Scenario of *Fusarium* Wilt of Chilli in India and Its Integrated Disease Management

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Abstract

Chilli (*Capsicum annum* L.) is one of the most important vegetable and spice crop belongs to family Solanaceae and genus *Capsicum*. India is the leading producer and consumer of chilli in the world. It is susceptible to several diseases and pests, which become major constraints in its production. Among them *Fusarium* wilt has emerged as a serious problem in past decade. Variable symptoms are observed which includes vein clearing, leaf epinasty, chlorosis, necrosis, abscission and wilting. The characteristic symptoms of the disease are brown vascular discoloration followed by upward and inward rolling of the upper leaves and subsequently wilting of the plants. The cultivation of resistant varieties is the most effective, economical and environmentally safe method for controlling plant diseases. Cultural practices offer an opportunity to alter the environment, the condition of the host and the behavior of pathogenic organisms in ways that adequately controls a particular disease. The biological management of plant pathogens is assuming significance on account of ill-effects of chemical fungicides and has become quite popular strategy to manage especially those diseases which are soil borne in nature and difficult to manage chemically. Chemical management is often the most feasible means of tackling a plant disease problem. Pathogens which are mainly soil and/ or seed borne, disinfection of seeds and soil with chemicals / fungicides has yielded encouraging results. Integrated disease management attempts to use all the known suitable techniques of control to maintain the particular pest population at a level below that which causes economical losses to the crop.

Introduction

Chilli (*Capsicum annum* L.) is one of the most important vegetable and spice crop belongs to family Solanaceae and genus *Capsicum*. It is grown for its green and ripe red fruit which is an indispensable condiment, digestive stimulant as well as flavoring and coloring agent in sauces, chutneys, pickles and other forms of food. India is the leading producer and consumer of chilli in the world. It is susceptible to several diseases and pests, which become major constraints in its production. Among them the most devastating are fungal diseases which lower the yield considerably annually. Leonian (1919) first time reported the wilt disease of chilli caused by *Fusarium* spp. *Fusarium oxysporum, F. solani*, *F. moniliforme* and *F. pallidoroseum* have been reported as the wilt causing agents from chilli growing areas but in India *F. oxysporum* and *F. solani* are the most prevalent species of *Fusarium* found associated with wilt disease of chilli (Naik, 2006). It has got great importance as it is having health benfits to mankind, with richness in antioxidants, vitamins like A, E, C and minerals like Ca. It also has anti-inflammatory and antibacterial properties so helping human beings in improving vision, boosting immunity, maintain digestive health of animals, keeping the skim radiant and young and giving soothing effects to respiratory system. Thus, it gained popularity.

Recently, anthracnose and *Fusarium* wilt becoming major yield declining fungal diseases. In India, wilt alone reducing the yield by 5 – 80 %. So it is a major problem, got attention by researchers as a epic work needed care to maintain the economy of the farmers with improved quality.

Symptomatology

Variable symptoms are observed which includes vein clearing, leaf epinasty, chlorosis, necrosis, abscission and wilting (Fig1). Symptoms are characterized initially by slight yellowing of the older leaves followed by younger leaves; the leaves became chlorotic and desiccated and the whole plant wither and die slowly. At first, the lower leaves and then upper leaves show loss of turgidity. Thereafter, stem

shrivels and entire plant wilts. By the time above-ground symptoms are observed, the vascular system of the plant is discolored, particularly in the lower stem and roots.

Epidemiology

The pathogen become active in favourable conditions like, dry weather and excess soil moisture with soil temperature around 23 - 30°C. The chlamydospores present in the soil start germinating in response to the root exudes produced from the chilli plants. The germinating germ tube will directly penetrate into root tip or damaged root hair then it invades the root cortex by covering maximum inter cellular space of the root.

IDM strategies

Once a field is infested, the pathogen may survive in the soil for many years, fungus can be transported by farm equipment, drainage water, wind, or animals, including humans and warmer and drier climates (>25C) favour disease and also when crop rotations are not practiced (Khan *et al.*, 2018).

The cultivation of resistant varieties is the most effective, economical and environmentally safe method for controlling plant diseases. Because of the soil borne nature of wilt pathogens, cultivation of resistant genotypes, if any, is best way of managing the problem. Various chilli wilt resistant varieties available are Musalwadi, Arka Lohit, Pusa Jwala, Pant C-2 and Jwahar-218 (Nayeema *et al.*, 1995).

Cultural practices offer an opportunity to alter the environment, the condition of the host and the behavior of pathogenic organisms in ways that adequately controls a particular disease. *Fusarium* wilt of chilli can be successfully managed by sowing plants on ridges and avoiding excessive irrigation as wet soils were found to favour the disease. Higher pH levels are known to restrict the growth and development of *Fusarium* spp. in soil and hydrated lime has often been used for the purpose. Soil solarization can also reduce the population of *Fusarium oxysporum* f. sp. *capsici* up to 0-15 cm depth in soil (Leonian, 1919).

The biological management of plant pathogens is assuming significance on account of ill-effects of chemical fungicides and has become quite popular strategy to manage especially those diseases which are soil borne in nature and difficult to manage chemically. *Trichoderma viride* and *T. harzianum* has been found as potent biocontrol agents against *Fusarium* wilt in chilli. The application of endophytic bacteria *Bacillus subtilis* and rhizobacteria *Pseudomonas fluorescens*, singly and in combination were found to be effective in controlling the *Fusarium* wilt of chilli disease by inducing systemic resistance (ISR). Also, the plant extracts (*Eucalyptus citriodora*) and essential oils (neem and garlic oil) provide an effective measure for *Fusarium* wilt disease management and it represents an alternative to reliance on fungicides (Joshi *et al.*, 2012).

Chemical management is often the most feasible means of tackling a plant disease problem. Pathogens which are mainly soil and/ or seed borne, disinfection of seeds and soil with chemicals / fungicides has yielded encouraging results. Seed treatment with fungicides like carbendazim 50 WP or captan 50 WP or thiram 75 DS at 2.5 g/kg seed before sowing, besides, seedling dip in carbendazim 50 WP (0.1 %) or benlate (0.05 %) or captan (0.2 %) for 30 minutes before transplanting has been found effective in managing the wilt disease of chilli. Applying fungicides as a drench around the stem of plants at the time of transplanting and again at 50 % flowering stage was found to be effective than using foliar sprays against wilt disease (Nelson *et al.*, 1981).

Conclusion

The routine application of fungicides for insurance purposes is not appropriate, as it does not focus the proper attention on the real problem and can lead to resistance and potential environmental issues. Integrated disease management attempts to use all the known suitable techniques of control to maintain the particular pest population at a level below that which causes economical losses to the crop. Added benefits of IDM are that disease control is greater than that achieved by individual method. In the present experiment, we found that a significant increase in per cent germination and other plant growth parameters along with least disease incidence and highest yield in module-III (adoptive module) where we integrated both chemicals, bio control agents and soil

amendments. This module found best for two seasons in two different locations of Karnataka. The cost economics was also calculated and found that, highest cost benefit ratio was obtained by following the adoptive module. There was significant reduction in pathogen population was also recorded from both the locations when compared with control treatment.

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