

Research Article

Enhancement of growth and suppressing the root diseases of tomato plant by using organic amendment

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Abstract

Cotton (*Gossypium hirsutum* L.) and mustard (*Brassica campestris* L.) cake used to suppress pathogenic fungi and ultimately enhanced the growth of tomato (*Lycopersicon esculentum*) plant. During field experiment tomato plant was treated alone and combine use of mustard and cotton cake with different concentration viz, 1, 3 and 5% W/V. *Fusarium solani*, *Botrytis cinerea* and *Fusarium samitactum* was completely controlled by the combine effect of mustered and cotton cake at 1%MC+5%CC, similarly *Rhizoctonia solani* was completely controlled at 1%MC+1%CC, while 5%MC, 5%CC, 1%CC+5%MC also showed the significant ($P < 0.05$) result by reducing the percent infection of *F. solani*, *R. solani* at 11.11 each. Plant height enhanced significantly ($P < 0.05$) by all treatments alone and combine, while maximum plant height and weight was produced by combine effect of mustard and cotton cake at 1%MC+5%CC was 14cm and 23.41g respectively.

Keywords: Cotton; Fungi; *Lycopersicon esculentum*; Mustard; Organic manure

Introduction

Organic soil amendments are not only safe to use and effective in controlling several plant pathogens present inside the soil like, root-knot nematode but also encourage soil biological activity and improve soil structure [1]. Generally most common organic amendments are animal manure, peat moss, compost, wood chips, sewage sludge, sawdust and straw used in soil [2]. Organic amendments suppressed the soil borne pathogens, enhance the yield of crops [3, 4]. Application of organic amendments improves structure, texture, color, humus, water holding capacity (WHC), aeration

and microbial activity of soil, all these yield reduce environmental pollution and increase production [5-9]. Improved structure of soil [10] and micro-organism [11]. Organic fertilizer can work as alternative use of inorganic fertilizers [12]. Organic fertilizer stimulates different species of plant, which discharge plant hormones alternate to stimulate absorption of nutrients and the plant growth [13]. Research in developing countries like South East Asia and Nigeria showed that soil modification with different organic matters resulted in effective root knot

nematode control and enhanced crop yield [14-16].

Numerous sources of organic matter available locally or regionally for controlling root infecting pathogen, a numeral of organic extracts of plant origin, like oil-cakes from plant extracts, used to develop soil structure [17]. Manure that obtained from plant biomass also used [18-20]. Two different types of oil cakes were found, non-edible and edible oilcakes, Edible oil cakes have nutritional significance; including 15% to 50% protein content [21]. Composition of oil cakes are varies depending on their extraction methods, growing form and on their variety. Due to the P N K contents of non-edible oil cakes, these cakes are used as organic fertilizers, enhanced to uptake the nitrogen and they also defend the plants from pathogens, nematodes, and insects; in this way it shows resistance against pathogens [21]. It is a very decent source of amino acids like lysine, methionine, tryptophan and threonine [22]. Amylase [23, 24], protease [25, 26] phytase, lipase [27] and glutaminase [28] and specific enzymes are produced by using these oil cakes as nutrient source. Oil cakes increase N uptake by the plants and check nitrification of the soil/urea, oil cakes comprising 2-7% of protein improve plant health and suppress soil nematodes [29]. In order to protect the crop nematodes, extracts of oil-cakes can also be used as seeds coating [30-32]. Oilseed press cakes prepared from cotton, mustard or other plant species suggested [33-36].

Mustard (*Brassica campestris* L.) symbolized by rape seed belongs to the genus *Brassica* of the family *Brassicaceae* (Cruciferae), it plays a very important role in human diet and is considered as the important oilseed crops in the world, mostly in Bangladesh [37]. In several mustard producing countries of the world it is used as a manure, condiment, salad and fodder crop and as a stem and leaf vegetable [37]. In Bangladesh local production of edible oil almost completely comes from

rapeseed and mustard occupying only about 2% area of total cropped area [38]. The share of rapeseed-mustard was 0.21 million tons from the annual oil seed production of 0.41 million tons, which comes about 52% of the total edible oil seed production [39]. Brassica residues have been described to decrease the number of chlamydo-spore of FOL in tomato [40]. Mustard oil cake reduces galls of nematodes and ultimately improve the yield of tomato plant [41, 42]. Oil seed cakes are rich in minerals, vitamins, proteins, antioxidants, fibers so they are used for feed preparation [43].

