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Response of different Propagation Methods on Economics of Water Spinach (*Ipomoea aquatica* Forsk.)

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ABSTRACT: A field experiment was carried out in the field of Pt. KLS College of Horticulture and Research Station, Rajnandgaon (C.G.) year 2021-22, under Vegetable Science Department with a view to study the response of different propagation methods on economics of Water Spinach (*Ipomoea aquatica* Forsk.). The crop Water spinach of variety Kalmi Reshmi was grown in 9 treatments with 3 replications in a Randomized Block Design (RBD). The PGR and biofertilizer used in the experiment were GA_3 100ppm and *Trichoderma viride* 2ml/L water as per the treatments *viz.,* T_1: Planting through cuttings of 15cm length treated with GA_3 (100ppm), T_2: Planting through cuttings of 15cm length treated with *Trichoderma viride* 2ml/l water, T_3: Planting through cuttings of 15cm length without treatment, T_4: Planting through seedlings treated with GA_3 (100ppm), T_5: Planting through seedlings treated with *Trichoderma viride* 2ml/l water, T_6: Planting through seedlings without treatment, T_7: Direct sowing of seeds treated with GA_3 (100ppm), T_8: Direct sowing of seeds treated with *Trichoderma viride* 2ml/l water and T_9: [Control] Direct sowing of seeds without treatment. The maximum total cost of cultivation Rs. 1,02,261.18 per ha was calculated for treatment T_2 (Planting through cuttings of 15cm length treated with *Trichoderma viride* 2ml/l water), maximum gross returns Rs. 3,26,666.67 per ha and maximum net returns Rs. 2,24,830.49 per ha. B:C ratio 2.21 was obtained in treatment T_4 (Planting through seedlings treated with GA_3 100ppm), while minimum was obtained in treatment T_9 (Control: Direct sowing of seeds without treatment). Treatment T_4(Planting through seedlings treated with GA_3 100ppm) was found significantly superior for all the economic parameters of water spinach (*Ipomoea aquatica* Forsk.). Although the study provides valuable insights into the effects of different propagation methods on the economics of Water Spinach cultivation, some challenges such as weather fluctuations, pest infestations, and soil variability were not considered in the study, which could impact the results.

Keywords: *Ipomoea aquatica*, *Trichoderma viride,* GA_3, B:C ratio, Cost of cultivation.

INTRODUCTION

Water spinach, also known as *Ipomoea aquatica* Forsk, is a semi-aquatic, herbaceous, and perennial plant belonging to the Convolvulaceae family, with a chromosome count of 2n = 30. Commonly referred to as Karmatta bhaji, kalmisaag, and paani palak, water spinach is indigenous to the tropics and subtropics, where it grows wild and cultivated in Southeast Asia, India, and Southern China. According to Umar *et al.* (2007); Pandey *et al.* (2019), water spinach is believed to have originated in China. The plant has arrowhead-shaped, green leaves that vary widely in size, ranging from 2.5 to 8cm in breadth. Its long, hollow, vine-like stems grow prostrate or float, and roots are produced from nodes that penetrate into wetland or mud. Water spinach is commonly cultivated in moist soil and water sources such as flooded soil, canals, and rivers (Manisha *et al.,* 2021).

In Chhattisgarh, water spinach is grown in all three Agro-climatic zones, *i.e.* Northern hills, Chhattisgarh plains and Bastar plateau. In Chhattisgarh, water spinach is cultivated in Dhamtari, Raipur, Ambikapur, Kondagaon, Bastar, Mahasamund, Bilaspur, Gariyaband, Durg and Kanker districts. There is no improved variety available in government and private sector. The cultivators rely upon the local genotypes, collect them from ponds and directly sell it to market (Anonymous, 2021).

It is well known that GA_3 treatments promote cell division and cell enlargements that may result in stem elongation. GA_3 treatments also enhanced other morphological and physiological traits in water spinach. It also plays a major role in altering germination, elongation, eradication of dormancy, enzyme

activation, as well as control leaf shape (Chandrakar *et al.,* 2020) and leaf size (Yesuf *et al.,* 2021).

Trichoderma viride being both a bio-fertilizer and a bio-fungicide, proves to be a boon to all agricultural problems. It improves overall plant health, by creating a positive environment with symbiotic relationship with plants and releases various types of secondary metabolites including, growth hormones, endochitinase, proteolytic enzymes and benefits the plants by taking advantage of plant-microbe interactions (Mohit *et al.,* 2016); (Gebarowska *et al.,* 2019).

