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# MANAGEMENT OF FRUIT ROT CAUSING SEED BORNE FUNGAL PATHOGENS IN CHILLI

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**ABSTRACT**
Chilli (*Capsicum annuum L.*), is severely infected by fruit rot disease which reduce quality and quantity of fruits and seeds. Fruit rot causing fungal pathogens are carried along with seed to cause deterioration of seed in storage, pre and post emergence damping off in nursery. In the present study, seed borne nature of fungi was tested by standard blotter method which revealed the presence of *Colletotrichum capsici*, *C. gloeosporioides* and *C. acutatum* also *Alternaria alternata*. *Fusarium sporotrichioides* and *F. oxysporum*. The frequency of these pathogens varied from 72.85 % (*C. capsici*) to 3.45% (*F. sporotrichioides*). As a preventive measure, seed treatment with eleven chemical fungicides and four bio fungicides in different combinations tested in nursery which revealed that carboxin 37.5% + thiram 37.5% WS (Vitavax power) @ 0.2% and metalaxyl 4% + mancozeb 64% WP (Ridomil gold) @ 0.2% showed least infection (7.25% and 10.09%) with highest seedling vigour index (932.02 and 871.70). Among four bio fungicides tested alone and in combination @ 10g/kg seed treatment, combination of *Trichoderma harzianum* + *Pseudomonas fluorescens* and *P. fluorescens* alone showed least seedling infection (14.89% and 14.94%) with highest vigour index (930.74 and 915.27) which remained on par with each other while, untreated control recorded (351.77).

## INTRODUCTION

Chilli (*Capsicum annuum* L.), is an important spice/ vegetable crop grown worldwide. India is the largest producer, grown over an area of 0.79 million ha. with an annual production of 0.13 million tons with the productivity of 1.5 tons /ha (Anon,2013). Chilli is known to suffer from many fungal, bacterial and viral diseases. Among fungal diseases fruit rot is very important as it reduce the market value of fruit and seed quality may cause yield losses of up to 50% (Pakdeevaraporn, 2005). This disease was first reported in India on chilli from Coimbatore of Madras Presidency (Sydow, 1913). The disease has been identified in all the chilli growing regions of the world and has become a serious constraint in chilli production. Different species of *Colletotrichum*, namely *C. capsici*, *C. gloeosporioides* and *C. acutatum* also *Alternaria alternata*, *Fusarium sporotrichioides* and *F. oxysporum* are known to cause fruit rot in chilli which also cause seed and seedling rot (Mesta 1996, Hemannavar *et al.*, 2009, Lydia and Zachariah, 2012, Santoshreddy *et al.*, 2012). Hence, in the present investigation an attempt was made to know the fruit rot fungal pathogens associated with seed by standard blotter method. Further as a preventive measure, seed health management was carried out by seed treatment with chemical fungicides and bio fungicides under nursery condition.

## MATERIALS AND METHODS

The present investigations were carried out in Department of Plant Pathology, UAS, Dharwad during the year 2013. Byadgi Dabbi a commonly grown good quality chilli genotype was susceptible to fruit rot was used in the study.

### Seed mycoflora study

Seed borne nature of fungi was tested by standard blotter method (Anon.,1996). Four hundred seeds were placed at the rate of 25 seeds per Petriplate (10 cm size) on moistened sterilized blotter paper. These plates were incubated at $27 \pm 1°C$ for seven days. Such seeds were examined under stereoscopic-binocular microscope (50X) after seven days for presence of fungal pathogens and identified based on morphology of mycelium, asexual fruiting body and conidia produced. The descriptions were compared with standard descriptions of Lilly and Barnett (1951). The frequency of mycoflora associated with chilli seeds affected by fruit rot was recorded.

### Evaluation of chemical and bio fungicides

The effect of three systemic fungicides (carbendazim 50WP, tebuconazole 2 DS, pyraclostrobin 20WG), two non systemic fungicides (captan 75WP, mancozeb 75WP) and six combi product fungicides carboxin 37.5% + thiram 37.5% WS, carbendazim 25% + mancozeb 50% WS, carbendazim 25% + iprodione 25% WP, hexaconazole 4 % + zineb 68 %WP, metalaxyl 4% + mancozeb 64% WP and tricyclazole 18% + mancozeb 62% WP @ 2g/kg . Four bio-fungicides collected from Institute of Organic Farming, UAS, Dharwad,*viz., Trichoderma harzianum, Pseudomonas fluorescens, Bacillus subtilis* and *Verticillium lecanii* @ 10g/kg and their combination (5.0 + 5.0 g/kg) were evaluated in nursery by seed treatment (Mesta, 1996, Choudhary, 2013) during *kharif* 2013 at Main

