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ECO-FRIENDLY APPROACHES FOR THE CONTROL OF ROOT ROT, WILT AND LEAF SPOT DISEASES OF OKRA

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ABSTRACT

Field experiment was conducted to develop an eco-friendly management practices against root rot, wilt and leaf spot fungal diseases as well as viral diseases of okra. Soil amendment with neem leaf compost @ 1kg/10sqm found to control 90-100% root rot and wilts as well as significantly increased yield (5016.5 kg/ac) of okra. Incidence of leaf spot was significantly reduced in plants sprayed with 10% neem leaves extract + 0.5 gm turmeric after 30 and 60 days of transplanting. 10% neem leaves extract reduced okra leaf curl disease (OLCD), yellow vein mosaic disease (YVMD) and their vector whitefly *Bemisia tabaci* population as compared to control.

Key words: Okra, *Fusarium oxysporum, F. solani, Alternaria alternate,* neem leaf compost, neem leaves extracts.

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) locally known as Bhindi is very important vegetable crop cultivated in the developing countries of Asia and Africa with very poor productivity. It is an oldest crop of Indo-Pak sub-continent (Athar & Bokhari, 2006). Globally, its annual area of cultivation is 1.83 million ha and yield is 9.62 million metric tons The area of okra cultivation is about 15,198 hectares and production is 114,734 thousand tons in Pakistan (FAOSTAT, 2017). Okra green pods contain 80% water and seeds are good source of protein, vegetable oils (Baloch, 1994; Yadav & Dhankhar, 2001; Khushk *et al.,* 2003; Gemede et al., 2015). It has multipurpose uses, consumed as vegetables, as salads, in soups, and stews (Salameh, 2014). It is an important source of calcium, potassium, iron, manganese, magnesium, vitamins A, B, C, and K, minerals and due to its dietary fibers and amino-acid considered as important constituent for balanced food (Hughes, 2009, USDA National Nutrient Database, 2016). Okra have medicinal properties against intestinal tract infection, cancer, high-cholesterol, and Diabetes mellitus because of valuable nutrients, soluble and insoluble fibers (Anon., 2007; Broek *et al.,* 2007; Jenkins *et al.,* 2005; Sabitha *et al.,* 2011).

Okra plants are attacked by various diseases caused by different viruses, bacteria, fungi, mycoplasmas, nematode and insects. The total loss of okra due to important diseases is about to 20 to 30%, which may increase up to 80 to 90%. The economically important diseases are damping off, *Fusarium* wilt, powdery mildew, *Cercospora* leaf spot, leaf curl virus, yellow vein mosaic virus. Leaf spot fungal disease caused by *Cercospora abelmoschii* or *C. malayensis*, *Alternaria sp*., *Ascochyta sp*. (Hafiz, 1986; Jha and Dubey, 2000; Kochhar, 2005; Jiskani, 2006). There is report of 53.5- 61.5% incidence of leaf spot caused by *Alternaria alternata* from different locations of Sindh (Arain *et al.,* 2012). Powdery mildew disease caused by *Erisiphae cichoracearum* is an emerging potential threat to okra crop which causes huge losses in yield up to 90 % (Ghanem, 2003).. Root system infection caused by *Fursarium oxysporum, F. solani* , *Macrophomina phaseolina*, *Rhizoctonia solani*, *Pythium butleri* and *Phytophthora palmivora* is serious problem and caused 10-45 per cent losses under favorable conditions. Root-knot nematode (*Meloidogyne* spp.) is one of the most devastating pathogen of okra (Anwar & Mckenry, 2010; Hussain *et al*., 2012). Three viruses of Begomovirus group viz., Yellow vein mosaic disease (YVMD), okra leaf curl disease (OLCD), and okra enation leaf curl disease (OELCD) caused serious losses in okra plants (Venkataravanappa *et al.,* 2013). The vector of begomoviruses is whitefly (*Bemisia tabaci*) which under field conditions caused heavy infestations in okra plants (Venkataravanappa et al., 2015). Yellow vein mosaic virus (YVMV) and okra leaf curl virus (OELCV) caused 30 to 100% loss in yield in okra and severity increased with the age of plants (Singh, 1996). Control of insect vectors of plant viruses by pesticides is very hazardous to the environment as well as the humans directly (Jabbar and Mohsin, 1992).

The general control of disease by integrative disease management is ecofriendly, easy to adopt, reduces the cost of healthy cropping and also reduces the possibility of attack by the other pathogens to okra crop. The present study has been undertaken to develop an eco-friendly management practice against root infecting and leaf spot fungal diseases as well as viral diseases of okra.

