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ASSESSMENT OF YIELD LOSSES CAUSED BY PURPLE BLOTCH DISEASE IN ONION (*ALLIUM CEPA* L.) AND ITS MANAGEMENT

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A B S T R A C T

Onion is one of the most important commercial vegetable crops grown in Pakistan. It is valued for its distinct pungent flavor and is an essential ingredient for the cooking in many regions. A number of diseases attack onion crops but purple blotch is the most important one and cause huge losses in different parts of world. To search out sources of resistance against this disease, twenty one varieties/ lines were evaluated against it. Not a single variety out of all varieties screened showed highly resistant/immune response towards disease. One variety i.e. Phulkara, exhibited resistant response, while five varieties/lines i.e. Desi red, Early red, Robina, Dark Red and Mirpurkhas showed moderately resistant response.VRIO-6, VRIO-1, VRIO-4 Red nasik, Desi black expressed moderately susceptible response and five i.e.VRIO-9, Pak-10321, Faisalabad Red, Pusa red, Red imposta expressed susceptible reaction while VRIO-3, VRIO-5, VRIO-8, VRIO-7, VRIO-2 showed maximum disease development with rating 5 towards purple blotch disease. For management, three fungicides and three plant extracts at three different concentrations were evaluated against purple blotch disease of onion under field conditions. Among these fungicides Mancozeb expressed minimum disease incidence, followed by Score, Dorazole, and Dora as compared to control. Among the plant extracts *Moringa oleifera* expressed minimum disease incidence followed by *A. indica* and *A. sativum* as compared to control. The present study will be helpful in order to manage the purple blotch disease in onion.

Keywords: Onion, purple blotch, plant extracts and fungicides.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the oldest bulb crops belongs to Amaryllidaceae family. The genus *Allium* comprises over 700 species which can be found throughout the tropical, temperate and sub-temperate regions of the world (Fritsch and Friesen, 2002). Onions are grown in every part of the world where plants are cultivated and can be grown from seeds, bulbs or sets. It shows great variation in many characteristics such as size, color, shape and pungency (Griffiths *et al*., 2002). Onions are a good source of certain minerals, vitamins and carbohydrates. The bulb contains carbohydrates (11.0 g), proteins (1.2 g), fiber (0.6 g), moisture (86.8 g) and energy (38 cal.) (Maini *et al*., 1985). Onion is one of the most important commercial vegetable crop grown in Pakistan and believed to be native to south west Asia and Mediterranean (Wani and Nisa, 2011). Total area of world under onion cultivation is 1.64 million hectares while the total production of onion is 86.34 million tones (FAO, 2011). In Pakistan its area under cultivation is 143.7 thousand hectares with a production of 1892 thousand tons during 2010-11 (FAO, 2011). There are a number of biological factors that are considered to cause deterioration of onion bulbs for instance respiration and pathogen which attacks and make the bulbs unfit for marketing (Pozzo *et al*., 2008). The most important disease of onion is considered to be purple blotch which is caused by pathogen *Alternaria porri* and it is reported as a pathogen on almost all growing area of onion in all corners of the world. The name of this disease "Purple blotch" was proposed by Nolla (1927). He also proposed the pathogen name *Alternaria alli* of this disease which was changed by *Alternaria porri.*

Purple blotch causes 5 to 50% losses in growing field all around the world (Maini *et al*., 1985). The pathogen *A.*

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porri mostly infects leaves and damages the leaf tissue. The result of this infection is that the bulb does not mature early and become susceptible to disease. It also attacks on umbel stalk, and when the infection become severe then umbel stalk is totally girdled and tissue becomes necrotic leading to the complete loss of seed production.

The fungus (*A. porri*) is found in the debris of plants and in waste material. During humid conditions the spores start infecting leaves. *A. porri* forms appressoria before it enters through stomata and epidermal cells (Aveling *et al*., 1994). The spores disperse through the wind when the debris of plants becomes dry. Favorable and optimum temperature for the development of the disease is 25º C. By adopting different crop rotations, the risk disease attack can be reduced. This disease can also be reduced by preventing the leaves from wetness. Another preventive measure can be adopted by the application of fungicides, removal of plants debris from the field and proper irrigation. Management through fungicides is effective but biological method is also used for managing the disease because natural enemies are best to control and not harmful for environment (Maini *et al*., 1985).

