Biological Forum – An International Journal **13(4): 675-678(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Eco-friendly Wilt Management caused by *Fusarium solani* in Cluster bean

Poonam Yadav[1], R.R. Ahir[2], Parvesh Kumar[3], Lokesh Yadav[4] and Pinki Devi Yadav[5]
[1]Ph.D. Research Scholar, Department of Plant Pathology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture & Technology, Udaipur-313001, (Rajasthan), India.
[2]Professor, Department of Plant Pathology, S.K.N. Agriculture University, Jobner, Jaipur- 303329, (Rajasthan), India.
[3]Ph.D. Research Scholar, Department of Plant Pathology, Chaudhary Charan Singh Haryana, Agricultural University, Hisar-125004, (Haryana), India.
[4]Ph.D. Research Scholar, Department of Plant Pathology, Chaudhary Charan Singh Haryana, Agricultural University, Hisar-125004, (Haryana), India.
[5]Ph.D. Research Scholar, Division of Plant Pathology, S.K.N. Agriculture University, Jobner, Jaipur-303329, (Rajasthan), India.

(Corresponding author: Poonam Yadav)*
(Received 06 September 2021, Accepted 08 November, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Ecofriendly compatible methods have proliferated in recent years in disease control. This review of the literature reveals that limited information is available on the natural management of the disease by bioagents, botanicals and plant resistance. The use of chemicals can cause harm to human health and is known to increase environmental pollution. To overcome this negative impact, other ways to manage *Fusarium solani* wilt bean collection are required. These practises reduce the density and activity of inoculums. Integration of bioagents, botanicals and plant resistance efficacy can be further improved and more long lasting. So bioagents, botanicals have been used to reduce losses and costs effectively for farmers due to deadly bacteria. Resistance to host plants offers the greatest potential.

Keywords: Bioagents, Botanicals, Ecofriendly, *Fusarium solani*, Host Resistance.

INTRODUCTION

The bean group [*Cyamopsis tetragonoloba* (L.) Taub.], Commonly known as guar, is a member of the Leguminosae family (Fabaceae) and is derived from the Sanskrit word Gauaahar which means cow fodder or in other ways livestock fodder. It is widely grown in countries such as India, Pakistan, USA, Morocco, Italy, Germany, Greece and Spain (Hymowitz and Matlock, 1963). In India, which is widely grown under the rainy season of the kharif and Zaid seasons for various purposes namely, vegetables, raw fodder, green manure, grains and amber. Its seed life has gained a lot in the past especially in textiles, paper, petroleum, medicine, food etc. Rajasthan alone contributes about 70 percent to Indian production. Apart from Rajasthan, it is also cultivated in Haryana, Gujarat, Punjab, Uttar Pradesh and Madhya Pradesh (Pandey and Roy, 2011). In Rajasthan, the growing guar regions of guar are Bikaner, Jaisalmer, Barmer, Hanumangarh, Sriganganagar, Jodhpur, Churu, Sikar, Nagour, Jalore and Jaipur. Cluster bean is an excellent plant for improving soil fertility by regulating atmospheric nitrogen. No other legume plant is as drought tolerant as a group bean with a rich source of high-quality protein and galactomannan which is very important in the industry (Punia *et al.*, 2009, Rai *et al.*, 2012). This galactomannan is better known as guar gum and makes up about 35 percent of the dry weight of the seeds. In India wilt of guar (*F. solani* f. sp. *caeruleum*) is a very serious disease and was first reported by Singh (1951) of Kanpur. Mathur and Shekhawat (1988) reported *Fusarium solani* with guar (*Cyamopsis tetragonaloba*) from Rajasthan. The occurrence of *Fusarium solani* in guar (*Cyamopsis tetragonaloba*) causing root rot / erosion was reported in Rajasthan by Mathur and Shekhawat (1988). The pathogen *Fusarium solani* causing wilt in cluster bean is broad-based in nature and can survive on seed and in soil in the form of its infective propagules that are difficult to manage by activist measures. The use of IPM strategies for its management is crucial. Looking to the increasing brutality of wilt of guar in Rajasthan and keeping in view the importance of the disease, the present studies were undertaken in order to decrease dependence on fungicides alone. Biocontrol and botanicals were integrated a range of combinations for ecofriendly management of this disease.

