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Growth and Flower Yield of *Tagetus patula* Plants on Tannery Waste Amended Soil Medium

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Abstract

Aim of the present study was to evaluate the effect of tannery waste on growth and flower yield of *Tagetus patula.* The planting media were prepared by mixing garden soil, sand and tannery waste in the ratio of 3:3:1, 3:3:2, 3:3:3, 3:3:4 and 3:3:5. The flower yield data obtained showed an increase in number (90 %) and weight (59 %) of flowers in *Tagetus patula* planted in medium with ratio of 3:3:2. Increase in plant height, shoot dry weight, root dry weight and numbers of branches were recorded maximum when plants were grown in planting medium with ratio of 3:3:1. However, a decrease in growth and flower yield of *Tagetus patula* was found when it was planted in media (higher tannery waste) containing garden soil: sand: tannery waste in the ratio of 3:3:3, 3:3:4 and 3:3:5. The results of the present study clearly showed that tannery waste at lower concentration promotes vegetative growth and flower yield of *Tagetus patula* and behaves as growth inhibitor at higher concentrations. Therefore, tannery waste can be successfully utilized in planting medium for production of *Tagetus patula* flowers. There is also a need to screen the effect of tannery waste based planting medium on other non edible floricultural crops.

Key Words: Tannery waste, Planting medium, Growth and flower yield promotion, *Tagetus patula*

Introduction

Tannery waste is generated in huge amounts during the process of tanning by leather industries throughout the world. It has been considered one of the most polluted industrial wastes and contains high amounts of metals which are very toxic to plants, animals and soil. Tannery wastes are of serious consequence since it has a role in pollution of fresh water bodies, streams and land. Various studies have been conducted earlier to evaluate the effect of tannery waste on physiological, biochemical, growth and yield parameters of crop plants. Tannery wastes are known to reduce germination, growth and yield of gram, wheat and lettuce crops when they are applied at higher ratio [2, 10]. An increase in growth and yield of tomato plants has been recorded when they were grown at lower ratio of the tannery waste amendments [14]. Sesame white plants grown in potting medium amended with higher ratio of tannery waste contains higher concentration of metals and toxic compounds. In white sesame plants concentration of accumulated toxic metals were found above the limits and they suggested not using tannery waste for crop plants [6].

It has been reported that plants uptake metals from tannery wastes and it is available in roots, shoots, leaves, flowers and fruits with minimum in fruits [9, 13, 16]. Plants are widely being used for a long time to remove contaminants from soil and water throughout the world [3, 4, 8, 11, 15].

Many edible crop plants grow and perform well on tannery waste amended medium but using the produce of these edible crop plants is very harmful for human and animal health. The present research study was undertaken to investigate the effects of tannery waste on growth and flower production of *Tagetus patula.* The objective was to develop and utilize tannery waste amended growth media for non edible floriculture crops and thereby reduce the pollutants.

Materials & Methods

Collection of tannery waste

Tannery waste was collected from leather tannery of Jajmau, Kanpur, U.P., India and was dried under shade conditions for one week till complete removal of moisture. After complete drying, tannery waste was finely grounded with the help of laboratory grinder to obtain fine particles of homogenous size.

Preparation of planting media and Pot Trials

Garden soil and sand was dried under shade conditions to remove the moisture content. Garden soil, sand and tannery waste were mixed properly in the ratio of 3:3:1, 3:3:2, 3:3:3, 3:3:4 and 3:3:5 to prepare planting medium for pot trials. Garden soil and sand was mixed at the ratio of 1:1 for control plants. The potting soil prepared by the above mentioned method was filled in earthen pots @ 6 kg/pot.

The pots were planted with *Tagetus patula* @ 1 plant/pot and kept in the net house for observation.

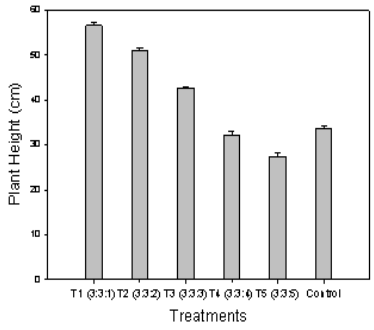
Growth and Flower yield

Tagetus patula planted in pots were observed regularly and data on plant height, shoot & root dry weight, number of branches and flowers and weight of flowers were collected. Plant height was recorded 45 days after plantation (DAP). Numbers of flowers were counted periodically and tagged starting from flowering to uprooting of plants. Root and shoot weight were recorded by uprooting the plants after full maturity 65 DAP. The roots were separated from shoots, dried at 50 – 55ºC in an oven and their weights were recorded. The experiments were conducted for two successive seasons following the same procedures.