The present study was planned to assess the yield losses cause purple blotch disease and to study the response of different germ-plasm against disease afterwards to evaluate the different fungicides and plant extracts in order to manage the purple blotch disease.

MATERIALS AND METHODS

Establishment of disease screening nursery of onion against purple leaf blotch: Onion varieties/lines were obtained from Ayub Agricultural Research Institute, Faisalabad (AARI). An experiment was conducted in the research area of Ayub Agricultural Research Institute Faisalabad. For screening purpose onion varieties/lines ranging from moderately resistant to highly susceptible were used as reference entries for purple blotch of onion.

Research for Screening of onion twenty one onion varieties/lines of onion (Phulkara, VRIO-2, VRIO-3, VRIO-4, VRIO-5, VRIO-6, VRIO-7, VRIO-8, VRIO-9, Robina, Dark red, Red imposta, Early red, Mirpurkhas, Desi red, Desi black, Desi nasik, Pusa red, Pak red, Faisalabad red, Pak-10321) were grown under randomized complete block design in experimental area of Ayub Agricultural Research institute Faisalabad.

Purple blotch disease was recorded by using the disease scale given by Sharma (1997). Disease incidence data was recorded after two and half month of transplanting on each cultivar by using following formula (Kumar, 2007).

$$\text{Disease incidence \%} = \frac{\text{Total infected plants observed}}{\text{Total plants observed}} \times 100$$

Management of purple blotch disease of onion through fungicides: Four fungicides (Mencozeb, Score, Dora, and Dorazole) at three different concentrations (0.05, 0.1 and 0.25%) with one control were evaluated against purple blotch disease of onion under natural field conditions. The field experiment was laid out in randomized complete block design (RCBD) in the research area of Ayub Agriculture Research institute Faisalabad. Healthy onion bulbs of variety (Phulkara) were grown into the field by adopting standard R-R and P-P spacing. All other cultural practices were followed to keep field in good conditions. Three sprays with fifteen days interval were used and data regarding disease incidence was recorded after seven and fourteen days of each spray. First spray was done soon after the appearance of disease symptoms.

Management of purple blotch on onion through plant extracts: Three plant extracts (*Moringa olifera, Allium sativum, Azadirachta indica*) were evaluated under field conditions at three concentrations (S/50, S/25 and S/15). Three sprays of all plant extracts were done with three replications. The first spray of plant extracts were applied just after the first appearance of first symptom of the disease in the field and the other sequential sprays at an interval of 15 days. For preparation of plant extracts, 75 grams of fresh leaves were macerated in 25 ml of sterilized water using sterilized pestle and mortar. The resultant solution was passed through four layers of sterilized muslin cloth and Whatman filter paper No.14, thus receiving standard (S) plant extract arbitrarily (Ilyas *et al*., 1996). Similarly S/50 and S/25 were prepared by mixing 100 ml standard concentration with 100 ml of sterilized water 25 ml standard concentration with 100 ml of sterilized water, respectively. Similarly S/15 solution was prepared.

Statistical analysis: The collected data was analyzed statistically by employing the Fisher analysis of variance technique and treatment means were compared by using Least Significance Difference (LSD) test at 5% probability level (M. Stat C).

RESULTS

Evaluation of onion germ plasm against purple blotch disease: Not a single variety showed highly resistant/immune response towards disease with rating

0, One variety i.e. Phulkara exhibited resistant response with disease ratings of 1 (Table1) while five varieties/lines i.e. Desi red, Early red, Robina, Dark Red, Mirpurkhas showed moderately resistant disease rating with 2. Similarly five varieties/lines i.e. VRIO-6, VRIO-1, VRIO-4 Red nasik, Desi black expressed moderately susceptible response with rating 3 and the five varieties i.e.VRIO-9, Pak-10321, Faisalabad Red, Pusa red, Red imposta expressed susceptible reaction (with rating 4).The remaining VRIO-3, VRIO-5, VRIO-8, VRIO-7, VRIO-2 showed maximum disease development with rating 5 towards purple blotch disease during (Table 1).

Table 1. Response of onion varieties/lines against purple blotch of onion.

