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Screening of Tomato (*Solanum lycopersicum* L.) Varieties against Damping off Disease under the Climatic Conditions of Batticaloa District, Sri Lanka

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Abstract: Damping off is a typical issue in tomato nursery beds in all over the world which affects the cultivation and cause significant losses to farmers. Concerning the elimination of chemical pesticide applications in agriculture, cultivation of disease resistant varieties as a preventive measure for control this disease is highly desirable. In this aspect, an experiment was carried out at the Eastern University, Sri Lanka during the period of April to May 2017 to find out the level of resistance of tomato varieties against damping off disease under the climatic conditions of Batticaloa district, Sri Lanka. Five tomato varieties namely *Thilina*, *K. C. 01*, *Rajitha*, *Money Maker* and *Platinum 701 F1* were selected for the experiment and laid out in a Completely Randomized Design (CRD) with three replications. Among these varieties tested, significantly highest germination percentage ($p<0.05$) was recorded in *Platinum 701 F1* and the least was in *Thilina.* The highest disease severity and infection percentage were registered in *Thilina* and *Money Maker* whereas the least values were witnessed by *Platinum 701 F1* and *Rajitha.* Therefore, *Platinum 701 F1* and *Rajitha* can be suggested to the farmers as resistant varieties for damping off disease especially for the cultivation of tomato under the climatic conditions of Batticaloa district, Sri Lanka. Hence, these resistant varieties can be used to improve the quantity and quality of the yield while reducing the negative impact of chemicals on human health as well as on environment.
Keywords: Damping off, Disease resistance, Disease severity, Germination percentage, Infection percentage, Tomato

INTRODUCTION

Beside the rice cultivation, vegetable cultivation is the most salient agricultural sector in Sri Lanka. Plenty of farmers are engaged in vegetable farming throughout the country and it is one of the principle sub-sectors contributing a lot to the Sri Lankan economy.

Tomato (*Solanum lycopersicum* L.) is one of the most essential and widely cultivated vegetable crops grown in Sri Lanka. Inspire of the fact that tomato is being an important cash crop for medium scale commercial farmers [1] the average productivity of tomato under Sri Lankan conditions (11 t ha $^{-1}$) is much lower than the world average production (24 t ha^{-1}) [2]. Diseases are being a major limiting factor for world-wide tomato production. The diseases caused by microorganisms that include fungi, bacteria, viruses and nematodes are infectious and if environmental conditions are conducive, swift spread of these diseases can be observed. Crop losses due to these diseases tend to be greatest in tropical countries where the environmental conditions are particularly favourable and income from crop cultivation in these countries is being low [3]. Among the diseases caused by microorganisms, soil borne diseases can be a major constraint to crop production, particularly for vegetables. It is an authentic challenge for farmers to control these diseases even with the conventional approaches [4]. Among the soil borne diseases, damping off of seedlings threatens tomato production by killing large number of seedlings [5] and as the infection is usually not lethal it reduces the plant growth and the quality and quantity of yield. This is a common issue in tomato nurseries which leads to patches in nursery beds and the affected plants are generally found in scattered areas. It has the potential to cause severe significant loss in tomato production. This disease is caused by several species of *Fusarium, Pythium, Rhizoctonia* and *Verticilliu*, and is widely distributed throughout the world [6]. They can cause the disease either as a single pathogen species or as group of pathogen species. Occasionally, the association of species of *Botrytis, Cylindrocladium* and *Diplodia* have also been detected with damping off diseases [7].

The most important general strategies for management of plant diseases include crop resistance, cultural methods, physical methods, pesticides and regulation. Among the traditional methods used to protect crops from diseases, chemotherapy is largely practiced to eradicate the infection [8]. Even though the pesticides hold credits including intensified economic potential, its debits have drastic effects on consumers as well as environment. It has not only the risk of poisoning humans and animals, contaminating livestock

and other food products, damaging the environment and polluting the atmosphere but also leaves harmful residues that lead to evolution of resistant strains of infectious microorganisms [9]. In this scenario, disease resistance of crop varieties can be exploited to solve this contemporary issue or to prevent a disease spread. Cultivation of disease resistant varieties is effective, economical and safer and it is the most important tool in Integrated Disease Management [10]. In such manner proper variety selection and protection of tomato seedlings from the attack of damping off is an important prerequisite for higher yield and quality [11]. However, there has been lack of information regarding resistance to damping off in locally available tomato varieties in Batticaloa district. Therefore, the present study was undertaken with five varieties of tomato to find out the resistant varieties under the climatic conditions of Batticaloa district, Sri Lanka.

MATERIALS AND METHODS

Description of the Experimental Site

A pot culture experiment was conducted at Eastern University, Sri Lanka which is located in the latitude of 70° 43' N and the longitude of 81° 42' E at an elevation of 7.8 m above mean sea level. It belongs to the agro ecological region of low country dry zone in Sri Lanka and the soil type is sandy regosol. The temperature of this area ranges from 30°C to 32°C and the mean annual rainfall ranges from 1400 mm to 1680 mm. The experiment was carried out during the period of 5th of April to 5th of May, 2017.

