Effect of Seed Priming with Some Plant Leaf Extract on Seedling Growth Characteristics and Root Rot Disease in Tomato

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Abstract: Tomato is one of the important vegetable crops. The problem of seedling establishment is found in tomato due to several soil borne diseases. One of them is root rot caused by *Fusarium oxysproum*. There are many chemical methods available to control this disease, but use of chemicals deplete the soil micro-environment and causes soil and water pollution and also do not fit within the framework of 'Organic farming'. Seed priming with certain phytochemicals may be an economic and ecofriendly alternative to such chemicals. In present study we primed tomato seeds with leaf extract of six different plants (White musale, Periwinkle, Neem, Wood apple, Lantana and White cedar). Different leaf extracts of dose of 2% was taken independently for seed priming. We found that priming with White musale, Periwinkle, Neem and wood apple leaf extract had an improvement in different seed and seedling growth parameters in presence of pathogen. Priming with Lantana and white cedar leaf extract showed a reduction in some of the parameters that may be due to allelopathic nature of these plants. Seed priming with leaf extract of Wood apple exhibited maximum survival rate (76.50 %) followed by Neem (68.46 %) and White Musale (52.60 %).

Keywords: Fusarium oxysporum; plant extracts; seed priming; seedling vigour; tomato

1. Introduction

Tomato is an important vegetable crop. Production of tomato is greatly affected by different diseases. One of the many diseases is root rot in tomato causes by *Fusarium oxysproum*. It is a soil born fungus found especially in warm regions. The organism is specific for tomato and is very longlived in soil (Suárez-Estrellaet *et al*., 2004). Various methods are tried to control this disease organically. Seed priming with phytochemicals can also be a method to increase the seed vigour of seeds and can improve performance of seeds in presence of pathogen.

The rationale of seed priming is to lessen the time between planting and emergence and to protect seeds from biotic and abiotic factors during critical phase of seedling establishment and to synchronize emergence, which leads to uniform stand as well as improved yield (Krishnaswami and Srimarthi, 2001). Priming is controlled hydration technique and enhances seed performance by increasing germination rate and uniformity resulting in faster and better seedling development in various crops (Powell *et al*., 2000, Afzal *et al*., 2008). Leaves of the plant contain alkaloids and phenolic compounds which protect the plants against pathogens and also produce antioxidant activity (Satish *et al*., 2007). In the present study we use leaf extracts from six different plants for priming and emphasized on the improvement in germination, seedling growth and survival of seedling in presence of *Fusarium oxysproum*.

2. Materials and Method

2.1 Plant Material

Present study was carried out using tomato seeds var. Money Maker. The fresh leaves of the White Musale (*Chlorophytum borivillianum*), Periwinkle (*Vinca rosea*), Wood apple (*Aegle marmelos*), Neem (*Azadirachta indica*), White cedar (*Melia azedarach* L) and Lantana (*Lantana camara*) were collected and dried separately under shade.

2.2 Preparation of Leaf Extracts and Dose Standardization

Leaf extract was prepared using cold extraction method. The dried leaves were powdered using electric grinder. First we standardize the dose of medicinal plants leaf extract. For this 1%, 2% and 4% solutions from the respective leaf powder were made in single distilled water. These solutions were kept at 30^0C temperature for 48 hours. After 48 hours the leaf extracts were filtered by two layer of muslin cloth to remove unwanted material and leaf debris. Seeds were soaked independently in different leaf extracts at room temperature for four hours. After soaking seeds were air dried and put on towel paper for germination test. The seeds primed with 2% and 4% solution of leaf extract showed better results than 1%, however difference between priming with 2% and 4% leaf extract were not pronounced therefore we used 2% leaf extract for further experiment.

2.3 Assessment of Various Growth Parameters

Pot experiment was conducted to assess the effect of seed priming on disease suppression. The soil was inoculated with 500mg/kg inoculums of *Fusarium oxysporum*. Three controls were taken for the experiment, (1) Positive control where the seeds were treated with fungicide and the soil was inoculated with pathogen, (2) Negative control where the seeds were not given any treatment but the soil was inoculated with pathogen and (3) Normal control where neither the soil was inoculated nor the seeds were treated.