Sr.	Varieties/ Lines	Disease incidence (%)	Disease rating	Response
1	Phulkara	7.667	1	R
2	Desi Red	12.200	2	MR
3	Early Red	13.700	2	MR
4	Robina	15.467	2	MR
5	Dark Red	17.100	2	MR
6	Mirpurkhas	18.133	2	MR
7	VRIO-6	25.667	3	MS
8	VRIO-1	29.667	3	MS
9	VRIO-4	31.583	3	MS
10	Red Nasik	34.600	3	MS
11	Desi Black	37.200	3	MS
12	VRIO-9	44.400	4	S
13	Pak-10321	47.600	4	S
14	Faisalabad Red	52.467	4	S
15	Pusa Red	52.867	4	S
16	Red Imposta	56.467	4	S
17	VRIO-3	63.608	5	HS
18	VRIO-5	65.667	5	HS
19	VRIO-8	71.267	5	HS
20	VRIO-7	75.667	5	HS
21	VRIO-2	77.483	5	HS

*Mean values in a column sharing similar letters do not differ significantly as determined by the LSD test ($P \leq 0.05$).

MR = moderately resistant R= Resistant

MS = moderately susceptible S = Susceptible

Management of purple blotch of onion through application of different fungicides: All the treatments (T), sprays (S), concentration (C), and their interactions (T x S), (T x C), (S x C) and (T x S x C) expressed significant results. Among all fungicides Mancozeb expressed minimum disease incidence followed by Score, Dorazole, Dora as compared to control as shown in (Figure 1). Mancozeb expressed maximum reduction in disease after 1^{s}, 2nd and 3rd spray followed by Score, Dorazole and Dora as compared to control. Interaction between Treatment x Concentration showed that maximum reduction in disease by Mancozeb at all concentrations followed by Score, Dorazole and Dora as compared to control. Interaction between (T x C x S) showed that Mancozeb during all sprays and at all concentrations expressed pronounced results. Mancozeb at three concentrations (0.05, 0.1 and 0.25%) reduced disease after first spray (29.81, 26.50, and 22.45) %, after second spray (26.28, 22.45 and 18.56) while after third spray reduced disease (21.75, 18.45 and 13.72) respectively as compared to control. Score followed Mancozeb express disease reduction after 1st spray (43.95, 40.68, and 36.56) % after 2nd spray (40.74, 36.54, and 32.50) while after 3rd spray (35.81, 32.60, and 29.45) respectively as compared to control. Dorazole followed Score expressed disease reduction after 1st spray (51.77, 47.58 and 43.62) %, after 2nd spray (46.71, 42.64, and 38.62) after 3rd spray (44.70, 38.60 and 35.52) respectively as compared to control. After Dorazole, Dora expressed disease reduction after 1st spray (61.85, 57.47, and 53.68) %, after 2nd spray (57.75 54.45, and 50.50) % after 3rd spray (53.67, 50.50, 46.62) respectively as compared to control (Figure 2).

