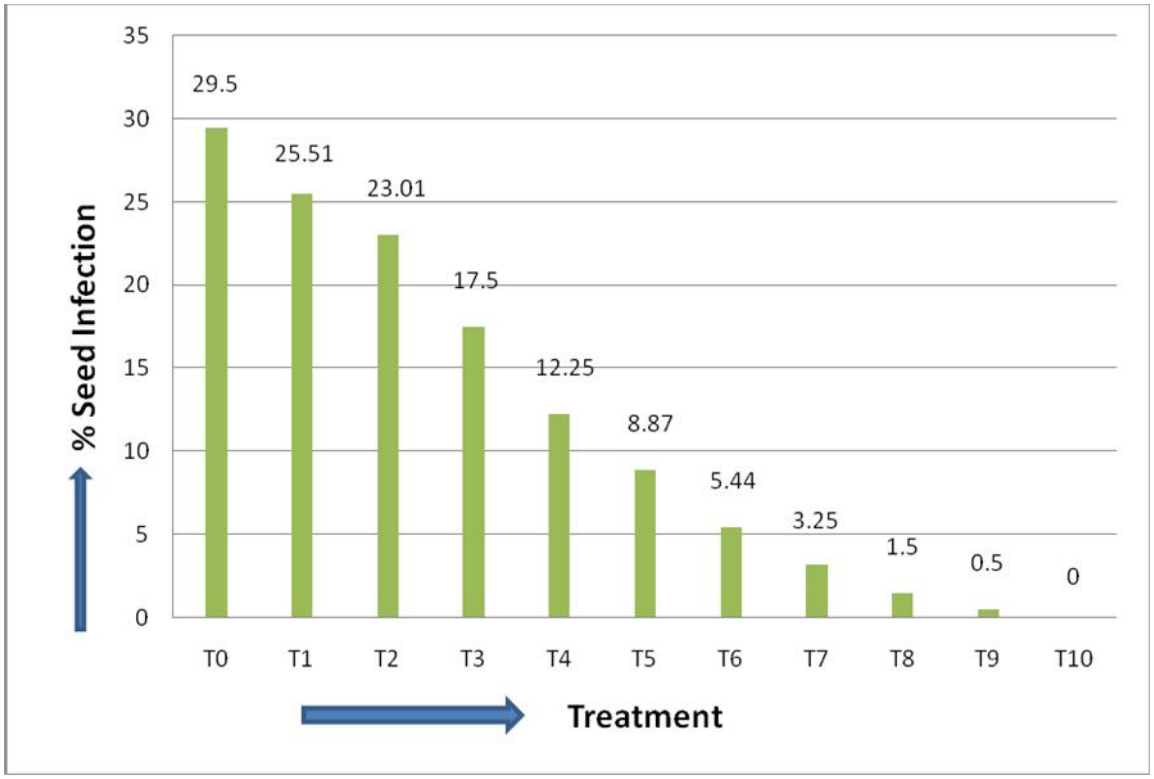
T_7=Seven field spraying with Rovral 50WP

T_8=Eight field spraying with Rovral 50 WP

T_9 =Nine field spraying with Rovral 50 WP T_{10} =Ten field spraying with Rovral 50 WP

4.6.2 Percent seed infection

Percent seed infection by *Alternaria porri*. of harvested seeds was varied due to the application of different treatments. Comparatively lower seed infection was found in the seed lot obtained from treated plot with higher number of sprays. Seeds obtained from control treatment showed the higest percent seed infection (29.5%) while seeds obtained from T_{10} (ten field spraying with Rovral 50 WP@0.2%) treated plots showed the lowest seed infection (0.0%).



Photograph 3: Effect of different treatments on percent seed infection of onion.

