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Effect of Various Mycorrhizae-based Products on Growth and Phytotoxicity Characteristics of Potato (*Solanum tuberosum* L.) cv. Kufri Sindhuri

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Authors' contributions

This work was carried out in collaboration among all authors. Authors Trivikram and BKS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author BKS guided the author Trivikram during the whole research period. Author AKT edited the manuscript. Authors AKS and PKS managed the analyses of the study. Author AKT managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Mycorrhiza refers to the symbiotic association between fungus and plant root. The arbuscular mycorrhizal symbiosis auguments the growth and plant resistance to biotic and abiotic stresses by enhancement through certain nutritional, biochemical, physiological as well as morphological plant responses thus it has gained a high degree of impetus in recent years. In this context, a study was conducted to study the effect of various mycorrhizae based products on growth and phytotoxicity characteristics of potato (*Solanum tuberosum* L.) cv. Kufri Sindhuri during Rabi 2016-17 at Vegetable research farm, Department of Horticulture, Institute of Agricultural Sciences, BHU, Varanasi to evaluate the effect of various mycorrhizal products at different concentrations on growth and phytotoxicity characteristic of potato. The field experiment consisted of 8 treatments involving different mycorrhizal products including the control (untreated). From the experiment it

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was found that soil application with Myc100 at 250 g/ha (treatment T_2) had very promising results for the investigated characters viz., number of leaves/hill (62.20), Plant height at 30 Days after planting (65.40 cm), Plant height at 60 Days after planting (98.24 cm) as compared to other treatment followed by T_8- soil application with Bolt Gr at 10 kg/ha. The maximum number of haulms per plant was observed in treatment T_6- soil application with Rhizomyxo 100 at 250 g/ha (4.35). No symptoms of phytotoxicity was observed in all treatments during crop growth.

Keywords: Growth; mycorrhiza; phytotoxicity; Solanum tuberosum L.

1. INTRODUCTION

Potato (*Solanum tuberosum* L.) is considered as a major tuber vegetable crop in many parts of the world and is mostly grown under tropical/subtropical and temperate region of India. The productivity of potato is low in India because of various factors, deficiency or imbalance use of nutrients. To promote yield, potato require a steady phosphorus, potassium and other micronutrients. AM fungi forms symbiotic associations with the roots of most plant species and help them in the uptake of nutrients especially those immobile in soil like phosphorus (P). In addition to the enhanced plant mineral nutrition, AM fungi can also stimulate plant growth regulating substances, increase photosynthesis, improve osmotic adjustment under drought stress, increasing resistance to pests and tolerance to environmental stresses (e.g., drought and salinity) and improving soil properties [1]. Inoculation with AM fungi at very early stages (e.g., at seed sowing) has been found to result in higher crop uniformity, reduced transplant mortality and higher yields after transplantation to the field. The mycorrhiza fungi colonize plant roots and enhanced host plant growth and mineral nutrient acquisition [2]. In order to improve plant growth, the benefits from a mycorrhizal association must be accompanied by a stimulation of photosynthetic carbon uptake that will at least compensate carbon lost to the fungus. It is generally assumed that enhancement of photosynthetic rates results from increased level of leaf phosphorus [3]. Keeping in view the above facts, the present investigation was carried out with different mycorrhizae-based products (as a soil drench) to study their effects on growth and phtotoxicity characteristic of potato.

2. MATERIALS AND METHODS

The experiment was carried out during Rabi season 2016-17 at Vegetable Research Farm of Department of Horticulture, Institute of Agricultural sciences, B.H.U., Varanasi (U.P.) in Randomized Complete Block Design (RBCD) with 3 replication with a spacing 60 cm between row and 15 cm between plant. Experiment consisted of two application of eight treatment of different products of mycorrhiza at different concentrations at 20 and 50 days after planting. The cultivar used in the experiment was kufri sindhuri. The mycorrhizal products included in the study are T_1- Control (without mycorrhiza), T_2- soil application with myc100 at 250 g/ha, T_3- soil application with myc100 at 500 g/ha, T_4- soil application with RhizoMyco100 at 250 g/ha, T_5- soil application with RhizoMyco100 at 500 g/ha, T_6- soil application with RhizoMyxo100 at 250 g/ha, T_7- soil application with RhizoMyxo100 at 500 g/ha, T_8- soil application with Bolt Gr. at 10 kg/ha. The observations were recorded on five randomly selected plants and data were statistically analysed using ANOVA of SAS statistical data analysis software. Duncan's multiple range tests was used to determine the most significant treatment. Symptoms like, leaf injury; stunting and wilting; epinasty and hyponasty; yellowing; vein clearing; and necrosis etc. considered as phytotoxicity and were recorded at 30 and 60 DAS.