Agricultural Research Station, Dharwad, Karnataka. The treated seeds were shade dried before sowing. Further seeds were sown in the raised bed of 2 X 1m size and 10.0 cm height with 4.0 cm line spacing in three replications with untreated control. Standard package of practices were followed for raising nursery except fungal disease management. Observations were taken on infection of seedling rot/damping off and seedling vigour 20 days after sowing in each treatment. Ten seedlings were taken at random and the root length was measured from the collar region to the tip of the primary root and the mean root length was expressed in cm. Shoot length was measured from the collar region to the point of growing tip. The mean shoot length was expressed in cm. Vigour index was calculated by the following formula, given by Abdul Baki and Anderson (1973). Vigour index = seed germination (%) x Seedling length (shoot length + root length (cm)). Data were analysed statistically using MSTAT C software.

## RESULTS AND DISCUSSION

### Seed mycoflora

The seeds which were showing fungal colonies were observed under stereoscopic-binocular microscope, morphology of mycelium, asexual fruiting body and conidia revealed the presence of *Colletotrichum capsici* (72.85%), *C. gloeosporioides* (9.26%) and *C. acutatum* (4.76%), *Alternaria alternata* (5.20%) and *Fusarium sporotrichioides* (3.45%) and *F. oxysporum* (4.30%) (Table-1, photo.1). the present studies are in conformity with Solanke *et al.* (2001) who reported the presence of *C. capsici*, *Fusarium moniliformae*, *Alternaria alternata* from chilli seed samples. *C. capsici*, species of *Alternaria* and *Fusarium* were observed in fruit rot affected chilli seed samples of northern Karnataka (Hemannavar *et al.*, 2009). *C. dematium* and *Alternaria alternata* associated with chilli seeds and found responsible for severe seed rot and seedling rot was reported by Bhale *et al.* (1999).

**Table 1: Chilli seed mycoflora under stereo binocular microscope**

| Fungi | Frequency (%) |
|---|---|
| *Colletotrichum capsici* | 72.85 |
| *C. gloeosporioides* | 9.26 |
| *C. acutatum* | 4.76 |
| *Alternaria alternata* | 5.20 |
| *Fusarium sporotrichioides* | 3.45 |
| *F. oxysporum* | 4.30 |

### Evaluation of chemical fungicides

Simple seed treatment is known to reduce the seed-borne infections and subsequently protect seed from deterioration. In absence of resistant cultivar the use of fungicides has become inevitable method in the management of seed borne fruit rot fungi in chilli. Evaluation of seed treatment fungicides (Table 2) revealed that among three systemic fungicides evaluated at 0.2% concentration pyraclostrobin 20WG shown least infection (11.63 %) with highest vigour index (861.17). Between two non systemic fungicides captan 75WP showed least infection (12.28%) with highest vigour index (754.64). Similar results were reported by Arunkumar and Vyas (2003). Among six combi product fungicides , carboxin 37.5% + thiram 37.5% WS showed least infection (7.25%) with highest vigour index (932.02) followed by metalaxyl 4% + mancozeb64% (10.09%, 871.70). Highest infection (43.26%) with least vigour index (351.77) was observed in untreated control. Among all tested fungicides carboxin + thiram, (Vitavax Power) at 0.2% was most effective seed treatment fungicide for chilli seed health management in nursery conditions. Similar results were reported by Hemannavar (2008) under laboratory conditions.

### Evaluation of bio fungicides

Seed treatment is the oldest practice in plant protection which provide economical and relatively nonpolluting and now, this is an attractive delivery system for either fungal or bacterial bioprotectants compared to other field application systems. The uses and expectations of seed treatment are greater today due to the impact of environmental regulations that have either banned or restricted use of organic mercurial fungicides because of their residual toxicity. Bioprotectants applied to seeds may not only protect seeds but also may colonize and protect roots and increase plant growth. *Trichoderma* spp. and *Pseudomonas fluorescens* have been considered as good model of biological control because of its ubiquitous nature, easy to isolate, rapid growth on many substrates affects wild range of plant pathogens acts as mycoparasite competes well for food and site, has enzyme system capable of attacking many plant pathogens and easy in application.