Treatment

T_0 = Control

T_1 = One field spraying with Rovral 50 WP

T_2 =Two field spraying with Rovral 50 WP

T_3=Three field spraying with Rovral 50WP

T_4=Four field spraying with Rovral 50 WP

T_5 = Five field spraying with Rovral 50 WP

T_6 = Six field spraying with Rovral 50 WP

T_7=Seven field spraying with Rovral 50WP

T_8 =Eight field spraying with Rovral 50 WP

T_9 = Nine field spraying with Rovral 50 WP T_{10}=Ten field spraying with Rovral 50 WP

4.7. Assessment of yield loss

Using the variation of Percent Disease Index (PDI) and corresponding yield loss from multiple treatment experiment, the predicted percent yield loss ($\hat{Y}$) was calculated using the regression equation and presented in Table 7. Further, using the predicted yield loss and corresponding disease severity , the yield loss assessment was made by the equation $\hat{Y}$= 0.04+0.56Xi. By setting any Xi's value (PDI) in the equation , the yield loss of onion due to purple blotch complex disease could be estimated.

Table. 7: Predicted yield loss calculated by percent disease index (PDI) and corresponding yield loss from multiple treatment experiment

Multiple Treatments	Percent Disease Index (PDI) (X)	Yield (kg/ha)	Yield loss (kg/ha)	% Yield loss (Y)	(PDI)X (% Yield Loss) (XY)	Predicted % yield loss
T_0	Xi=78	365.26	284.14	Yi=43.75	3412.5	43.72
T_1	Xii=70	394.4	255	Yii=39.27	2748.9	39.24
T_2	Xiii=60	430.83	218.57	Yiii=33.66	2019.6	33.64
T_3	Xiv=52	459.97	189.43	Yiv=29.17	1516.84	29.16
T_4	Xv=44	489.11	160.29	Yv=24.68	1085.92	24.68
T_5	Xvi=35	521.9	127.5	Yvi=19.63	687.05	19.64
T_6	Xvii=27	551.04	98.36	Yvii=15.15	409.05	15.16
T_7	Xviii=18	583.83	65.57	Yviii=10.09	181.62	10.12
T_8	Xix=10	612.98	36.42	Yix=5.61	56.1	5.64
T_9	Xx=7	623.9	25.5	Yx=3.92	27.44	3.96
T_{10}	Xxi=0.0	649.4	0.00	Yxi=0.00	0.00	0.04
Total =	∑X = 401			∑Y = 224.93	∑XY = 12145.02	

Photograph 4. Field view of vegetative stage of onion

Photograph 5. Field view of flowering stage of onion

Photograph 6. Floral Stalk of onion at Maturity stage

a b

Photograph 7.a. Initial stage of purple blotch complex of onion and b. advanced stage of the disease

a b

Photograph 8. Conidia of (a) *Alternaria porri* and (b)*Stemphylium vesicarium* as

Seen under microscope

CHAPTER V

DISCUSSION

In the present study, the effect of treatments in controlling purple blotch complex of onion caused by *Alternaria porri* and *Stemphylium vesicarium* was assessed based on the result of percent leaf infection, percent leaf area diseased (% LAD), percent infected seed stalk, percent Stalk Area Disease (%SAD), height of seed stalk (cm), number of seed stalk per hill, number of umbel per plot, thousand (1000) seed weight (g) and seed yield.

In the field experiments the application of fungicides with different spray schedule had significant effect in reducing the disease incidence, severity and increasing the seed yield. Among the treatments, ten field spraying with Rovral 50 WP @ 0.2% at 7 days interval completely controlled the disease which was statistically identical with the application of nine field spraying. It was observed that the incidence and severity of the disease increased gradually with the decreasing number of spraying of Rovral 50 WP @ of 0.2 % at the advanced growth stage of the crop.

The treatments had remarkable effect on yield contributing characters like Seed stalk height, number of umbel per plot and 1000 seed weight that influenced the seed yield. The highest seed yield (649.40kg/ha) was obtained from the plot where ten field spraying was applied with Rovral 50 WP @ 0.2% against the disease that increased seed yield by 43.75% compared to control. The second highest seed yield (623.90kg/ha) was obtained from the plot where nine field spraying was applied with Rovral 50 WP @ 0.2% that increased seed yield by 41.45% compared to control. It was observed that seed yield increased gradually with the increase of number of spraying of Rovral 50 WP @ of 0.2%.

