

Bioefficacy and phytotoxicity study of Fosetyl Al 80 WP on tomato seedlings against the damping off disease

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Abstract

Damping-off is a widely distributed and devastating disease causing severe seedling damage to nursery grown vegetable crops. The present study was undertaken to evaluate different doses of fosetyl-Al 80 WP against damping-off disease of tomato under field conditions in two consecutive seasons *i.e.*, 2014-15 and 2015-16. The pooled data indicated that fosetyl-Al 80 WP @ 3g/l provided the best disease control (85.37%) amongst all the treatments against untreated control. In addition, it has increased the dry root mass and plant height by 39.1 and 64.86%, respectively above the untreated control. Application of fosetyl-Al 80 WP was not phytotoxic on tomato seedlings up to the dose of 12g/l.

Key words: Bioefficacy, phytotoxicity, Fosetyl Al 80, damping off disease

Introduction

Tomato (*Solanum lycopersicum*) an important vegetable crop gained a considerable importance due to its acid sweet taste and unique flavour in global market. Tomato provides nutrient components like vitamins, carbohydrates, minerals, protein, water and roughages, which is essential for a balanced diet. In addition, it also helps to forestall prostate cancer due to the presence of a tetraterpene 'lycopene' (Lee et al. 2011). In India, 18.73 million tonnes of tomatoes are produced from an area of about 0.77 million ha during 2015-16 (Anon 2017a). However, the productivity of tomato suffered due to the onslaught of several biotic factors. 'Damping off' of tomato seedlings, at the nursery stage, caused by a pathogen complex of *Pythium*, *Fusarium* and *Rhizoctonia* (Lucas et al. 1997) is widely distributed

throughout the world. Among them *P. aphanidermatum* is a predominant cause of the disease as it thrives under warm conditions (Saha et al. 2011). Phosphonates, esters of phosphonic acid, generally are known to control plant diseases caused by *Phytophthora* spp. (Vawdrey et al. 2004; Panicker et al. 1999) and downy mildew pathogens (Panicker et al. 1999). Their efficacy against *Pythium* spp. (Abbasi et al. 2005) also has been described. Various salt-based formulations of phosphorus acid and its esters have been used as agricultural fungicides. One such fungicide, fosetyl-Al (also known as efosite aluminum) was registered in 1977 (Guest et al. 1991) and is reported to be effective against *Phytophthora* spp. when used as a soil drench (El-Hamalawi et al. 1995; Farih et al. 1981). However, there is no published record on their use as a soil drench against damping off in tomato. The objective of this study was to investigate the efficacy of fosetyl-Al as a soil drench treatment to control damping-off of tomato under field conditions.

Materials and Methods

The trial was conducted in nursery conditions at ICAR-Indian Institute of Vegetable Research at Varanasi, Uttar Pradesh, India for two consecutive kharif seasons (2014-15 and 2015-16) during first fortnight of October. Five treatments includes fosetyl Al 80% WP @ 2 g/L, 2.5 g/L and 3 g/L, an untreated control and a standard check fungicide, mancozeb 75% WP @ 3 g/L. Five replications of each treatment were maintained in the randomized block design (RBD). In each of the sick plots 100 seeds of tomato of variety Kashi Vishesh treated with 0.01% HgCl₂ (mercuric chloride) were sown. Nursery soil drenchings twice were done *viz.* the first one seven days after germination and the second one at fourteen days after first application. The plants were at 4-5 leaf stage. The untreated control plot was drenched with water only. Observations on number of infected seedlings, healthy seedlings, plant height and dry root mass of tomato were taken ten days after second drench

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at the time of transplanting. For plant height and root mass of tomato seedlings, twenty five plants were selected randomly from each replication. Mean of each parameter was observed and pooled mean of the same were taken for a logical conclusion. All the data obtained were statistically analyzed. For phytotoxicity observations, the tomato seedlings were treated with the fosetyl-Al @ 2.5, 3.0, 6.0 and 12g/l doses. Observations on phytotoxicity such as malformation, leaf injury, wilting, necrosis, epinasty and hyponasty were recorded from each plot at 0, 1, 3, 5, 7 and 10 days after application (DAA). The maximum and minimum temperature were 37.8°C and 21.5°C respectively while the relative humidity and total rainfall recorded were 79.2% and 70.2 mm respectively during the period of trial.

Results and Discussion

Damping-off disease occurs primarily in moist soils in the field where young seedlings of direct-seeded crops were killed before or soon after they emerge. It is a major constraint for nursery grown vegetable crops. In the trial conducted, all chemical treatments (Fosetyl Al 80 WP and mancozeb 75 WP) were significantly superior to untreated control. Fosetyl-Al 80 WP manifested an

increased control of the disease as compared to untreated check at all the doses. Ten days after the second drenching, the test fungicide gave the best control @ 3g/L where the pooled mean number of infected seedlings per 100 cm² was 14.22 as compared to untreated control value of 44.65 and the corresponding pooled mean number of healthy seedlings per 100 cm² were 56.02 and 36.22 respectively (Table 1). Fosetyl-Al 80 WP @ 2.5g/L gave the second best control which was at par with the check fungicide mancozeb 75 WP@ 3g/L. Thus, fosetyl-Al 80 WP @2.5 and 3g/L manifested a percent disease control of 56.39 and 68.15 respectively over untreated control. The plant height and dry root mass of fosetyl-Al 80 WP treated plants were also superior to that of untreated control. A plant height of 21.35 cm and 20.4 cm were observed in case of fosetyl-Al 80 WP @ 3g/L and 2.5g/L, respectively, while the corresponding values for dry root mass were 12.7g and 11.6 g, respectively (Table 2). The plant height and dry root mass of untreated control were 17.15 cm and 9.13 g, respectively.

