MANAGEMENT OF PURPLE BLOTCH OF ONION THROUGH CHEMICALS AND PLANT EXTRACTS

A Thesis
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CERTIFICATE

This is to certify that the thesis entitled, "*MANAGEMENT OF PURPLE BLOTCH OF ONION THROUGH CHEMICALS AND PLANT EXTRACTS* " Submitted to the *DEPARTMENT OF PLANT PATHOLOGY*, Sher-e-Bangla Agricultural University, Dhaka in partial fulfilment of the requirements for the degree of *MASTER OF SCIENCE* in *PLANT PATHOLOGY* embodies the result of a piece of *bona fide* research work carried out by *UMMEY SARIFUN AKTER* Registration No. *26157/00454* under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma in any other institute.

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

Dated 27.12.2007

Place: **Dhaka, Bangladesh**

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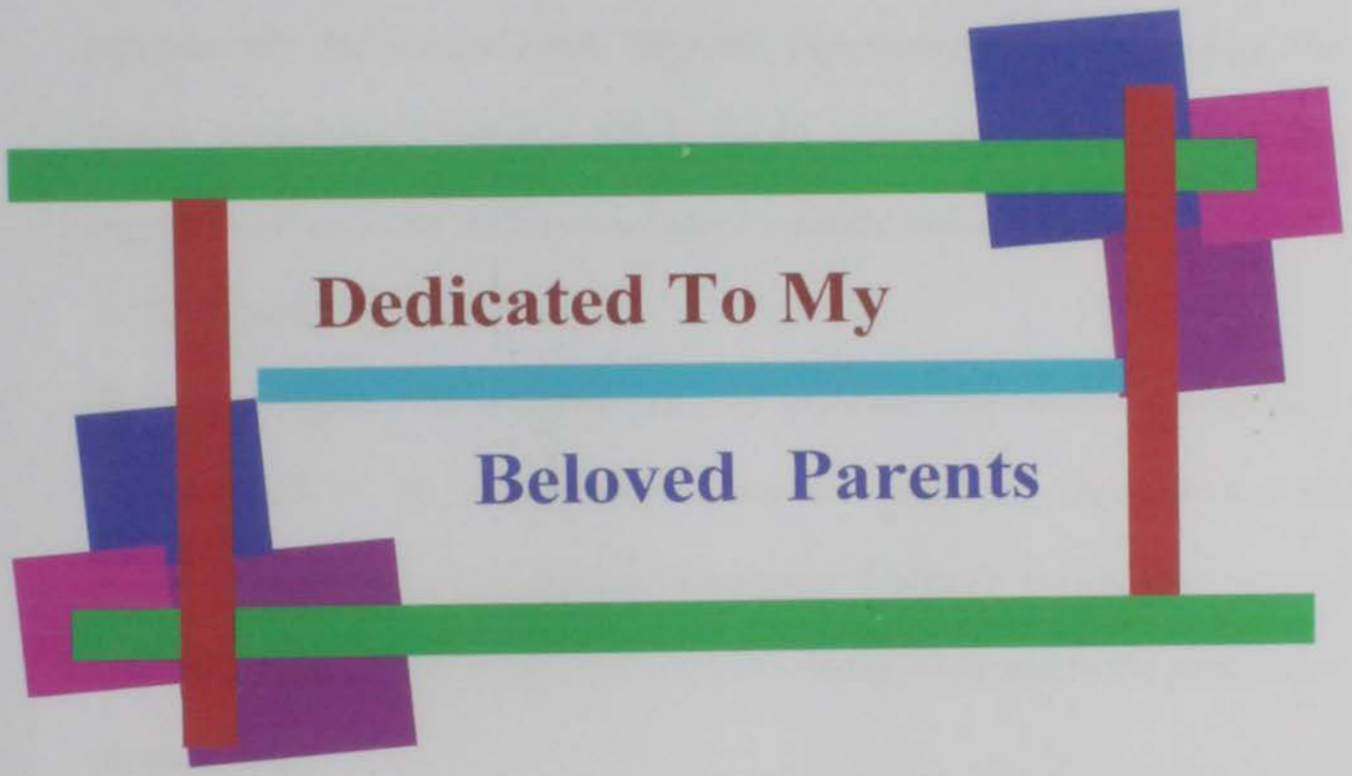
Dedicated To My
Beloved Parents

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The Author

MANAGEMENT OF PURPLE BLOTCH OF ONION THROUGH CHEMICALS AND PLANT EXTRACTS

Abstract

A field experiment was conducted at the research farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the rabi season of 2006-07 to study the management of purple blotch of onion through chemicals and plant extracts. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 3 (three) replications. Eleven treatments comprising Dithane M-45, Rovral 50WP, Bavistin 50WP, Cupravit 50WP, Proud 250 EC, Champion, Tilt 250 EC, Ridomil Gold, Neem leaf extract, Alamanda leaf extract and Control were tested in the experiment. A positive and significant effect of fungicides and plant extracts was found on the management of purple blotch of onion including, germination, plant height, bulb diameter and bulb yield of onion. The highest bulb yield (8.767 t/ha) and bulb diameter (3.787 cm) were obtain with Rovral 50WP. The percent plant infection, percent leaf infection, percent Leaf Area Diseased (%LAD) and Percent Disease Index (PDI) were found the lowest in foliar spray with Rovral 50WP. Between the two plants extracts Neem leaf extract performed better then Alamanda leaf extract.

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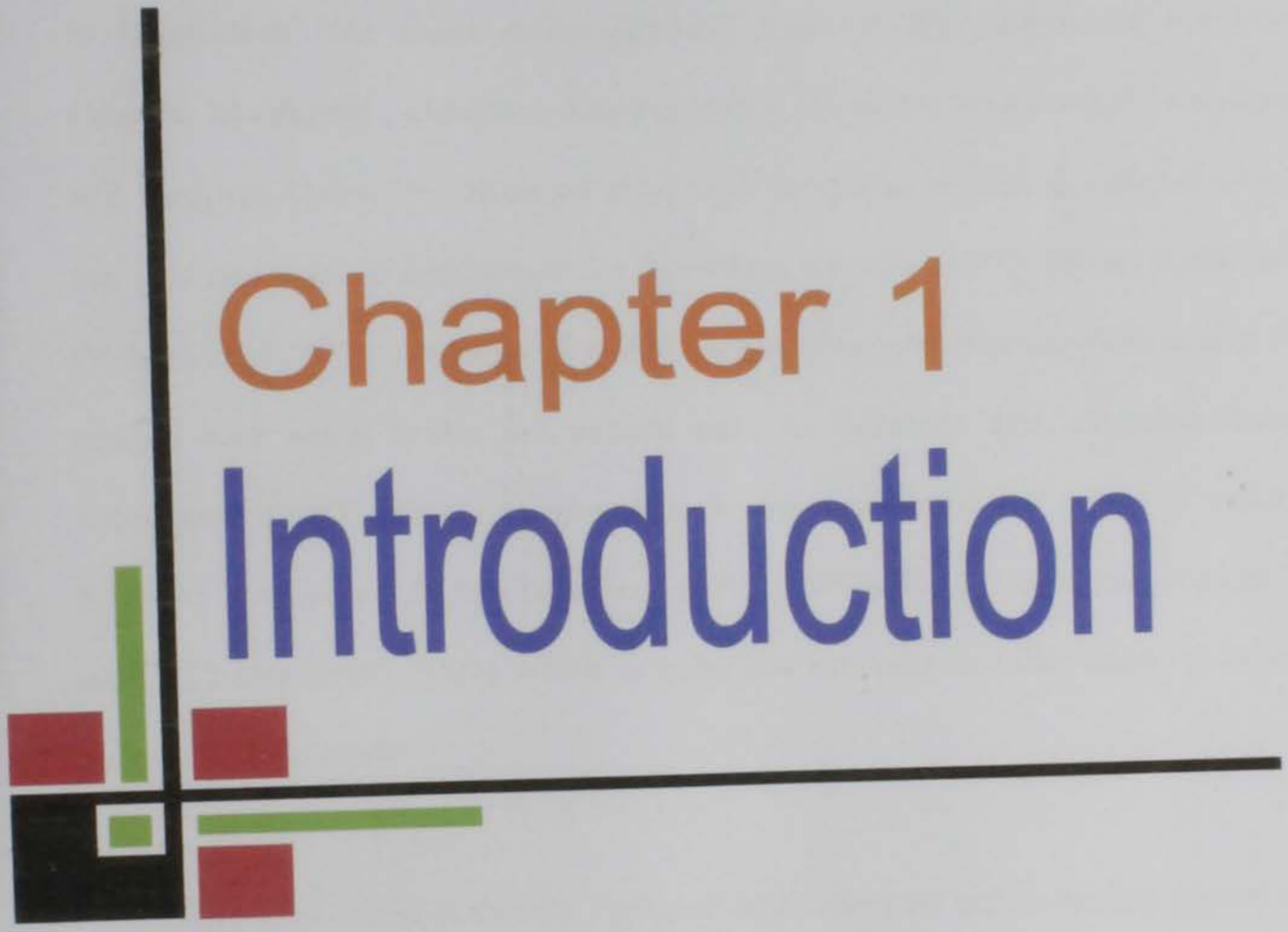

Chapter 1
Introduction

Chapter 1

INTRODUCTION

Onion (*Allium Cepa* L.) is one of the most important and familiar spices crop throughout the world. It is a member of the family Alliaceae. It is also used as popular vegetable in many countries of Asia and very common and favourite spice in Bangladesh. The major onion growing areas of Bangladesh are Faridpur, Comilla, Manikgonj , Dinajpur, Jessore, Pabna, Rajshahi, Mymensingh, Jamalpur and Rangpur. Onion has manifold uses; such as spices, vegetable, salad-dressing etc. It is also used as condiments for flavouring a number of foods and medicines (Vohora *et al*., 1974). In terms of global weight of vegetable production, nearly 28 million tons onion bulbs per annum next to tomatoes and cabbages bears importance (FAO, 1991). In Bangladesh, the production of onion is nearly 8,12,000 tons from 1,42,000 ha of land (BBS, 2007). The national annual yield is only 5.71 t/ha (BBS, 2007) which is quite low compare to other onion growing countries of the world.

