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A REVIEW ON FUSARIUM WILT OF LENTIL IN RAJASTHAN

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ABSTRACT

Lentil (Lens culinaris Medic.) suffers from a number of diseases which are caused by fungi, bacteria, viruses, nematodes and plant parasites (Khare et al, 1979).Diseases such as Ascochyta blight and Lentil wilt play a major role in reducing lentil yield ((Hamdi et al., 1996). Lentil wilt, caused by *Fusarium oxysporumf.splentis* is one of the main limiting factors to successful cultivation.The diseases rust, vascular wilt, and Ascochyta blight, caused by *Uromyces viciae-fabae*, *Fusarium oxysporum f. sp. lentis*, and *Ascochyta fabae f. sp. lentis*, respectively, are the key fungal pathogens of lentil(Erskine et al.,1993). In Rajasthan it is mainly cultivated in Ajmer, Bundi, Barmer, Bharatpur, Bikaner, Churu, Dausa, Dholpur, Hanumangarh, Jaipur, Jalore, Jhunjhunu, Karauli, Kota, Nagaur, Pali, Sirohi and Tonk.There is no research on Fusarium wilt of Lentil in Rajasthan as the disease occurred in severe form in recent years.One hundred fifty seed samples belonging to 18 disticts of Rajasthan were screened in untreated and chlorine pre -treated seeds in standard blotter method (SBM) while 46 samples belonging to Rajasthan were screened by Potato Dextrose Agar (PDA) method. A Total of 26 fungal species were isolated from lentil seeds in blotter and PDA test respectively. Management of pathogen by fungicides and bio-control agents was also studied.

KEY WORDS:LENTIL, *F. oxysporum*,Fungicides,Bioagents

INTRODUCTION

Lentil (Lens culinaris L.) is the second most important cool-season legume crop in India (Ram and Punia, 2018). It covers an area of 1.51 million ha with a production of 1.56 million tons and productivity of 1,032 kg ha−1 (Directorate of Economics and Statistics, 2020).

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HISTORY, ORIGIN AND CULTIVATION

Lentil are among ancient plants known to be cultivated by man carbonized lentil found in Neolithic villages in the Middle East have been dated as being between 8 and 9

thousand years old. After initial cultivation of the crop in the Middle East. Lentil use began to spred around the Mediterranean.By 2200B.C lentil begain to appear in Egyptian tombs (Pooja, 2005) According to de Candolle (1986) .lentil has been cultivated in the East, the Mediterranean basin, Central Europe and even in Switzerland from pre-historic times. The center of origin of *L. culinaris* is the near east and first was domesticated in the Fertile Crescent around 700 B.C. (Zohary, 1973). According to Cubero (1981) lentil first spread to the Nile from the near East to Central Europe and then to the Indian Subcontinent and the Mediterranean Basin by end of Bronze Age. Ethiopia is amongst the centers of diversity for lentil. Lentil probably originated in the Near East and rapidly spread to Egypt, Central and Southern Europe the Mediterranean Basin, Ethiopia, Afghanistan, India and Pakistan, China and later to New world including Latin America (Cubero, 1981; Duke 1981; Landizinsky, 1979).Bentley and Trimen (1999) reported that native country of the lentil is not known. It is one of the anciently cultivated plants, was well known to be Egyptian and Persians and in Europe has been grown since the days of the Roman Empire. Lentil (*Lens culinaris* Medikus) is originally from the Near East and has a long history of cultivation as a food crop (Webb and Hawtin, 1981). In Canada the history of lentil cultivation began in 1969 (Morrall, 1997), and the harvested area of lentil reached 532,200 ha in 2007 (FAO, 2009).Ethiopia is amongst the centers of diversity for lentil. Lentil is currently an important pulse crop grown widely throughout the Indian subcontinent, Middle East, Northern Africa, Southern Europe, North and South America, Australia and west Asia (Ford and Taylor, 2003; Erskine, 1997).

Lentil, Lens Culinaris medic, was domesticated with wheat, barley and other pulses in the fertile crescent near East and spread through southern Europe, the Middle East, North Africa and across the Indo-Gengetic plain before 1000 BC (Cubero, 1981).

Morphology of Fusarium

*Fusarium solani*and *F. oxysporum*were among the mostfrequent microorganisms isolated from the disease symp-toms (Monge *et al.*, 1994).*F.solani*is a cosmopolitan species and is classifiedinto the section Martiella (Booth, 1971). *F. solani*can bedistinguishedinto50subspecificlineagesandmostofthemhavenotbeenfurtherdescribedformally(O'Donnell,2000).Thespeciesisamongawell-knownplantpathogen,causingvarioustypesofdiseasesonawiderangeofplants andtherearеatleast111plantspeciesfrom87generathatarecommonlyinfectedby*F.solani*(KolattukudyandGamble, 1995). *F.oxysporum*isacosmopolitanspeciesthatarewidely spread in all types of soil worldwide (Burgess,1981). They are economically important species as theycausedseverevascularwiltsandrootrotdiseasesinvariouscrops (Nelson *et al.*, 1981)..Theidentificationof*Fusarium*speciesismainlybased on distinctive characters of the shapes and sizes ofmacro-andmicroconidia,presenceandabsenceofchlamydosporesaswellascolonyappearances,pigmentationsandgrowth rates on agar media (Leslie and Summerell, 2006).