The findings of the field experiments are well supported by the previous researchers. Sultana *et al*. (2008) conducted an experiment in the field of Plant Pathology Division, BARI, Joydebpur to assess yield loss of onion bulb due to purple blotch disease. She reported that 71.95% disease reduced in the fungicide spraying plot over control. Weight of l0 bulb (g) and yield/plot also increased by 10.6% and 50.9% in fungicide sprayed plot over control.

The finding also keeps in with the findings of Rahman (2004) and Ali (2008). Rahman (2004) reported that eight spraying of Rovral 50WP (0.2 %) or Ridomil MZ-72 (0.2) with 7 days interval minimized the disease incidence and disease severity of purple blotch complex of onion and increased the bulb yield. Ali (2008) reported that spraying of Rovral 50WP (0.2%) along with application of micronutrients remarkably reduced the incidence and severity of purple blotch of onion.

Seed health regarding seed infection and seed germination were found to differ significantly due to the application of different treatments. No seed infection and 100% seed germination was obtained in the seed lot collected from the plot treated with 9/10 field spraying with Rovral 50 WP @ 0.2%. Seeds obtained from control plots showed the lowest (80.01%) seed germination and maximum (29.05%) seed infection. The present findings corroborate with the findings of previous research report. Anonymous (1992) reported that foliar spray of Rovral significantly reduced the seed borne infection of *Alternaria porri* and increased germination percentage of onion seed. It was reported that, seed born infection of *Alternaria porri* was reduced above 90% and seed germination was increased above 9% over control while seed infection was reduced up to 18.8% with 3 times foliar spray of Rovral.

The yield loss assessment was made by the regression equation $\hat{Y}$ = 0.04+0.56Xi

Where $\hat{Y}$ stands for percent predicted yield loss and Xi stands for the disease severity (PDI) of purple blotch complex of onion in the standing crop. Calculating the disease severity in the standing crop and putting it in the regression equation, the percent yield loss could be calculated prior to harvest. From regression equation it is revealed that increase of 1% of disease severity (PDI), the seed yield will be decreased by 0.56 %. Thus, in case of epidemic outbreak of purple blotch complex of onion, the Government will receive the information about the national yield loss and will able to take the necessary initiatives to meet up the national demand of disease free onion seed and thus the production rate of onion will boost up. The market crisis of onion will be minimized and dependence for importing onion from the neighboring countries will be rational.

CHAPTER VI

SUMMARY AND CONCLUSION

Onion (*Allium cepa* L.) is considered as one of the most important spices crop that ranked at the top of the list as per consumer's demand in Bangladesh as well as in all over the world. Production of bulb onion as well as seed onion is affected by different disease in Bangladesh. Purple blotch complex of onion that caused by of *Alternaria porri* and *Stemphylium vesicarium* is one of the top five infectious diseases. Purple blotch complex of onion caused tremendous yield loss. The fungus reduces the bulb yield, seed production and quality of onion seeds. The present research program was conducted to determine the Yield loss (Seed) assessment due to purple blotch complex of onion caused by *Alternaria porri* and *Stemphylium vesicarium*. The experiment was conducted in the farm of Sher-e-Bangla Agricultural University, Dhaka during the period from November'2011 to march, 2012.

The experiment was laid out in a RCBD (one factor) with four replications. There were eleven treatments, Viz. T_0 (No field spraying with Rovral 50 WP @ 0.2%); T_1 (One field spraying with Rovral 50 WP @ 0.2%); T_2 (Two field spraying with Rovral 50 WP @ 0.2%); T_3 (Three field spraying with Rovral 50 WP @ 0.2%); T_4 (Four field spraying with Rovral 50 WP @ 0.2%); T_5 (Five field spraying with Rovral 50 WP@ 0.2%); T_6 (Six field spraying with Rovral 50 WP@ 0.2%); T_7 (Seven field spraying with Rovral 50 WP@ 0.2%); T_8 (Eight field spraying with Rovral 50 WP@ 0.2%); T_9 (Nine field spraying with Rovral 50 WP@ 0.2%) and T_{10} (ten field spraying with Rovral 50 WP@ 0.2%). Data were collected on percent infected leaf, disease severity (leaf), % infected stalk, disease severity (stalk), yield contributing characters and yield of onion. Data were analyzed and the mean value was adjudged with Duncan Multiple Ranges Test (DMRT).