SYMPTOMATOLOGY

Affected bean plants gradually turn yellow, the leaves fall off and the roots develop black spots on the surface. Eventually the diseased plants wither and die prematurely. In the case of root rot, the roots show a dark brown color change (Satyaprasad and Ramarao 1981). The pathogen is a seed found in both extracellular and intra-embryonal that exhibits a change in white color and irregular shape or is covered with a white layer of mycelium that causes rot (Pareek and Verma 2015). However, the symptoms in chickpea are yellow and dry leaves from bottom to top, deep petioles and rachis, improper separation of vascular bundles and eventual wilting of plants (Nene and Haware 1980). Singh and Shrivastava (1988) see the symptoms of root rot as a sudden death of web bean seedlings. The leaves begin to wither and dry out and root rot is followed by killing the whole plant. Diseased roots showed brown to black sores. Li *et al.,* (2010) first reported the decay of the cucumber crown caused by *Fusarium solani* causing yellowing and shrinking of cucumber leaves attached to a tropical China. Lodha (1993) wrote that rot of dried bean roots collects can occur at any stage of the plant from germination to maturity. Seedling damage occurs mainly in cotyledons as tall black cankers on growing plants. Infected seedlings show the brightness and depth of the tender surface and the parts can be easily removed. According to White (2000), *Fusarium* spp. is commonly reported. separated from the roots of corn was *F. oxysporum* schlectend and *F. solani* Sacc. Karimi *et al.,* (2012) reported that soil-borne fungus enters the blood vessels at the edges of the roots through wounds leading to the progression of chlorosis of the leaves, branches, wrinkles and deterioration of the root system. Temperature, soil type, soil moisture environment and nutrient availability have been shown to affect *Fusarium* value.

MATERIAL AND METHODS

Screening of bio-control agents was done by Dual Culture Technique (Dennis and Webstar, 1971). In vitro, efficacy of six bio-control agents, viz. *Trichoderma harzianum, T. viride, T. virens, T. asperlum, Bacillus subtilis* and *Pseudomonas fluorescens* was tested using dual culture plate method and 20ml of autoclaved PDA was poured into each sterilized Petri plates and allowed for solidification after 3 hours of pouring. These plates were inoculated with 5 mm diameter mycelial bit - taken from 7 day old culture of *Fusarium solani* and antagonistic fungal agents both were placed separately at equal distance on the periphery of Petri plates. PDA Petri plates inoculated with pathogen alone served as check. Inoculated Petri plates were incubated at 25+1ºC in BOD incubator for 7 days. Linear growth of pathogen as well as biocontrol agents was measured and per cent growth inhibition was recorded after 7 days of incubation.

The effect of each plant extract was tested at three concentrations (5 & 10 and 15%) equal amount of sterilized distilled water (*i.e*. 1: 1 ratio, w/v). The extract thus obtained was considered as of 100 percent concentration. Required quantity of each plant extract (i.e. stock solution) was mixed thoroughly in melted PDA, to get desired concentration, just before pouring in sterilized 9 cm diameter glass Petri plates and was allowed to solidify for 12 hours. Each plate was inoculated with 5 mm dish of mycelia bit taken with the help of sterilized cork borer from the periphery of 7 days old culture of on PDA. The inoculated Petri plates were incubated at 25+1ºC. The Control was also maintained where medium was not supplemented with any plant extract.