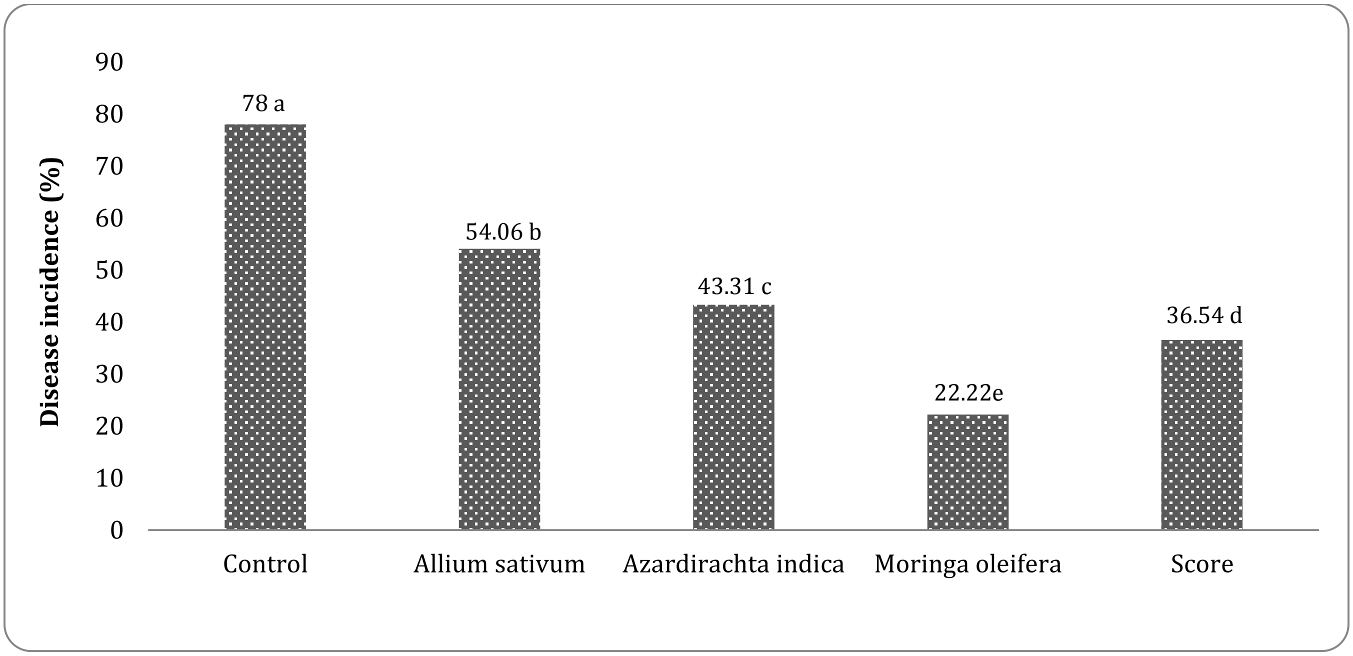

Figure 1. Impact of different fungicides against purple blotch disease of onion under field conditions.

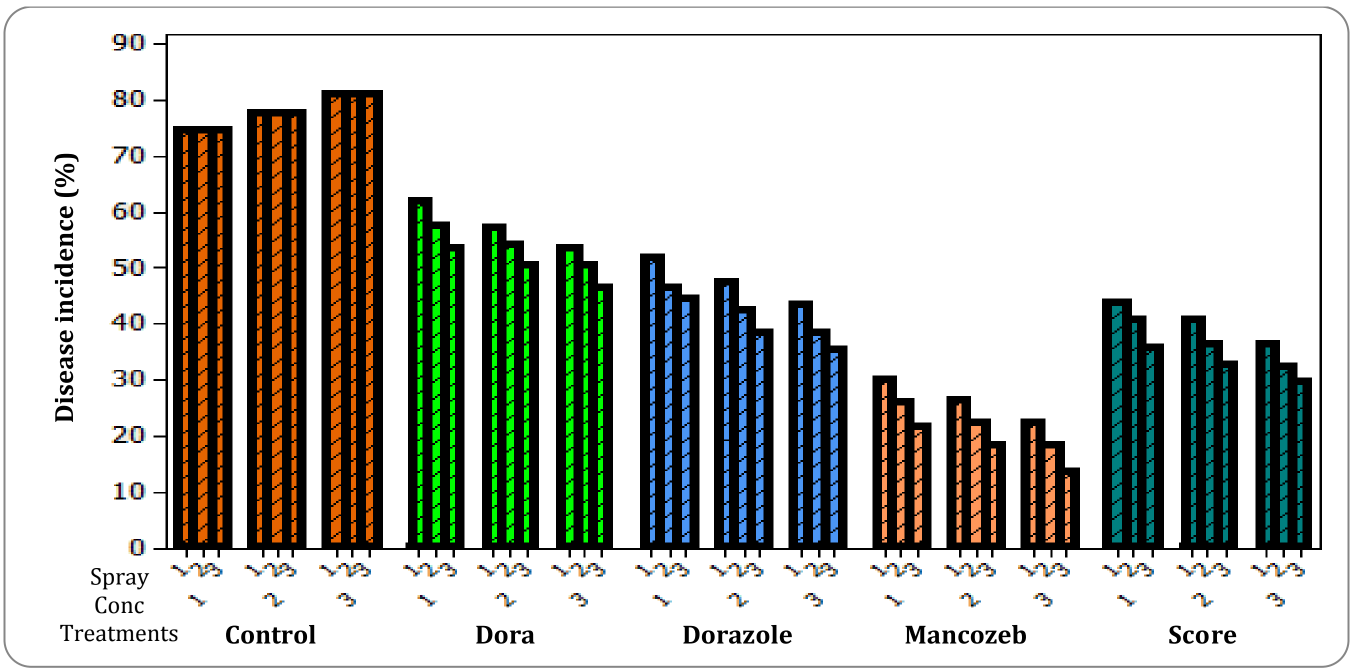

Figure 2. Evaluation of interaction of treatments, spray and concentration (T XSXC) against purple blotch disease of onion under field conditions