The application of fungicide (Rovral 50 WP @ 0.2 %) significantly influenced almost all of the parameters like disease incidence, disease severity, seed yield and seed yield contributing characters.. The lowest percent of leaf infection (0.0%), percent leaf area diseased (0.0%), stalk infection (0.0%), stalk area diseased (0.0%), were recorded from the field where 10 sprayings with Rovral 50 WP @ 0.2% was done. The highest percent of leaf infection (74.03%), percent leaf area diseased (63.85%), and stalk infection (72.94%), stalk area diseased (39.18%) were recorded from control (T_0). Leaf infection, leaf area diseased, stalk infection, stalk area diseased decreased with increasing number of spraying with Rovral 50 WP @ 0.2%.

The highest stalk height (74.46cm) was found from the plot where ten fields spraying was applied with Rovral 50 WP. The highest number of umbel per plot (107.8) was also found from the plot of ten field spraying with Rovral 50 WP @ 0.2%. Similarly the highest weight of thousand seed (3.52gm). The highest seed yield (649.40 kg/ha) was obtained from the plot where 10 field spraying with Rovral 50 WP @ 0.2% was applied. The lowest seed yield (365.26 kg/ha) was obtained from the plot of control (T_0). Yield increased with increasing number of spraying with Rovral 50 WP @ 0.2%. The highest percentage of seed germination (100 %) was obtained from the seed lot where ten field spraying was applied with Rovral 50 WP @ 0.2% and the lowest percentage seed germination (80.01 %) was obtained from untreated plot (control). The highest percentage of seed infection (29.5%) was obtained from the seed lot of untreated plot (control) and no seed infection obtained from the seed lot where ten field spraying was applied with Rovral 50 WP @ 0.2%.

The seed yield loss assessment was made by using regression equation $\hat{Y}$= 0.04+0.56Xi. It indicated that each percent increase of disease severity reduced 0.56% seed yield of onion. On the basis of present findings of the study it may be concluded that onion seed grower may be suggested to apply Rovral 50WP @ 0.2% with seven days interval in controlling purple blotch complex of onion

for increasing seed yield and quality seed production of onion. However the multiple treatment experiments need to be carried out in different Agro-Ecological Zones (AEZ) for at least 3 consecutive years to justify the findings of the present experiment.

