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Effects of selected biological control agents and plant extracts on early blight disease management and yield of cherry tomato

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Abstract
The trial was conducted at the experimental research farm of Department Plant Pathology and Agricultural Microbiology, Mahatma Phule Krishi Vidyapeeth, Rahuri during the academic year of 2019-20. In the experiment of efficacy of selected biocontrol agents and plant extracts in disease management and yield of cherry tomato indicated that, all the biocontrol agents and plant extracts tested were found effective and thereby recorded significant reductions in the disease incidence and disease intensity, which consequently recorded significant increase in fruit yield. The significantly least disease incidence and intensity was recorded at 15 days after 3rd spraying with T_2, biocontrol agent *Trichoderma harzianum* (39.76% and 36.20% respectively) which is significantly superior over all treatments except recommended chemical followed by T_1, *Trichoderma viride* with disease incidence and disease intensity (40.53% and 38.45%) both were at par with each other. It was followed by T_3, *Pseudomonas fluorescens* (42.29% and 39.37%) and T_4, plant extract *Azadirachta indica* (43.38% and 40.31%) with disease incidence and disease intensity. Treatments T_1, T_3 and T_4, three were at par with each other. So overall out of the biocontrol agents and plant extract tested, T_2, biocontrol agent *Trichoderma harzianum* @5%was found most effective with highest percent control in the disease incidence and intensity to the tune of 22.21% and 21.17% respectively with significantly highest fruit yield of 42.04 t/ha followed byT_1, *Trichoderma viride* with percent control in disease incidence and intensity 19.94% and 19.54%with 38.87 t/ha fruit yield.

Keywords: Cherry tomato, Early Blight, Botanicals, *Trichoderma* spp, *Psuedomonas*.

Introduction
Tomato (*Lycopersicum esculentum*) belongs to the genus *Lycopersicon* under the Solanaceae family. Tomato is originated from Peruvian and Mexican region. It is the world's largest vegetable crop after Potato and Sweet potato, but it tops the list of canned vegetables. The Cherry tomato [*Solanum lycopersicum* var. *cerasiformae* (Dunnel) A. Gray] is a cultivated species of tomato. The variety generally considered to be similar but not identical to the wild relatives of the domestic tomato. They are becoming very popular in the retail chains and marked premium price compared to regular tomatoes. However, like domesticated tomato, cherry tomato crop is also infected by many fungal, bacterial, viral and abiotic diseases. Like early blight, late blight, wilt, Septoria leaf spot, tomato mosaic etc. Among all these diseases the fungal disease early blight caused by *Alternaria solani* (Ellis and Martin) (Jones and Grout) during all stages of plant growth. Early blight is one of the most destructive diseases affecting potato, tomato and other solanaceous plants like brinjal and pepper. The causal organism is air borne and soil inhabiting in nature. It is important foliar disease of tomato which causes destructive loss under both protected and open cultivated condition. This disease is most severe in *Kharif* season but it is also appearing throughout the year affecting the yield and quality of fruits. The characteristic symptoms of the disease are leaf spot which are generally dark brown to black, often numerous and enlarging and usually developing in concentric rings, which give the spots a target-like appearance. Lower, senescent leaves are usually attacked first, but the disease progresses upward and make affected leaves turn yellowish, become senescent, and either dry up or droop or fall off. Dark sunken spots develop on branches and stems of plants of tomato. Stem lesions developing on seedlings may form cankers, which may enlarge, girdle the stem, and kill the plant (Agrios, 5th edition, 2005) [3]. The yield losses reported are in the range of 48-50 percent due to early blight (*Alternaria solani*) damage in India, USA, Canada and Nigeria (Pandey and Pandey, 2002) [11]. In western Maharashtra early blight disease intensity ranges from 20.78 to 42.30%.
The disease is managed by the use of several conventional fungicides. But due to development of resistance in most of common pathogenic fungi against fungicides and also the factor of exposure risks, fungicide residues and human health hazards have given a push for obtaining alternatives to control *Alternaria solani*. It is necessary to adopt such control measures that are

ecologically sound and environmentally safe. The use of natural plant origin extracts and bio control agents is the best alternative to overcome the losses caused by the disease and to avoid the pollution hazards due to the fungicides.
Therefore, the present investigation is undertaken with an objective to study the efficacy of biocontrol agents and plant extracts in management of early blight of cherry tomato.