Results of four bio fungicides (Table 3) alone (@ 10.0 g/kg) and in combination (5.0 +5.0 g/kg ) seed treatment revealed that *T. harzianum* 5.0g + *P. fluorescens* 5.0g showed least infection (14.89 %) with highest vigour index (930.74) followed by *P. fluorescens* (10.0 g/kg) 14.94% infection with 915.27 vigour


**Figure 1: Fruiting bodies of *Colletotrichum* on (a) seed, (b) plumule and (c) radical under stereoscopic-binocular microscope (50X )**

**Table 2: Effect of fungicide seed treatment on per cent seedling infection and vigour index in chilli**

| Common name | a.i. and formulation | Trade name | Per cent seedling infection | Vigour index |
|---|---|---|---|---|
| Systemic fungicides @ 0.2% | | | | |
| Carbendazim | 50 WP | Bavistin | 12.28(20.50)* | 825.62 |
| Pyraclostrobin | 20 WG | Headline | 11.63(19.93) | 861.17 |
| Tebuconazole | 2 DS | Raxil | 13.40(21.46) | 772.35 |
| Nonsystemic fungicides @ 0.2% | | | | |
| Captan | 75 WP | Captaf | 19.99(26.54) | 754.64 |
| Mancozeb | 75 WP | Indofil-M45 | 20.09(26.61) | 660.03 |
| Combi product fungicides @ 0.2% | | | | |
| Carboxin 37.5% + Thiram 37.5% | 75 WS | Vitavax power | 7.25(15.60) | 932.02 |
| Carbendazim 25% + Mancozeb 50% | 75 WS | Sprint | 16.67(24.08) | 744.22 |
| Carbendazim 25% + Iprodione 25% | 50 WP | Quintal | 13.12(21.23) | 808.90 |
| Hexaconazole 4 % + Zineb 68 % | 72 WP | Avtar | 14.11(22.05) | 762.30 |
| Metalaxyl 4% + Mancozeb 64% | 68WP | Ridomil-Gold | 10.09(18.51) | 871.70 |
| Tricyclazole 18% + Mancozeb 62% | 80 WP | Merger | 11.17(19.51) | 864.15 |
| Control | - | - | 43.26(41.10) | 351.77 |
| SEm ± | | | 0.17 | 5.87 |
| CD @ 5% | | | 0.49 | 17.22 |

* Arc sine transformed values

**Table 3: Effect of bio fungicide seed treatment on per cent seedling infection and vigour index in chilli**

| Treatments (10g/kg) | Rate per kg seed | Per cent seedling infection | Vigour index |
|---|---|---|---|
| *Trichoderma harzianum* | 10g | 16.66(24.07)* | 804.90 |
| *Pseudomonas fluorescens* | 10g | 14.94(22.72) | 915.27 |
| *Bacillus subtilis* | 10g | 17.44(24.67) | 804.29 |
| *T. harzianum + P. fluorescens* | 5g+5g | 14.89(22.68) | 930.74 |
| *T. harzianum + B. subtilis* | 5g+5g | 16.16(23.69) | 833.14 |
| *P. fluorescens + B. subtilis* | 5g+5g | 15.39(23.08) | 900.99 |
| *T. harzianum + Verticillium lecanii* | 5g+5g | 16.35(23.84) | 831.53 |
| *P. fluorescens + Verticillium lecanii* | 5g+5g | 15.58(23.23) | 836.00 |
| *B. subtilis + Verticilium lecanii* | 5g+5g | 16.64(24.06) | 815.12 |
| Control | - | 42.99(41.10) | 361.87 |
| SEm ± | | 0.20 | 4.94 |
| CD @ 5% | | 0.59 | 14.68 |

*Arc sine transformed values

index. Highest seedling infection (42.99%) with least vigour index (361.87) was observed in untreated control. Suthin Raj and Christopher (2009) reported that seed treatment with *Pseudomonas fluorescens* (5g/kg) and *Trichoderma harzianum* (10g/kg) reduces 25% and 24.10% incidence of *Colletotrichum capsici* and increased seedling vigour of chilli by 13.70% and 12.10% respectively. *P. fluorescens* showed higher antagonistic activity against *C. capsici* under *in vitro* conditions and also less seedling rot was obtained in *P. fluorescens* treated seeds compared to *T. harzianum* (Hegde *et al.* 2001, Srinivas *et al.,* 2006, and Azad *et al.,* 2013). Seed treatment with *Trichoderma harzianum* recorded least damping off incidence followed by *T.viride* and *Pseudomonas fluorescence* compared to untreated control in chilli (Deshmukh *et al*., 2012). Choudhary *et al.* (2013) reported that seed treatment with carbendazim, thiram and *T. viride* effectively managed seedling rot caused by *C. capsici*.

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