CHAPTER VII

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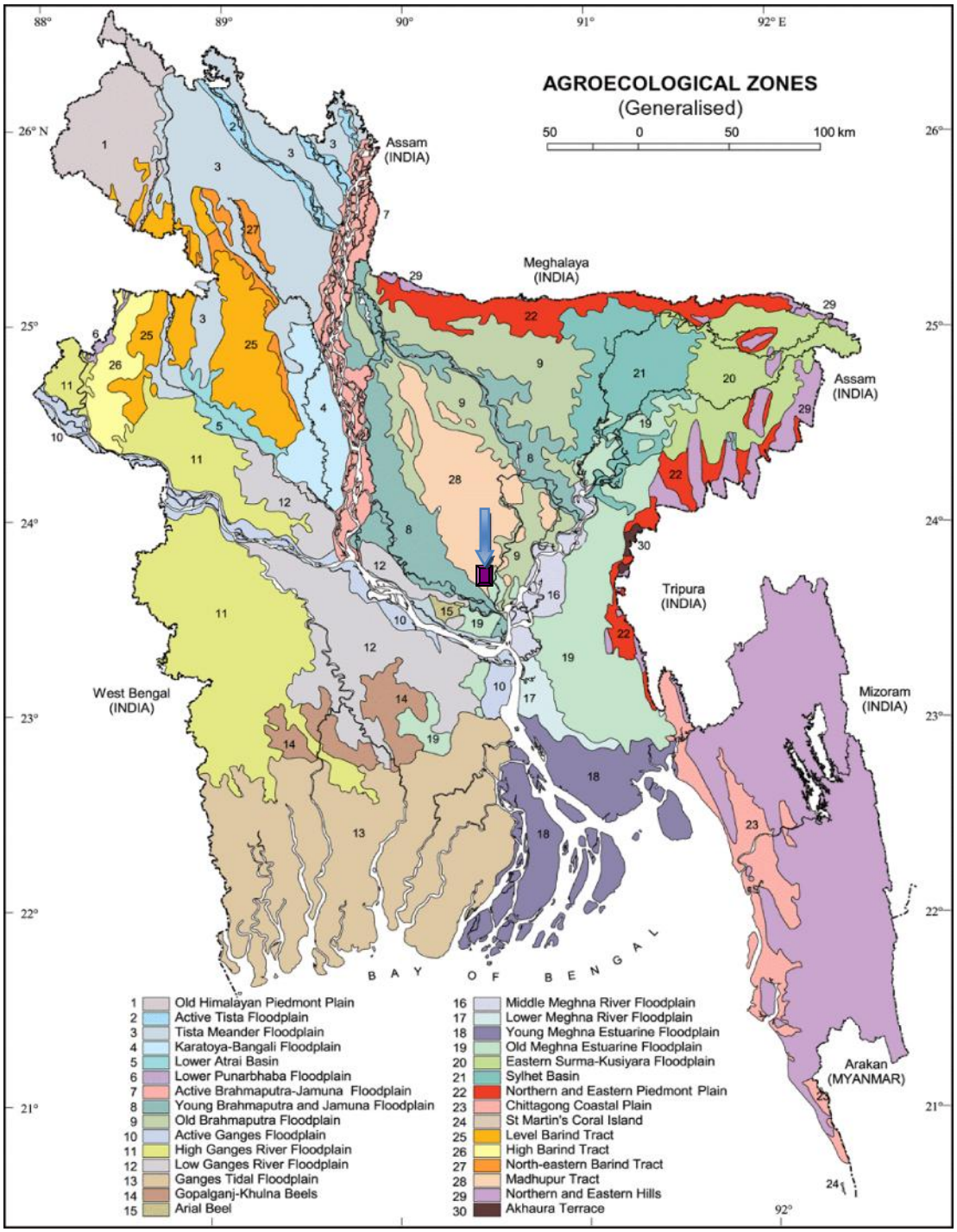
CHAPTER VIII

APPENDICES

Appendix I: Experimental location in the map of Agro-Ecological Zones of Bangladesh



Appendix-II: Particulars of the Agro-ecological Zone of the Experimental

Site.

Agro-ecological region	: Madhupur Tract (AEZ-28)
Land Type	: Medium high land
General soil type	: Non- Calcareous Dark gray floodplain soil
Soil series	: Tejgaon
Topography	: Up land
Location	: SAU Farm, Dhaka
Field level	: Above flood level
Drainage	: Fairly good
Firmness(consistency)	: Compact to friable when dry.