Materials and methods

Plant material

Tomato (*Lycopersicon esculentum*) Advanta 1204 ICI Pakistan Its seeds, Mustard and cotton cake were purchased from Swabi Market.

Preparation of oil seed cake

Oil seed cakes were obtained from Cotton (*Gossypium herbaceum* L.) and Mustard (*Brassica campestris* L.) and used to control root diseases and growth enhancement of tomato plants. Both these oil cakes (Cotton and Mustard) were dried, grinded in electric grinder and finally prepared 1% W/V, 3% W/V and 5% W/V solutions.

Soil used for seedling

Sandy loam soil with pH 8.0 taken from a trial field of the Botanical Garden, Department of Botany, Women University Swabi, Swabi, Pakistan was sterilized and used for tomato seedling.

Field Experiment

Field Experiment was performed in the Botanical Garden, Women University Swabi in completely randomized block design. The soil was having natural invasion of 0-5% colonization of *R. solani*, 1-8 sclerotia/g of soil of *Macrophomina phaseolina* and 4600 cfu/g soil of *F. solani*. Solution of cotton cake and mustard cake of 1% W/V, 3% W/V and 5% W/V were transferred from each concentration in sandy loam soil @1000ml /2 meters row, watered 2-3 days interval and let the organic matters to decompose. After two weeks of cotton cake and mustard cake

decomposition, Three week old equal sized tomato seedlings were transplanted in oilseed cakes treated experimental field. Each treatment was replicated 3 times with 12 seedlings of each replicate. Seedlings were planted at the edges of the experimental field and watered twice a week subject to the condition of soil moisture and weather. Seedling transferred into the untreated rows of experimental field served as control. Observations were noted after 45 days of transplantation. Three plants from each replicate were uprooted to check the Infection caused by pathogens and subjected for further process.

Root rotting fungi

To find out the frequency of fungal infection in root, nine plants rooted out from each treatment and were washed under tap water and sterilized with 1% bleach. Then the root is cut into five equal pieces of 1cm length and transferred on potato dextrose agar plats treated with penicillin (100,000 units / L and streptomycin (0.2g/ L). Incubated for five days at 28 °C, fungi appeared on root pieces after incubating period, were identified, infection and colonization percentage was calculated by following formula.

Infection % = No of plants infected by pathogen / Total No. of plants × 100

Colonization % = No of root pieces colonized by pathogen / Total No. of root pieces of all Plants × 100

Different growth parameters were also recorded.

Statistical analysis

The experiment was performed two times and data were recorded to analysis of variance (ANOVA). For growth parameter and fungal infection percentage were subjected to one-way ANOVA followed by the least significant difference LSD test at P=0.05. All analysis was performed using IBM-SPSS STATISTICS program [44].

Results and discussion

Field experiment

F. solani infection was completely controlled by the combine effect of mustard

and cotton cake at 1% MC + 5%CC, While significant maximum reduction in infection of *F. solani* found at 5%MC,5% CC, 1%CC+5%MC and 1%CC+3%MC. Application of mustard and cotton cake at 1%MC +1%CC showed complete suppression of *R.solani*. Significant reduction of *M. phaseolina* was recorded by the use of 3%CC, 5%MC, 5%CC, 1%MC+1%CC, 1%MC+3%CC, 1%MC+5%CC, 1%CC+5%MC. Complete suppression of *F. samitactum* and *B.cinerea* was found by 1%MC+5%CC while *B. cinerea* was also completely controlled by combine effect of mustard and cotton cake at 1%MC+3%CC. The combination of 1% CC+5%MC show equal and minimum reduction (11.11%) for all root rotting fungi (Table 1).

Greater plant height and weight was produced at 1%MC+5%CC, while all treatments (1% MC, 1%CC, 3%MC, 3%CC, 5% MC, 5%CC, 1% MC +1% CC, 1% MC +3% CC, 1% MC +5% CC, 1% CC +3% MC, and 1% CC +5% MC) enhanced plant height significantly (Figure 1) (Table 2).