Materials and Methods

1. Disease management

1.1 Efficacy of selected biocontrol agents and plant extracts in disease management and yield of cherry tomato

The field experiment (Plate I) was conducted on farm of Department of Plant Pathology and Agri. Microbiology, Rahuri during *Kharif*, 2019 to evaluate the efficacy of selected biocontrol agents and plant extracts which were found most effective against *Alternaria solani*.
Thirty days old healthy seedling of cherry tomato Cv. Phule Jayashree grown on trays were transplanted on 17 August 2019 and the crop was raised as per recommended package of practices and drip irrigation was given as and when required.

1.2 Experimental details for field trial: Design of experiment: Randomized Complete Block Design, Number of replications: Three, Number of treatments: Eight, Variety: Phule Jayashree, Plot size: 1.5m ×8m, Spacing: 90cm×30cm.
Treatment details:

Table 1: Treatment details for field trail

Treatment No.	Treatment Details	Conc. (Spray)
T_1	*Trichoderma viride*	5g/lit. of water
T_2	*Trichoderma harzianum*	5g/lit. of water
T_3	*Pseudomonas fluorescens*	5g/lit. of water
T_4	Neem (*Azadirachta indica*)	10%
T_5	Tulasi (*Ocimum sanctum*)	10%
T_6	Zinger (*Zingiber officinale*)	10%
T_7	[Carbendazim (12%) + Mancozeb (63%) WP]	0.15%
T_8	Control	-----

Total of three spraying of all the treatments were undertaken at an interval of 15 days, starting first spraying at first appearance of early blight disease symptoms. One plot in each replication was maintained as unsprayed control without receiving any plant extract, and bioagent.

2. Observations

2.1 Effect of biocontrol agents and leaf extracts on disease incidence (%) and intensity (%) of early blight of cherry tomato.

The field observations on disease incidence and disease intensity will be recorded regularly at a scheduled interval. The plants of cherry tomato were observed daily for incidence of early blight under field condition. Disease incidence was recorded by observing the total number of leaves per plant and number of leaves infected per plant.

$$\text{Disease incidence (\%)} = \frac{\text{Number of plants showing disease symptoms}}{\text{Number of plants observed}} \times 100$$

The first observation was recorded on the same day of appearance of disease and subsequent two observations were recorded at an interval of 15 days. The final i.e., 4thobservation was recorded 15 days after 3rd spraying. Five plants per treatment per replication were selected randomly and tagged; three leaves (bottle, middle and top) from main branch on each observation plant were selected for recording the observations. As regard of disease intensity, three branches of each plant, one from top, one from middle and on from bottom were tagged for recording observations. From each branch six leaves were examined individually, and their intensity of disease was recorded separately. Observations on foliage were early blight disease incidence and intensity were recorded at 15 days after last spraying.
The observations were graded into 0-9 scale as described Mayee and Datar (1985) as given below:

Table 2: Rating scale (grade) used for disease intensity

Rating scale	Description
0	No symptoms on leaf.
1	Small, irregular spots covering 1 percent or less of the leaf area.
3	Small, irregular, brown spots with concentric rings covering 1-10 percent leaf area.
5	Lesions enlarging, irregular, brown with concentric rings covering 11-25 percent of the leaf area.
7	Lesions coalescing to form irregular brown patches with concentric rings. Coverings 26-50 percent of the leaf area. Lesions also on stem and petioles.
9	Lesions coalescing to form irregular, dark brown patches with concentric rings covering 51 percent or more of the leaf area. Lesion on stem and petioles.

Percent disease intensity (PDI) was worked out by applying following formula (McKinney, 1923).

$$\text{PDI} = \frac{\text{Summation of numerical ratings observed}}{\text{No.of leaves observed} \times \text{maximum grading/rating}} \times 100$$

2.2 Effect of biocontrol agents and plant extracts on fruit yield of cherry tomato

In the field experiment mature and ripen fruits were harvested regularly in all the treatments replicated and yield (t/ha) was calculated.

2.3 Statistical analysis

The data obtained in all experiments were statistically analysed (Panse and Sukhatme, 1978). The percentage values are transformed into arcsine values. The standard error (SE) and critical difference (CD) at 5% level of significance were worked out and results obtained were compared statistically.

