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Innovation The Research Concept

Studies on Bacterial Wilt Diseases of Groundnut Crops and its Biological Control

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Abstract

Groundnut is an economically and commercially important crop in India and widely used over the world with attention. Groundnut crop suffers from bacterial wilt disease caused by *Ralstonia solenaciarum*. Heavy crop losses due to bacterial wilt disease have been reported. Negative impact on environment occurs due to excessive use of chemical pesticides which draw the attention of researchers towards biological control of the disease. Use of disease free seed inoculums, crop rotation and plant extracts, disease resistance varieties and fertilizer are some non-hazardous remedies to control incidence of these disease. Present study reviews the biological control measures to attain a sustainable and eco-friendly management of groundnut diseases.

Keywords: Eco-friendly, Biological control, Bacterial Wilt disease, Non-hazardous.

Introduction

Groundnut is an important crop which is grown throughout the world. The groundnut crop is cultivated in 109 countries on about 22.8 million hectares, of which 13.89 million ha are in Asia (India 8.2 million ha), and the global production of the crop is 30 million tonnes. India, China, and the United States are the leading producers and grow about 70% of the world's groundnuts (FAOSTAT, 2019). Groundnut (*Arachis hypogaea*) is an important oilseed crop of India and is cultivated during kharif and rabi-summer season. Andhra Pradesh, Gujarat, Tamil Nadu, Karnataka, Rajasthan and Maharashtra are major groundnut growing states contributing about 80 percent area and production in India. In Rajasthan, ten districts viz., Bikaner, Jodhpur, Churu, Jaipur, Hanumangarh, Sikar, Dausa, Alwar, Nagaur and Tonk are found as major groundnut producing districts. Mentioned districts collectively comprise 84% of the total groundnut areas of Rajasthan. The highest production was estimated in Bikaner, the district with the largest acreage (35.4%) in the state. Bikaner alone, accounted 39.4% of the estimated production of Rajasthan. Total production of in shell groundnut in Rajasthan was estimated at 14,16,981 MT with an average yield of 2,389 kg/ha (IOPEPC Kharif-2019).

Aim of the Study

Studies about bacterial wilt diseases of groundnut crops and its causal agent. Know about loss of groundnut production by bacterial wilt diseases.

Bacterial Wilt Diseases of Groundnut and its Biological Control

Bacterial wilt is one of the most economically important bacterial diseases in developing countries like India; its presence on crops such as groundnut, banana, tobacco, tomato, eggplant, pepper and potato is a big challenge for the farmers of developing countries where these crops are important cash crops. Under favorable conditions for the disease, wilt incidence is very high and it causes huge economic loss. The published research record of bacterial wilt in Indonesia, on several crops affected by *R. solanacearum,* was first time reported in 1892 and on the groundnut in 1905 (Kelman 1953).

The result of research on bacterial wilt in Indonesia, which is wider than any other source, has been well reviewed by Machmud (1986). In compare to many other countries of the world, in China bacterial wilt of groundnut is prevalent in sandy soil, particularly in gritty soil, but not in heavy clay or loam (Ma and Gao 1956; Li 1958; OCRI of CAAS 1977b). Wilt symptoms can be seen 2-3 weeks after planting. The first sign of

disease is a slight drooping or curling of one or more leaves. In more advanced stages, the plants may bend over at the tip, appear dry, and eventually turn brown, wither, and die. Infected plants have discolored and rotten roots and pods. The diagnostic characteristics of this disease are the dark brown discoloration in the xylem and pith, and the streaming of 'bacterial ooze' (Mehan et al. 1994).

A systematic study of the relationship between sand content of soil and bacterial wilt incidence indicates that the higher the percentage of sand in soil the more groundnut plants wilted. For instance, in pure sand (100%) bacterial wilt incidence of groundnut plants was 92%, while in heavy yellow loam the bacterial wilt incidence was almost nil. The bacterial wilt incidence also reached up to 21.8% in the treatment 60% sand + 40% yellow loam, whereas the bacterial wilt incidence noticed up to 4.2% in the treatment 60% yellow loam + 40% sand (Hou and Wang 1980). Bacterial wilt of groundnut is known as a disease of wet and warm regions. High temperature and moisture have been reported to favour its development (Zhou and Liu 1962; Li et al. 1981).

According to observations in Linyi, Shandong province, when the air temperature was higher than 20° C and the 5cm depth soil temperature was kept stable at 22° C or more, the disease symptoms were noticed in 10 days. When the soil temperature exceeded up to 25° C, accompanied by a positive amount of precipitation, bacterial wilt developed rapidly (Wang et al. 1983). Precipitation or soil moisture affected wilt development less than the temperature, although they were necessary factors. Large amounts of precipitation or high moisture, usually reduced soil temperature, which might slow down the wilt development (Li et al. 1981; Wang et al. 1983).