Management of purple blotch of onion through application of different plant extracts: All the treatments (T), sprays (S), concentrations (C), and their interactions (T x S), (T x C), (S x C) and (T x S x C) expressed significant results. Among all the plant extracts treatment with *Moringa oleifera* expressed minimum disease incidence, followed by *Azadirachta indica*, *Allium sativum* as compared to control (Figure 3). *Moringa oleifera* expressed maximum reduction in disease after 1st, 2nd and 3rd spray followed by *Azadirachta indica* and *Allium sativum*as compared to control. Interaction between Treatment x Concentration showed that maximum reduction in disease by *Moringa oleifera* in all concentration followed by *Azadirachta indica* and *Allium sativum* as compared to control.

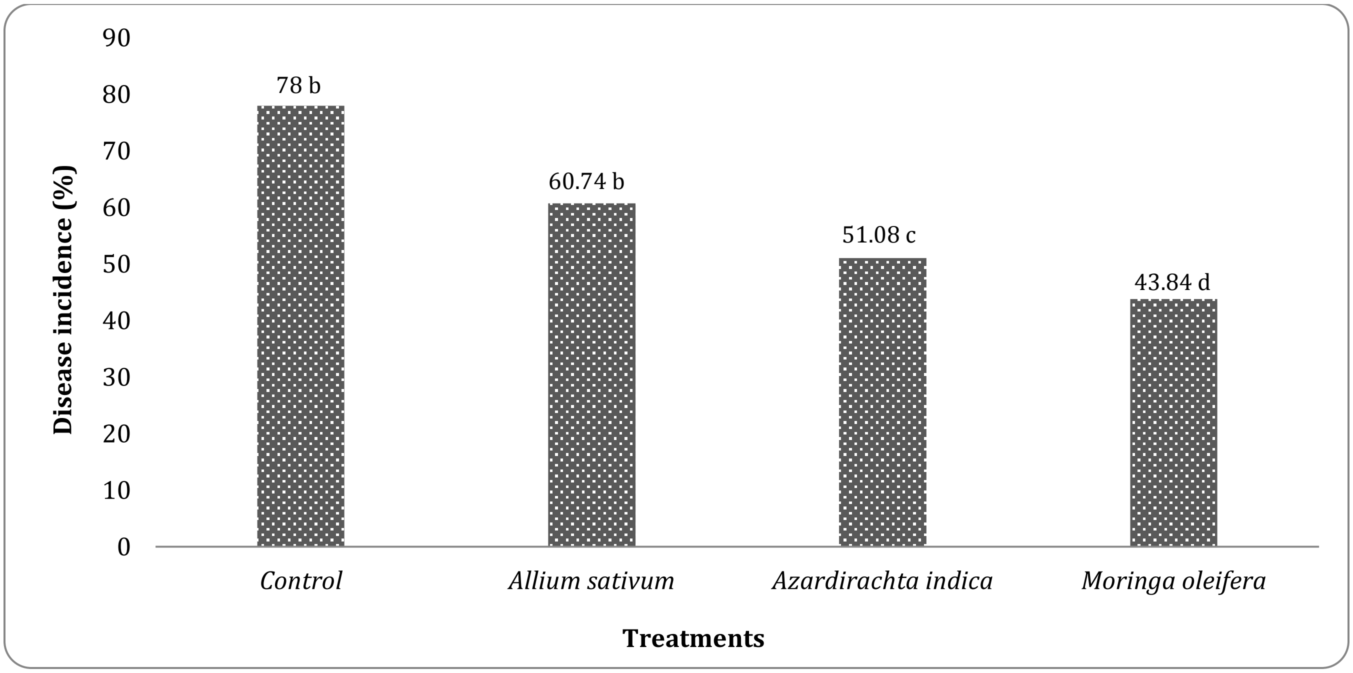

Figure 2. Evaluation of plant extracts against purple blotch disease of onion under field conditions.