The local varieties namely Faridpuri and Taherpuri are commonly grown in Bangladesh. In Bangladesh, the demand of bulb onion as well as the onion seeds is increasing every year and the price of the true seeds remains fairly high in each season. Adoption of high yielding varieties of onion and its modern production technologies are yet to be furnished by the onion growers of Bangladesh. Diseases of the crops are considered as the major limiting factors of onion production in the country.

Onion crops are affected by a number of diseases (Munoz *et al.*, 1984; Ahmed and Hossain, 1985; Meah and Khan, 1987). Among those diseases purple blotch, commonly known as leaf blotch, caused by *Alternaria porri*, is noted as the major disease throughout the world including Bangladesh (Ahmed and Hossain, 1986; Munoz *et al.*, 1984; Meah and Khan, 1987; Bose and Som 1986 and Castellanos-Linares *et al.*, 1988). Now a days, *Stemphyllium botryosum*, 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 *Stemphyllium botryosum* initiate the infection and facilitates *Alternaria porri* for causing purple blotch and hence the disease is treated as purple blotch complex (Castellanos-Linares *et al.*, 1988)..

The cultivars Faridpuri and Taherpuri are susceptible to the disease (Rahman, 1990). Onion production in Bangladesh is gradually decreasing due to this disease (BBS, 2001). For its less production, Bangladesh is depended on the neighbouring countries like India, Barma, Pakistan for importing onion to meet the national demand. The disease is characterized with small water-soaked lesions initially on leaves and seed stalk that quickly develop white centre. As lesions enlarged, they become zonate, brown to purple, surrounded by a yellow zone and extents upward some distance. Under humid condition, the surface of the lesion may be covered with brown to dark gray structures of the fungus. A few large lesions have been formed, in a leaf or seed stalk, which may coalesce and girdle of

the leaf or seed stalk and tissues. Usually the affected leaves fall down and die within few days if the environment favors the disease (Gupta *et al.*, 1991).

In Bangladesh, not much attempts have been taken to find out the suitable control measures of this disease (Rahman, 1990). A good number of fungicides and plant extracts are yet remained unexplored against this disease. The literatures indicating that a large number of plant extracts have been reported to have the antipathogenic activity (Ahmed and Sultana, 1984; Singh *et al.*, 1991; Bhowmick and Vardhan, 1991 and Sharvamangala and Datta, 1993) that could be a nice option for the management of the disease.

In Bangladesh, no resistant source is available against the disease. The varieties grown in the country are highly susceptible to the disease. Furthermore, people globally are conscious about environmental deterioration due to discriminate and enormous use of toxic chemicals.

To save the nature and environment, a judicial use of fungicides and plant extracts are to be employed. In this context, the present study was undertaken to achieve the following objectives:

1. To identify the effective fungicides to control purple blotch of onion for bulb production.
2. To evaluate the performance of plant extracts in controlling purple blotch disease of onion.

Chapter 2
Review of Literature

Chapter 2

REVIEW OF LITERATURE

Many researches have been carried out on the purple blotch of onion, its epidemiology and transmission especially for the management of this disease. Management of the disease by using chemicals and plant extracts is being explored in many countries of the world. Literature in relation to management of purple blotch of onion are presented below:

2.1 Chemical control

In a field experiment on the efficacy of some fungicides, Bekhit *et al.* (1963) observed that Zineb and Captan were superior to Bordeaux mixture for the control of *Alternaria porri* , where infection of seed onions was reduced by 50%.

Ashrafuzzaman and Ahmed (1976) tested 5 fungicides in a field experiment and observed that Benlate (Benomyl) and Dithane M-45 (Mancozeb) at 500 ppm gave the best control of *Alternaria porri* on onions and significantly increased the yield.

Patil *et al.*, (1976) evaluated different fungicides against leaf blotch of onion. Kitazin, Cuman, Difolatan, Vitavax, Captan Hinosan, Dutex, Miltox and Aureofungin inhibited the fungus in the culture media. As a prophylactic spray, Kitazin was proved to be superior to all the other fungicides tested.

Padule and Utikar (1977) found the best control against *Alternaria porri* and highest yield of onion by using Dithane M-45 followed by Zineb, Miltox (Zineb+Ca) and Fytolan (Cu-oxychloride) in a field trial.

Bedi and Gill (1978) studied on purple blotch of onion and its control in Punjab. *Alternaria porri* on onions was significantly reduced by spraying Bordeaux mixture or Dithane M-45 (Mancozeb) + Thiodan (endosulfan).

Joi and Sonone (1978) evaluated nine fungicides for the control of leaf blight of onion (*Alternaria porri*) over three years. They found that Dithane M-45 reduced the disease by 23.6% and increased the yield by 35%, whereas Miltox reduced the disease by 22.6% and increased the yield by 26%.

Quadri *et al.,* (1982) reported that out of eight fungicides, Difolatan. (Captafol), Dithane M-45 (Mancozeb) and Bavistin (Carbendazim) gave the best control of *Alternaria porri* (in vitro)

Nuchnart Joglackha *et al.,* (1982) worked on the effectiveness of ten selected fungicides against the fungus cultured on PDA, artificially inoculated plants and infected plants in the field. It was revealed that Mangate-D was the most effective one while Dithane M-45 and Antracol becomes the second.

Georgy *et al.* (1983) observed the effect of several fungicides which were tested against *Peronospora destructor* and *Alternaria porri* on onion at Sakha, Kaha, Sids Malaway and Shandwii research stations, during the growing seasons of 1979-80, 1980-81. Under natural infectioncoddition, they found that disease severity reached up to 100% on plants in nonsprayed plots. Fungicides differed significantly in their effectiveness. Ridomil MZ (Metalazyl + Mancozeb) proved

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to be the most effective in reducing disease severity and increasing bulb and seed yield.

Sharma (1984) observed comparative effectiveness of 10 fungicides to control Alternaria infection (*Alternaria spp.*) of mustard in India. He reported that among the tested fungicides Dithane M-45 gave the best control against the pathogen followed by Daconil, Difolatan and Dithane Z-78. The fungicides reduced the infection rate by 16.6 - 30.1%

Ramos *et al.*, (1985) reported that in a field trail under natural infection, condition Metalaxyl gave the best results against *Alternaria porri.*

Miura (1985) reported that 97.4% control of *Alternaria porri* causing purple blotch of onion with Rovral (Iprodione) was achieved.

As foliar spray, Rovral (iprodione) was recommended for controlling Alternaria leaf spot of mustard and cabbage. Rovral has also been effective against other diseases of onion such as bulb rot (Presly and Maude, 1981; Kritzman, 1983; Rod and Janyska, 1984; leaf spot (Rod and Janyska, 1984; Hall and Kavanagh, 1981).

Sharma (1986) reported that the best control of *Alternaria porri* under field condition was given by Dithane M-45 (mancozeb) at 0.2% conc. applied 6 times from the onset of infection; however 3 sprays were found optimun for maximizing bulb yields.

Gupta *et al.* (1987) tested 10 fungicides for 3 growing seasons and found Dithane M-45 (Mancozeb) effective against *Alternaria porri* with a max. Return/net profit. Spraying 5 times at 15-d intervals with Dithane M-45 + the sticker Triton was recommended for control of purple blotch in onion seed crops.

Ahmed and Goyal (1988) reported that onion seedlings (Nasik Red) with 85% natural inection by *Alternaria porri* were dipped in suspensions of Aureofungin (Parnino Ocetophenone), Bavistin (Carbendazim), Brassicol Quintogene), B-stem 50 (Carbendazin), Cuman (Ziram), Difolatan (captafol), Dithane M-45 (Mancozeb), Dithane Z-78 (Zineb) and Topsin-M (Thiophanate methy1) and then transplanted. Half of the plots were sprayed 3 times later with the same fungicide at 20 days intervals. All treatments significantly reduced disease, best control and maximum bulb yield resulted from the treatment where seedlings dipped followed by a foliar spray with 0.2% Copper oxychloride.

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 filed conditions, all the test fungicides gave significant reduction of severity but significant increase of onion yield was achieved only with Rovral, Dithane M-45 and Bordeaux mixture gave 61, 35 and 29% yield increase, respectively.

Barnoczki-stoilova *et al.,* (1989) conducted trails with onion cv. Makoi Brons to determine the efficacy of several treatments (2 insecticides and 4 fungicides) for pest and disease control during flowering. At the initiation of flowering (10-15% open flowers), spraying had a beneficial effect on seed yield and plant health. Spraying at full bloom (50-60% open flowers) should be avoided for harmful effect. At the end of flowering (5 - 10% open flowers), spraying

improved seed health. Ridomil plus 50 WP (methyl + copper oxychloride) and Rovral 25 FW were the most effective fungicides.

