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Efficacy of organic amendments and plant extracts against tomato fruit rot

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Abstract
The efficacy of organic amendments *viz*., Farm Yard Manure (FYM), Decomposed coir pith, vermicompost, Neem cake, Ground nut cake, Pungam cake, Castor cake and Sesame cake. were tested against tomato fruit rot pathogens in PKM 1 variety under pot culture technique. Among them Neem cake @ 10 g/Kg of sterilized pot mixture recorded maximum plant growth (57.59 cm) and yield (1.66 Kg/ plant), with an incidence of 18.00 per cent over control. When the neem cake was combined with *T.v 3* the efficacy of neem cake was slightly increased which recorded the plant growth 57.70 cm, yield 1.68 Kg/ plant and disease incidence 15 percent over control. The efficacy of Neem cake was further amplified when it was combined with *P.f* 3 which recorded the maximum plant growth of 58.68 cm, yield 1.71 Kg/plant with the minimum disease incidence of 10 percent over control and considered to be the superior among the bio agents tested. To identify the antimicrobial property of plant products against tomato fruit rot pathogens an experiment was conducted with following plant products which are locally available *viz., Allium sativum, Allium cepa, Eucalyptus tereticornis, Prosopis juliflora, Pithecellobium dulse, Azadiractha indica, and Pongamia glabra*. The result indicated that the water extract prepared from *Allium sativum* at 10 per cent concentration recorded the maximum growth inhibition per cent against the fruit rot pathogens *viz., A.solani* (68.58 mm) *C.capcici* (69.49 mm) *Fusarium solani* (69.28 mm) and *P. capcici* (70.83 mm). Field trial was conducted on PKM 1 variety with the bulb extract of *Allium sativum* at 10 percent concentration sprayed at 15 days interval. The trial indicated that seven sprayings commencing from 30 DAP was found to be effective against tomato fruit rot pathogens which was recorded the plant growth of 54.00 cm, 1.42 Kg yield /plant and 20 per cent disease incidence over control. The cost benefit ratio in respect of *Allium sativum* bulb extract was 1:3.5 because of frequent spray and comparatively low yield than other treatments.

Keywords: Organic amendments, Plant extracts, Biocontrol agents, Tomato, Fruit rot

Introduction
Tomato is one of the most important economically grown vegetables in Asia. It ranks top in the list of industrial crops because of its exceptional processing qualities. Even through India is having fabulous potential in tomato cultivation, a high proportion of harvested fruits are being shattered before they reach the consumer due to various factors. Among these factors, tomato fruit rot is an important one which can cause huge yield loss both in field as well as in storage. Considering the high cost of chemical pesticides and their side effects, alternative methods such as using organic amendments and biological control of plant diseases have been suggested (Mulder, 1979) [20]. Chauhan, (1988) [4] reported that the fungicides applied at the time of sowing will not persist throughout in the cropping season of tomato hence, the biological control can be an alternate approach for managing plant diseases. Gasoni *et al*., (1998) [8] stated that the bacteria belonging to the genera of *Pseudomonas* sp and *Bacillus* sp were found to be effective against *Rhizoctonia solani* in tomato. Misagi *et al.,* (1990) [19] reported that the bacterial antagonist will colonize the tomato root and compete with the other pathogens for ecological niches in the rhizosphere. Kaushik *et al.* (2000) [11] reported that the fluorescent pseudomonads are ubiquitous soil microorganisms and common inhabitants of rhizosphere. Certain strains suppress the plant diseases by protecting the roots from infection by soil born pathogens. They play an important role in biological control of plant pathogens. Fluorescent pseudomonads dominate in the rhizosphere and posses several antifungal properties to inhibit the pathogens. Lazarovits *et al.* (2001) [15] reported that organic soil amendments and conditioners traditionally used by organic growers as a part of soil fertility programes also have potential against a variety of disease problems.

