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Field Evaluation of Different Silicon Sources against Early Blight of Tomato (*Alternaria solani*)

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ABSTRACT

A field experiment was conducted at ZARS, GKVK, Bengaluru to evaluate the effect of different silicon sources against early blight of tomato.The PDI recorded from 15 to 90day after planting (DAP) at 15 days intervalsshowed that both silicic acid and orthosilicic acid @ 0.4 per cent reduced disease severityby 52.25 and 50.45 percent respectively which were on par with the chemical fungicide Mancozeb 75 WP @ 0.3 per cent (53.15). However, there was no difference between the two sources of silicon *viz.,* silicic acid and orthosilicic acid with respect to their performance in disease suppression.

TOMATO (*Solanum lycopersicum* L.) is growing in an area of 0.879 million hectare with a production of 18.22million tonnes and the productivity being 20.72 tonnes per hectare. The leading tomato growing states are Andhra Pradesh, Karnataka, Orissa, West Bengal, Maharashtra, Haryana, Uttar Pradesh, Punjab and Bihar. Karnataka, occupies area of 0.57 lakh hectares with a production and productivity of 19.16lakh tones and 33.15 tonnes / ha, respectively (Anon., 2013). Tomato crop is attacked by many serious diseases both under greenhouse and field conditions. Several important diseases of tomato include, early blight, caused by *Alternaria solani*, late blight incited by *Phytophthora infestans*, tomato leaf curl virus disease and tomato spotted wilt virus disease. Early blight disease isthe most devastating diseases next to late blight in the recent years. Since no commercially available cultivars have resistance to early blights, cultural practices and fungicides application at weekly intervals form the basis for their management programs (Tumwine *et al.,* 2002). Indiscriminate use of fungicides leadto development of fungicidal resistance, accumulation of residues in fruits, reduction of beneficial phylloplane and soil microbes besides environmental pollution are the associated problems (Akinnifesi *et al*., 2005). Environmental considerations have necessitated increasing restrictions on the use of pesticides and focus on environmental friendly production methods for plant disease suppression in the recent years. Hence, the present study aims to investigate the suppressive effect of silicon on early blight intensity in tomato.

The Field experiments for the evaluation of silicon sources were conducted at the ZARS, GKVK, Bengaluru during *Rabi* 2015-16. Twenty five day old tomato seedlings raised in portrays were transplanted to experimental plots with a row spacing of 60 cm and plant spacing of 45 cm. The experiment was laid out in randomized complete block design with three replications using variety NS 501. All recommended agronomic practices were followed. Two silicon sources *i.e.* silicic acid and orthosilicic acid were evaluated against early blight of tomato.

Treatmentdetails

T_1: Untreated control

T_2: Mancozeb 75 WP at 0.2 per cent at 15, 30 and 45 days after transplanting

T_3: Silicic acid @ 0.2 per cent @ 15, 30 and 45 days after transplanting

T_4: Silicic acid @ 0.4 per cent @ 15, 30 and 45 days after transplanting

T_5: Orthosilicic acid @ 0.2 per cent @ 15, 30 and 45 days after transplanting

T_6: Orthosilicic acid @ 0.4 per cent @ 15, 30 and 45 and after transplanting

$T_{7:}$ Mancozeb 75 WP @ 0.3 per cent @ 15 DAP and Silicic acid @ 0.2 per cent @ 30 and 45 days after transplanting

$T_{8:}$ Mancozeb 75 WP @ 0.3 per cent @ 15 DAP and orthosilicic acid @ 0.2 per cent @ 30 and 45 days after planting

The intensity of disease was recorded in each treatment following the score chart 0–9 scale proposed by Latha *et al*. (2009).

Scale	Description
0	Healthy
1	1-5 % of the leaf area infected
2	6-10 % of the leaf area infected
3	11-25 % of the leaf area infected
5	26-50 % of the leaf area infected
7	51-75 % of the leaf area infected
9	>76 % of the leaf area infected

Per cent disease index (PDI) was worked out using formula given by Wheeler (1969):

$$\text{PDI} = \frac{\text{Sum of all the numerical disease rating}}{\text{Total no. of leaves observed X Max disease rating scale}} \times 100$$