Mishra (1989) evaluated 7 fungicides against purple blotch of onion (*Alternaria porri*) and found Dithane M-45 as effective at 0.2% followed by Jkstein that reduced disease intensity and increased bulb yield by 25.73 and 17%, respectively over the untreated control.

Rahman *et al.,* (1989) evaluated six fungicides viz. Antracol (Propineb) 65 WP, Bordeaux mixture (copper slphate 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 (*Allium cipa*) in laboratory and field condition. All the fungicides gave significant reduction of mycelial growth and disease severity but increase of onion yield was achieved only 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%).

In a field trails at the Regional Research Station, Karnal, Haryana, India, during 1987-89, Gupta *et al.,* (1991) found 3 sprays of Mancozeb at 0.25% applied at 7 days interval after the appearance of disease symptoms provided good control of *Alternaria porri* on onions (disease intensity= 8.7%) and resulted maximum yield (8.0 t/ha).

Srivastava *et al.,* (1991) evaluated 3 fungicides viz, Copper oxychloride, Carbendazim and Thiram against *Alternaria porri* and all the fungicides significangly reduced the disease incidence.

Tahir *et al.* (1991) tested 7 fungicides against *Alternaria porri* in a field and found Daconil (Chlorothalonil) as the most effective one followed by Cupravit, Ridomil MZ-72 and Pencozeb (Mancozeb). Fungicidal treatments increased bulb yield by 8.4 - 19.9% over control.

Perez-Moreno *et al.*, (1993) observed that Iprodione gave the best disease control of purple spot and downey mildew followed by Fosetil. Fosetil gave the best control of the disease control in the fresh market cultivars (national materials), whereas, Iprodione gave the most effective disease control in the hybrids (USA origin). Iprodione gave the highest overall yield followed by Fosetil.

Gupta *et al.*, (1992) observed that *Alternaria porri* cause the most important disease purple blotch of onion in India and 4 sprays of Dithane M-45 (mancozeb) successfully controlled at 0.25% applied at weekly intervals.

During surveys in the Cape Province of South Africa, Aveling *et al.* (1993) found *Alternaria porri* and *Stemphylium vesicarium* to be very dstructive seed-borne pathogens of onion. Six fungicides (Anilazine, Benomyl, Carbendazim/Flusilazole Mixture, Procymidone, Tebuconazole and Thiram) were tested for their efficacy to control *Alternaria porri* on the seed. None of the treatments eradicated *Alternaria porri* and *Stemphylium vesicarium* from onion seeds.

Kolte *et al.* (1993) reported association of *Alternaria porri* in 142 out of 200 diseased samples of onion. They observed that foliar spray with Dithane M-45 at 40 DAT(days after transplanting), 61 DAT and 82 DAT were the most economic and effective compared with Thiram, Copper oxychloride, Bavistin

(Carbendazim), Calixin (Tridemorph), Aliette (Fosetyl), Topsin (Thiophanate methyl) and Rovral (Iprodione).

Perez Moreno Chavez *et al* (1993) conducted an experiment with three fungicides (Iprodione, Fosetyl-alumium and Mexico). They observed that Iprodione had excellent performance in reducing disease intensity and gave the highest yield.

Shrivastava and Gupta (1993) reported that three fungicides (0.25% Mancozeb, 0.3% Coper oxychloride and 0.25% Captan in combination with 2 insecticides (0.05% Monocrotophos and 0.05% Demetonmethyl) were assessed against *Alternaria porri*. *Thrips tabaci* on onion in Maharastra, India, in 1988-89. Mancozeb (0.25%) + monocrotophos (0.5%) reduced disease infection and insect infestation and increased seed yield and improved the cost benefit ratio.

Sugha *et al.,* (1993) conducted an experiment during the winter seasons of 1989-90 and 1990-91 to study the effect of heat treatment of bulbs alone and in combination with a spray of Metalaxyl + Mancozeb (Ridomil MZ) for the control of *A. porri* in the onion cv. Patna red. Heat treatment to onion bulbs at 35C for 8h before sowing followed by a single prophylaetic spray of Metalaxyl + Mancozeb (0.25%) at the bolting stage or no heat treatment and 3 sprays of Metalaxyl + Mancozeb (0.3%) at 15 days intervals from the appearance of disease gave the most effective control. Heat treatment of bulbs at 40 and 45C reduced crop growth. Sprays of Metalaxyl+Mancozeb (0.3%) were superior to those of Copper oxychloride (0.25%), Captafol (0.27%) and Mancozeb (0.25%).

Yazawa (1993) reported that application of Captan, Dithane M-45 and Benlate at 10 days interval gave excellent control of *Alternaria porri* for healthy onion seed production.

Rochecouste (1994) recommended use of Ridomil (Metalaxyl + Mancozeb) against *Puccnia allii. Alternaria porri* and *Peronospora destructor* of garlic and onion.

Borkar (1995) tested different fungicides for control of *Alternaria porri* on onions during a severe disease outbreak. Mancozeb reduced disease intensity by 6%, increased yield by 10.99% and also had a higher cost: benefit ratio than the other fungicides.

Upadhyay and Tripathi (1995) reported the result of a field trial conducted to determine the effect of Bavistin (Carbendazin), Blitox (Copper oxychloride) Calixin (Tridemorph), Captafol, Dithane M-45 (Mancozeb), Dithane Z-78 (Zineb), Jkstein (Methy1), Benjimidazole (Carbamate), Karathane EC (Dinocap) and Topsin M-70 (Thiophanate-methy1) in controlling *Alternaria porri* on onions (*Allium cepa*). All treatments significantly reduced disease incidence and increased yield over control. The best results were obtained with Captafol.

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.

Srivastava *et al.,* (1999) conducted an experiment at Nashik, India, during the robi seasons from 1994 to 1998, using onions cv. Agrifound Light Red. The treatments for integrated weed and disease management were Pendimethalin (0 or

3.5 litres /ha), Nitrogen (0, 50 or 100 kg/ha) and Mancozeb (0.25%), Copper oxychloride (0.3%), or no fungicides application against purple blotch disease. The most effective combination of treatments for controlling weeds and purple blotch and increasing yield was noted 3.5 litres Pendimethalin/ ha, 100 kg N/ha and Mancozeb (0.25%).

Islam (1995) evaluated seven fungicides against *Alternaria porri* causing purple blotch of onion. Score (Difenconazole) was found 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.

Ayub et al.(1996) evaluated seven fungicides to control alternaria blight of mustard caused by *A.* brassicae and *A. brassicicola* and found that Rovral as the best in reducing disease severity, increasing 100 seed weight and seed yield . The maximum reduction of disease severity and increased yield were achieved when the spraying began at 40 days of plant age.

Islam (2003) reported the relative efficiencies of ten fungicides against *Alternaria porri* causing purple blotch of onion. Rovral and Ridomil reduced all disease parameters and incurring higher seed yield.

Rahman (2004) observed the effect of three fungicides viz., Ridomil, Rovral and Tilt (0.2%) comprising 13 treatments in a field experiment. Eight sprays of Rovral or Ridomil at 7 days interval minimized disease incidence and increased yield. Rovral (0.2%) spray 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.

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 was the best in reducing mean severity of the disease and increased bulb yield compared to control.

2.2 Plant extracts

Reports are available about the successful use of plant extracts in reducing the sporulation, growth and infection of fungal pathogen; some of them are incited below:

Ahmed and Sultana (1984) reported that the bulb extract of garlic (*Allium sativum*) at different concentrations inhibited the spore germination of some important fungal pathogens of jute including those of major seed-borne diseases caused by *Macrophomina phaseolina, Botryodiplodia theobromae* and *Colletotrichum corchori.* All the three concentration of garlic solution (5, 7.5 and 10%) inhibited the germination of spores of all the fungi except *B. theobromae* where the germ tube showed stunted and abnormal growth with toxic symptoms at 5 and 7.5% concentration.

Murty and Nagarajan (1986) suggested that the germination percentage of seeds treated with Vitavax-200 and garlic paste were significantly higher; and the percentage of seeds infested both by pathogens and saprophytes were lower than control. Similarly, in the experiments carried out in the greenhouse, both in sterilized and unsterilized soil, garlic paste treated seeds showed almost similar

results to those of Vitavax treated seeds both in germination and in reducing the post-emergence death of seedlings.

The antifungal activity of leaf extracts *Datura alba* and Cannabis sativa efficiently reduced the seed mycoflora of *Eleusine coracana* at all concentrations. *Aspergillus flavus* was completely inhibited at 10% and *D. rostrata* at 20% (Rao and Ratnasudhakar, 1992).

Lakshmanan *et al.* (1990) reported that Aqueous extracts of Neem (*Azadiracta indica*) and Baganbilash (*Bougainvillea spectabilis*) inhibited mycelial growth and sclerotial germination of *Thanatephorus cucummeris*.