Collection of Sick Soil

A tomato nursery bed with damped off seedlings was identified in the Agronomic farm of Eastern University, Sri Lanka and infected soil from the diseased nursery was collected and immediately transported to the Agricultural Biology Laboratory.

Pot Culture

Small sized garden trays with holes were used for this experiment and trays representing the different varieties were filled with 4 kg of sick soil. Seeds of different tomato varieties were sown in the garden trays separately to raise seedlings. Seeds were sown at a depth of 2-3 cm and covered with a fine layer of soil followed by light watering by small sized water can. Each garden tray contained three rows and each row had 5 seedlings.

Experimental Design

The experiment consisted of five different varieties (*Thilina, K. C. 01, Rajitha, Money Maker* and *Platinum 701 F1*) and laid out in a Completely Randomized Design (CRD) with three replications.

Data Gathered

Germination Percentage: The data related to percentage germination calculation was gathered after the emergence of seedlings. This was calculated using the following formula.

$$\text{Germination Percentage} = \frac{\text{No. of seeds germinated}}{\text{No. of seeds sown}} \times 100\%$$

Percentage Infection: Seedlings with the disease symptoms were counted and the percentage infection was calculated using the following formula.

$$\text{Percentage Infection} = \frac{\text{No. of damped off seedlings}}{\text{Total number of germinated seedlings}} \times 100\%$$

Disease Severity: This was evaluated and calculated using the following formula and an erratic scale below.

$$\text{Percentage Severity} = \frac{0n0 + 1n1 + 2n2 + 3n3 + 4n4}{N\,(4)} \times 100\%$$

0n0, 1n1, 2n2, 3n3, 4n4 - Number of test plants showing a rating of 1, 2, 3, 4 respectively.
N - Total number of the test plants emerged/germinated.
4 - The highest rating scale.

Scale : Description

0: No infection (Healthy seedlings)
1: 1 - 25% of seedlings showing girdled stem near soil line.
2: 26 - 50% of seedlings showing girdled stem near soil line.
3: 51 - 75% of seedlings showing girdled stem near soil line.
4: Above 75% of seedlings showing girdled stem near soil line and/ or damped off seedlings.

Statistical Analysis

Proc. PROBIT was done for the analysis of these non-parametric data and necessary mean separation was adopted using the procedure suggested by Conover [12].

RESULTS AND DISCUSSION

Germination Percentage

According to the results, there was a significant difference ($p<0.05$) among the tomato varieties used on germination percentage (Table 1). Among the varieties, germination percentage of the variety *Platinum 701 F1* was significantly higher (93.3%) than that of other four varieties. This was followed by the variety *Money Maker* which germination percentage was on par with the germination percentage of *Rajitha* and *K. C. 01* and the mean germination percentages were 68.9%, 57.8% and 55.6% respectively. The least percentage germination was recorded in *Thilina* as 13.3%.

Percentage Infection

The experiment results revealed that there was a significant difference ($p<0.05$) among the tomato varieties used on percentage infection (Table 1). *Thilina* was found to have the highest mean percentage infection with 47.2%. This was followed by a statistically comparable result obtained from the variety *Money Maker* with a mean percentage of 45.3% and the *Platinum 701 F1* depicted the lowest percentage infection with 32.8% which was statistically identical with the percentage infection of *Rajitha* (34.0%).

Disease Severity

Results on disease severity showed that there was a significant difference ($p<0.05$) among the tomato varieties used (Table 1). The variety *Thilina* recorded the highest disease severity with 23.1% and the variety *Money Maker* showed a mean disease severity of 22.8% which was statistically similar to *Thilina*. This was followed by *K. C. 01*, *Rajitha* and *Platinum 701 F1* which were statistically identical with a disease severity of 17.4%, 16.1% and 15.2% respectively.

Table-1: Germination percentage, damping off infection percentage and disease severity of five tomato varieties

Variety	Germination Percentage	Percentage Infection	Disease Severity
Thilina	13.3c	47.2a	23.1a
K. C. 01	55.6b	39.3b	17.4b
Rajitha	57.8b	34.0c	16.1b
Money Maker	68.9b	45.3a	22.8a
Platinum 701 F1	93.3a	32.8c	15.2b

Values with the same letter within the same column are not significant ($p=0.05$).
Values are the means of 45 plants in 3 replications.

The results revealed that among the five tomato cultivars tested in the present study, the resistant varieties for damping off disease are *Platinum 701 F1* and *Rajitha* whereas *Thilina* and *Money Maker* are found to be the susceptible varieties. *K. C. 01* seems to be moderately resistant to this disease.

CONCLUSIONS

It can be concluded that among the tested varieties *Platinum 701 F1* and *Rajitha* are found as resistant and *K. C. 01* variety is moderately resistant. This study also confirmed that *Thilina* and *Money Maker* are the susceptible varieties for damping off under the climatic conditions of Batticaloa district in Sri Lanka.

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