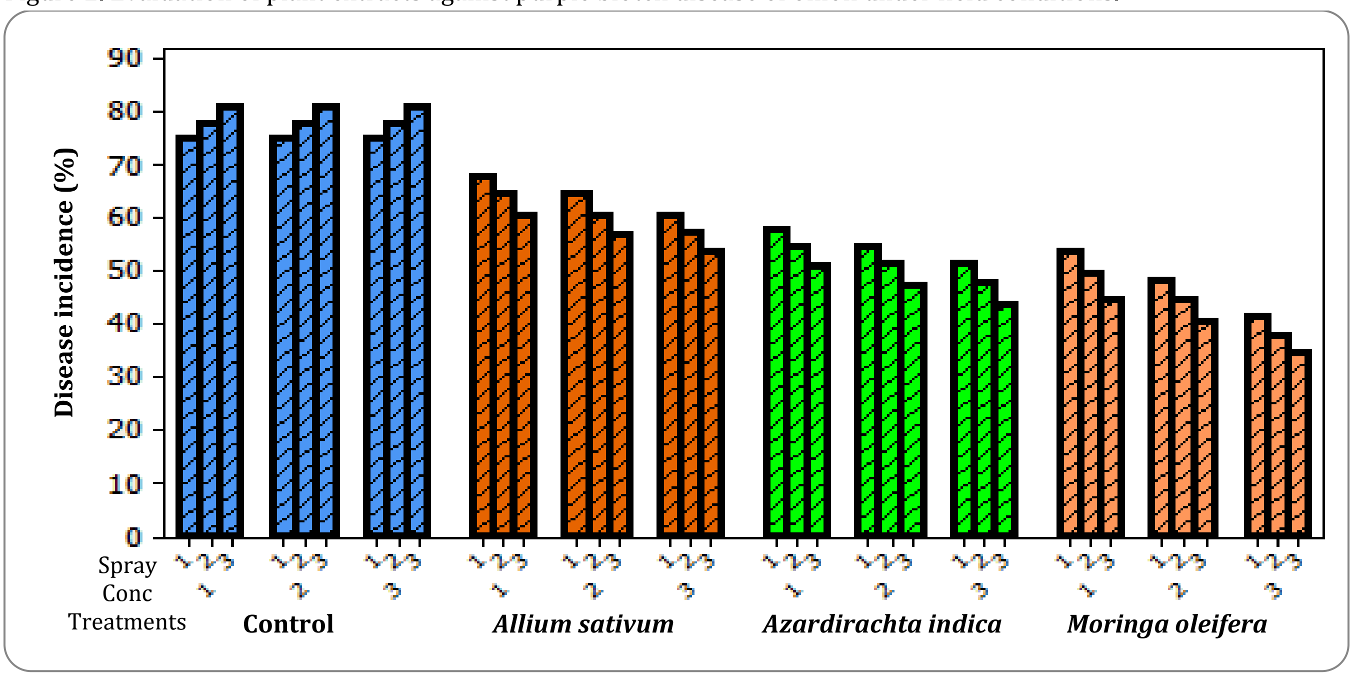

Figure 3. Evaluation of interaction of treatments, spray and concentrations (TXSXC) against purple blotch disease of onion under field conditions.

Interaction between (T x C x S) exhibited that *Moringa oleifera* during all sprays and at all concentrations expressed pronounced results. *Moringa oleifera* at three concentrations (S/50, S/25, and S/15) reduced disease after first spray (57. 67), (54.62), (50.66) % after second spray (47.97), (44.53), (40.50) and while after third spray reduced disease (41.72), (37.53), (34.53) % respectively as compared to control. *Azadirachta indica* followed *Moringa oleifera* express disease reduction after 1st spray (57.67, 54.62, and 50.66) % after 2nd spray (54.62, 51.66, 47. 52) % while after 3rd spray (51.66, 47.76, 43. 57) % respectively as compared to control. *Allium sativum* followed *Azadirachta indica* expressed disease reduction after 1st spray (68.00, 64.66, and 60.50) %, after 2nd spray (64.66, 60.50, and 56.62) % after 3rd spray (60.50, 57.60, and 53.66) % respectively as compared to control (Figure 4).