Seed of ten cultivars of clusterbean collected from RARI, Durgapura S.K.N. College of Agriculture, Jobner and Private Companies were evaluated against wilt of cluster bean under pot conditions during *kharif* season 2018. Inoculum multiplied on sorghum grains was applied in pots (20 g/ pot) to increase the disease pressure. Inoculum was added before sowing. Seeds were washed thoroughly with sterilized water. Ten seeds of each cluster bean cultivar were sown in each pot. Two replications were maintained under pot conditions. Observations on disease incidence was recorded after 60 days of sowing. On the basis of disease incidence resistance cultivar (0-20), Moderately susceptible (21-50), Susceptible (51-80), Highly susceptible(81-100) PDI shows.

Bio-agents: Use of biocontrol agents is an alternative eco-friendly approach for the management of plant diseases. Weindling (1934) described the mycoparasiticaction of *Trichoderma* fungus on *Rhizoctonia* and *Sclerotinia* and its beneficial effects for plant disease control. Papavizas and Lumsden, (1980) and Majumdar *et al*., (1996) revealed that *Trichoderma harzianum* is one of the most important antagonists against many soil borne pathogens. Seed treatment with the antagonists reported to be the cheapest method and delivery of antagonists to the rhizosphere of crop plants that are to be protected from seed and soil borne disease (Ahmed and Grainge 1982). Vasudeva *et al*. (1952) reported a strain of *Bacillus subtilis* which produced antibiotic bulbiformin against *Fusarium solani*. Okhovvat and Karampour (1996) reported that biological agents like *Trichoderma harzianum* (T1and T2), and *Trichoderma viride* (T3 and T4), *Trichoderma koeinngii* (T5) and *Gliocladium virens* (G1 and G2) to management *Fusarium solani.* Ghasolia and Jain (2003) observed that seed treatment with biocontrol agents i.e. *Trichodermaharzianum* and *Trichoderma viride* were found effective against *Fusarium* wilt. Jat *et al*., (2017) studied on biocontrol agent's i.e. *Trichoderma harzianum, T. viride, Bacillus subtalis* and *Pseudomonas fluorescens* against *Fusarium oxysporum* f. Sp. *coriandri. Trichoderma harzianum* (83.69%) was found most effective to

inhibitthe mycelial growth of fungus followed by *Trichoderma viride* (81.1).

Kiran and Bunker (2020) studied on the antagonism activity of *Trichoderma viride* found to be highly effective in controlling the mycelia growth (73.5%) against F. solani among biocontrol agents tested under dual culture method. In vivo study revealed that maximum germination per cent (82.78 per cent).

Botanical: Botanicals gains value in plant protection due to their selective properties, low cost and safety in the ecosystem. Many botanicals have been identified as effective in controlling plant diseases (Ahmed and Grainage, 1982). Singh *et al.,* (1980) found that the growth of *Fusarium oxysporum* f. sp. *ciceris* was blocked by the finely ground seeds of neem leaf planted in infected soil to produce disease-free seedlings. Bianchi *et al*. (1997) found that garlic strongly inhibited the growth of mycelia *Fusarium solani*. Philip and Sharma (1997) examined the fungitoxic effect of leaf and cake oil extracted from neem (*Azadirachta indica*) on mycelial growth, spore production and *Fusarium solani* spore germination causing root rot and they found that the extract inhibited the growth and development of spore both viruses. Neem extracts were very effective on both fungi. However, both fungi were more sensitive to the extraction of onions, ginger, neem and garlic followed by mint, eucalyptus. The effectiveness of the *Azadirachta indica* leaf extract was evaluated by Bansal and Gupta (2000) reported that complete inhibition of mycelial growth and spore growth was achieved by 100% leaf extract concentration. Verma and Dohroo (2003) have shown that the extraction of garlic cloves results in a complete inhibition of the growth of *Fusarium oxysporum f. sp pisi*. Lakhran and Ahir (2018) examined the efficacy of various extracts of aak, datura, garlic, neem, kheep and tumba against the rot of dried chickpea roots caused by *Macrophomina phaseolina*. Among these garlic extracts have been found to be very effective in reducing root rot followed by neem leaf extract.