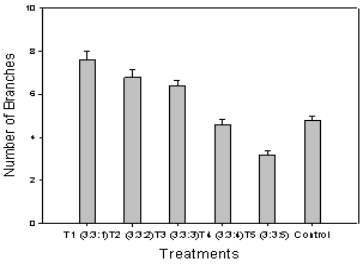
Results

The results obtained shows that there was an increase of 68%, 51% and 26% in height of *Tagetus patula* grown on potting soil having ratio of 3:3:1, 3:3:2 and 3:3:3. However, at higher concentrations (3:3:4 & 3:3:5) of tannery waste amendments a decrease in plant height was recorded as compared to control plants. Plants grown at higher ratio had stunted growth and leaves were small and yellowish. *Tagetus patula* grown on lower concentrations of tannery waste showed more vigorous growth than the control (Graph 1).

Tagetus patula grown using tannery waste amendments at the ratio of 3:3:1, 3:3:2 and 3:3:3 recorded 58%, 41% and 33% more branches than the control plants. *Tagetus patula* showed stunted growth when grown on tannery waste amendments with ratio of 3:3:4 and 3:3:5. The lower concentration of tannery waste amendments showed inducing effects and was found supportive in increasing branches of *Tagetus patula* (Graph 2).

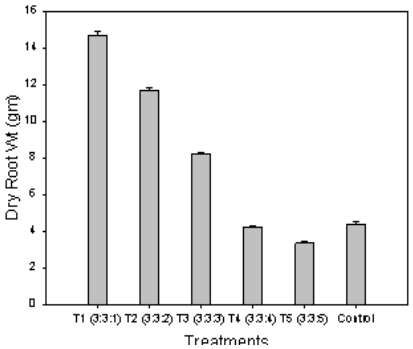


Graph 1. Effect of Tannery waste on plant height
Data are means of replicate with SE

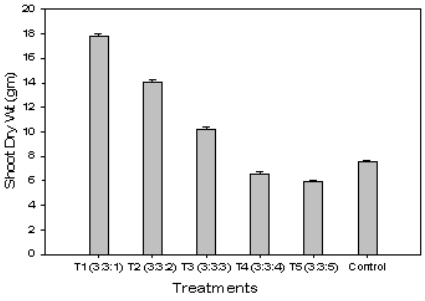


Graph 2. Effect of Tannery waste on number of branches. Data are means of replicate with SE

The root dry weight of *Tagetus patula* grown on potting soil containing tannery waste in ratio of 3:3:1, 3:3:2 and 3:3:3 showed an increase of 233%, 165% and 86% respectively over control. The plants had more longer, branched and thick rooting system as compared to control. Data collected on root dry weight showed that at higher concentration of tannery waste amendments the growths of roots were suppressed (Graph 3).



Graph 3. Effect of tannery waste on dry root weight of *Tagetus patula.*
Data are means of replicate with SE

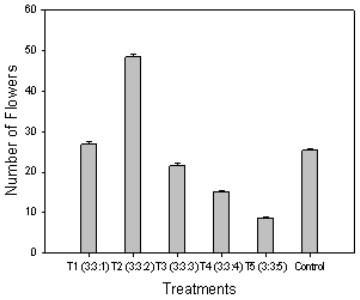


Graph 4. Effect of tannery waste on dry shoot. weight of *Tagetus patula*. Data are means of replicate with SE.

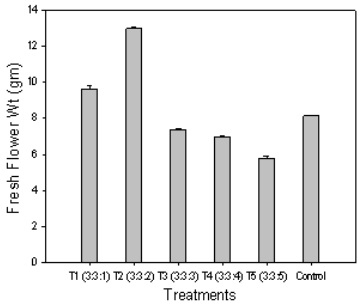
Results of shoot dry weight clearly indicated that *Tagetus patula* grow very well in the potting soil amended with tannery waste in ratio of 3:3:1, 3:3:2 and 3:3:3. It showed an increase of 135%, 86% and 35% in shoot dry weight over control plants. A decrease of 12% and 20% was found in shoot dry weight of *Tagetus patula* planted in potting soil amendments with ratio of 3:3:4 and 3:3:5. The plants grown at 3:3:4 and 3:3:5 ratios showed stunted growth as compared to control plants (Graph 4). Tannery waste amendments were found to be supportive in improving the growth of root, shoot and leaves of plants when they were applied at lower ratio.