Results and Discussion

1. Disease incidence of early blight disease of cherry tomato.

Results (Table 3) revealed that all the spray treatments significantly influenced the percentage early blight disease incidence recorded after each spray treatment in cherry tomato Cv. Phule Jayashree during *Kharif* 2019 season. The disease was found to appear first on 60th day after transplanting of the crop. The sprayings of different treatments were initiated when the disease incidence increased up to 22.31 to 30.25 percent.
After 1st spraying i.e. one day before second spraying observations were recorded. The disease incidence was ranged from 26.82% to 36.68 %as against 39.46% in unsprayed control. All the treatments were found significantly superior over unsprayed control. Significantly least disease incidence was recorded in T_7, 26.82% (Carbendazim (12%) +Mancozeb (63%) WP) which was superior over all biocontrol agents as well as plant extract treatments. Among

biocontrol agents and plant extracts next biocontrol agent T_1, *Trichoderma viride* with 31.98% disease incidence was recorded which was followed by T_2, *Trichoderma harzianum* (33.1%), both were at par with each other. Further treatment Plant extract T_4,*Azadirachta indica* showing (34.44%) least disease incidence after above treatments which is at par with T_2, *Trichoderma harzianum* (33.1%), T_6,*Zingiberofficinale* (35.13%) and T_3,*Pseudomonas fluorescens* (35.2%). Further treatment T_6, *Zingiber officinale* (35.13%) is at par with biocontrol agent T_3, *Pseudomonas fluorescens* (35.2%) as well as T_5, *Ocimumsanctum* (36.68%). Recommended chemical T_7, Carbendazim (12%) + Mancozeb (63%) WP and unsprayed control significantly different from all other treatments.

After 2nd spraying i.e., one day before third spraying observations were recorded. The disease incidence was found slightly increased over that of observed after 1st spraying and it was ranged from 30.43% to 41.86% as against 46.51% in unsprayed control. All the treatments were found most effective with significantly superior over unsprayed control. Recommended chemical T_7, Carbendazim (12%) + Mancozeb (63%) WP with least disease incidence (30.43%) was found significantly superior as well as significantly different from all other treatments. Among biocontrol agents and plant extracts T_2, *Trichoderma harzianum* was found most effective and statistically significant with least (36.28%) disease incidence and significantly superior over remaining treatments except recommended dose of chemical. Further second biocontrol agent T_1, *Trichoderma viride* (38.32%) followed by plant extracts T_4, *Azadirachta indica* (39.95%), T_6, *Zingiber officinale* (40.09%) and biocontrol agent T_3, *Pseudomonas fluorescens* (40.22%) disease incidence, four were at par with each other. The plant extract T_4, *Azadirachta indica* (39.95%) followed by plant extract T_6, *Zingiber officinale* (40.09%), biocontrol agent T_3, *Pseudomonas fluorescens* (40.22%) and plant extract T_5,*Ocimum sanctum* (41.86%) with disease incidence, four were at par with each other. Recommended chemical T_7, Carbendazim (12%) + Mancozeb (63%) WP and unsprayed control significantly different from all other treatments.

The disease incidence recorded at 15 days after 3rd last spraying was found decreased in progress of disease incidence and it was ranged from 28.78% to 46.75% as against 56.21% in unsprayed control. All the treatments were found significantly superior over unsprayed control. Recommended chemical T_7, Carbendazim (12%) + Mancozeb (63%) WP with least disease incidence (28.78%) was found significantly superior as well as significantly different from all other treatments. Among biocontrol agents and plant extracts statistically significant less disease incidence recorded with two biocontrol agents T_2, *Trichoderma harzianum* (39.76%) and T_1, *Trichoderma viride* (40.53%), both were at par with each other. Third best biocontrol agent was found T_3, *Pseudomonas fluorescens* (42.29%) which is followed by biocontrol agent T_1, *Trichoderma viride* (40.53%) as well as plant extract T_4, *Azadirachta indica* (43.68%) disease incidence, three were at par with each other. The plant extract T_4, *Azadirachta indica* (43.68%) which is followed by plant extract T_6, *Zingiber officinale*(44.52%) and biocontrol agent T_3, *Pseudomonas fluorescens* (42.29%) disease incidence, three were at par with each other. Plant extract T_6, *Ocimum sanctum* with maximum (46.75%) disease incidence is statistically less significant from all other treatments.

Average disease incidence and its percent disease control recorded with all spray treatments were ranged from 27.09% to 38.89% as against unsprayed control (42.82%) and 10.35% to 36.74%. Among biocontrol agents and plant extracts statistically significant least average disease incidence (33.31%) and its highest percent reduction (22.21%) was recorded with the biocontrol agent T_2, *Trichoderma harzianum*. This was followed by biocontrol agentsT_1, *T. viride* (34.28% and 19.94%), T_3, *Pseudomonas fluorescens* (35.82% and 16.35%) and plant extracts T_4, *Azadirachta indica* (36.30% and 15.23%), T_6, *Zingiber officinale* (36.98% and 13.64%) and T_5,*Ocimum sanctum* (38.89% and 10.35%) with average disease incidence respectively. Recommended chemical T_7, Carbendazim (12%) + Mancozeb (63%) WP showing average disease incidence (27.09%) and its highest percent reduction (36.74%) over all treatments as compared to control.