Economic importance

Lentil is used mainly for human consumption as a protein source in a diverse range of products ranging from deserts to soups, stews and vegetarian dishes.Lentil (Lens culinaris L.) Contains large amount of proteins and has the ability to fix, symbiotically with certain bacteria, atmospheric nitrogen and thus contributes greatly to soil fertility. (Anjam et al., 2005 and Karim et al., 2003).Lentil, like chickpea, has no anti nutritional factors except for ingredients that cause flatulence (Muehlbauer, 1993). The seed of Lentil are an important source of protein and carbohydrate-rich food in many developing regions and are becoming increasingly popular in developed countries where they are perceived as a healthy component of the diet (Savago, 1991).Lentil is mostly cultivated for its seed and eaten as dhal. Dhal is decorticated and split.Seed has a relatively higher content of protein, carbohydrate and calories compared to other legumes and are the most desired crop because of its high average protein content and fast cooking characteristic in many lentil producing regions (Muehlbauer et al., 1985).It can be used as a main dish, side dish, or in salads. Seeds can be fried and seasoned for consumption; flour is used to make soups, stews, purees, and mixed with cereals to make bread and cakes; and as a food for infants (Williams and Singh, 1988). In Jordan lentil is mainly consumed as soup or "Mjddara", both of which serve as a popular dish and are rich in a relatively cheap source of protein. (Al- karaki, G.N., 1986). The seeds are detexturized and used in preparation of snacks. Sometimes lentils are also used as sprouts, which enhances the biological value. Some international preparations are 'lentil ole', 'devlish lentil salad', 'lentils with spinach and lemon', 'lentil nut leaf and 'postage esau' (red lentil+rice) etc.Fermentation and extrusion cooking have great potential to produce better quality products (Ali, 2004).Lentils are supposed to remedy constipation and other intestinal afflietions. "In India, Lentils are pouliticed onto the ulcers that follow smallpox and other slow-healing sores" (Duke, 1981). It is important for humans because of its high nutritional value and its straw is also used as livestock feed. (Arumuganathan and Earle, 1991). Lentil straw is also a valued animal feed (Erskine et al., 1990). Besides use as a food source for human being, lentil also provides feed for animals, e.g. poultry (Aw-Hassan et al., 2003), ram (Kalkan.andKarabulut, 2003), and sheep (Erskine et al., 1990b). Straw, pod walls and seed coats of lentil can be valuable animal feed sources. Husks, dried leaves, stems, fruit walls and bran (residues), can be fed to livestock. Lentil residues contain about 10.2% moisture, 1.8% fat, 4.4% protein, 50% carbohydrate, 21.4% fiber, and 12.2% ash (Muehlbauer et al., 1985). Green plants make valuable green manure. Seeds are a source of commercial starch for textile and printing industries (Kay, 1979).

Fusarium wilt management options

Chemical Control

Fungicides

A detailed account of studies on the reduction of collar rot caused by *Sclerotium rolfsii* by seed inoculation with antagonists (Trichoderma harzianum and a bacterium); fungicidal seed treatments with dithane M-45 or thiram + benlate against wilt (*Fusarium oxysporum f. sp. lentis*); effects of irrigation at various growth stages on wilt; and the reactions of 104 lentil lines in the field when exposed to wilt infection (Khare-MN 1975).

Kasyap et al. (2008) Amongst the partially effective fungitoxicants, copper oxychloride caused the lowest inhibition of growth (63.0%) and was statistically inferior to the rest of the fungitoxicants but superior over control (85.0 mm).

Karande et al. (2007) reported carbendazim (0.1%) as most effective fungitoxicant in vitro against mycelial growth of Fusarium*oxysporum* isolated from cashew.

Sharma et al. (2002) reported that there was no mycelial growth of *Fusarium oxysporumf.sp. lini* causing linseed wilt at 500, 1000 and 1500 ppm concentrations of bavistin and benomyl.

De et al. (2003) reported that seed treatment with carbendazim was highly effective against lentil wilt caused by *Fusarium oxysporum f. sp. lentis.* Similar results were also reported by Sinha and Sinha (2004).

Fundazol [benomyl] was successfully tested during 1998-99 in the Ukraine as a seed treatment for root rot caused by *Fusarium* in lentils (cv. Luganchanka). Seed treatment also increased yield (Kirik et al.,2000).

Seed treatment with Crown (thiabendazole and carbathiin [carboxin]) improved seedling survival, reduced root rot severity and increased seed yield relative to the inoculated control. Vitaflo-280 (thiram and carbathiin) also improved establishment and yield, but the effect was not as strong or consistent. Treatment with Raxil (tebuconazole) and Apron (metalaxyl) had no effect (Hwang et al., 2000).

