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Response of different media on growth and yield of water spinach (*Ipomoea aquatic* Forsk) under container gardening

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Abstract
The field experiment was conducted during *Rabi* season of 2015-16 at the Horticulture Research farm, IGKV University, Raipur (C.G.). The experiment was laid out in a randomized block design with three replications. The treatments consisted of Thirteen combination of different agro input management practices viz., treatments T_1 Coco peat, T_2 Black Soil, T_3Vermicompost (50%) +Coco peat (50%), T_4 FYM (50%) + Coco peat (25%) +Sand (25%), T_5 Coco peat (50%)+Sand (25%) + Black Soil (25%), T_6 Vermicompost (50%) + Black Soil (50%) T_7 Black Soil (50%) +FYM (50%), T_8 Black Soil (50%) +Paddy Husk (50%), T_9 Sand (50%)+FYM (25%) + Coco peat (25%), T_{10} Black Soil (50%) + Vermicompost (25%) +Charcoal (25%), T_{11} Black Soil (50%) +FYM (25%) + Sand (25%), T_{12} Black Soil (50%) +Paddy husk (25%) +Vermicompost (25%), T_{13} *Laterite* soil (50%) +FYM (25%) +Coco peat (25%). The maximum net profit/ha was recorded under treatment T_3 (Rs.47877.50) while minimum net profit/ha was obtained in treatment T_{11} (Rs. 25955.50). The maximum gross profit/ha was recorded in treatment T4 (Rs. 74952.00) whereas, minimum gross profit/ha was recorded in treatment T9 (Rs. 53477.00). Thus, the maximum income (both gross and net) was obtained with T_3. The significantly maximum B:C ratio 1.76 was recorded under the treatment (T4). And the minimum B:C ratio 0.99 was recorded under the treatment (T8).

Keywords: Vermicompost, FYM, coco peat and spinach

Introduction
Water spinach (*Ipomoea aquatica* Forsk) locally known as *Karmatha bhaji* belongs to family convolvulaceae. It is a variable water and marsh plant, rich in protein, that is traditionally planted as a vegetable in many tropical countries (AFRIS, 2005) [1]. It has a short growth period and can be cultivated either in marshy land or flooded soils. Moreover, it has been found that water spinach has a high potential to convert nitrogen from biodigester effluent into edible biomass with high protein content (Sophea and Preston, 2001) [3].
Ipomoea aquatica used as carminative agent and lessens inflammation, and is useful in fever, jaundice, biliousness, bronchitis, liver complaints, etc. *Ipomoea aquatica* is a rich source of vitamins, minerals, proteins, fibers, carotenes, and flavanoids with many health benefits.
The plant *Ipomoea aquatica* is a common trailing vine with milky sap belongs to the family Convolvulaceae. The plant is commonly known as aquatica morning glory, Chinese water spinach, Kangkong, morning glory, swamp cabbage, swamp morning glory, water convolvulus, water spinach, etc. The plant is considered to have a wide distribution and grows in moist soils as well as the side-lines of fresh water, ditches, lakes, ponds, marshes and wet rice field. The plant is grown in the wild and is usually grows all-round the year as well as cultivated throughout South East Asia and is generally consumed as a vegetable in different regions of the world

Material and methods
Economics
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:

Net return	= Gross return	– Cost of cultivation
(Rs ha^{-1})	(Rs ha^{-1})	(Rs ha^{-1})

$$\text{Benefit: cost ratio} = \frac{\text{Net return (Rs ha}^{-1})}{\text{Total cost of cultivation (Rs ha}^{-1})}$$