MATERIALS AND METHODS

The experiment was carried out during the period from March 2016 to October 2016 at experimental field having plot size 2m x 2m in a randomized complete block design with 3 replications. Seeds of okra variety were sown in seedbed on mid-March 2016. Cow dung 10 tons per ha was applied one month before bed preparation. and no chemical fertilizer was used in this experiment. The okra seeds were sown at 15-30 cm distance on ridges and distance between rows was 60 cm. The leaves of neem (*Azadirachta indica)* plants were collected and rinsed twice with distilled water and were soaked in boiled water at 1:1 w/v, vigorously stirred, left for 24 hours and straining through 5 ply muslin cloth. The extracts obtained were considered 100% pure, further 10 % was prepared by adding distilled water. There were 7 treatments as follows:

T_1 = A+ D
T_2 = A+ E
T_3 = B+ D
T_4 = B+ E
T_5 = C+D
T_6 = C+E
T_7 = Control (Untreated)

A = Soil amendment with mustard oil cake @ 2 tons/ ha., 15 days prior of seed sowing.
B = Soil amendment with neem oil cake @2 tons/ ha., 15 days prior of seed sowing.
C = Soil amendment with neem leaf compost @ 1kg/10sqm., 15 days prior of seed sowing.
D = Foliar spraying with 10% neem leaves extracts 30 and 60 days of transplanting.
E = Foliar spraying with 10% neem leaves extracts + 0.5 g turmeric powder after 30 and 60 days of transplanting.

The incidence of root rot and wilt were recorded during crop season. The intensity of leaf spot caused by *Alternaria alternata* were recorded 30 days after transplanting till maturity by randomly selected 5 plants showing leaf spot symptoms. The disease incidence percentage was calculated for each treatment by formula as given below.

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased leaves/treatment}}{\text{Total number of leaves/treatment}} \times 100$$

The data collected were statistical analyzed by using SPSS version 19. Duncan multiple range test was used to compare different treatments combinations.

RESULTS AND DISCUSSION

The incidence of root rot and wilt caused by *Fusarium oxysporum* and *F. solani* significantly reduced in plants where treatment comprised of soil amendment with neem leaves compost @ 1kg/10sqm and mustard oil cake @ 2 tons/ ha followed by neem oil cake @ 2 tons/ ha., as compared to control (Table 1). Leaf spot incidence was significantly reduced in plants sprayed with 10% neem leaves extracts + 0.5 g turmeric powder after 30 and 60 days of transplanting followed by treatment comprises foliar spray with 10% neem leaves extracts 30 and 60 days of transplanting as compared to control. The data showed that 90-100% control of root rot and wilt and significant increase in yield (5016.5 kg/ac) of okra were recorded in treatment comprises of soil amendment with neem leaf compost @ 1kg/10 sq.m followed by treatment comprises mustard oil cake (4326.5 kg/ac) and neem oil cake (3955.8 kg/ac) @2 tons/ ha, as compared to control (3034.6 kg/ac). The reduction in viral disease viz., okra leaf curl disease (OLCD), yellow vein mosaic disease (YVMD) and their vector whitefly (*Bemisia tabaci*) population was noticed in treatments where 10% neem leaves extracts were used as compared to control.

The leaf spot disease initially appeared as light brown spot on the infected leaves, and gradually turned to concentric dark spots. *Alternaria alternata* was isolated from severely infected leaves of okra and identified on the basis of its morphological and cultural characteristics. Significant reduction in severity of *A. alternata* leaf spot was observed in plants sprayed with neem leaves extracts + 0.5 g turmeric powder mixture as compared to control. Patil *et al.*, (2001) who found that neem leaves extracts reduced disease incidence of *Alternaria solani* and increased yield of tomato. Chaudhary *et al*., (2003) using neem leaf extracts against *Alternaria alternata* causing early blight of potato, revealed 50% inhibition. Similarly Sanjeet *et al*., (2005) reported *Azadirachta indica* extracts provided good control of leaf spot of faba bean caused by *Alternaria alternata* under field condition. These results of the study are in agreement with Chattopadhyay (1999), who found that foliar spraying of *A. indica* leaf extracts decreased the severity of *Alternaria alternata* causing loss of sunflower and tomato and increased the yield. Hassanein *et al*., (2010) have reported that natural extract from leaves of neem tree very effective against to common pathogens

Alternaria alternata and *Fusarium solani* that affect some of the important vegetables in Egypt. Shervin *et al.* (2011) have shown neem seed powder to significantly reduce the tomato wilt disease severity caused by *Fusarium oxysporum.* Neem not only controlled disease but also increased growth characters such as plant weight and length (Salim and Simon, 2015). The findings of Raj and Kapoor (1996) and Afroz *et al*. (2008) reflected mustard oil cake affectivity against. *F. oxyporum*, have effectively controlled the wilt disease where none of plants died. The suppressive effect on *F. oxyporum* might have perhaps due to improved host nutritional status and produc (Khan *et al*., 1973; Pacumbaba *et al*., 1997; Agrios, 2005).

Table 1. Effect of interaction of treatments on diseases incidence and yield of okra.

Treatments	Disease Incidence		Yield (Kg/ ha)
	Root rot & wilt (%)	Leaf spot (%)	
T_1	1.06_b	6.5_c	4018.5_b
T_2	0.00_a	2.9_a	4326.5_b
T_3	2.16_c	4.8_b	3671.8_c
T_4	2.60_c	3.5_a	3955.8_c
T_5	0.56_a	5.0_b	4916.5_a
T_6	0.00_a	3.0_a	5016.5_a
T_7	5.16_d	11.0_d	3034.6_d

Mean followed by the same letter within a column are not significantly different at (P=0.05) according to Duncan's multiple range test.

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