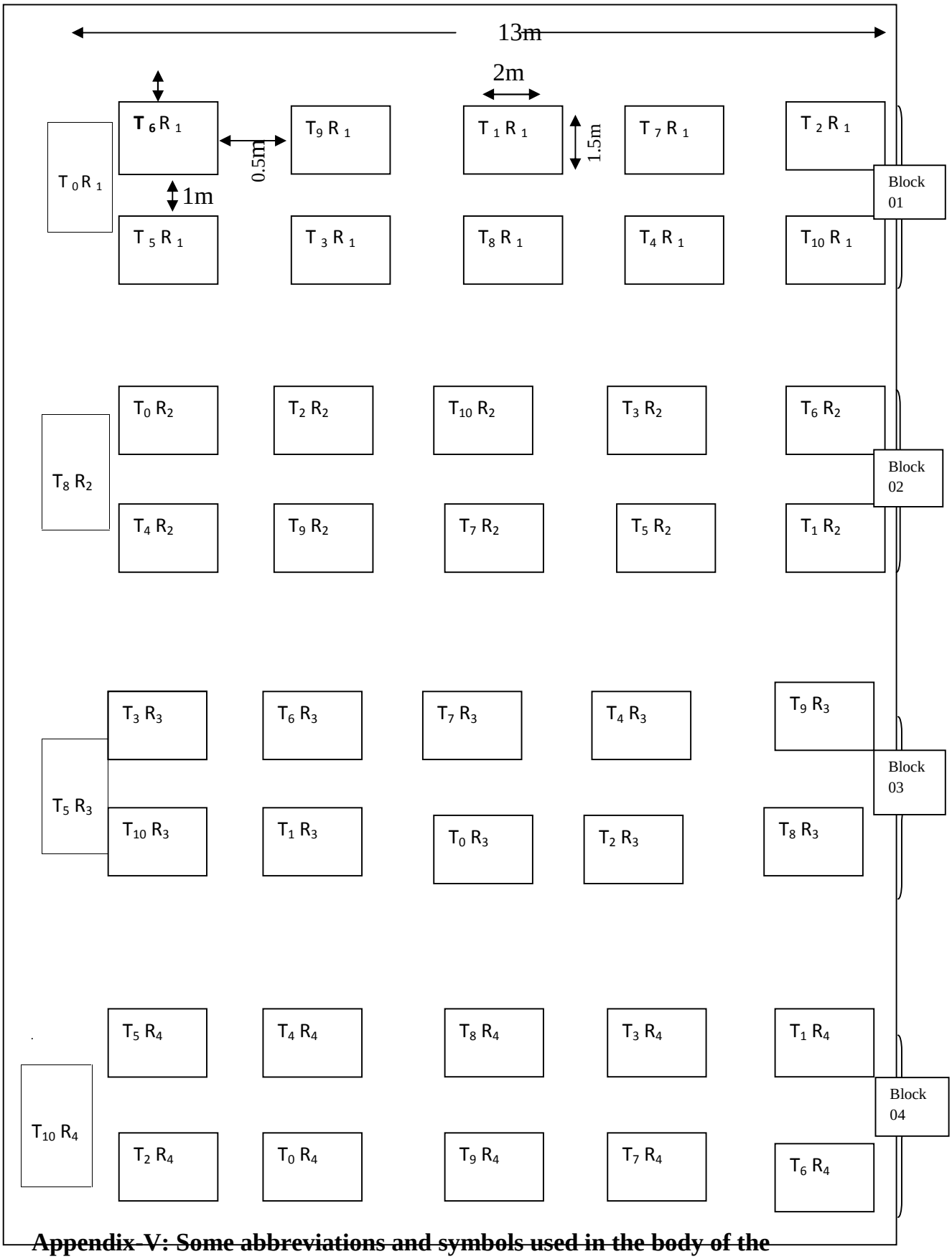
Appendix III: Monthly mean weather of the experimental site

Monthly mean of daily maximum, minimum and average temperature, relative humidity, total rainfall and sunshine hours during November/2011 to March/2012 are given bellow:

Year	Month	Air temperature(0^0)			Relative Humidity (%)	Rainfall (mm)	Wind Speed (km/hr)
		Max.	Min.	Average			
2011	November	31.2	17.3	23.4	66.6	0.00	0.6
	December	25	15.7	19.5	68	0.00	1.3
2012	January	24.4	16.4	19.6	72.2	1.27	1.2
	February	29.5	16.9	22.4	51.3	0.00	1.4
	March	32.5	20.4	26.45	66.4	0.97	1.3

Source: Bangladesh Meteorological Department (Climate Division), Agargoan, Sher- e-Bangla Nagar, Dhaka-1207

Appendix IV: Layout of the field experiment: (RCBD)



Appendix-V: Some abbreviations and symbols used in the body of the Thesis.

Abbreviations	Full word
%	Percent
@	At the rate of
AEZ	Agro-Ecological Zone
Agric.	Agriculture
Agril.	Agricultural
Agron.	Agronomy
ANOVA	Analysis of variance
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
BD	Bangladesh
BSMRAU	Bangladesh Sheikh Mujibur Rahman Agricultural University
CEC	Cation Exchange Capacity
cm	Centi-meter
CV%	Percentage of coefficient of variation
DAI	Days After Incubation
DAS	Days After Sowing
df	Degrees of Freedom
DMRT	Duncan's Multiple Range Test
EC	Emulsifiable concentration
et al.	and others
etc.	Etcetera
FAO	Food and Agricultural Organization
g	Gram
hr.	Hours