Use of inorganic chemical to control root rotting fungi and plant parasitic nematodes is very effective but also caused soil pollution [45]. Application of bio-control agent is very effective and alternative method in the replacement of pesticides to control the root rotting fungi [46, 47].

In the current study, use of organic amendment such as cotton cake and mustard cake reduce *F. solani*, *R. solani*, *B. cinerea* and *M. phaseolina* infection on tomato plant. Organic amendment could kill pathogenic fungi and resulting in increased in yield. [48] Studied that organic amendments produced significant effect against disease of tomato produced by *Fusarium* specie. Use of mustard cake enhanced nutrients availability and plant uptake growth [49]. Present result indicates increase in growth parameters when cotton cake and mustard cake is coated to seeds, colonization percentage of *M. phaseolina* was observed less [50]. It suggested that

combine used of cotton and mustard cake to seed were found to be very effective in controlling infection of *M. phaseolina* on roots of plants. [51] Conducting field trial during Rabi season from 2001-2004 for management of wilt disease, induced by *Fusarium* through soil amendment with two oil cakes viz, cotton and mustard cake. The increase in length of plant due to organic manure also increases the fertility of soil [52, 53] observed that soil had significant effect when used with oil cakes

on seed germination and plant size. In the present study different growth factors of tomato plant were observed, the plant showed significant ($p < 0.05$) greater root and shoot length 12.47cm and 14cm respectively at the rate of 1%MC+5%CCw/w. Thus, amendment of soil with Cotton and Mustard cake was effective and enhanced the growth of tomato plant and also suppressed the pathogens compared to control.

Table 1. Effect of organic amendment on the infection% of root rotting fungi

Treatments	Infection %				
	<i>F. solani</i>	<i>M. phaseolina</i>	<i>R. solani</i>	<i>B. cinerea</i>	<i>F. samitactum</i>
Control	100.00	77.77	33.33	66.66	33.33
1%MC	55.55	44.44	22.22	33.33	55.55
1%CC	77.7	44.44	11.11	44.44	22.22
3%MC	55.55	66.66	44.44	44.44	22.22
3%CC	66.66	33.33	11.11	22.22	22.22
5% MC	11.11	11.11	22.22	11.11	11.11
5%CC	11.11	11.11	11.11	0.00	11.11
1% MC +1% CC	66.66	33.33	0.00	33.33	33.33
1% MC +3% CC	55.55	22.22	11.11	0.00	11.11
1% MC +5% CC	0.00	11.11	11.11	0.00	0.00
1% CC +3% MC	22.22	44.44	33.33	11.11	22.22
1% CC +5% MC	11.11	11.11	11.11	11.11	11.11
LSD _(0.05)	26.48	32.43	28.08	28.08	28.08

⁽¹⁾Mean values of treatments in columns show a difference in LSD values that are significantly different at ($p < 0.05$)

Table 2. Effect of organic amendments on the growth of Tomato plant

Treatment	Root length	Shoot length	Root weight	Shoot weight
Control	2.42	5.03	0.49	1.16
1%MC	3.57	6.20	0.66	1.60
1%CC	4.49	9.83	1.45	5.05
3%MC	4.05	8.00	1.38	3.44
3%CC	9.51	12.00	2.58	10.90
5%MC	6.03	10.33	2.02	5.46
5%CC	9.88	13.67	13.20	22.75
1%MC+1%CC	6.89	8.53	1.33	3.11
1%MC+3%CC	10.06	12.33	3.017	11.48
1%MC+5%CC	12.47	14.00	14.08	23.41
1%CC+3%MC	4.48	9.33	2.74	4.54
1%CC+5%MC	5.89	13.33	2.71	6.90
LSD _(0.05)	0.70 ⁽¹⁾	1.20 ⁽¹⁾	0.58 ⁽¹⁾	1.02 ⁽¹⁾

⁽¹⁾Mean values of treatments in columns show a difference in LSD values that are significantly different at ($p < 0.05$)

