Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(3): 1624-1627
Received: 03-03-2020
Accepted: 07-04-2020

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Purple Blotch disease in onion: Management through biological agents

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Abstract
Alternaria porri (Ellis) Cifferi, a Deuteromycetetious fungus, is the most critical pathogens causing Purple Blotch disease in onion. The paper reveals symptomatology, microscopic studies, seed treatment experiments and management of Purple Blotch disease in onion. It was observed that the spread of disease caused due to the presence of *Thrips tabaci* Lind. In the initial stage of infection the disease symptoms appeared as tiny, water-soaked, orange coloured lesions encircled by yellow hallow. As, the disease progressed the lesions enlarged and became elliptical with concentric rings, turning into necrotic patches. Under the cultural conditions, the fungus showed white fluffy growth of mycelium producing dark orange to purple pigmentation.
The seed treated with *Trichoderma harzianum* and *Pseudomonas fluorescens* @ 10g/kg of seed gave the best results to increase germination % and yield of onion bulbs. The prophylactic spray of Neembicidine @ 0.3% and *T. harzianum* @ 1% was observed as the most effective in the management of disease or thrips and was the most efficient in prolonging the disease occurrence respectively under field conditions.

Keywords: Onion, purple blotch, *Alternaria porri*, bio-agents, thrips

Introduction
Onion is one of the major crops in India famous as a potential source of earning in the country which is grown in about 1285 hectare area with an approximate annual production of 23262 tonnes. In 2018-2019 onion production is recorded to be around 23.62 million tonnes (MT) as against 23.26 MT in 2017-18 (The Economic Times Agriculture, 2019) [10]. In India the large scale production of onion has been recorded from Maharashtra, Madhya Pradesh, Karnataka, Bihar, Rajasthan, Andhra Pradesh, Gujarat, Haryana, West Bengal, and Uttar Pradesh. Onion is known as one of the oldest medicines of our civilization. It contains an organosulphur compound 'Allyl propyl disulphide' which is responsible for smell, pungency and irritation of eyes. It has most important properties of antioxidant, anticancer, antimicrobial, anti-diabetic and anti-asthmatic (Ashwini and Sathishkumar, 2014) [1]. The productivity of onion bulb is severely affected by a number of insect pest and diseases. The Purple Blotch disease of onion is responsible for causing huge losses to onion bulb crop.
According to Suheri and Price (2001) [9] the disease is most severe in warm and humid conditions and responsible for dropping 62-92% of foliage production. Srivastava *et al.*, (1994) [8] surveyed and observed that in *Kharif* crop the problem of Purple Blotch reaches up to 87.8% under high humid conditions.

Material and Methods
To assess the occurrence and severity of Purple Blotch disease of onion, the field survey was conducted during the Rabi season of the years 2015-16 and 2016-17 in Bhabar area of Uttarakhand. The diseased samples showing the distinctive symptoms of fungus on different parts of plant including leaf, flower stalk and seeds were brought to laboratory for further examination.

Seed Treatment Experiment
Under the experiment of seed treatment different fungicides and biological agents were used for the treatment of apparently healthy seeds. Towel paper method was used to determine the germination percentage of seeds. The seeds were positioned @100 per replication on a set of rolled towel paper and incubated at 27 ± 1^0C for eight days. Towel papers were soaked properly in water to maintain the adequate humidity. Untreated seeds were considered as control samples. Under laboratory conditions the germination percentage was recorded after 8^{th} day of incubation. Percent germination was recorded after 15 days of sowing under glass house and field conditions. Percent emergence was calculated as:

$$\text{Per cent emergence} = \frac{\text{Total number of emerged plants}}{\text{Total number of seeds planted}} \times 100$$

Mother Bulb Production (Nursery Preparation)

The onion bulb production was obtained through nursery preparation. Elevated seed beds of 15-20 cm were used so as to avoid the risks of over moistening. For the supply of nutrients, farmyard manure was mixed in nursery soil. Nursery was prepared to germinate the seeds at the rate of 6-8 kg seeds per hectare in the first week of November. Polyethylene sheets were used to cover the seed beds. In the morning hours, the covers were removed with the emergence of seedlings.