Bhowmick and Vardhan (1991) reported the relative efficacy of leaf extracts of some plants on growth, sporulation and spore germination of *Curvularia lunata* manifesting different types of leaf spot diseases. Among the leaf extracts, *Cinnamonum camphora* and *Catharanthus rosens* completely checked the radial growth and spore germination of the test fungus followed by *Azadirachta indica, Clerodendrum viscosum* and *Vitex megundo.* Leaf extracts of *Nyctanthes arbor-tristis, Acalypha indica* and *Kalanchoe pinnata* were ineffective. Mycelial dry weight of the test pathogen was reduced in varying proportions after treatment with all the above mentioned leaf extracts. Scantly sporulation was induced by the application of leaf extracts of *V. megundo, A. indica, C. viscosum* and *Phyllanthus fraternise*; moderate sporulation by *Lantana camara* var. *aculeata* and *Nyctanthes arbortristis* and excellent sporulation by *Acalypha indica, Kalanchoe pinnata* and in control (no leaf extract, only plain water) treatments.

Mia *et al.* (1990) tested extracts of 16 plants species against five fungal pathogens of rice; where 4 showed more than 50% inhibition of mycelial growth of either one or more pathogens over control. *Sapium indicum* was effective against *Gerlachia oryzae, Pyricularia oryzae* and *Rhizoctonia solani* with 92.5, 76 and 78.8% growth inhibition respectively over control. Cent percent inhibition of *Sarocladium oryzae* was obtained by *Tagetes erecta*, which also inhibited growth of *G. oryzae* by 76%, *Polyalthia longifolia* effectiveness was 52.9 and 58.4% for *G. oryzae* and *Fusarium moniliformae*, respectively. *Leucaena leucocephala* was found effective against *G. oryzae* (79.7%), *F. moniliformae* (60.7%), *F. oxysporum* (50.9%) and *R. solani* (80.69%) in inhibiting mycelial growth. More than 40% inhibition of growth was obtained with *Butea frondosa* against *F. moniliformae* and *R. solani*; *Zingiber officinale* and *Curcuma longa* against *G. oryzae*; *Blumea lacera* against *G. oryzae* and *P. oryzae* and *S. indicum* against *F. moniliformae*.

Singh *et al.* (1991) evaluated the effectively of ginger rhizome extracts stored at different temperature to control powdery mildew of pea. Although both stored as well as fresh extracts had shown significant effect on the reduction of disease intensity and thereby increasing the yield, the fresh extract had shown better performance over others. The yield was significantly reduced in both the controls (sterile water spray and no spray).

Dubey and Dwivedi (1991) investigated the fungitoxic properties of *Acacia arabica* (fruit and berk), *Allium cepa* and *A. sativum* (leaf ant bulb) against vegetative growth and sclerotial viability of *Macrophomina phaseolina* and found that bulb extract of *A. sativum* was more effective than its leaf extract. Even 0.1%

concentration extracts checked the growth of *M. phaseolina* by 54.2%. Similarly, berk extract of *A. arabica* exhibited two-fold greater inhibitory effect on fungal growth than the fruit extracts. Bulb extract of *A. sativum* revealed greater fungal effect than *A. cepa* where sclerotia germination was reduced significantly by 27% as compared to control.

Bashar and Rai (1991) evaluated the fungitoxicity of 26 species of higher plants against *Fusarium oxysporum, F. ciceri* in vitro by poisoned food technique at the concentrations of 5, 10 and 20% in Czapek-dox agar (CDA) medium. All the extracts inhibited the linear growth of the fungus to varied degrees and their inhibitory effects increased with their increasing concentrations. *Clematis gouriana* was found to be most inhibitory to the fungus followed by *Allium sativum, Datura stramonium, Eucalyptus globulus, Asparagus acendens, Curcuma longa* and *Anagallis arvnsis*. The bulb and leaf extracts of *A. sativum* caused 99.33% and 67.53% inhibition, respectively at 20% concentration.

Ashrufuzzaman and Hossain (1992) demonstrated bioefficiency of some plant extract against Bipolaris sorokiniana and reported about Pudina (*Mentha viridis*) extract which inhibited mycelial growth as well as spore germination. Extracts of *Castor (Ricinus communis*) and Dandha kalas (*Leucas aspera*) were also found inhibitory against mycelial growth and spore germination of *Bipolaris sorokiniana*.

Antifungal activity of leaf extracts of *Azadirachta indica, Calotropis gigantea, Catharanthus roseus, Eucalyptus sp., Parthenium hysterophorus* and *Pangamia pinnata* were tested by Sarvamangala and Datta (1993) against *Cerotelium fici* and *Cercospora moricola* in vitro causing leaf rust and leaf spot

diseases of mulberry, respectively. *Azadirachta indica* was more effective, inhibiting spore germination by 91.2% whereas extracts of *Eucalyptus sp.* and *C. gigantea* proved highly toxic to *C. moricota* inhibiting conidial germination by 91.5 and 91.3% respectively.

In a study in vitro, Hossain, (2000) found that Kalo jira (*Nigrella sativa*) extract completely inhibited the mycelial growth and sclerotial formation of *Rhizoctonia solani.*

Islam (2003) reported the relative efficiencies of seven plant extracts (Dhatura, Dholkalmi, Garlic, Ginger, Marigold, Neem, Nymbicidine) which was tested in the field condition , Nymbicidine showed significantly the best performance in reducing the disease incidence and giving higher yield.

Chapter 3
Materials and Methods

Chapter 3

MATERIALS AND METHODS

The experiment was conducted at the research farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, during December' 2006 to April 2007 for the management of Purple blotch of onion through chemicals and plant extracts.

3.1 Experimental site and Climate

The experimental site was located at $23^0$77' N latitude and $90^0$03' E longitude with an elevation of 1.0 meter from sea level (Fig. 1). The soil of the experimental site belongs to Tejgaon series under the Agro-ecological zone, Madhupur Tract (AEZ-28). The experimental area was under the sub tropical climate which characterized with the comparatively high rainfall, high humidity, high temperature, relatively long day during April to September and scantly rainfall, low humidity, low temperature and short day period during October to March. The later period is favorable for onion cultivation.

Fig.1. Map showing the experimental site under study

3.2 Preparation of Soil

The soil of the experimental field was clay loam. The land was first ploughed with a tractor drawn disc plough. Ploughed soil was brought into desirable tilth condition by four operations of ploughing and harrowing with country plough and ladder. Then a wooden hammer broke the soil clods. After ploughing, the field was left to nature for 10 days for sun and nature to work upon. When the weeds were sufficiently dried off, the stubbles of the previous crops and weeds were removed recommended, fertilizers applied and the land was prepared finally after a light irrigation to ensure the optimum condition of the soil moisture for transplanting.

3.3 Fertility Status of the Field Soil

The soil of experimental site was analyzed in Soil Resource Development Institute. (SRDI), Dhaka and the physical and chemical properties of the experimental field are shown in Table 1.

Table 1. Physical and chemical properties of the soil of experimental site

Soil properties	Value
1. Soil texture	clay loam
2. Soil pH	5.8
3. Organic matter (%)	1.35
4. Total N (%)	0.08
5. C : N ratio	10 : 1
6. Available P (ppm)	35
7. Exchangeable K (me/100g soil)	0.18
8. Available S (ppm)	40

3.4 Fertilizer Application

Soil was fertilized with Nitrogen, Phosphorus, Potassium, Calcium and Sulphur in the form of Urea, Triple Super Phosphate (TSP), Muriate of Potash (MP) and Gypsum respectively. Cowdung was applied during final land preparation. Whole quantity of TSP and Gypsum and half MP and half of urea was applied at final land preparation. The rest half urea and half MP were applied 40 days after transplanting. Cow dung was applied at the rate of 10 tons/ ha. Doses of fertilizer were used considering existing nutrient of the field soil mentioned below as BARC fertilizer recommendation guide.

Fertilizer	Doses
Cowdung	10 tons/ha
TSP	200 Kg/ ha
Mp	150 Kg
Urea	200 Kg/ha
Zypsum	100 Kg/ha

3.5 Variety Used

A local onion cultivar, Taherpuri collected from Savar Bazar, Dhaka was used in this experiment. Taherpuri is a popular local variety, which is commonly cultivated in Savar, Manikgonj, Faridpur and other onion growing areas of the country for its attractive size and shape, demand and higher market price.

3.6 Unit plot and spacing

The unit plot size was 1.5 m x 2 m and experimental plot size was 10.5m x 19.5 m. The row to row and seedling to seedling distance was maintained 30 cm and 15 cm, respectively.

3.7 Treatment of the Experiment

All together 11 different treatments were explored in the experiment as stated below:-

The treatments were applied into the assigned plots as per design of the experiment:

Treatments

T_1= Dithane M-45

T_2= Rovral 50WP

T_3= Bavistin 50WP

T_4= Cupravit 50WP

T_5= Proud 250EC

T_6 = Tilt- 250 EC

$T_{7=}$ Champion

$T_{8=}$ Ridomil Gold

$T_{9=}$ Neem leaf extract (*Azadirachta indica)*

$T_{10=}$Alamanda leaf extract (*Allamanda cathartic*)

$T_{11=}$ Control.

3.8 Design of the Experiment

The experimental units were arranged in Randomized Complete Block Design (RCBD) with three (3) replications. The unit plot size was 1.5m x 2m. One block is separated from other by 1.0 m. and within a block each unit plot separated from each other by 0.5 m.

3.9 Date of transplanting

The seedlings grown in the seedbed were uprooted gently and cleaned. The healthy seedlings were selected for transplanting in the experimental plots. The seedling were transplanted on 16th December' 2006.

3.10 Gap filling

The dead or sick seedlings were replaced by healthy seedlings within 10 days after transplanting. The damaged plants in the subsequent period were also replaced by the seedling maintained as border plants. Gap filling was done on 28th December, 2006.