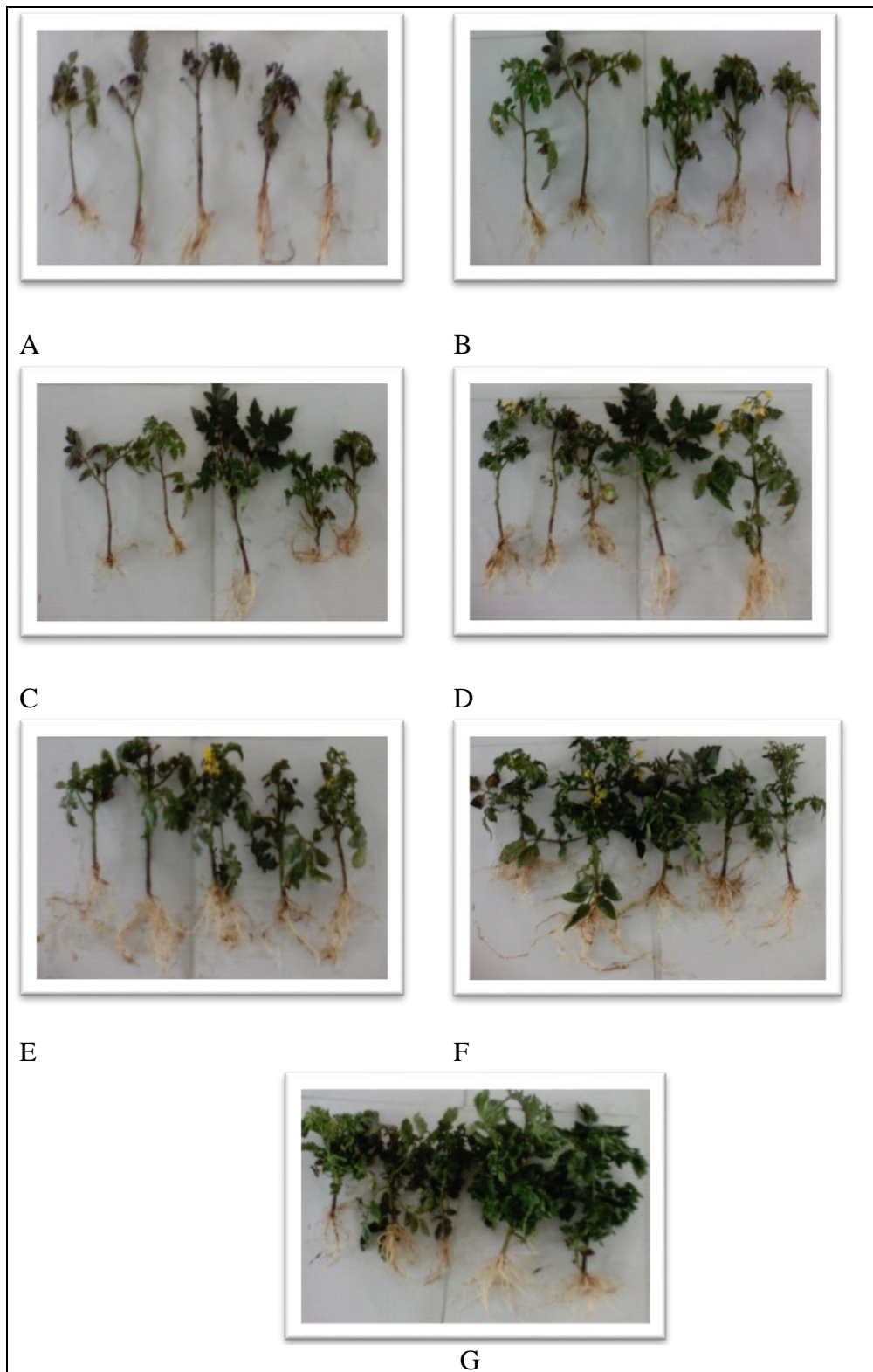


Figure 1. Combine effect of cotton and mustard cake on the growth of tomato plant. A = Control, B = 3% MC, C = 1% MC, D = 5% MC, E = 1% CC, F = 1% MC + 3 % CC, G= 1% MC + 5% CC

Conclusion

Mustard and Cotton oil cakes alone or mixed could be used as manure for management of soil-borne diseases and growth enhancement of tomato plant.

Authors' contributions

Conceived and designed the experiments: G Parveen, Performed the experiments: G Parveen, Analyzed the data: Kaleemullah Contributed materials/ analysis/ tools: G Parveen & MK Sheikh, Wrote the paper: G Parveen & N Mukhtar.

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