Similar results were obtained by Ankur Verma *et al.,* (2018) [5] reported that *Trichoderma harzianum* was most effective in disease severity (24.67%) followed by *Pseudomonas fluorescens* (25.33%), *Trichoderma viride* (31.33%), Datura leaf extract (32.67%), Neem leaf extract (36.67%) compare to treated and untreated control (20.33% and 40.33%) respectively.

Mitali Pattnaik *et al.,* (2012) [16] evaluated ten plant extracts on growth parameters and diseases, of *Lycopersicum esculentum*. Among the plant extract tested in field *Azadirachtaindica* reduced the early blight and leaf spot disease by 53.84% and 40.78% respectively.

2. Disease intensity of early blight disease of cherry tomato.

Results (Table 4) revealed that all the spray treatments significantly influenced the early blight disease intensity in cherry tomato Cv. Phule Jayashree. The disease intensity was recorded at first appearance of the disease (60 DAT) ranged from 22.84 % to 29.21 %.

After first spraying i.e., one day before second spraying observations were recorded. The disease intensity recorded was ranged from 24.85% to 35.70 % as against 38.13% in unsprayed control. All the treatments were found significantly superior over unsprayed control. The treatment of T_7, Carbendazim (12%) + Mancozeb (63%) WP with 24.85% disease intensity only, was found significantly superior over all biocontrol agents and plant extracts. Among biocontrol agents and plant extracts significantly least disease intensity was recorded with biocontrol agent T_1, *Trichoderma viride* (30.20%) showing least disease intensity and superior over remaining treatments which was at par with second biocontrol agent T_2, *Trichoderma harzianum* with 31.76% disease intensity. Further the treatment T_2,*Trichoderma harzianum* (31.76%) followed by plant extract T_4,*Azadirachta indica* (32.42%) and third biocontrol agent T_3,*Pseudomonas fluorescens* (33.46%) disease intensity, were at par with each other. Next plant extract T_4,*Azadirachta indica* (32.42%) followed by T_3, *Pseudomonas fluorescens* (33.46%) and T_6, *Zingiber officinale* (34.32%) disease intensity, were at par with each other. It is followed by plant extract T_6, *Zingiber officinale* (34.32%) which is at par with plant extract T_5, *Ocimum sanctum* (35.70%). Recommended chemical and unsprayed control significantly different from all other treatments.

After second spraying i.e., one day before third spraying observation were recorded. The disease intensity recorded was comparatively increased over that of observed after first spraying and was ranged from 26.33% to 39.96% as against 41.26% per cent in unsprayed control. All the treatments were

found significantly superior over unsprayed control. T_7, Carbendazim (12%) + Mancozeb (63%) WP with 26.33% disease intensity was found significantly superior over all biocontrol agents and plant extracts. Among the biocontrol agents and plant extract, statistically significant least disease intensity was recorded with two biocontrol agents *viz*., T_2, *Trichoderma harzianum* (34.45%) is most effective followed by T_1, *Trichoderma viride* (35.45%), both were at par with each other. Further biocontrol agent T_1, *Trichoderma viride* (35.45%) is followed by biocontrol agent T_3, *Pseudomonas fluorescens* (36.61%) and plant extract T_4, *Azadirachta indica* (37.35%) disease intensity, three were at par with each other. Further the plant extract T_4, *Azadirachta indica* (37.35%) is followed by remaining two plant extractsT_6, *zingiber officinale* (38.05%) and T_5, *Ocimum sanctum* (39.96%) disease intensity, three were at par with each other. Recommended chemical and unsprayed control significantly different from all other treatments.