Layout of Experiment for Bulb Production

The experiment was conducted in an area of 300m^2 following the Randomised Block Design (RBD) pattern by selecting ten treatments with three replications. The onion cultivar Agrifound Dark Red was used for the experiment. At about 3-4 true leaves stage (after 40 days of sowing) the seedling were transplanted. The intensity of disease and yield of the crop was recorded by applying prophylactic spray of different fungicides and bio-agents. Disease severity was recorded by using 0-5 scale Sharma (1986) [6]. Wheeler (1969) [13] formula was used for assessing the Percent Disease Index (PDI) and analyzed statistically.

Results and Discussion

Symptomatology

Distinct appearances of Purple Blotch were noticed on the leaves as small, water-soaked lesions in the beginning. Under congenial environmental conditions, conspicuous round to oval shaped orange coloured lesions surrounded by yellow hallow were observed. With the progress of the disease, the lesions appeared as eye shaped purplish spot with concentric rings, turning into the necrotic patches. At maturity, black powdery growth of the fungus persists at the site of the lesions.

The disease enhancement (Purple Blotch) was observed due to the presence of *Thrips tabaci* Lindeman (Thysanoptera: Thripidae). A severe attack of disease was noticeable particularly in the area of heavy infestation of thrips which provided suitable substrate for the entry of the pathogens, resulting the onion plant more prone for disease spread.

The results of the present study closely resembled with that of the earlier studies made by Boisson and Renard (1967) [2] regarding the appearance of the characteristic symptoms. He recorded the eye shaped purple coloured lesions of encircled by chloratic margins. Montano *et al.*, (2011) [3] considered *T. tabaci* as a global pest of onion, responsible for causing blotches, premature senescence, and producing undersized bulbs.

The cottony mycelial colony of *A. porri* was observed under laboratory conditions producing light orange to dark purple pigmentation. The branched, septate, hyaline to light brown fungal mycelium was observed to produce rounded to globular chlamydospores. The rate of spore production was observed to be very slow. Usually conidiophore produced solitary conidium at maturity but occasionally a very short chain of straight to curved conidial production was not uncommon. The conidial length was measured ranging from 115-300 µm X 10-20 µm. The muriform conidia were measured with 7-12 transverse and 1-2 longitudinal septa. Our observations resembled closely with that of the findings of Shahnaz *et al.*, (2013) [4] regarding mycelial characteristics.

To assess the percent germination of onion seeds with the treatment of different fungicides and bio-control agents was carried out under laboratory, glasshouse and field conditions. The highest percent germination was recorded approximately 96%, 88% and 77% in the samples of *T. harzianum* treated healthy seeds followed by *Ps. fluorescens* under different conditions. Neembicidine and tebuconazole treated seeds showed adverse affect under all conditions. However, the percent germination was recorded as 64%, 58% and 41% in control conditions under laboratory, glasshouse and field conditions respectively. Chemical treatment with thiram was turned out as the best followed by captan in all the conditions (Fig.1). The germination percentage was recorded to be above certification standared in lab conditions while poor seed germination was obtained in both glasshouse and field conditions. Due to the infection the seedlings did not appear and collapsed.

During the course of field study, the prophylactic spray of biocontrol agents in the onion crop has given the remarkable results. Neembicidine (Neem based bioproduct) treatment was found to be most effective for minimizing the disease severity amongst all treatments in both consecutive years. During the year 2015-16 the diseases severity was recorded as 4.2% while (Fig. 2), in 2016-17 it was1.32% (Fig. 3) respectively. The prophylactic spray of bioagent, *T. harzianum* turned out to be very effective in minimizing disease severity upto 5.4% and 3.1% in two successive years. The disease severity, in control condition was found to be 70.2%, and 51.22% respectively.