The data on PDI of early blight was recorded periodically from 15 to 90 days after planting (DAP) with an interval of 15 days (Table I and Fig 1. Plate 1 & Plate 2). It was found that in all treatments PDI increasedwith age of the plants. Data on disease severity showed that silicon sources tested reduced the disease intensity significantly compared to untreated control. The data recorded at 90 days after planting (DAP) revealed that Mancozeb 75 WP at 0.2 per cent recorded minimum PDI of 38.52 per cent followed by silicic acid @ 0.4 per cent (39.26 %), Orthosilicic acid @ 0.4 per cent (40.74 %), Mancozeb 75WP @ 0.3 per cent and orthosilicic acid 0.2 per cent (42.2 %), silicic acid @ 0.2 per cent (43.72 %), Mancozeb 75WP andsilicic acid @ 0.2 per cent (43.70 %), orthosilicic acid @ 0.2 per cent (44.44 %) compared to untreated control with PDI of 82.22 per cent. Among the treatments the greatest reduction of disease severity was achieved withsilicic acid @ 0.4 per cent (52.25 %) followed by Orthosilicic acid @ 0.4 per cent concentration (50.45 %), however, the least reduction was obtained when tomato plants were treated with orthosilicic acid @ 0.2 per cent (45.95 %).

The previous literature indicate significant and positive results of Si nutrition in reducing the intensity of economically important fungal diseases on barley, cucumber, corn, grape, rice, rye, strawberry and wheat (Datnoff *et al*., 2007). Silicon is regarded as an essential element for many plant species and demonstrated to inhibit various plant pathogens, e.g. *Magnaporthe oryzae* infecting rice (Rodrigues *et al*., 2004), *Blumeria graminis* f. sp. *tritici* infecting wheat (Belanger *et al*., 2003; Remus Borel *et al*., 2005) and *Podosphaera fuliginea* infecting cucumber (Menzies *et al*., 1991). The decrease in leaf blast severity by Si alone was equal to or greater than the fungicide edifenphos alone. The severity of neck blast decreased as effectively as or greater than the full rate of tricyclazole (Seebold *et al*. 2004). The findings of this study, in association with previous reports on other pathosystems, support the conclusion that early blight intensity can be reduced with the application of silicon which can be an alternate to the fungicides.

TABLE I

Effect of different silicon sources on early blight disease of tomato under field condition

Disease incidence	PDI (%) (15 DAP)	Reduction (%)	PDI (%) (30 DAP)	Reduction (%)	PDI (%) (45 DAP)	Reduction (%)	PDI (%) (60 DAP)	Reduction (%)	PDI (%) (75 DAP)	Reduction (%)	PDI (%) (90 DAP)	Reduction (%)
T_1	2.22(8.57)	0.00	15.56(23.19)	-	27.41(31.54)	-	44.44(41.78)	-	61.48(51.71)	-	82.22(65.54)	-
T_2	2.96(9.77)	-33.33	7.41(15.76)	52.38	13.33(21.29)	51.35	23.70(29.13)	46.67	29.63(32.98)	51.81	38.52(38.35)	53.15
T_3	2.96(9.77)	-33.33	8.15(16.55)	47.62	15.56(23.19)	43.24	28.15(32.04)	36.67	34.07(35.70)	44.58	43.70(41.36)	46.85
T_4	3.70(10.97)	-66.67	7.41(15.76)	52.38	13.33(21.37)	51.35	24.44(29.57)	45.00	30.37(33.43)	50.60	39.26(38.79)	52.25
T_5	2.22(8.57)	0.00	8.89(17.35)	42.86	16.30(23.80)	40.54	28.15(32.02)	36.67	34.07(35.68)	44.58	44.44(41.80)	45.95
T_6	2.22(8.57)	0.00	8.15(16.56)	47.62	13.33(21.42)	51.35	24.44(29.62)	45.00	32.59(34.80)	46.99	40.74(39.65)	50.45
T_7	2.22(8.57)	0.00	7.41(15.76)	52.38	14.81(22.62)	45.95	25.19(30.12)	43.33	34.07(35.67)	44.58	43.70(41.33)	46.85
T_8	2.96(9.77)	-33.33	8.15(16.47)	47.62	14.81(22.55)	45.95	25.93(30.52)	41.67	34.81(36.16)	43.37	42.22(40.51)	48.65
S. Em ±	0.85	-	0.90	-	1.08	-	1.37	-	1.45	-	2.04	-
C.D. at 5%	2.57	-	2.72	-	3.29	-	4.16	-	4.41	-	6.18	-

T_1: Untreated control; T_2: Mancozeb 72 WP @ 0.3 %; T_3: Silicic acid @ 0.2 %; T_4 Silicic acid @ 0.4 %; T_5: Orthosilicic acid @ 0.2%;

T_6: Orthosilicic acid @ 0.4%; T_7: Mancozeb 72 WP @ 0.3 + Silicic acid @ 0.2 %; T_8: Mancozeb 72 WP @ 0.3 + Orthosilicic acid @ 0.2 %.

