# Antagonistic Effect of Different Bioagents on Diseases and Productivity of Pulses – a review

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**Abstract**

With the increasing effect of chemical pesticides on crops the harmful effect on human as well as domesticated animal is now a burning issue in Agricultural productivity in India. So biological control is an important device to overcome this problem. Pulses are the main plan- based protein for vegetarians. The 68th UN General Assembly acknowledged '2016' the International Year of Pulses (IYP) for supporting association of human food habit that would better use of pulse-based protein. *Fusarium* wilt, Bacterial blight, Anthracnose, Gray mold causes fungal diseases which are responsible for most of the damages of the pulse production. Many workers proved that use of certain bio-agents like *Pseudomonas fluorescens, Trichoderma viride, Rhizobium leguminosarum, Glomus fasciculatum*for control of diseases of pulses isthe most important strategy for sustainable production of pulses along with maintenance of soil health.

Some specific members of the *P. fluorescens* had shown the potentially for controlling plant diseases by defending the seeds and roots from fungal contamination. Antagonistic effect of *Pseudomonas fluorescens* were reported against *Fusrium oxysporumf.sp.ciceri* causing wilt in pulses.*Trichoderma* have long been recognized as biocontrol agents for the control of plant diseases and for their ability to enhance root growth and development, crop productivity, resistance to abiotic stresses, and uptake & use of nutrients. *Trichoderma* is used as biocontrol agents of soil borne fungal pathogens and antagonistic activity against plant pathogenic fungi on Chickpea *in Vitro* and *in Vivo. Glomus fasciculatum*, one special types of VAM reduced *Fusarium* wilt of pigeon pea. In addition, inoculation of *G. fasciculatum* resulted in an increase in phosphorus content which offset symptoms of the pathogen infestation.

As the interaction between VAM and *Rhizobium* is very effective to enhance crop productivity, this synergistic interaction may well be exploited to enhance the yield, particularly in legumes. These crops havethe ability to form two type of symbiotic association with micro-organisms; one with *Rhizobium* bacteria which is involved in the fixation of atmospheric nitrogen and the other with vescicular arbuscular mycorrhizal (VAM) fungi, which is effective for the uptake of phosphorus and other nutrients.

The fungicide carbendazim moderately decreased the spreading of the wilt disease in chickpea, caused by *F. oxysporum* and *R. solani*. Carbendazim has been found to be effective against both these pathogens in mono-pathogenic and concomitant situations, and it provides satisfactory control of the diseases in vegetable and pulse crops. However, from different report it has been found that bio-based fungicides for management of wilt disease of pulses are also very much effective and are also a safe management practice for environment and sustainable agriculture.

***Key words:*** Pulses, wilt, rhizobium, VAM, antagonistic effect, fungicide

## Introduction:

The 68th UN General Assembly acknowledged '2016' the International Year of Pulses (IYP). The IYP 2016 planned some aims to enhance public awareness of the dietary benefits of pulses as part of sustainable food production, food safety and nutrition. This programme have created unique prospect to support associations throughout the food chain that would better use pulse-based proteins, further global production of pulses, better utilize crop rotations and dal of pulses.

India is the principal producer, importer and consumer of pulses, accounting for 25% of global manufacture from 35% of global area under pulses. Insufficient implementation of production technology, higher price volatility, production risk and low level of irrigation are the important influencing factors responsible for stagnation in the production of these crops (Ali and Gupta, 2012).

Currently (4th advance estimate) pulse production in India is 16.47 million tonnes (2015–16) which is deficit by 3.58 million tones as against the target of 20.05 million tonnes. In 80.8 ha area, the total production of pulses was 73 million tonnes during 2013–14 but significantly increased from 40.78 million tonnes and 68.03 million ha in the year 1961 [3]. Our country is the largest producer of chickpea (*Cicer arietinum* L.) and pigeon pea, *Cajanus cajan* (L.) Millsp. with 67.5 and 63.7% of share in global production respectively (Reddy, 2004).