Lightly decomposed organic matter colonized by varied microflora is typically suppressive to diseases caused by *Pythium* spp. in container systems (Hoitink and Boehm, 1999) [9]. Adisa (1985) [1] reported that oils of coconut, groundnut, Palm kernel, will inhibit the spore germination of *Rhizopus oryzae, Curvularia lunata, Phoma sorghiana, Fusarium equisetti* (dry rot) in the laboratory condition. Fawcett and Spencer (1971) [7] emphasized the use of naturally occurring compounds, obtained from higher plants in controlling plant diseases in view of their low phytotoxicity. Malik *et al*. (2016) [16] reported that aqueous leaf extracts of *Allium sativum*, *Datura alba* and *Withania somnifera* at five per cent concentration inhibited the growth of *Alternaria alternata, A. brassicola* and *Myrothecium roridum*. Khan *et al*. (1998) [12] found that the aqueous extract of *Allium cepa* at ten percent concentration *exhibited* antifungal activity against *Helminthosproium turcicum* and *Ascochyta rabiei*. Tomato fruits with pre and postharvest inoculation with potassium iodide and *Thuja orientalis* extract did not display rotting symptoms (Khanna and Chandra, 1981) [13]. Prasad (1995) [22] reported that the leaf extract of *Datura fistulosa* and *Ocimum sanctum* at five per cent concentration reduced the soft rot of sponge guard fruit caused by *Fusarium scirpi.* With this background the present investigation was carried out to work out the efficacy of plant extracts and organic amendments both individually and in combination with biocontrol agents.

Materials and Methods

Evaluation of organic amendments combined with antagonists *in vivo.*

The superior fungal and bacterial antagonist (2.5 Kg / ha) combined with different organic amendments *viz.*, Farm yard manure (12.5t/ha), Neem cake (150 kg/ha), Decomposed coir pith (6.25t/ha), Vermi compost (6.25t/ha), Groundnut cake (150 kg/ha), Pungam cake (150 kg/ha) were tested under field condition by Randomized Block Design (RBD). The antagonists and organic amendments were applied by ridges and furrow method at recommended dose. In each treatment 12 plants per plot (2.5 m^2) were maintained with the recommended dose of fertilizer and spacing (60 x 45 cm). Periodical irrigation was provided based on need. In all the field experiments PKM 1 variety was used. Observations on plant growth yield and disease incidence were recorded in all field trials.

Evaluation of Plant extracts

The leaf extract of six plants as mentioned in table were evaluated for their antifungal activity against *Alternaria* solani, *Colletotrichum capsici, Fusarium solani*, and *Phytophthora capsici*.

S. No	Common name	Scientific name
1	Garlic	*Allium sativum*
2	Neem	*Azadiractha indica*
3	Eucalyptus	*Eucalyptus tereticornis*
4	Pungam	*Pongamia glabra*
5	Seemai karuvel	*Prosopis julifera*
6	Kodukka palli	*Pithecellobium dulse*
7	Onion	*Allium cepa*

Preparation of plant extracts (Cold water extract)

Fresh leaves of plant species were collected and washed with distilled water and then ground in a pestle and mortar by adding sterile distilled water at the rate of 1:1 W/V. The macerated solution was filtered through double layered cheese muslin cloth, followed by centrifuged at 10000 rpm for 10 min. The supernatant solution was used for further assay. This formed the standard plant extract solution (100 per cent). The plant extracts so prepared were heated at 40-50 ^{0}C in a water bath for ten minutes to avoid contamination (Jaganathan and Narashimman 1988) [10].

The inhibitory effect of plant extracts on mycelial growth was assessed by poisoned food technique (Bagachi and Das, 1968) [2]. Five ml of 100 percent extract was mixed with 45 ml of PDA medium to get ten per cent concentration. In each petridish, 15 ml of this mixture was poured and inoculated with 10 day old disc of pathogen. PDA medium without plant extract served as control. Then the plates were incubated for seven days at room temperature (28 ± 2^0 C). The percent inhibition of mycelial growth was calculated by using the formula described by Vincent (1927) [25].

$$I = \frac{(C-T)}{C} \times 100$$

Where
I=percent inhibition of mycelial growth or spore germination
C=Mycelial growth / spore germination in control
T= Mycelial growth/ spore germination in treatment.

