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FIELD PERFORMANCE OF DAUGHTER PLANT OF STRAWBERRY AS INFLUENCED BY TRICHO-COMPOST AND TRICHO-LEACHATE

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Abstract

Effect of soil incorporated Tricho-compost @ 5.5 t/ha (T_1) and foliar spray of Tricho-leachate @ 4 ml/l at 15 days interval (T_2) each alone or in combination (T_3) were evaluated on mortality of strawberry plant in the maintenance nursery and growth and development of daughter plants in the main filed. Traditional practice of maintenance of plants in the nursery bed was considered as control (T_4). The study was conducted at the Regional Horticultural Research Station, Bangladesh Agricultural Research Institute, Sibpur, Narsingdi, during June 2015 to March 2016 and BARI Strawberry-1 was used in the study. The lowest mortality (6.67%) in the nursery bed was recorded in saplings treated by T_3, while the highest mortality (16.67%) was recorded in the control plot (T_4) and the trend was also followed in the main field. Days to flowering (47.67) and days to first harvest (71.67) of saplings treated by T_1 were earlier as compared to that of saplings of control plot (60.67 and 93.33 respectively). The maximum harvest duration was recorded in saplings treated by Tricho-compost (74 days) followed by T_2 (61.33 days) and T_3 (59.33 days). Total Soluble Solid (TSS) of fruits were also improved when the plants were treated by Tricho-products. The maximum fruit yield (621.68g per plant) was recorded from T_3; while, the lowest yield (396.83g per plant) was recorded in saplings treated by Tricho-leachate @ 4ml/l.

Keywords: Strawberry, Trichoderma, Tricho-compost, BARI Strawberry-1.

Introduction

Strawberry is a newly introduced fruit crop in Bangladesh. It is a perennial herb and propagated by runner, the specialized vegetative propagating part arising from the crown. However, it is cultivated as a seasonal crop in Bangladesh during winter. Planting is done in mid-November and plant produces fruits in short winter days of December-January. After the fruiting season, farmers maintain stock plants in the field or in the nursery for seedling production of next year crop. During perpetuating of stock plants, runners come out from the crown and rooted in soil and form new daughter plants. Death of stock plant particularly in rainy season due to unknown causes is a serious bottleneck of strawberry

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cultivation. The existing studies in the literatures of mortality of stock plants and runner production of nursery are scanty. The other jobs related to soil borne diseases in seedling production narrated that organic manures and bio-fertilizers increase plant growth and reduce diseases susceptibility caused by plant pathogenic fungi, bacteria, viruses and nematodes (Kloepper *et al.*, 2004). Tricho-compost is a kind of organic manures made form micro-organism *Trichoderma harzianum*, a free living soil born fungus. It grows quickly and vigorously in soil and attack pathogenic fungus for their survival and causes reduction of harmful plant pathogen population. In addition, *T. harzianum* adds many micro-organic substances during metabolic processes and secretes organic acids in rhizosphere which favor root growth and stimulate metabolic process of plants (Fravel *et al.*, 2003). Tricho-leachate is the secretion of Tricho-population which is collected from their artificial culture. The leachate contains many nutrient elements, important metabolites of *T. harzianum*, and cytoplasmic bodies of substrates which plant can absorb through cuticles and stimulate enzymatic activities in plant for metabolic processes (Kielan, 1996; Nosir, 2016). Considering the facts, the study was undertaken to find out the effectiveness of Tricho-compost and Tricho-leachate on survivability of strawberry plants in the maintenance nursery including growth and development of subsequent daughter plants in the main field.

Materials and methods

The experiment was conducted at the Regional Horticulture Research Station (RHRS), Sibpur, Narsingdi during June 2015 to March 2016. Land type of the experimental plot was sandy loam. Inherent nutrient status of the soil was estimated before starting the experiment and data are presented in Table 1. The experiment consisted of four treatments which are as follows:

T_1= Soil incorporated Tricho-compost @ 5.5 t/ha

T_2= Foliar application of Tricho-leachate @ 4 ml/l at 15 days interval

T_3= Combined application of T_1+T_2;

T_4= Control (Traditional practice of maintenance of plants in the nursery bed)

Tricho-compost, a Trichoderma based compost fertilizer, was prepared at the Horticulture Research Centre (HRC), BARI, Joydebpur, Gazipur following the procedure described by Nahar *et al.* (2012) by mixing a definite concentration of spore suspension of a *Trichoderma harzianum* strain with measured amounts of processed cow-dung, poultry refuse, water hyacinth, vegetable wastes, sawdust, maize bran and molasses. Tricho-leachate, a liquid by-product of the Tricho-compost, was obtained during decomposition of Tricho-compost materials. Required Tricho-compost and Tricho-leachate were collected from the HRC. Nutritional status of Tricho-products was determined in the Laboratory of the Soil Science Division, BARI, Joydebpur in February 2015 and results are presented in Table 2.