The disease intensity recorded at 15 days after 3rd spraying and it was ranged from 23.84% to 43.74% as against 51.35% in unsprayed control. All the treatments were found significantly superior over unsprayed control. T_7, Carbendazim (12%) + Mancozeb (63%) WP with 23.84% disease intensity was found significantly superior over all biocontrol agents and plant extracts. Among the biocontrol agents and plant extracts statistically significant least disease intensity was recorded with the biocontrol agents T_2, *Trichodermaharzianum* (36.2%) which was found significantly superior over all treatments except recommended chemical, followed by biocontrol agent T_1, *Trichoderma viride* (38.45%) disease intensity, both were at par with each other. Further biocontrol agents T_1,*Trichoderma viride*, T_3, *Pseudomonasfluoresce* sand Plant extract T_4,*Azadirachta indica* showing disease intensity (38.45%, 39.37% and 40.31%) respectively, three were at par with each other. The plant extract showing minimum disease intensity was T_4, *Azadirachta indica* (40.31%) followed by plant extract T_6, *Zingiber officinale* (42.28%), both are at par with each other. The plant extract T_6, *Zingiber officinale* (42.28%) followed by T_5, *Ocimum sanctum* (43.74%) showing maximum disease intensity, both were at par with each other. Recommended chemical and unsprayed control statistically significant from all remaining treatments.

Average disease intensity and it's percent disease control with all the spray treatments were ranged from 23.79% to 36.81% as against 39.72% unsprayed control and 40.11% to 7.33%. Among biocontrol agents and plant extracts statistically significant least average disease intensity (31.31%) and its highest percent reduction (21.17%) were recorded with the biocontrol agent T_2, *Trichodermaharzianum*. This was followed by biocontrol agents T_1, *Trichoderma viride* (31.96% and 19.54%), T_3,*Pseudomonas fluorescens* (33.44% and 15.81%) and plant extracts T_4,*Azadirachta indica* (33.89% and 14.68%), T_6,*Zingiber officinale* (36.42% and 8.31%) and T_5,*Ocimum sanctum* (36.81% and 7.33%) with average disease intensity and percent reduction.

Similar results were obtained by Qayssar NZ *et al.,* (2014) conducted experiment to evaluate the effect of bioagents (*Trichoderma harzianum* and *Pseudomonas fluorescens*) and fungicide (Mancozeb) against early blight of tomato. Sahar Murmu *et al., (*2015) explained that among biocontrol agents *T. viride* was found effective in percent disease reduction (52.39%) of disease over control treatment and among plant extracts only neem leaf extract exhibited percent reduction of disease (33.18%) over control treatment in field condition and inhibition of radial growth (59.85%) and spore germination (81.95%) in *In vitro.* Yogita thakur *et al.,* (2017) [19] conducted field experiment against Alternaria leaf blight in mustard in which foliar spray of *Trichoderma harzianum* have shown most effective treatment.

3. Efficacy of selected biocontrol agents and plant extracts in yield management against early blight disease of cherry tomato.

Among the biocontrol agents and plant extracts, biocontrol agents were found most effective with maximum fruit yield, shown in (Table 5). Biocontrol agent T_2, *Trichoderma harzianum* was found most effective with statistically significant highest fruit yield (42.04t/ha) and highest increased (37.83%) in fruit yield over unsprayed control over all the treatment except recommended chemical T_7, Carbendazim (12%) + Mancozeb (63%) WP with highest fruit yield (49.56t/ha) and highest increased (62.49%) in fruit yield over unsprayed control. Further biocontrol agent T_1, *Trichoderma viride* is statistically significant after first treatment giving fruit yield (38.87t/ha) and increase in fruit yield by (37.83%) over unsprayed control. Further third biocontrol agent T_3, *Pseudomonas fluorescens* and plant extract T_4, *Azadirachta indica* with fruit yield (36.78t/ha and 35.76 t/ha) and increase in fruit yield by (20.59%and 17.34%), both were at par with each other respectively. This was followed by the treatments *viz.*, T_6, *Zingiber officinale* (33.47 t/ha and 9.74%) and T_5, *Ocimum sanctum* (32.58 t/ha and 6.81%) with fruit yield and percent increase in fruit yield, respectively over unsprayed control (30.50t/ha). Plant extract T_5, *Ocimum sanctum* also recorded significant reduction in disease and increased fruit yield over unsprayed control, but were found less effective as compared to rest of treatments. Thus, all the biocontrol agents and plant extracts were found effective against the early blight of cherry tomato and recorded significant increase in the fruit yield over unsprayed control during *Kharif* 2019 season

Plate 1: General view of Field Experimental Plot of Management of Early blight disease *Alternaria solani* on cherry tomato cv. Phule Jayashree *Kharif* 2019

Table 3: Efficacy of selected biocontrol agents and plant extracts against early blight disease incidence of cherry tomato in field condition