Results and Discussion

It is evident that organic amendments check the further spread of soil born diseases because of its high antagonistic population. To boost the efficacy of organic amendments an experiment was conducted in PKM 1 variety with eight organic amendments individually and in combination with *T.v 3* and *P.f 3* separately. Among the organic amendments tested soil application of Neem cake @ 150 Kg/ha recorded significant result individually and in combination with fungal(*T.v3*) and bacterial antagonist (*P.f3)* which recorded maximum plant growth (57.59 cm) yield (1.66 Kg/ plant), with an incidence of 18.00 per cent individually over control. When it was combined with *T.v 3* the efficacy of neem cake was slightly increased which recorded plant growth (57.70 cm) yield (1.68 Kg/ plant), with an incidence of 15 percent over control. The efficacy of Neem cake was amplified further more when it was combined with *P.f* 3 which recorded maximum plant growth of (58.68 cm), yield (1.71 Kg/plant) with the minimum disease incidence of 10 percent over control and considered to be the superior among the bio agents tested. These results are identical with the results of other scientists also. Mayakrishnan (1990) [18] found that application of farm yard manure significantly reduced the incidence of Fusarial disease of tomato in the field. Chakrabarti and Sen (1991) [3] reported that the neem cake and mustard cake found to inhibit the growth of *Fusarium* wilt of muskmelon. Upadhyay *et al*, (1998) [24] reported that the oil cakes like mustard cake and neem cake were good source for the multiplication of *T. viride* and *T. harzianum*. Krishnamoorthy and Bhaskaran (1994) [14] found that addition of neem cake in to the soil induced the multiplication of *Trichoderma sp*. Oil cakes like ground nut cake and karanj cake was effective against *Thanatephorus cucumeris* which caused web blight of mung bean (Dubey and Patel, 2000) [6]. The benefit cost ratio in respect of Neem cake (150 Kg/ha), the individual application of neem cake recorded low yield than the other two combinations hence the CB ratio was reduced to 1:3.6 but when it was combined with *T.v*3 and *P.f*3 the benefit cost ratio was increased as 1:6.0 and 1:6.3

correspondingly due to low cost and higher yield. To identify the antimicrobial property of plant products against tomato fruit rot pathogens an experiment was conducted with *Allium sativum, Allium cepa, Eucalyptus tereticornis, Prosopis juliflora, Pithecellobium dulse, Azadiractha indica, and Pongamia glabra*. The result indicated that the water extract prepared from *Allium sativum* at 10 per cent concentration recorded the maximum growth inhibition per cent against the fruit rot pathogens *viz., A. solani* (68.58 mm) *C. capcici* (69.49 mm) *F. solani* (69.28 mm) and *P.capcici* (70.83 mm) followed by *Prosopis juliflora* which also recorded considerable growth inhibition 56.00, 62.11, 64.85, and 60.84 over control respectively. Prabakar, (1997) [21] reported that extract from *Adenocalyma alleaceum* and *Bougainvillea spectabilis* were very effective in controlling *Colletotrichum gloeosporoides* of mango. The aqueous leaf extracts of *Allium sativum*, *Datura alba* and *Withanea somnifera* at five per cent concentration inhibited the growth of *Alternaria alternata*, and *A. brassicola* in cruciferous plants (Devi *et al*., 2017) [5]. Among the 300 species of plants belonging to 43 families screened against *Botrytis cinerea*, five percent of garlic extract showed effective antifungal activity (Sesan *et al*., 2015) [3]. Based on these reports, the water extract of *Allium sativum* was used for further study because of its exceptional anti microbial property. The results of field trial indicated that seven spraying of *Allium sativum* at fifteen days interval commencing from 30 DAP was found to be effective against tomato fruit rot pathogens which was recorded plant growth of 56.00 cm, 1.42 Kg yield /plant and 20 per cent disease incidence over control.