Host plant resistance: Gupta *et al., (*2003) investigated that in 220 cluster bean genotypes, 67 genotypes were resistant, 69 genotypes were easily infected and 10 genotypes were at high risk of root rot caused by *Rhizoctonia baticola.* Chitale and Tak (2003) examined cluster bean genotypes for resistance to coal decay and found that genotypes RGM-113 and RGM-115 showed resistance as they had 5.0 percent disease. John *et al.,* (2005) studied resistance to germplasm / cultivars of sesame 30 against coal decay caused by *R. bataticola* (*M. phaseolina*) also showed differences in their response to disease under high pressure inoculum. Of the 30 tested strains, TLC-246, TLC-279 and TLC-281 were resistant to coal decay. Patel *et al.,* (2002) revealed Cluster bean varieties namely, GAUG 998, GAUG 9112, GAUG 605 and GAUG 9010 which showed moderate resistance to aganist wilt (*Neocosmospora vasinfecta*). Seven popular types of guar namely Krishna 51, B 53, Pusa Nav Bahar, Swati 55, Neelam 51, BM 83 and Amul 51 were tested by Bohr *et al.,* (2011) against guar root rot pathogens *F. solani* and *Rhizoctonia solani*. Based on root rot actions under injected conditions, Swati 55, Neelam 51, Amul 51, Krishna 51, B 53, BM 53 and Pusa NavBahar are considered to be easily affected. This study shows that most Cluster bean cultivars are readily available from root rot pathogen and there is a need to develop resistant cultivars for stress.

RESULTS AND DISCUSSION

In this experiment was found that all biocontrol agents *viz., Trichoderma harzianum, T.viride, T. asperlum, T. virens, Bacillus subtilis and Pseudomonas fluorescens* were antagonistic to the *Fusarium solani.* Maximum inhibition of mycelial growth (85.20%) of *Fusarium solani* was recorded by *Trichoderma harzianum* followed by *Trichoderm aasperlum* (82.80%), *Trichoderma viride* (82.20%) and *Trichoderma virens (*78.00%). Minimum inhibition of mycelial growth of *Fusarium solani* was recorded by *Bacillus subtillis* (64.00%).

The efficacy of five plant extracts was tested *in vitro* at three concentrations *viz.*, 5, 10 and 15 per cent against *Fusarium solani* on PDA by Poisoned Food Technique. Among five plant extracts, Neem extract was found most effective in inhibiting mycelial growth (56%,78% and 80%) of *Fusarium solani* followed by Garlic (51.00%, 73.00% and 74.00%), at 5 ,10 and 15 per cent, respectively over control.

Ten cultivars of cluster bean received Jobner or RARI, Durgapura or Private Companies were evaluated against wilt of cluster bean under pot conditions during *kharif* season 2018. In all varieties none was found immune or resistant to wilt of clusterbean. However, RGC- 197 variety susceptible and other were found moderately susceptible.

FUTURE SCOPE

Wilt eco-friendly control is a good factor in reducing the use of pesticides in the control of plant disease. It usually involves biocontrol, botanicals and plant-resistant plants or plant pathogens to reduce pathogen growth and limit its adverse effects on the host plant. Since, the pathogen *Fusarium solani* causing wilt in cluster bean is cosmopolitan in nature and can survive on seed and in soil in the form of its infective propagules that are difficult to control by conventional measures. The use of IPM strategies for its management is crucial. Looking to the increasing severity of wilt of guar in Rajasthan and keeping in view the importance of the disease, the present studies were undertaken in order to reduce dependence on fungicides alone. Biocontrol (*Trichoderma viride*) and botanicals were integrated with the fungicide in various combinations for ecofriendly management of this disease.