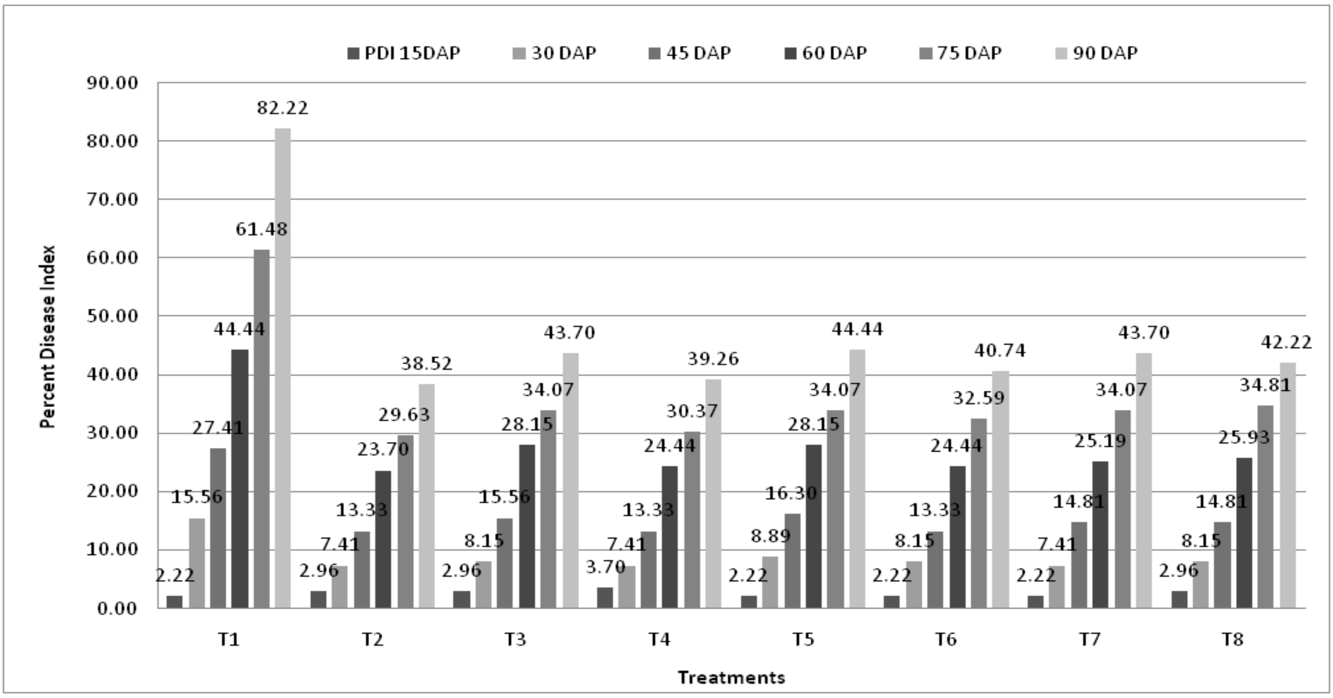

Fig 1. Effect of different silicon sources on early blight disease of tomato under field condition

T_1: Untreated control;
T_2: Mancozeb 72 WP @ 0.3 % ;
T_3: Silicic acid @ 0.2 % ;
T_4 Silicic acid @ 0.4 % ;
T_5: Orthosilicic acid @ 0.2%;
T_6: Orthosilicic acid @ 0.4% ;
T_7: Mancozeb 72 WP @ 0.3 + Silicic acid @ 0.2 % ;
T_8: Mancozeb 72 WP @ 0.3 + Orthosilicic acid @ 0.2 %.