2.4 Data Analysis

Observations on germination percentage, speed of germination, germination value, root length, shoot length, fresh weight,

dry weight, mortality rate were recorded and seedling vigour I and II were calculated. The data was statistically analysed using ANOVA to calculate the magnitude of F value.

3. Results and Discussion

In the present study seed priming with different plants extract showed significant increase in different parameters over control. Seed priming with *Chlorophytum* extract was found best among all the treatments for different morphological and physiological parameters Maximum speed of germination was observed with the seed primed with *Chlorophytum* with 76.89% increase over control (Figure 1). Improved Germination percentage was recorded in all the treatments. Germination percentage ranged from 68 to 90% (Table 1). Neem leaves shows a moderate effect on the germination and seedling growth in comparison to other treatments.

This increase in speed of germination and germination percentage may be due to the modification of physiological and biochemical nature of seed embryo and its associated structures, i.e. pre –enlargement of the embryo (Austin *et al*., 1969) and biochemical changes like enzyme activation, Gibberellins like substances (Lee and Kim, 2000, Basra *et al*., 2005) may release during the II phase of germination which triggers the synthesis of hydrolytic enzymes that causes the early availability of high energy compounds and vital biomolecules to the germinating seedling (Renugadevi and Vijayageetha, 2006).

Maximum seedling length, Dry weight, seedling vigour I and seedling vigour II were found for treatment T1 followed by T3 (Table 1). The increase in dry weight was claimed to be due to enhanced lipid utilization and enzyme activity due to the presence of bioactive substances in the leaf extracts (Rathinavel and Dharmalingam, 1999) and development of seedling to reach autotropic stage and enabling them to produce relatively more quantity of dry matter which discerning the cause for the hike in vigour index by hardening treatment. It is generally assumed that the active constituents which are contributing to these anti-fungal properties

Table 1. Effect of seed priming on various seedling growth parameters and disease suppression in pot experiment.

Treatments	Speed of germination (plant /Day)	Germination percentage	Seedling length (cm)	Fresh weight (gm)	Dry weight (gm)	Seedling vigour I	Seedling vigour II	Mortality (%)
White Musale	8.65	90.83	10.30	0.57	0.06	481.75	5.62	47.33
Periwinkle	7.52	84.17	9.97	0.46	0.06	418.88	4.64	56.33
Wood apple	6.03	88.33	10.26	0.58	0.06	464.61	5.59	23.33
Neem	6.32	88.33	9.96	0.54	0.06	437.56	5.11	32.67
White cedar	4.68	89.17	9.34	0.59	0.05	476.35	4.16	58.00
Lantana	4.80	76.67	10.73	0.61	0.05	439.25	3.58	63.67
Control	5.54	71.67	8.75	0.44	0.04	340.75	2.74	35.55
Positive control	8.33	93.33	10.33	0.54	0.05	497.92	4.98	12.67
Negative control	4.89	68.33	7.16	0.40	0.03	146.65	2.16	70.67
cd at 5%	1.0102	4.74	0.80	0.12	0.01	71.88	1.02	5.46

of the extracts are phyto-chemicals. Physiologically active substances might have activated the embryo and other associated structures which resulted in the absorption of more water due to cell wall elasticity and development of stronger and efficient root system and that would have ultimately resulted in higher vigour index (Rangaswamy *et al*., 1993). Many researchers also reported the benefits of seed hardening with different medicinal plants leaf extract to overcome the adverse condition (Renugadevi *et al*., 2008; Kamaraj and Padmavathi, 2012).