3.11 Intercultural operations

- **Irrigation**

Light irrigation was given in two times each day (morning and evening) up to 7 days after transplanting. Then the irrigation was given as per requirement of the soil with regular intervals. First deep irrigation was given after 25 days of transplanting and continued up to harvesting of the as and crop when necessary. Water can with perforated mouth piece was used for soft discharged of water. Irrigation was generally followed the each weeding of the crops.

- **Weeding and mulching**

Weeding and mulching were done as and when required to keep the crop free from weeds and for better soil aeration and conservation of soil moisture. The common weeds found in the experimental plots were *Cynodon dactylon* L (Durba grass), *Cyperus rotundus* L. (Mutha) and *Chenopodum album* L. (Bathua). Weeding was done carefully keeping the delicate young plants undisturbed.

3.12 Preparation of chemicals and plant extract solutions

At recommended dose, suspension/solution of fungicides and plant extracts were prepared by mixing thoroughly with requisite quantity of chemical with normal clean water. For extraction of plant extracts, required amount of respective plants

of each plant was taken, washed in tap water, crushed in mortar pestle. The crushed materials were blended in an electric blender adding equal amount of sterile water for 1:1 solution. The blend was filtered through sterile cheesecloth. The supernatant was diluted in amount of sterile water for 1:4 solutions. The concentration of the spray solution (for 5 decimal land) of the fungicides or plant extracts used in the experiment where presented below (Table.2).

Table2. The concentration of the spray solution and the active ingredient of the fungicides

Treatments	Active ingredient	Concentration
1. Dithane M-45	Mancozeb 80%	0.45%
2. Rovral 50WP	Iprodione 50%	0.2%
3. Cupravit 50WP	Cupperoxycloride	0.7%
4. Bavistin 50WP	Carbendazin 50%	0.1%
5. Proud 250EC	25% Propiconazole	0.1%
6. Tilt-250EC	25% Propiconazole	0.1%
7. Champion	50% Cupperhydrooxide	0.2%
8. Ridomil Gold	Mamcozeb68 % a.i/Kg	0.2%
9. Neem extract		1 : 4 (Leaf : water)
10. Alamanda extract		1 : 4 (Leaf : water)
11. Control	Only Water	

3.13 Seed Treatment

According to the requirement of seedlings for each treatment 200 seeds were soaked in water for 12hr, and then treated for each case with the respective fungicidal solution and plant extracts by dipping the seeds in the suspension for five minutes. The seeds were then drained off, shade dried and sowing in the seedbed without delay.

3.14 Seed germination test:

Germination test of collected seeds of onion were performed at the seedbed. Two hundred seeds were taken randomly for germination test. Data collection on germination was started after the first germination and continued up to 15 days with 7days intervals.

3.15 Application of spray:

Spraying was started from 7 days after transplanting. Totally 5 sprayings were done with 15 days intervals with a hand sprayer. Two liter of suspension of each fungicide/ plant extract was used to spray the plants under each treatment. To avoid the drifting of the fungicides during application, temporary fencing was made with polythene sheet surrounding the unit plot at the time of spraying. A control treatment was maintained in each block where spraying was done with plain water.

3.16 Isolation and identification of pathogens

Isolation and identification pathogen were made in two ways-

a) By direct inspection

b) By inoculating sample tissues on Potato Dextrose Agar (PDA) medium.

a) By direct observation

The diseased leaves of onion plants were collected and kept in polythene bags and tagged. The samples were then taken to the laboratory. Then slides were prepared from the diseased samples, observed under microscope and identified the pathogen according to CMI Description.

b) By growing on potato dextrose agar (PDA) medium

The diseased leaves were cut into pieces (4mm diameter) and surface sterilized with $HgCl_2$ (1: 1000) for 30 seconds. Then the cut pieces were washed in sterile water thrice and were placed on to acidified PDA in Petridish. The plates containing leaf pieces were kept at room temperature for seven days. When the fungus grew well and sporulated, then slides were prepared from pathogenic structures and was observed under microscope and identified with the help of relevant literature (CMI description).

3.17 Collection of data

Five plants were selected randomly from each row of middle 3 rows of the unit plot and tagged. All the, 15 plants were considered for data recording for each unit plot. Data recording was started after the onset of the disease and continued up to maturity with 15 days intervals. Data were recorded on the following parameters.

3.17.1 Percent(%) infected plant per plot

Number of plants infected per plot were recorded and used for calculation of percent plant infection. The leaf with characteristic purple colored spot or blotch or blighted tip was denoted as diseased plant.

3.17.2 Percent (%) of infected leaf per plot

Number of leaf infected per plant were recorded and used for calculation of percent leaf infection The leaf with characteristic purple colored spot or blotch or blighted tip was denoted as diseased leaf.

3.17.3 Calculation of disease incidence

The percent disease incidence was calculated using the following formula.

$$\% \text{ Plant infection} = \frac{\text{Number of infected Plants}}{\text{Total number of plants observed in unit plot}} \text{X } 100$$

$$\% \text{ Leaves infection} = \frac{\text{Number of infected Leaves}}{\text{Total number of leaves observed in unit plot}} \text{X } 100$$

3.17.4 Leaf area diseased (LAD) per plant

Leaf area diseased of the selected plants in every row under each treatment were measured and recorded by conversion to percentage. Mean percentage of leaf area diseased was calculated by dividing number of total observation and used for PDI (Percent disease index) estimation.

Estimation of PDI

The following diseased scoring scale (0 – 5 scale) (Basak 1997) was used to estimate the disease severity (PDI) of purple blotch disease of onion for each unit plot under each treatment.

0 = no disease symptoms

1 = a few spots towards the tip, covering less than 10% leaf area

2 = several dark purplish brown patches covering less than 20% leaf area

3 = several patches with paler outer zone, covering up to 40% leaf area

4 = long streaks covering up to 75% leaf area or bricking of leaves / stems from the centre

5 = complete blighting of the leaves/ stems or breaking of the leaves/stems from the base.

The percent disease index (PDI) was calculated using the following formula:

$$PDI = \frac{\text{Total sum of numerical ratings}}{\text{No. of observation X maximum disease rating in the scale}} \text{ X } 100$$

0 1 2 3 4 5

Plate-1: Disease severity grade on 0-5 scale

3.17.5 Plant height (cm)

Plant height was recorded at the maximum growth stage. Plant height was measured up to tip of the leaf from the ground level with a metallic scale.

3.17.6 Bulb yield (t/ha)

Bulb yield of onion per plot was recorded individually by digital balance (0.001 g) for each treatment. Then it was converted into t/ha.

3.17.7 Bulb diameter (cm)

Diameter of 15 randomly selected bulbs from each plot was determined using slide calipers. Then average diameter was taken for statistical analysis.

3.18. Harvesting of the bulbs

Onion bulbs were harvested on 13th April, 2007, at which the plants have been showing the sign of drying out of most leaves. Onion bulbs were carefully lifted with the help of khurpi. To avoid injury, care was taken during harvesting the bulbs. Then the stalks were cut 2 cm/ above bulbs and dried in the sun and weight was taken.

3.19. Storing of bulbs

After harvesting, curing and sun drying, the onion bulbs were stored, for the month of May to August, on the floor of a pakka room keeping good ventilation.

3.20. Statistical analysis of data

The recorded data on different parameters were statistically analyzed to find out the significant differences among the treatment means. Data were analyzed using MSTAT-C Computer Program. Data were transformed, whenever necessary, following Arcsine transformation. Means of treatment were separated using Duncan's Multiple Range Test (DMRT).

Chapter 4
Results

Chapter 4
RESULTS

This Chapter includes the experimental results. Effect of the treatments in controlling purple blotch of onion caused by *Alternaria porri* was assessed based on the result of seed germination, percent plant infection, percent leaf infection, percent leaf area diseased (%LAD), percent disease index (PDI), plant height, bulb yield and bulb diameter (Table. 3-7, Figs. 2 and Plates 2-7).

4.1 Seed Germination

Influence of fungicide and plant extracts on seed germination was observed and presented in Table.3. The highest seed germination was recorded in case of Rovral 50 WP (93.0 %) followed by Ridomil Gold (92.5 %), Dithane M-45 (84.0 %) and Bavistin 50WP (81.5 %). The lowest seed germination was recorded in control treatment (50.5 %) proceeded by Alamanda lead extract (55.5 %), Neem leaf extract (56.0 %) and Proud 250 EC (56.5 %). The rest of the fungicides showed moderate effect on seed germination.

Table 3. Effect of fungicides and plant extracts on the germination of onion seeds.

