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In vitro Efficacy of Fungicides and Bioagents against Wilt of Pigeonpea Caused by *Fusarium oxysporum* f. sp. *udum*

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A B S T R A C T

Pigeonpea wilt disease caused by *Fusarium oxysporum* f. sp. *udum* is one of most devasting seedborne disease. In this experiment total eight seed dressing fungicides at their recommended dosages were evaluated *in-vitro* by poisoned food technique, against *Fusarium oxysporum* f. sp. *udum* causing wilt. The systemic fungicides *viz.* Carbendazim 50% WP, thiophanate methyl 70% WP, tebuconazole 25% WG, pyroclostrobin 20% WG and combi fungicides *viz.* corboxin 37.5% + thiram 37.5% WP, carbendazim 12% + mancozeb 63% 75 WP and contact fungicides captan 75% WP were evaluated. However, the fungicides *viz.*, tebuconazole 25% WG, carboxin 37.5% + thiram 37.5% 75 WP and carbendazim 12% + mancozeb 63% 75 WP were found most effective with 100 per cent mycelial growth inhibition of *Fusariumoxysporum*f. sp. *udum*. The eight bioagents evaluated by dual culture technique, among that most effective bioagent was *Trichoderma harzianum*, which resulted in significantly highest mycelial growth inhibition (85.62%), followed by *T. hamatum* (82.61%). *T. asperellum*, *Aspergillus niger*, *T. koningii*, *T. longibrachitum* which also caused mycelial growth inhibition in the range of 61.64 to 77.32 per cent.

Introduction

Pigeonpea (*Cajanus cajan* (L.) Millsp.) is a legume belonging to family of Fabaceae. Other common names are "Red gram, Arhar, Tur, Congo pea, Gunga pea, Turvarica, Thogari or Ganduland No-eye pea" (Sheela, 2013). It is an important grain legume crop of rainfed agriculture in the tropics and subtropics. Compared with other grain legumes, pigeonpea ranks only sixth in area and production, but it is used in more diverse ways than other.

Pigeonpea is a versatile crop grown primarily as a vegetable and a multi-use green crop (dhal) in India. Pigeonpea seed is composed of cotyledons (85%), embryo (1%) and seed coat (14%). *Fusarium* wilt is the most important disease of pigeonpea in India which is responsible for yield losses up to 67 per cent at maturity and 100 per cent in case of infection at pre-pod stage (Kannaiyan and Nene, 1981). Seedborne diseases are regarded as major constraints in pigeonpea (*Cajanus cajan* (L.) Millsp.) production. Seedborne pathogens produce toxic metabolites, which

adversely affect germination as well as seedling vigour. The literature revealed that more than hundred pathogens are known to affect the pigeonpea crop. Amongst them *Fusarium* wilt, *Alternaria* blight, *Phytophthora* blight, *Alternaria* leaf spot, *Rhizoctonia* root rot and *Cercospora* leaf spot are the most common fungal pathogens associated with stored seeds, mainly responsible for seed deterioration and reduction in the germination potential and also seedling vigour. Fungi of genera *Aspergillus, Fusarium, Penicillium* and *Rhizoctonia* produce toxic substances (Singh *et al.,* 1991) that cause decrease in the quality of seeds. Fusarium wilt characterized by wilting of the affected plants and characteristic internal browning or blackening of the xylem vessels extending from root system to stems. Partial wilting of the plants and patches of dead plants were reported to be common in the fields during advanced stages of plant growth. Present investigation was carried out with in vitro evaluation of fungicides for control of *Fusarium oxysporum* f. sp. *udum* causing wilt disease of Pigeonpea.

Materials and Methods

The experiments (*in vitro*) were conducted at Department of Plant Pathology, College of Agriculture, Latur during 2018-2019. Efficacy of various seed dressing fungicides were evaluated at their recommended dosages against *Fusarium oxysporum* f. sp.*udum*,by applying Poisoned food technique (Nene and Thapliyal, 1993) and using Potato Dextrose Agar (PDA) as a basal culture medium. Based on active ingredient, requisite quantity of each test fungicide was calculated and mixed thoroughly with autoclaved and cooled (45^0C) PDA medium separately in conical flasks to obtain desired concentrations of the test fungicides. Fungicide amended PDA medium was then poured (20 ml / plate) separately and aseptically in Petri plates (90 mm dia.) and allowed to solidify at room temperature. After solidification of the medium, all the plates were inoculated aseptically by putting in the center a 5 mm culture disc obtained from a week old actively growing pure culture of *F. oxysporum* f. sp. *udum*. Each of the test fungicides and its concentration was replicated three times. Test pathogens were assessed separately. Petri plates filled with plain PDA (without fungicide) and inoculated with the culture disc of *F. oxysporum* f. sp. *udum*. Fungal and bacterial biocontrol agents were evaluated *in-vitro* against *Fusarium oxysporum* f. sp. *Udum* fungi pathogenic to pigeonpea, applying dual culture technique (Dennis and Webster, 1971). Seven days old cultures of the test bio-agents and the pathogens were used for the study. Discs of 5 mm diameter of culture growth of the *F. oxysporum* f. sp. *Udum* the test bioagents were cut out with sterilized cork borer. Then two culture discs, one each of the test fungus and test bio-agent were placed at equidistance and exactly opposite to each other on autoclaved and cooled PDA medium in petri plates and incubated at 26 ± 2^0C. Test pathogens were assessed separately. PDA plates inoculated separately with culture disc of *F. oxysporum* f. sp. *Udum* were maintained as untreated control. The colony diameter of the fungus pathogens on medium was recorded and per cent inhibition was calculated by using following formula (Vincent, 1927).