Sharma (2012) [5] reported that the *A. porri*, which is responsible for causing enormous yield loss in onion crop, was found to be controlled by the foliar spray of *T. harzianum* isolates. He emphasized the use of bio-control agents as the most successful sustainable approach for the disease management. Our findings are in accordance with the earlier work presented by Upadhayay *et al.*, (2009) [11] and Singh *et.al.*, (2010) [7] in which it was investigated that the biopesticide (neem based) was found to be useful in the management of onion thrips. Use of *Trichoderma* sp. as bio-control agents reported by Vannaci and Harman (1987) [12] has been the most effective against the infection of *Alternaria* spp.

Acknowledgement

We are grateful to the Head of the Department of Plant Pathology, College of Agriculture, G. B. Pant University of A. & T. Pantnagar for providing necessary laboratory facilities. The authors are highly thankful to Shri. D. D. Tewari for providing experimental land. The corresponding author is highly grateful to the Dean and Director of Graphic Era Hill University Bhimtal for their constant support and encouragement.

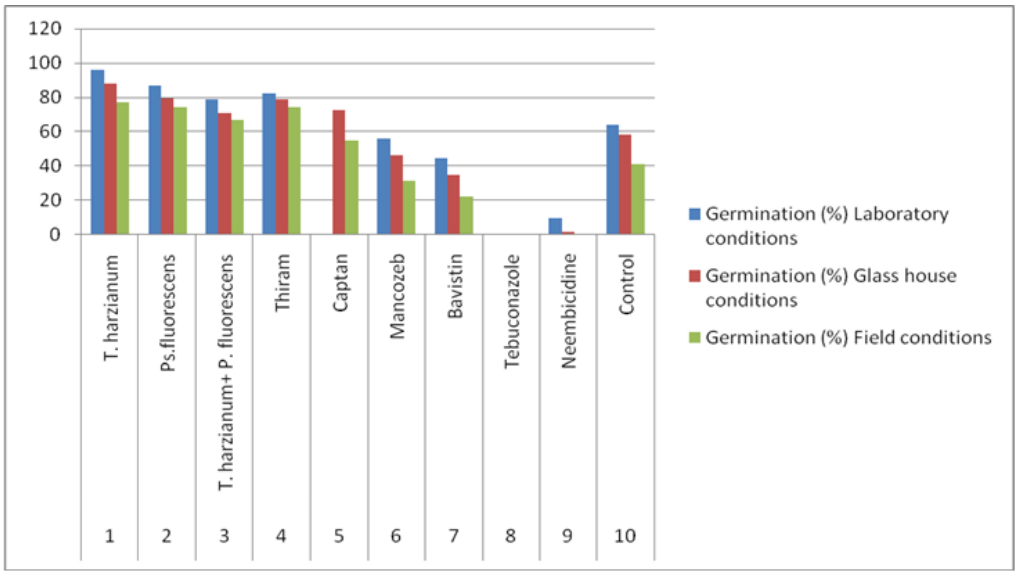

Fig 1: Germination percent of treated apparently healthy seeds of onion under laboratory, glasshouse and field conditions.