Treatment	Seed germination %
Dithane M-45	84.0
Rovral 50WP	93.0
Cupravit 50WP	78.5
Bavistin 50WP	81.5
Proud 250 EC	56.5
Tilt 250 EC	69.5
Champion	75.5
Ridomil Gold	92.5
Neem leaf extract	56.0
Alamanda leaf extract	55.5
Control	50.5

4.2 Percent (%) plant infection

Results obtained on the effect of spray of Dithane M- 45, Rovral 50 WP, Bavistin 50WP, Cupravit 50WP, Proud 250EC, Tilt 250EC, Champion, Ridomil Gold, Neem leaf extract and Alamanda leaf extract in controlling purple blotch of onion in terms of plant infection was presented in Table-4. The effects of the treatments on plant infection were differed significantly. At 15 DAT (Days after Transplanting) the lowest plant infection (7.143%) was observed in the plot sprayed with of Rovral 50WP followed by Dithane M-45 (8.627%), Ridomil Gold (10.94%), Till 250EC (11.69%), Bavistin 50WP (14.15%), Proud 250EC (15.35%), Champion (15.80%), Cupravit 50WP (16.68%) and Neem leaf extract (17.38%). The effect of Alamanda leaf extract was statistically identical with control. The highest plant infection (25.23 %) was recorded in control. Further at

30 DAT, 45 DAT, 60 DAT and 75 DAT the trend of plant infection was more or less similar with that of plant infection observed at 15 DAT. The lower plant infection was recorded in case of spraying with Rovral 50WP that were 12.12% , 16.91% , 22.53% and 27.96% respectively at 30DAT, 45DAT, 60DAT and 75DAT. Similarly the highest plant infection was recorded in control plot and that were 39.98 %, 47.11%, 53.38% and 66.54%, respectively at 30 DAT, 45 DAT, 60 DAT and 75 DAT. It was noted that the plant infection was gradually increased with the increase of the age of the plant. But the rate of plant infection of the treated plot with fungicides or plant extracts were slower then the control plot.

Table 4. Effect of fungicides and plant extracts on % plant infection of purple blotch of onion at different DAT

Treatment	**% plant infection**				
	15 DAT	**30 DAT**	**45 DAT**	**60 DAT**	**75 DAT**
T_1= Dithane M-45	8.627 d	20.37 cde	24.65 cde	31.66 cd	37.35 de
T_2= Rovral 50WP	7.143 d	12.12 e	16.91 e	22.53 d	27.96 e
T_3= Bavistin 50WP	14.15 bc	21.00 cde	26.84 cde	32.98 cd	40.34 cd
T_4=Cupravit 50WP	16.68 b	25.13 bc	33.76 bc	41.03 bc	49.94 bc
T_5=Proud 250 EC	15.35 bc	23.01 cd	30.03 bcd	33.36 cd	41.82 cd
T_6= Tilt 250 EC	11.69 cd	19.99 cde	26.95 cde	32.10 cd	43.14 cd
T_7= Champion	15.80 bc	16.63 cde	23.54 cde	31.04 cd	40.34 cd
T_8= Ridomil Gold	10.94 cd	15.16 de	19.72 de	26.57 d	36.91 de
T_9= Neem leaf extract	17.38 b	25.64 bc	32.10 bc	39.79 bc	50.53 bc
T_{10}=Alamanda leaf extract	22.69 a	32.43 ab	39.51 ab	47.77 ab	59.73 ab
T_{11}= Control	23.55 a	39.98 a	47.11 a	53.38 a	66.54 a
CV (%)	15.48	17.4	16.47	14.03	12.98
LSD $_{(0.01)}$	4.438	8.098	9.68	9.733	9.937

Figure in column, having same letter(s) do not differ significantly at 1% level of significance

4.3 Percent (%) leaf infection

Data recorded on percent leaf infection after application of different fungicides and plant extracts are presented in Table 5. The effects of different treatments recorded at different days after transplanting (DAT) were differed significantly as compared to control. The results showed that the spraying of Rovral 50WP gave the lowest leaf infection irrespective of different days after transplanting that were 3.46 %, 7.41 % , 13.23 %, 18.07 % and 25.15 % respectively at 30 DAT, 45 DAT, 60 DAT and 75 DAT followed by Dithane M- 45. The highest leaf infection was recorded in control irrespective of days after transplanting which was statistically similar with the effect of Alamanda leaf extract. It was noted that the percent leaf infection was gradually increase with the age of the crop and increasing rate was much slower in Rovral 50WP and Dithane M- 45 treated plot compared to control.

Table 5. Effect of fungicides and plant extracts on % leaf infection of purple blotch of onion at different DAT

Treatment	% leaf infection				
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT
T_1= Dithane M-45	9.260 cd	13.80 de	20.16 de	22.80 fg	30.63 de
T_2= Rovral 50WP	3.460 e	7.417 e	13.23 e	18.07 g	25.15 e
T_3= Bavistin 50WP	16.81 b	21.72 bcd	28.76 bcd	34.66 cde	41.49 bc
T_4=Cupravit 50WP	18.23 b	24.60 bc	31.43 bc	37.82 bc	45.52 b
T_5=Proud 250 EC	17.70 b	26.47 b	33.90 abc	39.04 bc	46.64 b
T_6= Tilt 250 EC	14.91 b	16.35 d	21.19 de	27.74 def	35.54 cd
T_7= Champion	13.82 bc	18.11 cd	24.70 cd	31.12 c-f	40.52 bc
T_8= Ridomil Gold	7.320 de	15.00 de	20.46 de	26.54 efg	35.86 cd
T_9= Neem extract	17.49 b	25.52 bc	31.38 bc	36.17 bcd	46.62 b
T_{10}=Alamanda extract	19.17 b	29.41 ab	35.29 ab	44.76 ab	56.07 a
T_{11}= Control	25.57 a	34.75 a	41.56 a	49.77 a	63.44 a
CV (%)	17.48	10.73	19.65	14.44	10.90
$LSD_{(0.01)}$	5.221	7.485	9.19	8.237	7.882

Figure in column, having same letter(s) do not differ significantly at 1% level of significance

4.4 % Leaf Area Diseased (%LAD)

The disease severity of purple blotch disease of onion in respect of %LAD was suppressed significantly due to the application of different fungicides under field condition (Table-6). The %LAD was as high as 31.94 at 75 DAT in the control plot where fungicide was not sprayed. The lowest %LAD (0.1067) was recorded at 15 DAT in treatment T_2, where Rovral 50WP was sprayed. The results showed that Rovral 50WP performed better at different DAT in suppressing %LAD followed by Dithane M- 45, Ridomil Gold, Champion, Tilt 250 EC, Proud 250 EC, Cupravit 50WP and Bavistin 50WP. Again between two-plant extracts,

Neem leaf extract had significant effect compared to Alamanda leaf extract in controlling purple blotch of onion. The effect of Alamanda leaf extract was statistically identical with that of control. From the result it was observed that % Leaf Area Diseased was increased gradually with increasing of the age of the plant.

Table 6. Effect of fungicides and plant extracts on % Leaf Area Diseased (%LAD) of onion at different DAT.

Treatment	% Leaf Area Diseased (%LAD)				
	15 DAT	**30 DAT**	**45 DAT**	**60 DAT**	**75 DAT**
T_1= Dithane M-45	0.1833 d	1.156 f	2.987 de	5.867 e	10.31 g
T_2= Rovral 50WP	0.1067 d	0.440 g	2.283 e	2.853 f	10.06 g
T_3= Bavistin 50WP	0.6287 cd	2.680 c	5.540 c	10.64 c	16.51 d
T_4=Cupravit 50WP	1.099 bc	2.437 cd	5.127 c	9.987 cd	15.73 de
T_5=Proud 250 EC	0.5967 cd	2.090 cde	5.043 c	10.55 cd	15.18 def
T_6= Tilt 250 EC	0.1400 d	1.893 de	4.350 cd	9.123 cd	13.91 def
T_7= Champion	0.4733 cd	1.683 ef	4.140 cd	9.190 cd	12.96 efg
T_8= Ridomil Gold	0.1690 d	0.9833 fg	2.813 de	7.367 de	12.67 fg
T_9= Neem leaf extract	0.9730 bc	3.493 b	7.690 b	15.67 b	23.13 c
T_{10}=Alamanda leaf extract	1.347 ab	4.710 a	10.71 a	17.09 b	26.69 b
T_{11}= Control	1.898 a	4.870 a	11.64 a	22.93 a	31.94 a
CV (%)	19.98	14.44	13.74	14.41	9.21
LSD $_{(0.01)}$	0.590	0.673	1.52	2.893	2.696

Figure in column, having same letter(s) do not differ significantly at 1% level of significance

4.5 Percent Disease Index (PDI)

There were significant differences among the effect of fungicides and plant extracts on Percent Disease Index (PDI) of purple blotch disease of onion compared to control (Table 7). On the basis of the effectiveness of the fungicides and plant extracts in reducing PDI of Rovral 50WP showed the best performance followed by Ridomil Gold, Dithane M-45, Tilt 250 EC, Cupravit 50WP, Proud 250 EC, Bavistin 50WP, Neem leaf extract and Alamanda leaf extract. The results showed that at 15 DAT, the lowest PDI (0.14%) was found in treatment T_2, where Rovral 50WP was sprayed, which was statistically same as Dithane M-45 and Ridomil Gold. Furthermore, the effect of Tilt 250 EC was identical with Champion, Proud 250 EC and Bavistin 50WP. The highest Disease Index was observed in control treatment, where only plain water was sprayed, which was identical with the treatment Alamanda leaf extract. Similar trend was found at 30 DAT, 45 DAT and 60 DAT. The result showed that with increasing the age of onion the disease index was increased. But in every case, control treatment showed the highest disease severity, which was statistically dissimilar with Alamanda leaf extract except 60 DAT and 75 DAT. Between two plant extract, Neem leaf extract showed better performance as compared to Alamanda leaf extract in reducing disease severity. Among the treatments, Rovral 50WP was best in reducing Percent Disease Index followed by Dithane M-45.

