USE OF *TRICHODERMA* ENRICHED BUTTON MUSHROOM SPENT SUBSTRATE (TEBMSS) FOR ENHANCING YIELD AND QUALITY OF KINNOW MANDARIN

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ABSTRACT

The left over compost after harvesting full or remunerative crop of button mushroom is generally called as spent mushroom compost (SMC). An investigation was carried out at Integrated Farming Systems unit of Project Directorate for Farming Systems Research, Modipuram, Meerut, India, during 2013-14 to evaluate the alternative use of SMC for mass multiplication of *Trichoderma harzianum* and its further evaluation in the form of *Trichoderma* enriched button mushroom spent substrate (TEBMSS) for enhancing growth and yield parameters of potential fruit crop Kinnow mandarin. One month old *Trichoderma* enriched button mushroom spent substrate (TEBMSS) was applied in root zone of Kinnow @ 25 kg/plant in the month of April (flowering/fruiting stage). Uninoculated plants were treated as control. The cfu of *T. harzianum*, which was in the range of 10^4/g substrate at starting (0 day), reached 8.72 x 10^6/g substrate at the end of 4th week. It indicates better growth and sporulation of *T. harzianum* in the SMC. In Kinnow, the average leaf area in treated plants was 24.40 cm^2 against 14.23 cm^2 in control. The SPAD and NDVI values were also significantly higher in treated plants. The number of fruits/plant (395), average fruit circumference (22.87 cm) and fruit weight (148.57 g) were significantly higher in treated plants as compared to control. There was over 3 fold higher fruit dropping in control plants during May-June and September-October when Kinnow fruits are generally vulnerable for dropping. The increased leaf area, general greenness and canopy cover; increased fruit numbers, circumference and weight and decreased fruit dropping in TEMBSS treated Kinnow plants clearly exhibited the alternative use of SMC for multiplication of the fungal bioagent and its potential use in increasing the growth and yield of fruit crops like Kinnow mandarin.

Keywords: SMC, *Trichoderma harzianum*, TEBMSS, Kinnow mandarin

INTRODUCTION

The left over compost after harvesting full or remunerative crop of button mushroom is generally called as spent mushroom compost (SMC). It is also known as spent mushroom substrate (SMS). On an average, 5 kg of SMC is produced after harvesting 1kg of fresh button mushroom. SMC is good quality organic manure rich in major and minor nutrients required for plant growth. Several modes have been documented to recycle the SMC for various purposes i.e. use as organic manure in field and horticultural crops, reclamation of soil and bioremediation of contaminated soil and water [1,2,3]. *Trichoderma* is a mycoparasitic fungus endowed with several beneficial effects in crop production i.e. plant disease management and yield enhancement. It is also a major contaminant and competitor mould in mushroom cultivation. The present investigation was aimed to recycle the SMC of button mushroom for mass production of *Trichoderma* and its utilization in the cultivation of important fruit crop, Kinnow mandarin.

MATERIALS AND METHODS

The experiment was conducted at Integrated Farming Systems unit of Project Directorate for Farming Systems Research, Modipuram, Meerut, India during 2013-14. The spent compost of button mushroom was obtained from mushroom unit and inoculated with a local strain of *Trichoderma harzianum*. The powdered formulation of *T. harzianum* was mixed in SMC to obtain an initial inoculum (0 day) of 10^4 cfu per gram of the substrate. Inoculated substrate was watered frequently to maintain 60-65 percent moisture and its turning was done at weekly interval. Colony forming units (cfu) of *T. harzianum* were estimated in the laboratory following serial dilution technique. One month old *Trichoderma* enriched button mushroom spent substrate (TEBMSS) was applied in root zone of Kinnow @ 25 kg/plant in the month of April (flowering/fruiting

stage). Uninoculated plants in normal intercropping system were treated as control. Fourteen replications were maintained for each treatment and observations were taken on the growth parameters and fruit yield of Kinnow mandarin.