Table 1. Analytical data of soil sample of Regional Horticulture Research Station of Bangladesh Agricultural Research Institute, Sibpur, Narsingdi

Lab. No.	Sample No.	pH	O.M. %	Ca	Mg	K	Total N %	P	S	B	Cu	Fe	Mn	Zn
				meq/100 ml				$\mu g/ml$						
5419	1 (West)	6.7	0.79	6.1	2.1	0.08	0.042	52.0	22	0.14	1.8	52	3.9	1.52
5420	2 (East)	6.8	0.34	6.3	2.2	0.07	0.018	44.0	25	0.10	2.0	45	3.6	0.8
Average		6.75	0.34	6.3	2.2	0.07	0.03	48.0	23.5	0.12	01.9	48.5	3.75	01.16
Critical level		**-**	**-**	**2.0**	**0.5**	**0.12**	**-**	**7.0**	**10**	**0.2**	**0.2**	**4.0**	**1.0**	**0.6**

Source: Analytical Laboratory of Soil Science Division, BARI (February 2015).

Table 2. Amount of nutrient element on Tricho-compost and Tricho-leachate

Materials	P^H	OM%	N%	K%	Ca%	Mg%	P	S	Cu	Fe	Mn	Zn	B
		(%)		meq/100 ml			μg/ml						
Tricho compost	8	20.0	1.20	0.93	1.71	0.40	14.1	2.4	1	1.2	0.2	0.2	0.2
Critical level in soil	-	2.0	-	0.12	2.0	0.5	7.0	10.0	0.2	4.0	1.0	0.6	.2
Tricho leachate	6.40	0.17	0.24	0.82	0.60	0.12	2.40	2.60	0.24	.0018	.0026	.002	0.03

Source: Analytical Laboratory of Soil Science Division of BARI (February 2015)

The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. The unit plot size both for nursery and crop field consisted of 1m x 3m, accommodating 12 plants in double rows planting system with 50 cm × 40 cm spacing. The plants of the previous crop were transferred in the maintenance nursery in 2nd week of June 2015. The nursery beds were treated with Tricho-compost @ 5.5 t/ha as per treatment allocation. Foliar application of Tricho-leachate was done @ 4 ml/l of water at 15 days interval. Blanket doses of cowdung, Urea, TSP, MoP, gypsum, zinc sulfate, borax were applied at the rate of 30 t/ha and 250, 200, 220, 150 10 and 12 kg/ha, respectively in the field before planting (Mondal *et al.,* 2011). Same fertilizers with similar doses were used in the main filed. Thirty day old sapling having three to four leaves obtained from each treatment were transplanted in the main field in 2nd week of November 2015. Same treatments of Tricho-products and similar plot sizes as used in nursery beds were followed in the main field for growing crop. Plants in the main field were covered with shade net that cuts thirty percent light to provide partial shade and also acts as a bird attack protector. Data on 1st flowering date, 1st harvesting date, harvest duration, plant height and spreading of plant at 1st harvest, number of leaves/plant at 1st harvest, cumulative number of fruits/plant, weight of individual fruit, fruits length, fruits breath, TSS% of fruit, yield per

plant were recorded. Data on plant mortality per cent was transformed by following ARCSIN transformation. Collected data were analyzed statistically and means were separated by LSD.

Table 3. Effect of Tricho-compost and Tricho-leachate on mortality and runner production of plant in the maintenance nursery and growth of daughter plant in the main field

Treat	Mortality (%)	No. of runner/ plant	Plant height (cm)	Spreading (cm)		Leaf number/ plant
				E-W	N-S	
T_1	13.22(20.39)*	3.58	19.33	33.33	32.56	22.33
T_2	10.33 (18.06)	2.97	17.22	31.67	32.67	18.11
T_3	6.67 (14.33)	3.81	19.11	30.44	33.67	23.56
T_4	16.67 (23.23)	3.39	20.22	31.89	32.78	19.22
CV (%)	5.86	5.81	7.89	11.30	8.68	26.62
LSD (0.05)	2.23	0.39	NS	NS	NS	NS

T_1: Soil incorporation of Tricho-compost; T_2: Foliar spray of Tricho-leachate; T_3: T_1+T_2
T_4: Traditional management

NS = Not significant

Data within parenthesis are the transformed value of original data.

Results and discussion

Mortality percent of plants in the maintenance nursery and subsequent growth of plant

Mortality percent of plants in the maintenance nursery (16.67) was recorded the highest in control plot (T_4) compared to plants treated by Tricho-products. The lowest mortality percent (6.67) was recorded in treatment T_3 followed by T_2 (10.33%) and T_1 (13.22%) (Table 3). Runner production per plant was counted the highest in T_3 (3.81), which was followed by T_1 (3.58) and T_4, (3.39) respectively. Similar effect of tricho-products on seedling mortality in main filed was observed (Table 4). Where, the lowest mortality (8.33%) of plants was recorded in treatment T_3 followed by T_2 (16.65%) and T_1 (16.67%). The height of plant, leaf number and spread of plant were not influenced by treatments (Table 3). It was noticed that Tricho-compost and Tricho-leachate although in small amount reduced mortality and allowed strawberry plant to grow vigorously. The results are in the line with the findings of Celar and Valic (2005) and Rabeerdran *et al.* (2000) who reported that Trichoderma species promoted seedling establishment and enhancement of plant growth in vegetable crops. Nahar *et. al*. (2012) reported that Tricho-compost and Tricho-leachate suppressed soil borne diseases of cabbage seedlings caused by *Sclerotium rolfsii* that is also in agreement with the findings of this study. The results of the study are plausible because application of Trich-compost might have increased the activities of