Table 1: Effect of soil application of individual organic amendments under *in vivo.*

Organics (150 kg/ ha)	Plant growth 120th day* (cm)	Yield Kg / Plant*	Disease Incidence (%)*
FYM	54.47	1.56	39.00
Coir pith	50.76	1.11	56.00
Vermi compost	55.91	1.50	38.00
Neem cake	57.59	1.66	18.00
Ground nut cake	53.93	1.37	33.00
Pungam cake	54.40	1.42	37.00
control	39.86	0.68	71.00
CD(0.5)	1.05	0.02	0.83

Table 2: Effect of soil application of organic amendments with *T.viride* under *in vivo.*

Organics + T.v (150+ 2.5 kg/ha)	Plant growth 120th day* (cm)	Yield Kg/plant*	Disease Incidence (%)*
FYM+ T.V	56.34	1.59	35.00
Coir pith +T.V	52.09	1.27	47.00
Vermicompost+ T.V	54.21	1.43	34.00
Neem cake+ T.v	57.40	1.68	15.00
Ground nut cake+ T.V	52.94	1.39	31.00
Pungam cake+ T.V	52.72	1.49	34.00
Control	40.39	0.65	72.00
CD (0.5)	**0.99**	**0.03**	**3.12**

Table 3: Effect of soil application of organic amendments with *P. fluorescens* under *in vivo.*

Organics+ P.f(150+2.5 kg/ha)	Plant growth 120th day* (cm)	Yield Kg/ Plant*	Disease Incidence (%)*
FYM+ P.f	56.55	1.65	32.00
Coir pith +P.f	53.68	1.34	40.00
Vermi compost+ P.f	56.34	1.53	31.00
Neem cake+ P.f	58.68	1.72	10.00
Ground nut cake+ P.f	54.36	1.48	27.00
Pungam cake+ P.f	54.74	1.56	30.00
Control	41.03	0.71	69.00
CD (0.5)	1.03	0.03	3.17

Table 4: Effect of plant extracts against tomato fruit rot pathogens *in vitro*.

Treatments	*A. solani*		*C. capcici*		*F. solani*		*P. capcici*	
Plant extracts	Mycelial growth (cm)	Growth inhibition over control (%)	Mycelial growth (cm)	Growth inhibition over control (%)	Mycelial growth (cm)	Growth inhibition over control (%)	Mycelial growth (cm)	Growth inhibition over control (%)
Eucalyptus tereticornis	5.68	36.18	5.25	39.72	5.46	37.88	5.35	39.61
Allium sativum	1.55	82.58	1.96	77.49	1.03	88.28	0.99	88.83
Bougainvillea	5.25	41.01	4.12	52.69	4.84	44.94	4.95	44.13
Pithecellobium dulse	5.47	38.54	5.46	37.31	5.36	39.02	5.15	41.87
Prosopis julifera	3.91	56.00	3.30	62.11	3.09	64.85	3.47	60.84
Azadiractha indica	4.50	49.44	4.22	51.55	4.27	51.42	4.47	49.55
Pongamia glabra	4.62	48.08	4.64	46.72	4.33	50.74	4.94	44.24
Control	8.90		8.71		8.79		8.86	
CD (0.5)	0.22		0.21		0.24		0.23	

Table 5: Effect of spraying garlic bulb extract under *in vivo*.

Spraying garlic bulb extract 10% (DAP)	Plant growth 120th day (cm)	Yield Kg/plant	Incidence Over control (%)
30	50.00	1.00	54.00
30+45	51.67	1.10	52.00
30+45 +60	53.21	1.16	49.00
30+45+60+75	55.26	1.21	42.00
30+45+60+75+90	54.43	1.38	35.00
30+45+60+75+90+105	53.66	1.39	30.00
30+45+60+75+90+105+120	56.00	1.42	20.00
Control	39.00	0.70	71.00
CD (0.5)	0.95	0.04	2.02

DAP- Days after Planting

Through this study it is evident that using organic amendments inhibit the activity of pathogens and the efficacy of organic amendments is further improved by the addition of fungal and bacterial antagonists. Among the different plant extract tested against tomato fruit rot pathogens, the bulb extract from garlic was found to be effective. By combining all these effective methodologies we can control the fruit rot diseases of tomato in an effective manner.