$$\text{Per cent inhibition} = \frac{C - T}{C} \times 100$$

Where,

C = growth of the test fungus in untreated control plate
T = growth of the test fungus in treated plate

Results and Discussion

A total of eight seed dressing fungicides at their recommended field dosages were evaluated *in vitro* by Poisoned food

technique, against *Fusarium oxysporum* f. sp. *Udum* of pigeonpea which were detected in seed health testing methods and the results obtained on their colony diameter (mm) and per cent inhibition of mycelial growth are presented in Table 1.

Table.1 *In vitro* efficacy of various fungicides against *F. oxysporum* f. sp. *udum* associated with pigeonpea seeds

Sr. No.	Treatments	*F. oxysporum* f. sp. *udum*	
		Colony diameter (mm)	Inhibition (%)
T_1	Carbendazim 50% WP	10.00	88.88 (70.52)
T_2	Thiophanate methyl 70 % WP	10.50	88.33 (70.02)
T_3	Tebuconazole 25 % WP	0.00	100 (90.00)
T_4	Captan 75 WP	17.78	80.24 (63.60)
T_5	Pyroclostrobin 20% WG	47.43	47.30 (43.45)
T_6	Carboxin 37.5 % + Thiram 37.5 % WP	0.00	100 (90.00)
T_7	Carbendazim12%+ Mancozeb 63% WP	0.00	100 (90.00)
T_8	Control (untreated)	90	0.00 (00)
SE ±		**0.39**	**0.61**
CD (P=s0.01%)		**1.16**	**1.79**

Table.2 *In vitro* efficacy of various bioagents against *F.oxysporum* f. sp. *Udum* associated with pigeonpea seeds

Sr. No.	Treatments	*F.oxysporum*f. sp. *udum*	
		Colony Diameter (mm)	Inhibition (%)
T_1	*T. asperellum*	20.41	77.32 (61.56)
T_2	*T. harzianum*	12.94	85.62 (67.71)
T_3	*T. hamatum*	15.65	82.61 (65.35)
T_4	*T. koningii*	24.50	72.77 (58.54)
T_5	*T. longibrachitum*	34.52	61.64 (51.73)
T_6	*Aspergillusniger*	21.95	75.61 (60.40)
T_7	*Pseudomonas fluorescens*	47.80	46.88 (43.21)
T_8	Control (Untreated)	90.00	0.00 (00)
SE±		**0.89**	**0.80**
CD (P=s0.01%)		**2.61**	**2.36**

The results revealed that, all of the test fungicides exhbited significant mycelial growth inhibition of the *Fusarium oxysporum* f. sp. *udum* over untreated control. However, the fungicides *viz*., tebuconazole 25 % WG @ 0.2 %, carboxin 37.5% + thiram 37.5% 75WP @ 0.25% and carbendazim 12% + mancozeb 63% 75WP @ 0.25% resulted in 100 per cent inhibition of mycelial growth of *Fusarium oxysporum* f. sp. *udum*. Rest of the fungicides, which also caused significant mycelial growth inhibition of *Fusarium oxysporum* f. sp. *udum* were carbendazim 50% WP @ 0.1% (88.88%), thiophanate methyl 70% WP @

0.1% (88.33%), followed by captan 75% WP @ 0.3% (80.24%) and pyroclostrobin 20% WG @ 0.1% (47.30%). Thus, except the fungicide pyroclostrobin 20% WG at their recommended dosage, rest of the six seed dressing fungicides tested were found highly effective against *Fusarium oxysporum* f. sp. *udum.*

A total of seven bioagents were evaluated *in vitro* by dual culture technique, against *Fusarium oxysporum* f. sp. *Udum* of pigeonpea and the results obtained on colony diameter (mm) and per cent inhibition of mycelial growth of these test fungi are presented in (Table 2). For (Table 2) *Fusarium oxysporum* f. sp. *Udum* significantly highest mycelial growth inhibition was with *T. harzianum* (85.62%), followed by *T. hamatum* (82.61%), *T. asperellum* (77.32%), *A. niger* (75.61%), *T. koningii* (72.77%) *T. longibrachatum* (61.64%) and *P. fluorescens* (46.88%).

Therefore, in present study, various *Trichoderma* spp., followed by *A. niger* and *P. fluorescens* were also found effective against seedborne pathogenic fungi of pigeonpea and also reported as most effective against pigeonpea seed borne diseases by several earlier workers (Dhar *et al.,* 2006, Gade*et al.,* 2007; Lokesha and Benagi, 2007; Barde *et al.,* 2016; Athira, 2017; Devamani *et al.,* 2017 and Kadam *et al.,* 2018).

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