Fungicides of the benzimidazole group *viz.* thiophenate methyl and carbendazim have been reported to control damping-off of tomato but the disease was predominantly caused by *Rhizoctonia solani* (Jiskani et

Table 1: Effect of different treatments of fosetyl-Al 80 WP on number of infected seedlings and healthy seedlings with damping off of tomato

Treatments	Dose (g/L)	Mean number of infected seedlings				Mean number of healthy seedlings			
		2014-15	2015-16	Pooled mean	Percent decrease over control	2014-15	2015-16	Pooled mean	Percent increase over control
Untreated control	-	39.3	50	44.65	-	23.7	36.75	30.22	-
Fosetyl Al 80 WP	2.0	16.7	35	25.85	42.10	36.0	52.75	44.37	46.82
Fosetyl Al 80 WP	2.5	12.7	26.25	19.47	56.39	46.0	58.5	52.25	72.90
Fosetyl Al 80 WP	3.0	11.7	16.75	14.22	68.15	48.3	63.75	56.02	85.37
Mancozeb 75 WP	3.0	16.7	26.25	21.47	51.91	36.7	52.75	44.75	48.08
CD (0.05%)		1.29	2.88		-	2.54	3.62	-	-
SEm ±		0.43	1.01		-	0.85	1.27	-	-
CV		7.52	12.48			7.24	8.73		

Table 2: Effect of different treatments of Fosetyl-Al 80 WP on dry root mass and plant height of tomato

Treatments	Dose (g/L)	Mean dry root mass (g) per 25 seedlings				Mean plant height (cm)			
		2014-15	2015-16	Pooled mean	Percent increase over control	2014-15	2015-16	Pooled mean	Percent increase over control
Untreated control	-	9.23	9.03	9.13	-	12.7	13.2	12.95	-
Fosetyl Al 80 WP	2.0	11.2	9.75	10.47	14.67	17.1	17.2	17.15	32.43
Fosetyl Al 80 WP	2.5	12.8	10.4	11.6	27.05	21.2	19.6	20.4	57.52
Fosetyl Al 80 WP	3.0	13.7	11.7	12.7	39.10	21.5	21.2	21.35	64.86
Mancozeb 75 WP	3.0	11.4	11.13	11.26	23.32	16.5	17.8	17.15	32.43
CD (0.05%)		0.77	0.34			1.19	0.63		
SEm ±		0.26	0.12			0.40	0.22		
CV		2.73	4.29			3.46	4.65		

*all the readings in Table 1 and 2 were noted ten days after the second drenching

al. 2007). Copper oxy chloride also was effective in controlling the *Rhizoctonia solani* incited damping-off of tomato (Satija and Hooda 1987). Dimethomorph treated seeds and soil was also able to ward off this disease in tomato caused by *Phytophthora nicotianae* var. *nicotianae* (Washington and McGee 2000) but the information regarding the role of phosphonates and salts of phosphoric acid in the control of the disease was lacking. Abbasi and Lazarovits (2006) reported that treatment of cucumber seeds with AG3 phosphonate solution significantly enhanced their survival compared with untreated controls when planted into a *Pythium aphanidermatum*-infested peat-based mix or a muck soil naturally infested with *Pythium* spp. and the efficacy of phosphonate seed-soak was better than that of phosphonate post-planting drench. In this study, soil drenching with fosetyl-Al 80WP at different doses such 2.5, 3.0, 6.0 and 12.0 g/l did not produce any kind of phytotoxicity on tomato seedlings. Although application of phosphonates through seed treatment is easy and cost effective, phytotoxicity to seeds of individual plant species can occur and the mode of action of phosphonates in seed application is yet to be understood. Soil drenching of fosetyl-Al @2.5-3g/L in the present study gave a good control against damping-off disease infected tomato seedlings and it corroborates to the findings of Farih *et al.* (1981) where it gave a good control of citrus root rot when applied as a soil drench. The mode of action of phosphonates is unknown (Anon, 2017b) but induction of plant defense responses have not been ruled out (Guest *et al.* 1990, 1991). The plant height and dry root mass of treated tomato plants were also higher than untreated control and the increase in weights of tomato plants was probably due to disease control as experienced in case of cucumber (Abbasi and Lazarovits 2006). From this study it is inferred that, fosetyl-Al 80WP is effective in managing the damping off disease in tomato.

Conclusion

Fosetyl-Al@ 2.5-3 g/L as a soil drench manifested significantly higher per cent control of damping off of tomato, and may be recommended for the management of the disease in tomato with subsequent inclusion in the Good Agricultural Practices (GAP) of tomato.

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सारांश

नर्सरी में पौध तैयार कर उगायी जाने वाली सब्जियों में पद गलन ज्यादा स्तर पर विनाशकारी बीमारी लगती है। वर्तमान अध्ययन टमाटर में पद गलन बीमारी के लिये फोसेटिल-एएल 80 घुलनशील पाउडर का प्रयोग प्रक्षेत्र दशा में लगातार दो वर्षों 2014-15 व 2015-16 में किया गया। समूहीकृत आंकड़ों से संकेत मिलता है कि फोसेटिल एएल 80 घुलनशील पाउडर की 3 ग्राम/लीटर मात्रा के प्रयोग से सभी शोधनों व अशोधित नियंत्रक की तुलना में बीमारी नियंत्रण (85.37 प्रतिशत) पाया गया। इसके अतिरिक्त इससे शुष्क जड़ भार व पौध ऊँचाई 39.1 व 64.86 प्रतिशत अशोधित नियंत्रक की तुलना में पाया गया। फोसेटिल एएल 80 घुलनशील पाउडर के 12 ग्राम/लीटर के छिड़काव से टमाटर के नर्सरी पौधों पर नुकसानदायक प्रभाव नहीं पाया गया।

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