The common symptom are day wilting and night recovering at the beginning, plus vascular discolouration of stem at a few cm above the soil line followed by some time a bronzing of leaves. Generally leaves wilt without changing of colour. A stem cut test shows the bacteria white ooze exudes coming out from vessels when placed under water. The same ooze can be observed from tubers eyes including stem-end-attachment.

When masses of soil are clumped to the tubers eyes it is good to cut the tubers and check for bacterial ooze or vascular discolouration because of bacterial exudates dries, a mass of soil may adhere to the tubers at the eyes. In post harvest inspection also it is important to section the tuber and look for vascular necrosis and white bacterial oozing symptoms (OEPP/EPPO, 2004).

Usually, *R. solanacearum* occurs in the latent form in temperate European countries when infected symptomless weeds such as *Solanum dulcamara* which grows along the waterways (Elphinstone et al., 1998). For isolation from that latent form, the SMSA media modified was found more effective in Europe (Elphinstone et al., 1998).

The morphological, physiological and biochemical characters can be observed on culture media. It can also observed by the pathogenicity test. Sterile PBS and a known isolate of *R. solanacearum* should be used as controls. With pure culture inoculum, typical symptoms are visible within four days (OEPP/EPPO, 2004).

According to French et al., in l995, the bacterium *Pseudomonas solanacearum* is very difficult to isolate by inexperienced researchers. While the bacterium can multiply readily in its host, it grows very slowly in vitro comparing to most of the pathogenic bacteria. In culture its rate of mutation is high so it is better to store it in the water. For its detection and identification of its biovars, specialized media can be used frequently. Also are available now several molecular biology tools for a fast identification; such as serological and different PCR test (Alvarez, 2004).

There has been the interest is increased in the research and use of biological control agents (BCAs) in disease management due to the environmental effects of the use of chemicals (Whipps, 2001). The advantages of BCAs including self-propagation after initial application are environmental friendliness and extended disease control (Quimby et al., 2002; Whipps et al, 2008). The activites of BCAs are through antibiosis, parasitism, induction of resistance, degradation of cell wall by enzymes and nutrient competition with pathogens (Agrios, 2005; Cook and Baker, 1983). To control of bacterial wilt has been dominated by avirulent strains of bacteria *R. solanacearum* (Yuliar et al., 2015).

Leaf extracts of various plant species such as *Azadirachta indica , Allium sativum, Carica papaya, Datura stramonium, Allium cepa var. aggregatum, Zingiber officinal, Parthenium hysterophorvus* and *Curcuma longa* may be used as the biological control agents (Seth et al., 2014).

Other several species have been found to control *R. solanacearum* include; *Clostridiaum* spp. (Momma, 2008), *Ralstonia picketii* (Wei et al., 2013), bacteriophages (Álvarez et al., 2007; (Yamada et al., 2007) Enterobacter (Xue et al., 2009) *Paenibacillus marcerans* (Li et al, 2011) and *Bacillus thuringiensis* (Zhou et al., 2008). Direct inoculation of *B. thuringiensis* to the plants for protection against *R. solanacearum* induced production of resistance genes like *PR-1* leading to resistance (Takahashi et al., 2014). The mode of action was exposed to be the production of siderophores and indole acetic acid (Yuan et al., 2014).

Some fungal pathogens like *Glomus versifyirme* have been shown to control bacterial wilt in groundnut with decrease of bacterial counts in the xylem tissues by 81 % (Zhu and

Yao, 2004). The relevance methods include, seed coating, root dipping with drenching reported to have had lower efficacy (Yuliar et al., 2015). Efficacy of BCAs is hindered by a number of factors such as, poor and inconsistent colonization, challenges of mass inoculums production, efficacy in narrow host range (Whipps et al., 2001).

Conclusion

Groundnut is an important crop playing a dominant role in the economy of many countries of the world. It suffers from a variety of diseases worldwide which affects its quality as well as quantity and finally the economy of the dependent stake holders. As a requirement of human and environment health, application of biological or ethno botanical control measures are being implemented. In groundnut crop also, these management strategies have performed well with the application of plant extracts such as *Nicotiana tabacum*, *Azadirachta indica, Moringo oleifera, Datura alba*, *Curcuma longa, Caleotropics procera, Eucalyptus globuls , Allium sativum* , *Datura stramonium and Aloe barbadensis*; effectively controlling pathogens such as *R. solanacearum* on groundnut species. Present study reviewed the potential bio-agents and plant parts to control wilt disease of groundnut.

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