beneficial microorganisms in rhizosphere, stimulated plant growth regulators and improved nutrients availability, which absorbed by the roots of plants. In addition, cellular products of substrates of Tricho-compost inhibited growth of pathogenic fungi in rhizosphere and induced host resistance (Whipps, 2001; Chang *et al.*, 1986; Fravel *et al.*, 2003). The beneficial effects of Tricho-products on mortality and seedling establishment were also reported by Haggag and Abosedera (2005) in cabbage. Strawberry plants are creeping or semi-creeping herbs without above ground woody tissue which cannot thicken and stiffen to support increasing vertical growth to reach towering. The treatment effects on vegetative growth were manifested in runner production (Durner *et al*., 2002). Proliferation of runner production in T_3 was a mode of vegetative growth due to the response of treatment (Walter *et al.*, 2005).

Table 4. Influence of Tricho-compost and Tricho-leachate on mortality, days to flowering, days to harvest and no. of fruit/plant in the main field

Treatment	Mortality (%)	Days to flowering	Days to harvest	Harvest duration	Number of fruits/plant
T_1	16.67 (23.25)	47.67	71.67	74.00	24.37
T_2	16.65 (22.79)	50.00	79.33	61.33	22.10
T_3	8.33 (16.18)	51.33	84.67	59.33	26.78
T_4	25.00 (28.74)	60.67	93.33	45.33	25.13
CV (%)	15.07	5.87	9.17	14.62	5.78
LSD (0.05)	6.84	6.14	15.00	17.53	2.83

T_1: Soil incorporation of Tricho-compost; T_2: Foliar spray of Tricho-leachate; T_3: T_1+T_2; T_4: Traditional management, Data within parenthesis are the transformed value of original data.

Days to flowering, fruit yield and harvest duration of daughter plants

Days to flowering of plant treated by Tricho-compost (T_1) and Tricho-leachate (T_2) alone or by their combination (T_3) ranged between 47.67 to 51.33 and it was earlier compared to control plot (60.67 days). The results attributed early fruit harvest as well as prolonged harvest duration (Table 4). Early flowering in plant may be attributed due to easy uptake of nutrients and simultaneous transport of growth promoting substances to the auxiliary buds and early transformation plant parts from vegetables to reproductive phase (Soni *et al*., 2018). Enhanced early flowering consequently lead to long reproductive phase and prolonged harvest duration (El-Sawy *et al.*, 2011). Treatment T_3 also influenced fruits set in plants (26.78/plant). However, the influence of Tricho-products on number of fruits/plant was found not very strong (Table 4). Tricho-compost and Tricho-leachate of treatment T_3 might allow plant to absorb low amount of Fe which promoted leaf chlorophyll content for photosynthesis and metabolic process and thus enhanced plant growth and development (Gyana and Sahoo, 2015). In

addition, Tricho-compost increased availability of essential micro and macro-nutrients in rhizosphere for growth and development of plants (Arif *et al.*, 2006).

Table 5. Effect of Tricho-compost and Tricho-leachate on fruit weight, size, quality and yield of daughter plants in the main field

Treatment	Individual fruit weight (g)	Fruit length (cm)	Fruit circumference (cm)	TSS (%)	Fruit yield/plant (g)	Fruit yield (t/ha)
T_1	21.37	5.07	9.85	10.77	518.42	11.52
T_2	17.99	4.86	10.00	9.83	396.83	8.82
T_3	23.29	5.20	9.98	10.13	621.68	13.81
T_4	17.35	5.02	10.04	9.53	434.03	9.64
CV (%)	6.51	5.30	11.97	5.30	8.87	8.86
LSD (0.05)	2.59	NS	NS	1.06	87.29	1.93

T_1: Soil incorporation of Tricho-compost; T_2: Foliar spray of Tricho-leachate; T_3: $T_1 + T_2$; T_4: Traditionnel management.

Fruit quality and fruit yield

Saplings treated by T_3 produced longer fruit (5.2 cm) with weight (23.29 g). Total Soluble Solid (%TSS) of fruit was also found to improve by the application Tricho-products. Circumference of fruit was not influenced by any one of the treatments (Table 5). However, the maximum %TSS was recorded in fruits when saplings treated by T_1 (10.77) followed by T_3 (10.13) and T_2 (%9.83). Tricho-compost alone or in combination with Tricho-leachate significantly affected yield per plant and total yield. The increase in yield and fruit qualities may be due to balanced availability of micro and macro nutrients and growth promoting substances produced by Tricho-products.

Conclusion

It appears that Tricho-compost and Tricho-leachate enhance flowering, fruit set and vegetative growth of strawberry with the added benefits of control of soil borne diseases in the field. Early harvesting could clearly be of great benefit to the growers. Soil incorporation of Tricho-compost with foliar application of Tricho-leachate was the most appropriate combination of Tricho-products.

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