Table 7. Effect of fungicides and plant extracts on the severity of purple blotch disease of onion

Treatment	Percent Disease Index (PDI) (%)				
	15 DAT	**30 DAT**	**45 DAT**	**60 DAT**	**75 DAT**
T_1= Dithane M-45	0.2433 c	1.533 f	3.983 de	7.813 e	13.75 g
T_2= Rovral 50WP	0.14 c	0.5867 g	3.007 e	3.807 f	8.450 h
T_3= Bavistin 50WP	0.8367 bc	3.580 c	7.390 c	14.19 c	22.01 d
T_4=Cupravit 50WP	1.467 b	3.250 cd	6.833 c	13.32 cd	20.98 de
T_5=Proud 250 EC	0.8033 bc	2.787 cde	7.170 c	14.07 cd	20.24 def
T_6= Tilt 250 EC	0.6300 bc	2.523 de	5.80 cd	12.17 cd	18.55 def
T_7= Champion	0.6333 bc	2.243 ef	5.523 cd	12.25 cd	17.27 efg
T_8= Ridomil Gold	0.2300 c	1.313 fg	3.753 de	9.827 de	16.89 fg
T_9= Neem leaf extract	1.300 b	4.66 b	10.26 be	20.89 b	30.85 c
T_{10}=Alamanda leaf extract	2.537 a	6.283 a	14.29 a	22.79 b	35.58 b
T_{11}= Control	2.617 a	6.493 a	15.53 a	30.58 a	42.59 a
CV (%)	19.57	14.42	13.87	14.41	9.39
$LSD_{(0.05)}$	0.878	0.896	2.05	3.86	3.59

Figure in column, having same letter(s) do not differ significantly at 1% level of significance

4.6 Plant height

The effect of fungicides and plant extracts on plant height of onion was different among the treatments and that ranged from 38.76 cm to 44.74 cm (Table 8). The highest plant height (44.74 cm) was recorded in plants where Dithane M-45 was applied, which was statistically similar with Rovral 50WP (44.63 cm) and Bavistin 50WP (43.62 cm), Tilt 250 EC (43.76 cm), Champion (43.29 cm), Ridomil Gold (42.35 cm). Plant highest (38.76 cm) was found in control treatment, where only plain water was sprayed. The application of plant extracts had no significant effect on plant height compared to control.

4.7 Bulb diameter (cm)

There were significant differences among the effect of different fungicides and plant extracts on bulb diameter of onion (Table 8). The bulb diameter was ranged from 3.787 cm to 3.053 cm. The highest bulb diameter was recorded in case of Rovral 50WP, which was identical with Dithane M-45 (3.73 cm) and Ridomi Gold spraying (3.71 cm) and the lowest bulb diameter (3.053 cm) was found in control treatment. The effect of other fungicides on bulb diameter of onion was more or less similar. Between two plant extracts application of Neem leaf extract is more effective in relation to bulb diameter of onion then Alamanda leaf extract.

4.7 Bulb yield

The bulb yield of onion differed due to the effect of different fungicides and plant extracts (Fig.2). Mean bulb yield of onion ranged from 8.767 t/ha to 5.8 t/ha. The highest bulb yield (8.767 t/ha) was recorded in the plot treated with Rovral 50WP, which was statistically similar with Dithane M-45 and Ridomil Gold. The lowest bulb yield (5.8 t/ha) was obtained in control plot. Bavistin 50WP, Cupravit 50WP and Tilt 250 EC had statistically similar effect on bulb yield. No significant effects was noticed among Proud 250 EC, Champion, Neem leaf extract, Alamanda leaf extract and control in respect of bulb yield.

Table 8. Effect of fungicides and plant extracts on growth and yield of onion

Treatment	plant height (cm)	Bulb diameter (cm)
T_1= Dithane M-45	44.74 a	3.700 a
T_2= Rovral50WP	44.63 a	3.787 a
T_3= Bavistin 50WP	43.62 ab	3.507 cd
T_4= Cupravit 50WP	40.15 cd	3.303 f
T_5= Proud 250 EC	40.12 bcd	3.423 c-f
T_6= Tilt 250 EC	43.76 ab	3.407 def
T_7= Champion	43.29 abc	3.493 cde
T_8= Ridomil	42.35 abc	3.710 ab
T_9= Neem leaf extract	39.90 cd	3.430 c-f
T_{10}=Alamanda leaf extract	39.75 cd	3.347 ef
T_{11}= Control	38.76 d	3.053 g
CV (%)	4.78	2.45
$LSD_{(0.01)}$	3.431	0.1425

Figure in column, having same letter(s) do not differ significantly at 1% level of significance

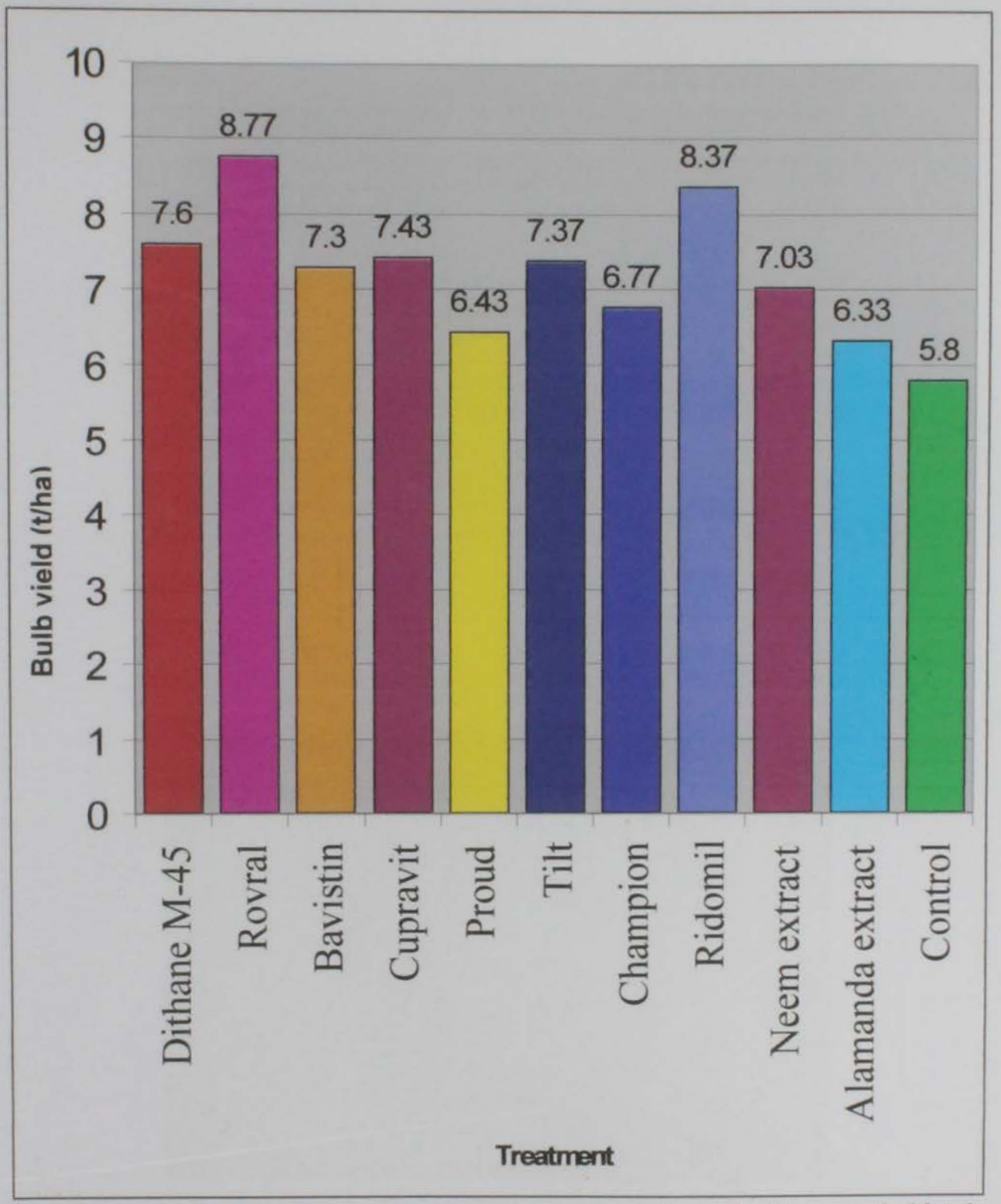

Fig. 2 Effect of different fungicides and plant extracts in controlling purple blotch of onion in response to bulb yield

Plate2. Showing healthy onion plants treated with Rovral 50 WP (T_2)

Plate3. Showing onion plants affected by purple blotch under treatment T_{11} (control).

Plate 4. The experimental plot of onion

Plate 5 . Purple blotch lesion on the onion leaf.

Plate-6: Pure culture of *Alternaria porr*

Plate-7: Conidia of *Alternaria porri* under compound microscope

Chapter 5
Discussion

Chapter 5
DISCUSSIONS

This Chapter includes the discussions of experimental results. Effect of the treatments in controlling purple blotch of onion caused by *Alternaria porri* was assessed based on the result of percent seed germination, percent plant infection, percent leaf infection, percent leaf area diseased (%LAD), percent disease index (PDI), and bulb yield. The effect of the fungicides and plant extracts against purple blotch of onion in terms of seed germination, disease incidence, disease severity, and yield it is revealed that Rovral 50 WP showed the promising performance among the treatmeants. The highest seed germination was 93% yielded by Rovral 50 WP. In case of disease incidence, the minimum plant infection was observed in the Rovral 50 WP treated plot irrespective of days after transplanting (DAT). The minimum plant infections were also noted in case of applying Rovral 50 WP at all DAT. From the result of plant infection and leaf infection it is revealed that the performances of plant extract used in the experiment was not appreciable.