MATERIALS AND METHODS

A field experiment was carried out in the field of Pt. KLS College of Horticulture and Research Station, Rajnandgaon (C.G.) during the year 2021-22, under Vegetable Science Department. The crop Water spinach of variety Kalmi Reshmi was grown in 9 treatments with 3 replications in a Randomized Block Design (RBD). The PGR and biofertilizer used in the experiment were GA_3 100ppm and *Trichoderma viride* 2ml/L water. The economics of water spinach crop production pertaining to each of the treatment has been worked out in terms of cost of cultivation. Gross return (Rs. ha^{-1}) was obtained by converting the harvest into monetary terms at the prevailing market rate during the course of studies for every treatment. Net return (Rs. ha^{-1}) was obtained by deducting cost of cultivation from gross return. The Benefit: Cost ratio was calculated with the help of following formula:

Benefit: Cost ratio = Net returns (Rs. ha^{-1}) / Cost of cultivation (Rs. ha^{-1})

(a) Cost of cultivation (Rs. ha^{-1}): The total expenditure incurred for raising crop in a treatment. The cost includes labour, tractor, value of seed, manures, fertilizers, macro and micro foliar nutrients, pesticides and irrigation charges.

(b) Gross return (Rs. ha^{-1}): The total monetary value of the produce and by products obtained from the crop raised in the different treatments is calculated, based on the local market prices.

(c) Net return (Rs. ha^{-1}): Net return was obtained by subtracting the cost of treatment from gross returns for each treatment.

RESULTS AND DISCUSSION

Data pertaining to foliage yield parameter influenced by 9 treatments has been given in Table 1.

The maximum total foliage yield 16,333.33 kg/ha was obtained under the treatment T4 (Planting through seedlings treated with GA3 100ppm) which was found at par with treatment T1 (Planting through cuttings of 15cm length treated with GA3 100ppm) (14,516.67 kg/ha) and followed by T5 (Planting through seedlings treated with *Trichoderma viride* 2ml/l water) (14,250.00 kg/ha) and T2 (Planting through cuttings of 15cm length treated with *Trichoderma viride* 2ml/l water) (13,338.89 kg/ha), while the minimum total foliage yield (8,083.33 kg/ha) was obtained in treatment T9 (Control: Direct sowing of seeds without treatment).

The increase in total foliage yield might be due to the effect of GA3 greatly increases the plant biomass by boosting photosynthetic activity and leaf production. An increase in plant biomass leads to higher total foliage leaf yield kg per ha. Also, similar results were reported by Pandey *et al.* (2019); Chouhan *et al.* (2017).

Table 1: Total Foliage Yield (kg/ha) of Water Spinach (*Ipomoea aquatic* Forsk.).

Tr. No.	Treatment details	Total Foliage Yield (kg/ha)
T1	Planting through cuttings of 15cm length treated with GA3 (100ppm).	14516.67
T2	Planting through cuttings of 15cm length treated with *Trichoderma viride* 2ml/l water	13338.89
T3	Planting through cuttings of 15cm length without treatment	9366.67
T4	Planting through seedlings treated with GA3 (100ppm).	16333.33
T5	Planting through seedlings treated with *Trichoderma viride* 2ml/l water.	14250.00
T6	Planting through seedlings without treatment	10116.67
T7	Direct sowing of seeds treated with GA3 (100ppm).	12683.33
T8	Direct sowing of seeds treated with *Trichoderma viride* 2ml/l water	11600.00
T9	[Control] Direct sowing of seeds without treatment.	8083.33

Data pertaining to economic parameters influenced by 9 treatments has been given in Table 2 and Fig. 1.

The maximum total cost of cultivation Rs. 1,02,261.18 per ha were calculated for treatment T_2 (Planting through cuttings of 15cm length treated with *Trichoderma viride* 2ml/l water), T_5 (Planting through seedlings treated with *Trichoderma viride* 2ml/l water) and T_8 (Direct sowing of seeds treated with *Trichoderma viride* 2ml/l water), while minimum was Rs. 1,01,236.18 per ha for T_9 (Control: Direct sowing of seeds without treatment).

The maximum gross returns Rs.3,26,666.67 per ha was obtained in treatment T_4 (Planting through seedlings treated with $GA_3$100ppm), followed by Rs. 2,90,333.33 per ha obtained in T_1 (Planting through cuttings of 15cm length treated with $GA_3$100ppm) and minimum gross returns Rs. 1,61,666.67 per ha was obtained in T_9 (Control: Direct sowing of seeds without treatment).

The maximum net returns Rs. 2,24,830.49 per ha was obtained in treatment T_4 (Planting through seedlings treated with $GA_3$100ppm), followed by Rs. 1,88,497.15 per ha obtained in T_1(Planting through cuttings of 15cm length treated with $GA_3$100ppm) and minimum net returns Rs. 60,430.49 per ha was obtained in T_9 (Control: Direct sowing of seeds without treatment).