RESULTS AND DISCUSSION

Spent mushroom compost (SMC) favoured good growth of *T. harzianum* as evident in Fig.1. The cfu of *T. harzianum*, which was in the range of 10^4/g substrate at starting (0 day), reached 8.72 x 10^6/g substrate at the end of 4th week. It indicates the better growth and sporulation of *T. harzianum* in the SMC. The compost or substrate of many mushroom species has been reported to favour good growth of the competitive fungus *Trichoderma* spp. [4].

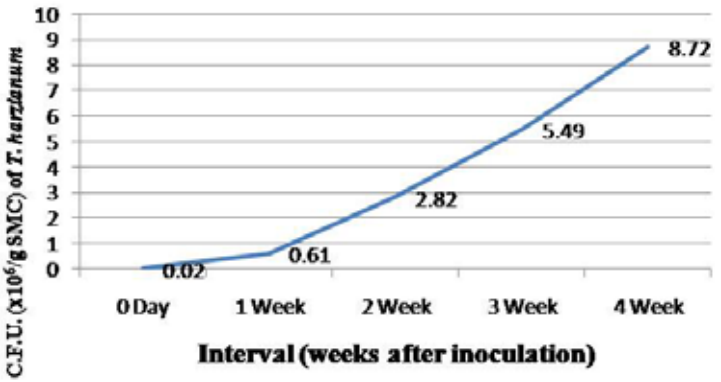

Figure 1. Growth of *T. harzianum* in SMC

There were encouraging results of TEBMSS application on the leaf growth and general canopy health in Kinnow mandarin (Table 1). Average leaf area in treated plants was 24.40 cm^2 against 14.23 cm^2 in control. The SPAD and NDVI values were also significantly higher in treated plants indicating increased greenness of leaves and better canopy coverage and this ultimately results in better accumulation of photosynthates and fruit yield. Use of nutrient rich spent mushroom substrate for enhancing yield and quality of some vegetables and fruits were also documented by Ahlawat [1] and Oei *et al.* [3]. In India, Punjab is number one in the production of spent mushroom substrate and Kinnow fruit as well and this opens the avenues for utilization of TEBMSS in Kinnow orchards for better yield. *T. harzianum* also possesses antifungal and anti-nematode properties which could also be beneficial for Citrus crops like Kinnow mandarin in long run.

Table 1. Effect of *Trichoderma* enriched button mushroom spent substrate (TEBMSS) on leaf growth parameters of Kinnow

Treatment	Avg. Leaf area (cm^2)	Avg. SPAD value	Avg. NDVI value
1. TEBMSS	24.40	59.35	0.92
2.Control	14.23	44.12	0.81
CD (*p*=0.05)	1.59	1.79	0.019

Table 2. Effect of *Trichoderma* enriched button mushroom spent substrate (TEBMSS) on fruit parameters of Kinnow mandarin

Treatment	No. of fruits/ plant at 5 month of age	Avg. fruit drop/ plant in May-June	Avg. fruit drop/ plant till maturity	Avg. fruit circumference at 5 month of age (cm)	Avg. fruit wt. at 5 month of age (g)
1. TEBMSS	395	13.57	21.14	22.87	148.57
2.Control	337	45.14	67.36	19.00	112.29
CD (*p*=0.05)	8.61	3.12	2.87	0.37	6.46

The number of fruits/plant (395), average fruit circumference (22.87 cm) and fruit weight (148.57 g) were significantly higher in treated plants as compared to control (Table 2). There was nearly 3 fold higher fruit dropping in control plants during May-June and September-October when Kinnow fruits are generally vulnerable for dropping. The positive effect of TEBMSS on fruit growth and negative effect on fruit dropping ultimately enhances the yield of Kinnow.

CONCLUSION

Spent mushroom compost (SMC) supported a good growth of *T. harzianum* indicating its potential use for the mass production of this important bioagent. The increased leaf area, general greenness and canopy cover; increased fruit numbers, circumference and weight and decreased fruit dropping in TEBMSS treated Kinnow plants clearly exhibited the alternative use of SMC for multiplication of the fungal bioagent and its potential use in increasing the growth and yield of fruit crops like Kinnow mandarin.

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