In terms of disease severity (% LAD and PDI), the result showed that Rovral 50 WP proved to be the best potential followed by Dithane M-45 irrespective of days after transplanting . At 75 DAT, Rovral 50 WP reduced 68.50 % Leaf area disease (LAD) and 80.15 % percent disease index (PDI) over control while Dithane M-45 reduced 67.72 % LAD and 67.71 % PDI over control.

In respect Bulb yield Rovral 50WP also contributed the best effect against purple blotch of onion in increasing bulb yield. The maximum yield (8.76 t/ha) was achieved by applying Rovral 50 WP which was 51.15 % increased over control.

The data recorded on disease incidence and severity of the disease at different days after transplanting indicated that the first on set of infection and preliminary

disease development was more or less identical after all the transplants but the disease incidence and severity appeared to be distinct among the treatments in compare to control due to the consecutive spraying with the fungicides and plant extracts. It indicates the inhibitory effect of the treatment applied to control the disease.

The findings of the present investigation are supported by reports of the previous researchers (Rahman, 2004 ; Islam,2003 ; Miura,1985; Rahman *et al* , 1988 & 1989; Islam, 1995; Ayub *et al,*1996; Ashrafuzzaman and Ahmed,1976; Paddule and Utikar,1978; Bedi and Gill, 1978; Joi and Sonone, 1978; Qadri *et al,*1984 of Nuehnant joglakha *et al,*1982; Sharma,1984; Gupta *et al,*1987; Sugha *et al*,1993). Rahman, (2004) reported that Rovral 50 WP (0.2%) was the best fungicides while evaluating 13 treatments against *Alternaria porri* causes purple blotch of onion that gave the highest reduction of disease incidence and severity and increased onion bulb yield . Islam, (1995, 2003) reported that fungicidal spray reduced disease severity (PDI) of purple blotch of onion up to 64.02% and increased bulb yield up to 95.53% over unsprayed control. Miura, (1985) reported that 97.4% control of *Alternaria porri* causes purple blotch of onion was achieved by apply Rovral 50 WP.

Chapter 6
Summary and Conclusion

Chapter 6

SUMMARY AND CONCLUSION

A field experiment was conducted at the research farm of Sher-e-Bangla Agricultural University, Dhaka, during December 2006 to April 2007 to study the management of purple blotch of onion caused by *Alternaria porri* through chemicals and plant extracts. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications of each treatment. Onion variety Taherpuri was used. The unit plot size was 3 m^2 (2.0 m x 1.5 m). There were 11 treatments in the experiment comprising 8chemicals viz. Dithane M-45, Rovral 50WP, Bavistin 50WP, Cupravit 50WP, Proud 250EC, Champion 77WP, Tilt 250EC, Ridomil Gold, 2 plant extracts viz. Neem leaf extract and Alamanda leaf extract and untreated control. The observation was made on the effect of the treatments on seed germination, percent plant infection, percent leaf infection, percent leaf area diseased, percent disease index, plant height, bulb diameter and bulb yield.

The highest performance (93.0%) in respect of seed germination was observed in Rovral 50WP treated seeds closely followed by Ridomil Gold (92.5%) and Dithane M-45 (84.0%). The lowest seed germination was recorded in control which was closely preceded by Alamanda extract (55.5%), Neem extract (56.5%) and Proud 250EC (56.5%).

The % plant infection was observed five times at an interval of 15 days starting from 15 DAT. At the first observation (15 DAT), plant infection was significantly higher in control (23.55%) which was statistically similar to Alamanda leaf extract (22.69%). The lowest plant infection (7.143%) was observed under foliar spray of Rovral 50WP. At the last observation (75 DAT), plant infection was also significantly higher (66.54%) in control treatment and the lowest plant infection (27.96%) was observed the plot sprayed with of Rovral 50WP Similar trends of result were found at 30 DAT, 45 DAT and 60 DAT. It was noted that the plant infection gradually increased with the increase of age of onion and this increase was sharp in control plot but very slower in Rovral 50WP treated plot.

The % leaf infection was also observed five times at an interval of 15 days starting from 15 DAT. The lowest percent leaf infection (3.46%) was found in case of foliar spray of Rovral 50WP at the first observation (15 DAT) and the highest leaf infection (25.57%) was found in control treatment. For each treatment % leaf infections were increased gradually. At the last observation at 75 DAT, the highest % leaf infection (63.44%) was recorded in control treatment and the lowest (25.15%) was found in the foliar spray of Rovral 50WP similar trend of results were found at 30 DAT, 45 DAT and 60 DAT.

The lowest percent leaf area diseased (0.106%) was observed in case of foliar spray of Rovral 50WP which was followed by foliar spray of Tilt 250 EC

(0.140%), Ridomil Gold (0.169%) and Dithane M-45 (0.1833%)while the highest % LAD was observed under control (1.989%) at 15 DAT. At 30 and 45 DAT, the highest %LAD was observed in control treatment followed by Alamanda leaf extract. Finally the highest %LAD (31.94%) was found in control treatment at last observation at 75 DAT and the lowest LAD (10.06%) was recorded in the foliar spray of Rovral 50WP, which was statistically same as foliar spray of Dithane M-45 (10.31%).

Fungicides and plant extracts had significant effects on Percent Disease Index (PDI) of purple blotch disease of onion. Among the five observations, the lowest PDI (0.14%) was found in the plot, where Rovral 50WP was sprayed and the highest PDI (2.617%) was recorded in control treatment, which was statistically identical with Alamanda extract (2.537%) at 15 DAT. At the last observation at 75 DAT, the lowest PDI (8.45%) was observed in Rovral 50WP treated plot and the highest PDI (42.59%) was found in control. The result also showed that the PDI was increased with increasing age of onion. But in every observation the lowest PDI was recorded in Rovral 50WP treated plots and the highest PDI was found in control treatments.

The effects of fungicides and plant extracts on plant height, bulb diameter and bulb yield was found positive and significant. The highest plant height (44.74 cm) was recorded in treatment T_1, where Dithane M-45 was sprayed, which was statistically similar with T_2 (44.33 cm), where Rovral 50WP was sprayed. The

plant (9.67 cm) was recorded in control treatment. The highest bulb diameter (3.787 cm) was observed from Rovral 50WP treated plot, which was statistically similar with Dithane M-45 (3.73 cm) treated plot. The lowest bulb diameter (3.053 cm) was recorded in control treatment. The maximum bulb yield (8.767 t/ha) was recorded in treatment T_2, where Rovral 50WP was applied, which was statistically similar with Ridomil treated plot (8.367 t/ha). The minimum bulb yield (5.8 t/ha) was recorded in control treatment.

From the findings of the present investigation it may be conclude that Rovral 50WP had a promising effect in reducing the incidence and severity of purple blotch of onion increasing bulb yield. Dithenm-45 and Ridomil Gold also showed better performance in suppressing the disease. Neem leaf and Alamanda leaf extract were not proved to be effective against the disease. Thus, may be suggested Rovral 50WP for the control of purple blotch of onion. However, further research works at different agro-ecological zones are needed to carryout the consecutive years to justify the present findings.

Chapter 7
References

Chapter 6

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APPENDICES

Appendix 1. ANOVA for effect of different fungicides and plant extracts on % plant infection of onion at 75 DAT

Source of variation	Degrees of freedom	Sum of squares	Mean of squares	f value
Replication	2	149.45	74.72	2.20
Treatment	10	3621.98	362.20	10.64
Error	20	680.77	34.04	--

Appendix 2. ANOVA for effect of different fungicides and plant extracts on % leaf infection of onion at 75 DAT

Source of variation	Degrees of freedom	Sum of squares	Mean of squares	f value
Replication	2	159.58	79.79	3.72
Treatment	10	3515.81	361.58	6.86
Error	20	428.10	21.45	--

Appendix 3. ANOVA for effect of different fungicides and plant extracts on % leaf Area Diseased of onion at 75 DAT

Source of variation	Degrees of freedom	Sum of squares	Mean of squares	f value
Replication	2	3.72	1.86	0.74
Treatment	10	1490.80	149.08	9.48
Error	20	50.12	2.51	--

Appendix 4. ANOVA for effect of different fungicides and plant extracts on Percent Disease Index of onion at 75 DAT

Source of variation	Degrees of freedom	Sum of squares	Mean of squares	f value
Replication	2	5.58	2.79	0.63
Treatment	10	3001.17	300.12	7.39
Error	20	89.06	4.45	--

Appendix 5. ANOVA for effect of different fungicides and plant extracts on plant height of onion

Source of variation	Degrees of freedom	Sum of squares	Mean of squares	f value
Replication	2	7.05	3.53	0.87
Treatment	10	171.62	17.16	4.23
Error	20	81.14	4.06	--

Appendix 6. ANOVA for effect of different fungicides and plant extracts on bulb diameter of onion

Source of variation	Degrees of freedom	Sum of squares	Mean of squares	f value
Replication	2	0.002	0.001	0.142
Treatment	10	1.18	0.118	3.527
Error	20	0.14	0.007	--

Appendix 7. ANOVA for effect of different fungicides and plant extracts on bulb yield of onion

Source of variation	Degrees of freedom	Sum of squares	Mean of squares	f value
Replication	2	1.75	0.874	1.70
Treatment	10	22.75	2.275	4.43
Error	20	10.27	0.513	--