Lentils were severely affected by *Fusarium solani* and to a lesser extent by *F. oxysporumf.sp. lentis*. Pathogenicity tests showed that F. solani caused yellowing and black root rot on all leguminous crops, but these symptoms were not observed on tomato and wheat plants. *F. o. f.sp. lentis* was only pathogenic on lentil (Setti,-B et al.,1998).

Seven fungitoxicants were tested against *Fusarium oxysporumf.splentis.* All these significantly checked the growth of the pathogen as compared to control. Carbendazim proved most effective fungitoxicant for checking the fungal growth (5.6mm) followed by captan (9.9mm) and hexaconazole and diniconazole (Maheshwari et al., 2008).

Vitaflo-280 (thiram and carbathiin) also improved establishment and yield, but the effect was not as strong or consistent. Treatment with Raxil (tebuconazole) and Apron (metalaxyl) had no effect (Hwang et al., 2000).

One approach for root disease management is seed treatment with fungicides. Protectant fungicides inhibit pathogen attack on seeds, whereas systemic fungicides also provide some protection for seedlings (Cremlyn 1978).

Sclerotium [Corticium] rolfsii and *Fusarium oxysporumf.sp. lentis* produced pectolytic and cellulolytic enzymes which caused similarly severe wilt in lentil plants. Enzyme action is probably involved in pathogenesis (Mehrotra et al., 1973).

Biological Control

Control by plant extracts

Earlier study was mostly on in vivo fungicidal effect of plant extracts (Biswas et al. 1995). Dubey (2002) tried Groundnut cake and Subabul leaf extracts against web blight of urd bean and mung bean. He also studied efficacy of Karanj leaf extracts (alone and in combination) for the control of the disease (Dubey 2003).

Kumar, Sharma and Singh (2002) tested the efficacy of leaf extracts against F.oxysporum f. sp. udum *causing wilt of pigeon pea. Leaf extracts of 18 plants were screened to control soil-borne pathogens including* F.oxysporum *and complete inhibition of the mycelial growth was observed (Kumar and Tripathi 1991).The antifungal efficacy of different plants viz. leaf extracts of* Boerhhavia*(Sharma and Bohra 2003).*

against *M.phaseolina*. The oil strongly inhibited the radial growth of the pathogen. Leaf extracts of noxious weeds such as *Solanum xanthocarpum* and *Argemone maxicana* were assessed for the management of *R.Solani* and *M. phaseolina* infecting tomato and chili (Mahmood et al. 2005).

The root extracts of *Tinospora cordifolia* revealed activity against *F.oxysporum* on cluster bean. The activity increased with increasing concentration of the extract (Agrawal et al. 2008).

Fungal antagonists

Various fungal and bacteria antagonists have been tried for control of Fusarium wilt in lentil. The most commonly used are *B.subtiles, Rhizobium leguminosorum, Glicladium virens, T.viride, Streptomyces gourgereti, Streptomyces sp.* (Essalmani and Lahlou, 2003; Singh and Mukhopadhyay, 2002; Mehrotra and Cladius, 1972).

They observed that isolates of *Pseudomonas, Erwinia, Rhizobium, Pencilliumexpansum* and *Tricodermalignorum* were antagonistic to *F. oxysporum* on lentil. *Tricodermaharzianum* and *Tricodermakonigii* showed antagonism against the lentil wilt pathogen in laboratory (Saxena and Mukhopadhyay 1987; Mukhopadhyay et al. 1989).

Bojdov'A (1993) found that Trichoderma harzianum RK-1 successfully controlled*Fusarium* infection of Lentil.

Bhat et al. (2003) and Singh, Mishra and Vyas (2007) reported that biocontrol agent *T.viride* and *T.harzianum* caused reduction in chickpea wilt and tomato wilt caused by *F.oxysporum*.

Srivastava and Mishra (2008) used antagonistic fungi in seed dressing for the management of chickpea and pigeon pea wilt respectively.

In present investigation all the two antagonists were quite effective but *Trichoderma* spp. gave best control of *R.solani* as also observed by Sharma (2003) and Agrawal (2002).

The biological agents not only reduced the recovery of pathogen but also showed increase in potential of seed germination.

Pandey and Upadhyay (2002) reported that *T.viride* causes loops and coiling of mycelium and rupture of cell wall of the pathogen. *G.virens* resulted in twisting, air bubbling and disintergration of the fungal hyphe, while *T.harzianum* causes severe vacuolation, shrinkage and coagulation of the cytoplasm of the fungal hyphae. Similar results were obtained by Mukherjee and Tripathi (2000) while screening *G.virens* against *Rhizoctonia solani*.

Khandelwal (2009) found accumulation of conidia of *G.virens* around the mycelium of the pathogen caused bending shrinkage and breakage of the fungal hyphae. Mycelium of *T.viride* coiled around the mycelium of the pathogen and also caused hyphal bulging T.harzianum showed discontinuity and coagulation of protoplasm.

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