Decline in speed of germination observed when the seeds were primed with *Melia* and *Lantana* (Figure 1). Ahmed *et al*. (2007) found in their experiment that different concentrations of aqueous leaf extracts of lantana caused significant inhibitory effect on germination, root and shoot elongation and development of lateral roots of receptor crops. The inhibitory effect was much pronounced in root and lateral root development rather than shoot and germination. Same results were reported by Phuwiwat *et al*. (2012) when studying the allelopathic effect of *Melia* leaves on the germination and seedling growth of barnyard grass. They found that both, water uptake and α-amylase activity of *E. crus-galli* were inhibited. It was concluded that leaves of *M. azedarach* contained water soluble allelochemicals and caused inhibition of both water uptake and α-amylase activity of *E. crus-galli* during germination process.

The maximum decrease in mortality rate was observed in the seeds primed with wood apple (66.99%) followed by neem (53.77%) (Table 1, Figure 2). *Chlorophytum* leaves are high in saponin, carbohydrate, proteins and various alkaloids (Chakraborty *et al*., 2014). Leaves of *Vinca rosea* are also high in alkaloids and phenolic compounds (Tiong *et al*., 2013). Neem leaves contains flavonoids, steroids, carbohydrates, glycosides, antiquinone, terpenoides and alkaloids (Raphael, 2012). Alkaloids, phnenolic and saponins compounds protect the plants against pathogens and also produce antioxidant activity. Sharma and Trivedi (2002) reported growth inhibition (72.0%) of *Fusarium oxysporum* f. sp cumini with the extract

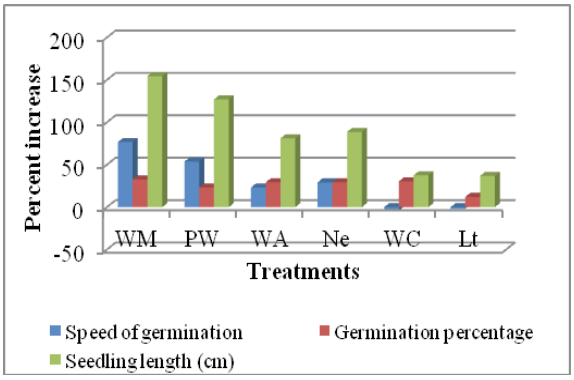

Figure 1: Increase in the different seedling growth parameters over negative control. WM- White Musale, PW-Periwinkle, WA- Wood apple, Ne- Neem, WC- White cedar and Lt- Lantana. Decrease in speed of germination observed in the seeds primed with white cedar and lantana.

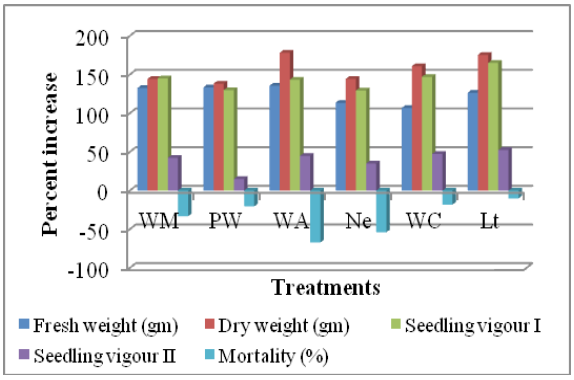

Figure 2. Increase in different planting value parameters over negative control. WM- White Musale, PW-Periwinkle, WA- Wood apple, Ne- Neem, WC- White cedar and Lt- Lantana. Minimum mortality rate was observed when the seeds were primed with leaf extract of wood apple.

of *D. stramonium*. Anti-oxidant properties scavenges the free radical activity thereby improves the germination. Saponins are readily soluble in water which may enhance the nutrient absorption (Satish *et al*., 2007).

4. Conclusion

We can conclude from the above findings that seed priming with 2% leaf extract of *Chlorophytum, Agel, Azadirachta* and *Vinca* were found suitable to enhance seedling vigour and reduce mortality rate in presence of *Fusarium oxysporum* in tomato. *Lantana* and *Melia* shows a reduction in some of the physiological characters but even they could improve the seed vigour in tomato. Seed priming with these plant leaf extract is cost effective and easy to apply at farmer's field and is suitable under 'Organic farming' framework. More research is needed to understand the physiological and biochemical changes occur due to seed priming from the leaf extract of medicinal plants.

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