Results and Discussion

Economics

The data related to total cost of cultivation, gross return, net return, benefit: cost ratio of weed management practices are presented in Table 1. The detailed common cost of cultivation of onion and treatment cost are presented in Appendix II and III, respectively. Total cost of cultivation was recorded under (four hand weeding) and unweeded control were (Rs. 75025.00) and (Rs.47425.00), respectively. Among the herbicidal treatments, maximum total cost of cultivation (Rs 59945.00) was observed under recommended practices Oxyfluorfen @ 0.25 kg ha^{-1} pre-transplanting and hand weeding at 30- 60 DAT and it was followed by pendimethalin pre-transplanting @ 1.25 kg ha^{1} followed by pendimethalin @ 1.25 kg ha^{-1} at 30 DAT (Rs 51175.00), Maximum gross return (Rs 419760.00 ha^{-1}) was under (T_8) (four hand weeding) whereas, net return (Rs. 359165.00 ha_{-1}) and benefit cost ratio (6.96) was highest under pendimethalin pre-transplanting @ 1.25 kg ha^{1} followed by Pendimethalin @ 1.25 kg ha^{-1} at 30 DAT (T_4), The benefit: cost ratio under other treatments were (T_1 - 6.00), (T_7 - 5.16), (T8 -.4.59), (T_5 -4.62), (T_2 -3.73).

Hand weeding gave maximum gross returns (Rs. 419760.00 ha_{-1}), whereas, net return (Rs. 359165.00 ha-1) and benefit cost ratio (6.96) was highest under pendimethalin pre-transplanting @ 1.25 kg ha^{1} followed by Pendimethalin @ 1.25 kg ha^{1} at 30 DAT (T_4), minimum gross returns (Rs. 162000.00), net returns (Rs. 114575.00) and benefit : cost ratio (2.42) were obtained under weedy check. This was due to lowest bulb yield obtained in the weedy check

However, in herbicide treatments recommended practices oxyfluorfen @ 0.25 kg ha^{-1} pre-transplanting and hand weeding at 30 - 60 DAT gave the maximum gross returns (Rs. 369360.00), net returns (Rs. 309415.00) and benefit: cost ratio (5.16). it was followed by oxyfluorfen pre-transplanting @ 0.25 kg ha^{-1} followed by oxyfluorfen @ 0.25 kg ha^{-1} (PT) at 30 DAT which gave gross return (Rs. 339120.00), net returns (Rs.290705.00) and benefit cost ratio (6.00), pendimethalin pre-transplanting @ 1.25 kg ha^{-1} followed by quizalofop-ethyl @ 0.5 kg ha^{1} at 30 DAT with gross returns (Rs 281970.00), net returns (Rs.231795.00) and benefit cost ratio (4.62) and oxyfluorfen pre-transplanting @ 0.25 kg ha^{1} fb quizalofop- ethyl @ 0.5 kg ha^{1} (PT) at 30 DAT with gross returns (Rs. 230580.00), net returns (Rs. 181785.00) and benefit : cost ratio (3.73), combined spray of pendimethalin @ 0.625 kg ha^{-1} and quizalofop-ethyl 0.25 kg ha^{-1} pre-transplanting and second application 30 DAT with gross returns (Rs. 217890.00), net returns (Rs. 167715.00) and benefit: cost ratio (3.34) and combined spray of oxyfluorfen 0.125 kg ha^{-1} and quizalofop –ethyl 0.25 kg ha^{-1} pre-transplanting and second application 30 DAT gross returns (Rs. 171090.00), net returns (Rs. 122295.00) and benefit cost ratio (2.91) Table 4.17. The higher returns under these treatments were due to higher bulbs yield of onions.

Singh *et al.* (2001) [2] also found that both pendimethalin and oxadiazon when applied 2 DAT in combination with one hand weeding at 60 DAT were found more effective in enhancing marketable bulb yield and recorded higher net returns than other treatment.

Table 1: The data related to total cost of cultivation, gross return, net return, benefit: cost ratio of weed management practices are presented

Treatments	Cost of cultivation Rs ha -1	Gross retuen Rs ha -1	Net return Rs ha -1	B:C Ratio
T1	24445	63968.50	39523.50	1.61683
T2	25675	69678.00	44003.00	1.71385
T3	25825	64788.00	38963.00	1.50873
T4	27075	74952.50	47877.50	1.76833
T5	28075	62757.00	34682.00	1.23533
T6	27825	72165.50	44340.50	1.59355
T7	27979	56007.50	28028.50	1.00177
T8	28129	54084.50	25955.50	0.92273
T9	26753	53477.50	26724.50	0.99893
T10	27095	59482.16	32387.16	1.19532

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