About 90 per cent of the total global pigeon pea, 65 per cent of chickpea and 37 per cent of lentil areas fall in India with the corresponding global production of 93 per cent, 68 per cent and32 per cent, respectively. The important pulse crops in India are Chick Pea, Pigeon Pea, Mung Bean, Lentil and Field Pea (Ahlawat et al.). However India's rank in productivity is low, 24$^{th}$ in Chick Pea, 9$^{th}$I in Pigeon Pea, 23$^{rd}$ in Lentil and 98$^{th}$ in total pulses (Montenegro and Mera, 2009a). In India, 26.3 million ha be the total area under pulse cultivation which very minimum to cereal cultivation and production of pulses is around 19.3 million tonnes with a very low productivity of 764 kg/ha (Montenegro and Mera, 2009b). However, in the case of Lentil, the average yield in India (629 kg/ha) is 25 per cent lower than the world average (1053 kg/ha) (FAO, 2007). Pulses are attacked with many seed borne diseases, a major cause of concern as its incidence,if not controlled, demolishing the crop. *Fusarium* wilt is wide spread in legumes growing regions (Singh et al., 2015).

Chick pea (*Cicer arietinum* L.) is the third important food pulse after soyabean and common bean. It is a herbaceous much branched small sized (25-50 cm in hieght) leguminous pulse play a vital role in Indian diet, it contain about 17% proteins. The green leaves contain oxalic acid and malic acid, used to treat intestine disorders. The grains are used as fodder to feed horse and cattles.

**Diseases lowering productivity of pulses:**

Among the various factors accountable for lowering the productivity of chick pea, fungus diseases are reported to cause 20-30% losses. The diseases are wilt caused by *Mycosphaerella rabiei*. Lentils suffer from differ remarkable fungal disease like rust (c.o-*Uromyces fabae*), wilt (c.o-*Fusarium orthoceros var. entidid*).

Among various factors accountable for lowering the productivity of *Lathyrus sativus* L, fungal diseases are reported to cause 20-30 percent losses (Campbell, 1997)

*Fusarium* wilt disease, caused by *Fusarium oxysporum*, is responsible for the decline of the pea. The different disease causes the poor yield of winter pulses are Aster yellow (*Phytoplasma* sp), Bacterial blight (*Pseudomonas syringae pv. pisi* and *Pseudomonas syringae pv. syringae*. *Xanthomonas campestris pv. cassie* is causual organism of bacterial blight in chickpea. Anthracnose of lentil and chickpea is caused by the fungus pathogen *Colletotrichum truncatum*. Gray mold is caused by *Botrytis cinerea* in chickpea and lentil.

**Influence and Antagonistic effect of bioagents:**

*Rhizobium* is the most important strategy for sustainable production of pulses along with maintenance of soil health. Nodules were formed on the roots of leguminous plants by strains of *Rhizobium*, *Sinorhizobium* and *Allorhizobium* of the family Rhizobiaceae, *Mesorhizobium* of family Phylobacteriaceae and *Bradyrhizobium* of family Bradyrhizobiaceae and also on leaves of some plants of Myrsinaceae and Rubiaceae by strains of *Phyllobacterium* belong to the family Phyllobacteriaceae. The genus *Azorhizobium* under the family Hyphomicrobiaceae formed stem nodules on some hydrophytic legumes. Pulse chick pea has the host specificity with *Rhizobium ciceri*, Lentil *with Rhizobium leguminosarum* and grass pea with *Rhizobium leguminosarum pv vicea* (Abi-Ghanem et al., 2013; Drouin et al., 2000).

*Pseudomonas fluorescens* functions by trapping a cluster of nonpathogenic saprophytes which take possession of soil, water and plant surface environments. It is a common gram negative, rod-shaped bacterium. It is a common gram negative, rod-shaped bacterium. It secretes greenish soluble pigment called fluorescene in the condition of presence of low iron. This obligate aerobic have special mechanism for electron accepting ability,it can utilize $NO_3$ as an electron acceptor in place of $O_2$. Some members of the *P. fluorescense* have shown the capability to resist against plant pathogen by suppressing the growth of disease causing fungi. Many of them also function as enhancer of plant growth promotion and also decrease the severity of many fungal diseases (Ganeshan and Manoj Kumar, 2005). Direct ntagonistic effect of *Pseudomonas fluorescens* were reported against *Fusrium oxysporum f.sp.* ciceri causing wilt in chickpea and other pulses (Kandoliya and Vakharia, 2013).