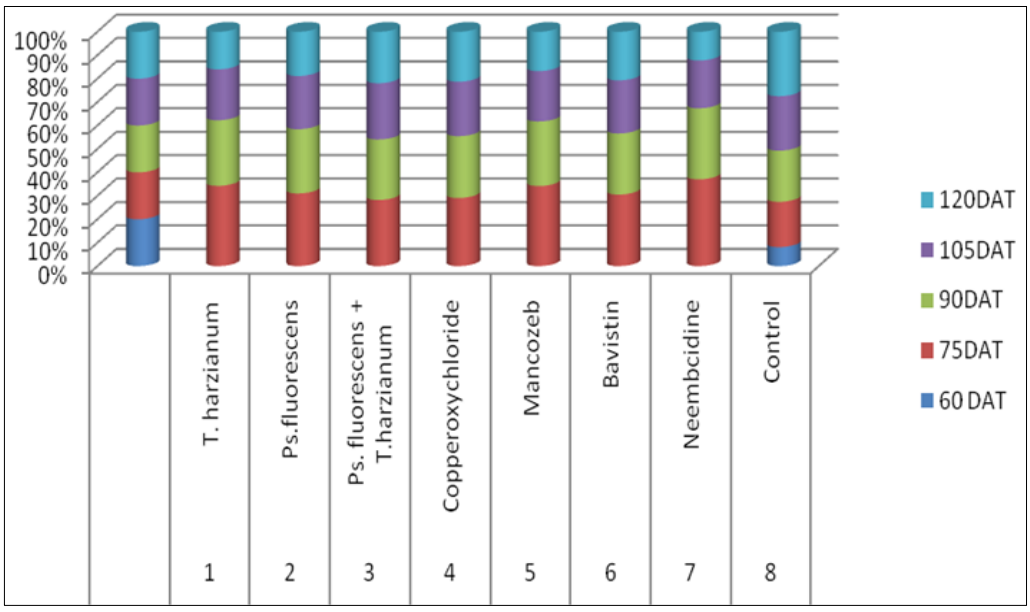

Fig 2: Effect of different fungicides and bio control agent on the severity of disease purple blotch in onion bulb crop of Bhabar region (2015-16)

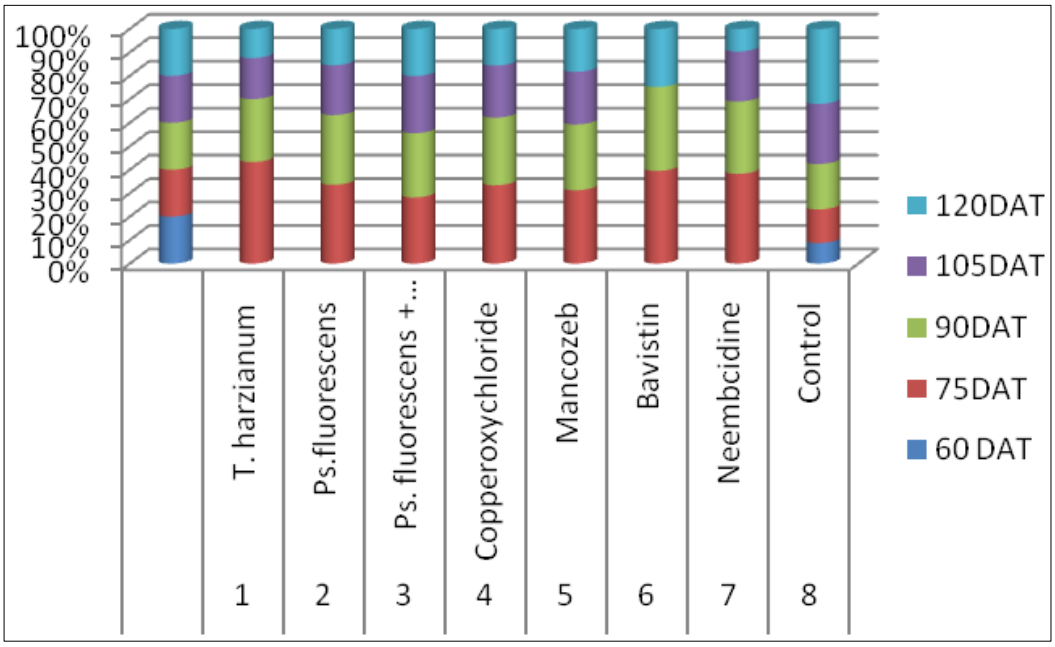

Fig 3: Effect of different fungicides and bio control agent on the severity of disease purple blotch in onion bulb crop of Bhabar region (2016-17)

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