DISCUSSION

In Pakistan fungal diseases causes a lot of problems in the production of onion. In fungal diseases, purple blotch of onion that is caused by *Alternaria porri* is a major threat for the onion crop (Lancaster *et al*., 1996). Disease can damage all above the ground parts of the plant and in epidemic form will result in the complete destruction of the crop. Out of twenty one varieties varieties/ lines only Phulkara exhibited resistant response towards purple blotch disease of onion. The results of present study are quite similar with research of Singh (1999) and Ahmad and Iqbal (2001) who evaluated onion germ plasm under field conditions and concluded that use of resistant varieties against purple blotch disease is the most economical and best method. Pathak *et al,* (1986) worked on different varieties and lines for screening purpose to found out the resistant source against purple blotch disease of onion. They found that only one line IR-56-1 was resistant. Five lines viz., IHR-25, IHR-44, IHR-499, IHR-500 and Arka Kalyan were moderately resistant. Six varieties such as Rampur Rose, Agri Rose, Arka Niketan, Arka Pitambur, Arka Pragathi and Arka Bindhu were found to be moderately susceptible and these were found in category III. Dhiman *et al.* (1986) studied 18 varieties of onion in which they observed the reaction of purple blotch disease against these varieties. They concluded that from these 18 varieties none of the variety that was grown for bulb crop was found to be resistant or immune.

Most effective method for the control of purple blotch disease is the use of resistant cultivars against the disease, but if the resistant cultivars are not available then only solution for the farmers is to use chemicals for management the purple blotch disease. That is why in the present study four fungicides were evaluated for the management of purple blotch disease. Maximum disease incidence in field was recorded on plants sprayed with Dora 54.05% followed by Dorazole 43.31%, Score 36.54% but the lowest disease incidence was on plants that were treated with Mancozeb 22.22% as compared to control with 78%. Dithiocarbamate, which is active ingredient of Mamcozeb, destroys fungal spores or will suppress germination tubes, hyphae and other fungal structure (Koike and Heinderson, 1998). The results of present study are also confirmed with Madhavi *et al*. (2012) who observed that Mancozeb is a systemic fungicide and is translocated in certain plant parts such as leaves or shoots and move short distance within the transpiration stream and is toxic and effective against enzymes which are responsible for different metabolic activities of pathogens like breakdown of host membrane and biochemical processes. The results are similar with Rehman *et al*., (1999) who described the efficacy of different fungicides like mancozeb and dicloran against the purple blotch disease and the mancozeb is good chemical for reduction in growth of *Alternaria porri*.

It is now known that the various natural products can reduce population of various pathogens and are environmentally safe (Bowers and Locke, 2004). Biologically active products occur in plants for protection against pests, pathogens and other plants. Such compounds could be valuable as bio-pesticides for controlling plant diseases because they are biodegradable and selective in their activities. So it is need of the hour to evaluate different plant extracts for management of plant diseases. That is why in the present experiment three plants extract (*Moringa oleifera*, *A. indica, A. sativum*) at three concentrations were evaluated against purple blotch disease of onion under field conditions. Among all these plant extracts, treatment with *Moringa oleifera* expressed minimum disease incidence followed by *A. indica*, *A. sativum* as compared to control. Madhavi *et al.* (2012) evaluated different plant extracts against *A. porri* the causal agent of purple blotch of onion and concluded that plant extracts are good for control of different fungi like *Alternaria porri*. The growth of *A. porri* was restricted with different plant extracts *Mentha arvensis* gave best results in checking the growth of *A. porri* followed by *Pongamia pinnata* and *Coriandrum sativum*. The inhibition level was high with increasing concentration of the plant extract (Mohan, 2001). The toxicity of *Allim cepa L., A. sativum., O. sanctum, Lawsonia inermis, Datura stramonium* L. and *Thuja orientalis* L. has been tested against *Alternaria* spp. and found to be effective (Ganapathy and Narayanasamy, 1993). Aqueous extracts from all the plant species tested, significantly reduced conidial germination of *A. porri*. Maximum reduction was observed with a leaf extract of *Polyalthia longifolia*, followed by *Eucalyptus citriodora*, *Datura alba, O.sanctum, Punica granatum, Azadricachta indica, Ipomoea carnea, Tridax procumbens* and

Pabernamontana cononaria (Datar, 1994).

Turkusay and Onogur (1998) reported that spore germination of *A. porri* was inhibited by *Hedera helix* Low concentration of extracts followed by *Datura stramonium* L. extracts. *Ficuscarica* L. and *Avena sativa* L. extract also affected colony development. Kumar *et al*. (2012) tested different plant extracts on solid and liquid media against *Alternaria spp*. and reported that *A. sativum* L. was found to be most effective. The bishkatali *(Polygonum hydropiper* L.), garlic (*A. sativum*), ginger (*Zingiber officinale*) and neem (*Azadirachta indica*) extracts were effective against *Alternaria* (Rehman *et al*., 1999).

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