Tr. No.	Treatments	Conc.	Disease Incidence (%)*				Average disease incidence (%)	Percent disease control
			Before spraying	After first spraying	After second spraying	After third Spraying		
T_1	*Trichoderma viride*	5g/lit.	26.28 (30.84) **	31.98 (34.42)	38.32 (38.23)	40.53 (39.53)	34.28	19.94
T_2	*Trichoderma harzianum*	5g/lit.	24.10 (29.40)	33.1 (35.11)	36.28 (37.02)	39.76 (39.08)	33.31	22.21
T_3	*Pseudomonas fluorescens*	5g/lit.	25.55 (30.36)	35.2 (36.37)	40.22 (39.34)	42.29 (40.55)	35.82	16.35
T_4	*Azadirachta indica*	10%	27.12 (31.38)	34.44 (35.92)	39.95 (39.19)	43.68 (41.35)	36.30	15.23
T_5	*Ocimum sanctum*	10%	30.25 (33.37)	36.68 (37.27)	41.86 (40.30)	46.75 (43.12)	38.89	10.35
T_6	*Zingiber officinale*	10%	28.19 (32.1)	35.13 (36.33)	40.09 (39.27)	44.52 (41.84)	36.98	13.64
T_7	Carbendazim (12%) + Mancozeb (63%) WP	0.15%	22.31 (28.18)	26.82 (31.17)	30.43 (33.47)	28.78 (32.43)	27.09	36.74
T_8	Control		29.09 (32.64)	39.46 (38.90)	46.51 (42.98)	56.21 (48.55)	42.82	--------
S.E.±			--	0.355	0.384	0.369		--------
C.D. at 5%			NS	1.087	1.176	1.129		--------
C.V.			--	1.723	1.718	1.565		--------

*Mean of three replications. **Figure in parenthesis are arcsine transformed values.
Conc.: Concentration

Table 4: Efficacy of selected biocontrol agents and plant extracts in management of early blight disease intensity in cherry tomato in field condition.

Tr. No.	Treatments	Conc.	Disease Intensity (%)*				Average disease Intensity (%)	Percent disease control
			Before spraying	After first spraying	After second spraying	After third spraying		
T_1	*Trichoderma viride*	5g/lit.	23.72 (29.14)	30.20 (33.32)	35.45 (36.53)	38.45 (38.30)	31.96	19.54
T_2	*Trichoderma harzianum*	5g/lit.	22.84 (28.53)	31.76 (34.27)	34.45 (35.93)	36.2 (36.98)	31.31	21.17
T_3	*Pseudomonas fluorescens*	5g/lit.	24.3 (29.53)	33.46 (35.32)	36.61 (37.22)	39.37 (38.85)	33.44	15.81
T_4	*Azadirachta indica*	10%	25.49 (30.32)	32.42 (34.69)	37.35 (37.65)	40.31 (39.40)	33.89	14.68
T_5	*Ocimum sanctum*	10%	29.21 (32.72)	35.70 (36.68)	39.96 (38.69)	43.74 (41.39)	36.81	7.33
T_6	*Zingiber officinale*	10%	26.18 (30.77)	34.32 (35.85)	38.05 (38.07)	42.28 (40.54)	36.42	8.31
T_7	Carbendazim (12%) + Mancozeb (63%) WP	0.15%	20.15 (26.67)	24.85 (29.89)	26.33 (30.86)	23.84 (29.22)	23.79	40.11
T_8	Control		28.15 (32.04)	38.13 (38.12)	41.26 (39.95)	51.35 (45.76)	39.72	00
S.E.±			--	0.38	0.36	0.45	-----	-----
C.D. at 5%			NS	1.18	1.11	1.38	-----	-----
C.V.			--	1.91	1.71	2.00	-----	-----

Table 5: Efficacy of selected biocontrol agents and plant extracts in yield management against early blight disease of cherry tomato.

Tr. No.	Treatments	Conc.	*Fruit yield (t/hectare)	Percent yield increase over control
T_1	*Trichoderma viride*	5g/lit.	38.87	26.46
T_2	*Trichoderma harzianum*	5g/lit.	42.04	37.83
T_3	*Pseudomonas fluorescens*	5g/lit.	36.78	20.59
T_4	*Azadirachta indica*	10%	35.76	17.34
T_5	*Ocimum sanctum*	10%	32.58	6.81
T_6	*Zingiber officinale*	10%	33.47	9.74
T_7	Carbendazim (12%) + mancozeb (63%) WP	0.15%	49.56	62.49
T_8	Control		30.50	00
S.E.±			0.66	
C.D.			1.99	

*Mean of three replications, Conc.: Concentration

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