Abbreviations	Full word
Kg/ha	kiligrams per hectare

kg	kilogram
LAD	Leaf area diseased
m	Meter
m^2	Square meter
MOA	Ministry of Agriculture
MSE	Mean square of the error
No.	Number
NUV	Near Ultra Violet
PDI	Percent disease index
PDA	Potato dextrose agar
SAD	Stalk Area Diseased
ppm	Parts per million
RCBD	Randomized complete block design
Rep.	Replication
Res.	Research
SAU	Sher-e-Bangla Agricultural University
Sc.	Science
SE	Standard Error
Univ.	University
var.	variety
WP	Wetable Powder
J.	Journal

Appendix-VI: ANOVA table of the experiment

Table .01: Effect of treatments on Percent leaf infection at 80 DAP

	Degree of freedom	Sum of squares	Mean square	F value	Probablity
Replication	3	1.70	0.568	0.47	0.7088
Treatment	10	22330.65	2233.065	1828.94	0.0000
Error	30	36.63	1.221		
Total	43	22368.99			
Coefficient of Variation: 3.33%					

Table . 02: Effect of treatments on Percent leaf area disease at 80 DAP

Source of variance	Degree of freedom	Sum of squares	Mean square	F value	Probablity
Replication	3	9.30	3.101	1.03	0.3955
Treatment	10	21811.94	2181.194	720.90	0.0000
Error	30	90.77	3.026		
Total	43	21912.01			
Coefficient of Variation: 5.76%					

Table. 3: Effect of treatments on Percent stalk infection 110 DAP

Source of variance	Degree of freedom	Sum of squares	Mean square	F value	Probablity
Replication	3	10.84	3.614	2.64	0.0675
Treatment	10	22749.83	2274.983	1662.04	0.0000
Error	30	41.06	1.369		
Total	43				
Coefficient of Variation: 3.63%					

Table. 4: Effect of treatments on Percent stalk area diseased at 110 DAP

Source of variance	Degree of freedom	Sum of squares	Mean square	F value	Probablity

Replication	3	74.07	24.689	6.04	0.0024
Treatment	10	6776.01	677.601	165.90	0.0000
Error	30	122.53	4.084		
Total	43	6972.61			
Coefficient of Variation: 14.98%					

Table. 5: Effect of treatments on stalk height

Source of variance	Degree of freedom	Sum of squares	Mean square	F value	Probablity
Replication	3	25.30	8.433	3.72	0.0219
Treatment	10	898.96	89.896	39.66	0.0000
Error	30	68.00	2.267		
Total	43	992.25			
Coefficient of Variation: 2.65%					

Table. 6: Effect of treatments on number of seed stalk /hill

Source of variance	Degree of freedom	Sum of squares	Mean square	F value	Probablity
Replication	3	0.16	0.054	1.53	0.2263
Treatment	10	2.02	0.202	5.70	0.0001
Error	30	1.07	0.036		
Total	43	3.25			
Coefficient of Variation: 14.94%					

Table. 7: Effect of treatments on number of umbel / plot

Source of variance	Degree of freedom	Sum of squares	Mean square	F value	Probablity

Replication	3	548.98	182.992	1.88	0.1540
Treatment	10	7199.50	719.950	7.40	0.0000
Error	30	2917.77	97.259		
Total	43	10666.25			
Coefficient of Variation: 11.92%					

Table. 8: Effect of treatments on weight of thousand seed(gm)

Source of variance	Degree of freedom	Sum of squares	Mean square	F value	Probablity
Replication	3	0.12	0.042	2.40	0.0878
Treatment	10	1.53	0.153	8.84	0.0000
Error	30	0.52	0.017		
Total	43	2.18			
Coefficient of Variation: 4.14%					

Table. 9: Effect of treatments on Seed yield (kg/ha)

Source of variance	Degree of freedom	Sum of squares	Mean square	F value	Probablity
Replication	3	403.45	1685.346	1.92	0.0371
Treatment	10	373313.10	22047.937	25.07	0.0000
Error	30	1257.97	879.363		
Total	43	374974.52			
Coefficient of Variation: 1.25%					