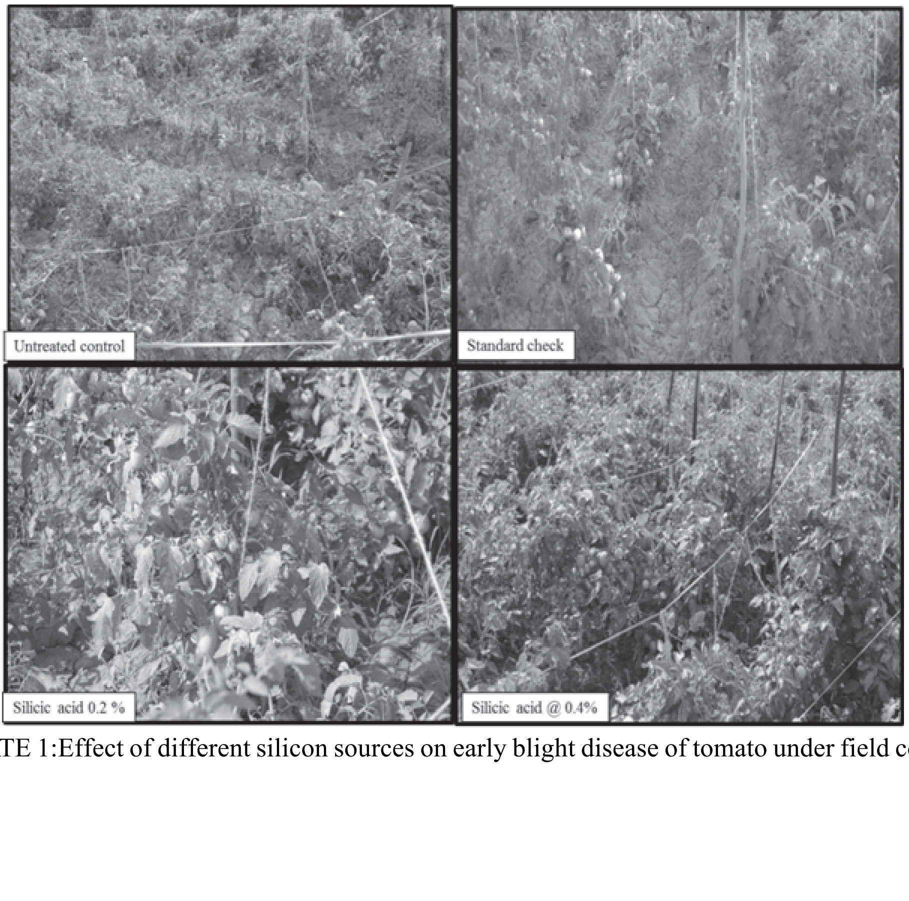

PLATE 1:Effect of different silicon sources on early blight disease of tomato under field condition

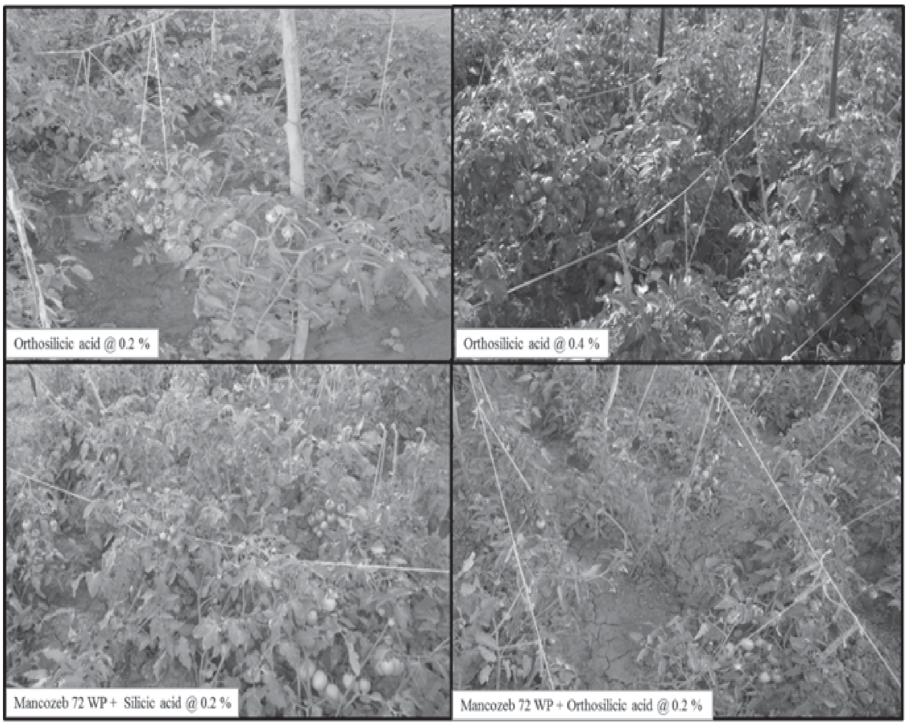

PLATE 2:Effect of different silicon sources on early blight disease of tomato under field condition

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