The perusal of detailed B:C ratio data revealed that the maximum B:C ratio 2.21 was obtained in treatment

T_4(Planting through seedlings treated with $GA_3$100ppm), followed by 1.85 obtained in T_1(Planting through cuttings of 15cm length treated with $GA_3$100ppm) and minimum B:C Ratio 0.60 was obtained in T_9 (Control: Direct sowing of seeds without treatment).

Overall, the results of this study suggest that the use of plant growth regulators and biofertilizers can have a significant impact on the gross returns of Water Spinach cultivation. Farmers can use these findings to inform their decision-making regarding the use of plant growth regulators and biofertilizers, which can lead to increased productivity and profitability. Additionally, policymakers can use these findings to promote the use of sustainable agriculture practices that incorporate plant growth regulators and biofertilizers, which can have positive environmental and economic impacts. The results obtained in the present study is in accordance with the results of Manisha *et al.* (2021).

Table 2: Economics of Water Spinach (*Ipomoea aquatica* Forsk.).

Tr. No.	Treatment Details	Total Cost (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C Ratio
T1	Planting through cuttings of 15cm length treated with GA3 (100ppm).	101836.18	290333.33	188497.15	**1.85**
T2	Planting through cuttings of 15cm length treated with *Trichoderma viride* 2ml/l water.	102261.18	266777.78	164516.60	**1.61**
T3	Planting through cuttings of 15cm length without treatment.	101236.18	187333.33	86097.15	**0.85**
T4	Planting through seedlings treated with GA3 (100ppm).	101836.18	326666.67	224830.49	**2.21**
T5	Planting through seedlings treated with *Trichoderma viride* 2ml/l water.	102261.18	285000.00	182738.82	**1.79**
T6	Planting through seedlings without treatment.	101236.18	202333.33	101097.15	**1.00**
T7	Direct sowing of seeds treated with GA3(100ppm).	101836.18	253666.67	151830.49	**1.49**
T8	Direct sowing of seeds treated with *Trichoderma viride* 2ml/l water.	102261.18	232000.00	129738.82	**1.27**
T9	[Control] Direct sowing of seeds without treatment.	101236.18	161666.67	60430.49	**0.60**

Selling Price = Rs. 20/kg.

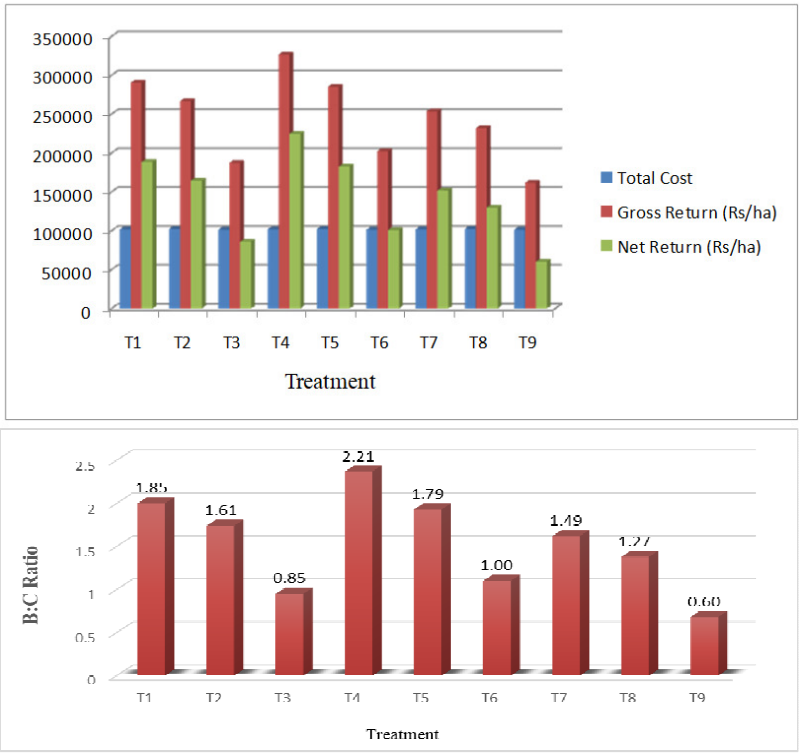

Fig. 1. Economics of Water Spinach (*Ipomoea aquatica* Forsk.).

CONCLUSIONS

In conclusion, the study on the response of different propagation methods on the economics of water spinach has shown that treatment T_4 (planting through seedlings treated with GA_3 100ppm) was significantly superior for all the economic parameters of water spinach. The maximum gross and net returns and the highest B:C ratio were obtained in this treatment. The results of this study can provide important insights for farmers and policymakers to adopt the most profitable and efficient methods for water spinach cultivation.

FUTURE SCOPE

Future scope of the study can include conducting experiments with different varieties of water spinach

and exploring the potential of other biofertilizers and PGRs. Further research can also be carried out on the impact of different ecological factors on the growth and yield of water spinach.

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Conflict of Interest. None.

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