Acknowledgment. I would like to extend my heartfelt thanks to my Grand Guide Dr. R. R. Ahir Professor, Department. of Plant Pathology, S.K.N. College of Agriculture, Jobner. I feel

blessed and fortunate to have him as my director. With this I take this wonderful opportunity to express my gratitude, debt and sincere respect to him for his valuable and encouraging guidance, critical suggestions and his support and encouragement throughout my study. Thanks again for providing me with all the necessary requirements for my research study.

I also extend my special thanks to my teammates, old and young. Finally, I owe my deepest gratitude and sense of responsibility to my dear parents (Anil Kumar Yadav and Indra Yadav), my brother and sister and other family members for their prayers, unconditional support, encouragement to pursue my interest and self-sacrifice, they have done for you. throughout my research and study.

Conflict of Interest. None.

REFERENCES

Ahmed, N., & Grainge, M. (1982). *Some promising plants for pest control under small scale farming operations in developing countries.* Working paper, Resource Systems Institute, East West Centre, Honolulu, HI, USA.

Bansal R. K. and R. K. Gupta (2000). Evaluation of plant extract against *Fusarium oxysporum* wilt pathogen of chickpea *Indian phytopath*, *53*(1): 107-108.

Bianchi, A., Zambonelli, A., D'Aulerio, A. Z., & Bellesia, F. (1997). Ultrastructural studies of the effects of Allium sativum on phytopathogenic fungi in vitro. *Plant disease*, *81*(11), 1241-1246.

Chitale, K., & Tak, S. K. (2003). Management of charcoal rot of clusterbean. *Advances in arid legumes research*, 412-414.

Dennis, C. and Webstar J. (1971). Antagonistic properties of Species group of *Trichoderma*. 1. Production of non-volatile antibiotics. *Transctions of the british Mycological Society*, *57*: 25 -39.

Ghasolia, R.P. and Jain, S.C. (2003). Seed treatment for the control of *Fusarium* wilt in cumin. *J. Phyto. Path., 16*: 67-72.

Hymowitz, T. and Matlock, R. S. (1963). Guar in the United States. *OklaAes Bull.*, B6. *11*: 1-34.

Jat, M.K. and Ahir, R.R. (2017). In vitro and In vivo evaluation of some fungicides and organic amendments to control of *Fusarium solani* causing Indian Aloe (*Aloe barbadensis*) root rot. *Inter. J. Plant Sci., 12*: 90-94.

John, P., Tripathi, N. N. and Kumar, N. (2005). Evaluation of sesame germplasm/cultivars for resistance against charcoal rot. *Res. Crops*, *6*(1): 152-153.

Kiran, L. and Bunker, R. N. (2020). Efficacy of Fungicides, Biocontrol Agents and Neem Cake to Suppress the Wilt of Cluster Bean caused by *Fusarium solani* (Mart.) Sacc. *Int. J. Curr. Microbiol. App. Sci., 9*(9): 1339-1350.

Lakhran, L. and Ahir, R. R. (2018). *In vivo* evaluation of different fungicides. Plant extracts, bio-control agents and organic amendments for management of dry root rot of chickpea caused by *Macrophomina phaseolina*. DOI: 10.18805/LR3939, pp1-6.

Li, B.J., Liu, Y., Shi, Y. X. and Xie, X.W. (2010). First report of crown rot of grafted cucumber caused by *Fusarium solani* in china.*Phytopathol., 94* : 1377.2

Lodha, S. (1993). Fighting dry root rot of legumes and oilseeds. *Indian Farming*, *43*: 11-13.

Majumdar, V.L., Jat, J.R. and Gour, H.N. (1996). Effect of biocontrol agents on the growth of *Macrophomina phaseolina*, the incitant of blight of mothbean. *Indian J. Mycol. Pl. Pathol., 26*(2): 202-203.

Mandhare, V. K. and Suryawanshi, A.V. (2009). *In-vitro* evaluation of botanicals against pathogen causing chickpea diseases. *J. Plant Dis. Sci., 4*: 128-129.

Nene, Y. L. and Haware M. P. (1980). Screening chickpea for resistance to wilt. *Plant Dis., 64*: 379-80.