Table 1. Phytotoxicity observation scale

Scale	% Crop affected
0	No phytotoxicity effect
1	1-10
2	11-20
3	21-30
4	31-40
5	41-50
6	51-60
7	61-70
8	71-80
9	81-90
10	91-100

3. RESULTS AND DISCUSSION

3.1 Number of Leaves/Hill

With respect to number of leaves/hill, treatment effects were found to be statistically significant

for number of leaves per hill and the maximum value was recorded by treatment T_2 –soil application with myc 100 @ 250 g/ha at 15-20 DAT (62.20), while the treatment T_1- untreated control registered minimum number of leaves (54.60). Increased number of leaves was noticed due to the fact that the photosynthetic capacity of plant as normal and any disorder free leaves have greater potential for carbohydrate production. This result was in accordance with the work of Chen et al. [4], Rodriguez et al. [5] and Kumar et al. [6].

3.2 Number of Haulms/Plant

A significant increase in the number of haulms per plant was recorded, due to increased absorption of nutrient such as phosphorus, copper, iron zinc. The maximum number of haulms per plant was observed with the treatment T_6 soil application with Rhizomyxo 100 @ 250 g/ha at 15-20 DAT (4.35), followed by T_8 soil application with Bolt Gr @ 10 kg/ha at 15-20 DAT (4.22) , T_2 soil application with myco100 @ 250 g/ha at 15-20 DAT (3.92), while minimum number haulms registered in treatment T_1 – untreated control (3.16) These results are in accordance with the finding of Ghosh and Das [7] and Kumar et al. [6].

3.3 Number of Leaves/Hill

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3.4 Number of Haulms/Plant

A significant increase in the number of haulms per plant was recorded, due to increased absorption of nutrient such as phosphorus, copper, iron zinc. The maximum number of haulms per plant was observed with the treatment T_6 soil application with Rhizomyxo 100 @250 g/ha at 15-20 DAT (4.35), followed by T_8 soil application with Bolt Gr. @ 10 kg/ha at 15-20 DAT (4.22), T_2 soil application with myco100 @ 250 g/ha at 15-20 DAT (3.92), while minimum number haulms registered in treatment T_1- untreated control (3.16) These results are in accordance with the finding of Ghosh and Das [7] Kumar et al. [6].

3.5 Plant Height at 30 and 60 Das (cm)

The increased plant height is due to increase nutrient uptake due to mycorrhiza, which made normally unavailable nutrients available to plants. Mycorrhiza also made available sufficient water quantity in plant by absorbing it through root from soil. Increased supply of nutrients mainly resulted

Table 2. Effect of various mychorrhizal products on number of leaves per hill, number of haulms per hill, plant height (at 30 and 60 DAS) and phytotoxicity on potato

Treatment	Number of leaves/hill	Number of haulms/hill	Plant height (cm)	Plant height (cm)	Phytotoxicity
			30 Days	60 Days	
T1 Control	54.60	3.16	58.30	91.20	0
T2 Myco100 @ 250 g/ha	62.20	3.92	65.40	98.24	0
T3 Myco100@ 500 g/ha	55.00	3.69	64.12	96.12	0
T4 RhizoMyco100 @ 250 g/ha	56.73	3.82	64.27	97.00	0
T5RhizoMyco100 @ 500 g/ha	56.53	3.47	62.00	65.60	0
T6 RhizoMyxo100@ 250 g/ha	58.73	4.35	64.01	95.87	0
T7 RhizoMyxo100 @ 500 g/ha	61.80	3.26	63.73	95.13	0
T8 Bolt Gr. @ 10 kg/ha	61.27	4.22	63.87	95.60	0
SE(d)	1.21	0.28	1.310829	1.42118	0
CD at 5%	2.59	0.60	2.811448	3.048128	0

in proper cell division and cell elongation, leading to increased height as compared to control. After 30 days of sowing, maximum plant height T_2 (65 cm) soil application with myco100 @ 250 g/ha at 15-20 DAT. While, minimum plant height was noticed in treatment T_1 - untreated control (58.30 cm). Plant height after 60 DAS, revealed that similar trend in increase was found, where maximum plant height was observed in treatment T_2 soil application with myco100 @ 250 g/ha at 15-20 DAT, followed by T_4 soil application with with RhizoMyco 100 @ 250g /h at 15-20 DAT (97 cm), while lowest plant height (91.20 cm) was found in treatment T_1 - untreated control. These results are in conformity with the findings of Edathil et al. [8] on tomato; Ghosh and Das [7]; Sajan et al. [9], Mahatam et al. [10], Alfonso and Galan [11] and Utkhede [12] on tomato; El-Haddad and Awad [13], Oseni et al. [14], Borca and Puia [15] on tomato and Kumar et al. [6] on potato.

3.6 Phytotoxicity

There were no any symptoms of phytotoxicity like, leaf injury; stunting and wilting; epinasty and hyponasty; yellowing; vein clearing; and necrosis was seen in any of the treatments during all the stage of crop growth.

4. CONCLUSION

The results thus reveal that all the mycorrhiza-based products have shown significant potential for good vegetative growth over the untreated treatment thus stressing the importance of symbiotic organisms in crop growth and resistance towards the stresses.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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