Amendment of potting soil with tannery waste at 3:3:2 ratios showed a positive effect on flower production of *Tagetus patula* and increased the number of flowers by 90% as compared control plants. Potting soil mixture with ratio of 3:3:1 showed a slight increase in number of flowers (5.51%). However, there was a reduction in flower production by 14%, 40% and 65% in *Tagetus patula* grown on potting medium with ratio of 3:3:3, 3:3:4 and 3:3:5 respectively, as compared to control plants. Flower production was promoted at 3:3:2 ratios in *Tagetus patula* (Graph 5).

Fresh flower weight of *Tagetus patula* increased by 18% and 59% when plants were grown on amendments of 3:3:1 and 3:3:2 ratios respectively. Fresh weights of flowers were reduced drastically when tannery wastes with higher ratios were used in the potting medium. The size of flowers was found to be maximum at 3:3:2 ratios while smaller sized flowers were recorded at 3:3:5 ratio. The tannery wastes had a negative effect on size and weight of *Tagetus patula* flowers when used at higher ratios (Graph 6).



Graph 5. Effect of tannery waste on flowering fresh flower of *Tagetus patula*
Data are means of replicate with SE.



Graph 6. Effect of tannery waste on weight of fresh flower of *Tagetus patula*
Data are means of replicate with SE. replicate with SE.

Discussion

An increase in the height of *Tagetus patula* was recorded when grown on potting soil having lower ratio of tannery waste (3:3:1, 3:3:2 and 3:3:3). At higher concentrations of tannery waste amendments resulted in decreased plant height. Plants grown at higher ratio had stunted growth and leaves were small and yellowish. Similar were the findings of [14]. They reported an increase in vegetative growth of tomato plants when grown at lower ratio of tannery waste amendments. *Tagetus patula* plants grown on tannery waste amendments at the ratio of 3:3:1, 3:3:2 and 3:3:3 recorded more number of branches. *Tagetus patula* plants showed stunted growth when grown on tannery waste amendments with higher ratio. The lower concentration of tannery waste amendments have inducing effects and was supportive in increasing number of branches in *Tagetus patula*.

The root dry weight of *Tagetus patula* grown on potting soil containing tannery waste increases at lower concentrations. The plants have more longer, branched and thick rooting system when grown on the tannery waste amendments. At higher concentration of tannery waste amendments the growths of roots were suppressed *Tagetus patula* grow very well in the potting soil amended with tannery waste at ratio of 3:3:1, 3:3:2 and 3:3:3. An increase and decrease in shoot dry weight of *Tagetus patula* was observed at lower and higher concentrations respectively. The plants were stunted due to higher concentrations of the tannery waste which proves the toxicity of tannery waste at higher concentration. Tannery waste amendments were found to be supportive in improving the growth of root, shoot and leaves of plants when they were applied at lower ratio [12, 13].

Amendment of potting soil with tannery waste at 3:3:2 ratios showed a positive effect on flower production of *Tagetus patula.* Number of flowers increased up to 90% as compared control plants clearly indicate that tannery amendments have an inductive effects on the flower production. Availability of metals in small concentration is helpful for the growth of the plants. Very low and very high concentration have an adverse effect on the plant growth and physiology which caused a reduction in flowering. Studies conducted earlier showed that use of tannery waste amendments at lower ratio increased growth and yield of tomato and *Vigna radiata* plants [1, 14]. However, at higher concentration of growth & yield parameters of sunflower and wheat are suppressed [5, 7].

An increase in the fresh flower weight of *Tagetus patula* plants is related to the growth promotary effect of the tannery waste amendments. Fresh weights of flowers were reduced drastically when tannery wastes with higher ratios were used in the potting medium. The tannery wastes had a negative effect on size and weight of *Tagetus patula* flowers when used at higher ratios.

Conclusions

The present study clearly indicated that vegetative growth (plant height, branching, root dry weight and shoot dry weight) of *Tagetus patula* plants is promoted by tannery waste at lower ratio (3:3:1, 3:3:2 and 3:3:3). However, at higher ratios (3:3:4 and 3:3:5) tannery waste suppressed the vegetative growth of *Tagetus patula* plants. Tannery waste when mixed at more or less in equal ratio (3:3:2) with garden soil and sand it increased the production of *Tagetus patula* flowers. However, at higher ratios (3:3:3, 3:3:4 and 3:3:5) it suppressed the flower production. The potting medium containing tannery waste amended with soil and sand at 3:3:2 ratios can be successfully employed in floriculture industry for increased production of *Tagetus patula* flowers. It is suggested that future studies are necessary to test the effect of tannery waste amended medium on other floricultural crops.

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