Okhovvat, M. and Karampour, F. (1996). Effect of some isolates of antagonistic fungi on the control of chickpea black root rot

Pandey, K. C. and Roy, A. K. (2011). Forage crops varieties. Pp. 66- 68. Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh, India.

Papavizas, G. C. and Lumsden, R. D. (1980). Biological control of soil borne fungal propagules. *Annu. Rev. Phytopathol., 18*: 389- 423.

Pareek, V. and Varma, R. (2015). *Fusarium solani* a dominant seed borne pathogen in seeds of clusterbean grown in Rajasthan. *Biosci. Biotech. Res. Comm., 8*(1): 29-34.

Patel, D. S., Patel, S. I. and Desai, A. G. (2002). Cluster bean varietal to wilt disease caused by *Neocosmospora vasinfecta* E.F. Smith. *J. Mycol. Pl. Pathol., 32*: 120-21.

Philip, T. and Sharma, D. D. (1997). *In vitro* evaluation of leaf and oil cake extracts of *Azadirachta indica* and *Pongamia glabra* on mulberry root rot pathogens. *Indian J. Mycol. Pl. Pathol., 36*: 150-152.

Punia, A., Yadav, R., Arora, P., & Chaudhury, A. (2009). Molecular and morphophysiological characterization of superior cluster bean (Cymopsis tetragonoloba) varieties. *Journal of Crop Science and Biotechnology*, *12*(3), 143.

Karimi, R., Owuoche, J. O., & Silim, S. N. (2012). Importance and management of Fusarium wilt (*Fusarium udum* Butler) of pigeonpea. *Intl. J. Agron. Agric. Res, 2*, 1-14.

Rai, P. S., Dharmatti, P. R., Shashidhar, T. R., Patil, R. V., & Patil, B. R. (2012). Genetic variability studies in clusterbean [*Cyamopsis tetragonoloba* (L.) Taub]. *Karnataka Journal of Agricultural Sciences*, *25*(1): 108-111.

Satyaprasad, K., & Ramarao, P. (1981). Root rot of guar caused by *Fusarium solani* [*Cyamoposis tetragonoloba* (L.) Taub.]. Note. *Indian Phytopathology*.

Singh, R. S. (1951). Root rot of guar. *Sci Cult., 17*: 131-34.

Singh, S. K., & Srivastava, H. P. (1988). Symptoms of *Macrophomina phaseolina* infections on moth bean seedlings. *Annals of Arid Zone*, *27*(2), 151-152.

Singh, U. P., Singh, H. B., & Singh, R. B. (1980). The fungicidal effect of neem (*Azadirachta indica*) extracts on some soil-borne pathogens of gram (*Cicer arietinum*). *Mycologia*, *72*(6), 1077-1093.

Vasudeva, R. S., Jain, A. C., & Nema, K. G. (1952). Investigations of the inhibitory action of *Bacillus subtilis* on *Fusarium udum* Butl., the fungus causing wilt of pigeon-pea (*Cajanus cajan* (L.) Millsp.). *Annals of Applied Biology*, *39*(2), 229-238.

Verma, S., & Dohroo, N. P. (2003). Evaluation of botanicals in vitro against Fusarium oxysporum f. sp. Pisi causing wilt of pea. *Plant Disease Research-Ludhiana*, *18*(2), 131-134.

Weindling, R. (1934). Studies on a lethal principle, effective in the parasitic action of *Trichoderma lignorum* on *Rhizoctonia solani* and other soil fungi. *Phytopathol., 24*: 1153-117.

White, D. G. (2000). Root rots. Compendium of corn diseases.

How to cite this article: Yadav, P.; Ahir, R.R.; Kumar, P.; Yadav, L.;and Yadav, P.D. (2021). Eco-friendly Wilt Management Caused by *Fusarium Solani* in Cluster bean. *Biological Forum – An International Journal, 13*(4): 675-678.