References

1. Adisa S. Naturally occurring antioxidants in leaf lipids. incidence and infection rate of *Alternaria* blight. *Indian phytopath.* 1985; 46:321.
2. Bagachi D, Das E. Effect of some plant extracts on the spore germination of *Alternaria alternate.Pl. Dis.,* 1968; 14:75-77.
3. Chakrabarti SK, Sen Bineeta. Indian Phytopath. 1991; 44(4):467-479.
4. Chauhan GP, Gupta K. Proceedings if international conference on plant pathogenic bacteria. (Fifth). 1988; 79:388-391.
5. Devi K, Pavankumar P, Bhadraiah B. Antifungal activities of plant extract against postharvest fungal pathogens. Int. Jour. Curr. Microbiol and App. Sci. 2017; 6(1):669-679.
6. Dubey SC, Patel B. *In vitro* evaluation of some oilcakes and plant extracts against *Thanaeiphorus cucumeris.* J. mycol. pl. Pathol. 2000; 30: 411-413.
7. Fawcett D, Spencer K. Fungitoxic properties of some plant extracts against *Alternaria solani,* the tomato leaf blight pathogen. J. Ectomycology Environmental monitori, 1971; 10:157-159.
8. Gasoni J, Lawton K, Ruess W, Masner P, Specker. Incidence of *Pseudomonas fluorescens* in rhizosphere of tomato and their antagonism towards *R. solani*. *Indian Phytopath*. 1998; 43:358-361.
9. Hoitink HAJ, Boehm MJ. Biocontrol within the context of soil microbial communities: a substrate-dependent phenomenon. *Annu. Rev. Phytopathol*. 1999; 37:427-446.
10. Jaganathan S, Narashimman K. Poisoned food technique. Indust. Engin. Chem. Analyst, 1988, 361-363.
11. Kaushik JC, Sanjay Arya, Tripathi NN. *In-vitro* evaluation of fungal and bacterial antagonists against fungal pathogen causing damping-off in forest nurseries. Indian Forester, 2000; 126(8):885-889.
12. Khan TZ, Nasir MA, Bokhari SAA. Antifungal properties of some plant extracts and oilcakes. Pak. J. Phytopathol. 1998; 10:62-65.
13. Khanna KK, Chandra S. Evaluation of fungicides and antibiotics in the control of some leaf blight caused by *Alternaria alternata*. Indian. J. Mycol. and. Pl. pathol. 1981; 11:110-112.
14. Krishnamoorthy AS, Bhaskaran R. Effect of some soil drenching fungicides on growth and sporulation of Trichoderma *viride* and *Trichoderma harzianum* and *Laetisaria arvalis*. In *Crop disease: Innovative Techniques and Management*, Kalyani Publishers, Ludhiana. 1994, 517-519.
15. Lazarovits G, Tenuta M, Conn KL. Organic amendments as a disease control strategy for soil borne diseases of high-value agricultural crops. *Australasian Plant Pathology*, 2001; 30:111-117.
16. Malik A, Ahmad N, Babitha. plant extracts in post harvest management (disease and spoilage) offruits. Journal of humanities and social sciences. 2016; 2(1):5-12.
18. Mayakrishnan L. Biological control of *Fusarium* wilt of tomato caused by *Fusarium oxysporum f. sp. lycopersici* (Sacc.) Synder and Hansen, M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, India, 1990, 120.
19. Misagi IJ, Stowell LJ, Grogan Rg. Fungistatic activity of water soluble fluorescent pigments of fluorescent Pseudomonads. Phytopathology, 1990; 72:33-36.
20. Mulder D. Soil disinfestation. Elsvier Scientific Publication 10, Amsterdam, 1979, 368.
21. Prabakar K. Anthracnose disease of mango fruits caused by Colletotrichum Gloeosporoides. Ph.D. Thesis. Tamilnadu Agric.Univ., Coimbatore. India, 1997, 152.
22. Prasad TC. Antifungal activity of some naturally occurring flavanoids. Z. Pfkankh. Pflschutz, 1995; 92:392-395.
23. Sesan TE, Enache E, Iacomi BM, Oprea M, Oancea F. Antifungal activities of some plant extracts against Botrytis cenerea in balckcurrent crop. Acta Sci. Pol. Hortorum cultus. 2015; 14(1):30-49.
24. Upadhyay Pandey KK. Sensitivity of different fungicides to *Fusarium udum Trichoderma viride, and Trichoderma harzianum* for integrated approach of disease management. Veg. Sci. 1998; 25:89-92.
25. Vincent. A. laboratory method for testing the toxicity of protective fungicids. J. Pomol. Hort. Sci., 1927; 15:253-266.