*Trichoderma* species are the commonly soil and root inhabited free-living fungi which are highly interactive in root, soil and phyllosphere. These organisms secrete a many types of primary and secondary compounds by which it can acquire systemic and local resistance. From this property, *Trichoderma* have long been recognized as biocontrol agents.

*Trichoderma* used as biocontrol agents of soil borne fungal pathogens and antagonistic activity against plant pathogenic fungi(Herath, 2015). Effect of this reported on Chickpea and wheat in Vitro and In Vivo (Mohammad, 2014), (Hasan, 2012). *Trichoderma* also effect antagonistic effect on tea (Naglot et al., 2015).

Vesicular-arbuscular mycorrhiza (VAM) is the symbiotic association between plant roots and certain soil borne fungi that play a pivotal role in nutrient management in ecosystem and protect plants against cultural and environmental stresses (Ramakrishnan and Bhuvaneswari, 2015) . This Mutualistic alliance is considered to be an extremely interdependent relationship where the fungi transfer nutrients from the soil to the host plants which in turn, give support to the fungal symbionts (Berruti et al., 2016). Mycorrhiza imparts disease resistance to plants through improvement of plant nutrition, alteration in mycorrhizosphere population and altered phenol metabolism. It was observed (Siddiqui and Mahmood, 1995) that *Glomus fasciculatum*, one special types of VAM reduced *Fusarium* wilt of pigeonpea. In addition, inoculation of *G. fasciculatum* resulted in an increase in phosphorus content which offset symptoms of the pathogen infestation (Akhtar and Siddiqui, 2007).

**Interaction effect of bioagents:**

As the interaction between VAM and *Rhizobium* is very effective to enhance crop productivity, this synergistic interaction may well be exploited to enhance the yield, particularly in legumes. These crops have the ability to form two type of symbiotic association with micro-organisms; one with Rhizobium bacteria which is involved in the fixation of atmospheric nitrogen and the other with vescicular arbuscular mycorrhizal (VAM) fungi, which is concentrated with the uptake of phosphorus and other nutrients (Zahran, 1999).

Many fungicide significantly decreased the severity of the wilt disease complex in chickpea, but carbendazim very useful for the treatment of this particular disease caused by caused by *F. oxysporum.* Carbendazim has been found to be effective against both these pathogens in mono pathogenic and concomitant situations, and it provides satisfactory control of the diseases in vegetable and pulse crops (Khan et al., 2014; Mohamed et al., 2016; Singh et al., 2016).

**Conclusion:**

The review work has covered that antagonistic effect of certain members of the *Pseudomonas fluorescens*, *Trichoderma* sp., *Rhizobium* sp. and *Glomus fasciculatum*, on pulses, particularly on winter pulses. These study shown *P. fluorescens*, to be potential agents for the biocontrol which suppress plant diseases by protecting the seeds and roots from fungal infection. They are known to enhance plant growth promotion and reduce severity of many fungal diseases. Antagonistic effect of *Pseudomonas fluorescens* were reported against *Fusrium oxysporumf.sp.ciceri* causing wilt in pulses. *Trichoderma* have long been recognized as biocontrol agents for the control of plant diseases and for their ability to enhance root growth and development, crop productivity, resistance to abiotic stresses, and uptake & use of nutrients. However, adoption rate of biopesticides is very slow, compared to synthetic chemicals.

*Trichoderma* is used as biocontrol agents of soil borne fungal pathogens and antagonistic activity against plant pathogenic fungi on Chickpea *in Vitro* and *in Vivo.Glomus fasciculatum*, one special types of VAM reduced *Fusarium* wilt of pigeonpea. In addition, inoculation of *G. fasciculatum* resulted in an increase in phosphorus content which offset symptoms of the pathogen infestation.

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