Eco. Env. & Cons. 28 (October Suppl. Issue) : 2022; pp. (S215-S219)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i06s.036

Response of Brahmi (*Bacopa monnieri* L.) Cultivars to Different Growing Media in Hydroponic System

Puneet Kaur, Gurbax Singh Chhina and Agumjot Kaur*

P.G. Department of Agriculture, Khalsa College Amritsar, Punjab, India

(Received 27 March, 2022; Accepted 6 April, 2022)

ABSTRACT

The field experiment was conducted at Students' Research Farm, Khalsa College, Amritsar during *kharif* 2019-20. There were total of 10 treatments comprising two cultivars i.e. C_1 – CIM-Jagriti and C_2 – Subodhak and five growing media i.e. G_1 – Cocopeat; G_2 – Sawdust; G_3 – Vermiculite; G_4 – Mixture (cocopeat + sawdust + vermiculite in 1:1:1) and G_5 – Soil (control). The results revealed that higher growth and yield attributes were found in cv. Subodhak than cv. CIM-Jagriti but they had non-significant difference whereas bacoside-A content was found to be higher in CIM-Jagriti than Subodhak. Growing media had influence on the performance of brahmi plants. Brahmi grown in G_1 responded better than other media. It was observed that the growth and yield parameters of brahmi were significantly higher in G_1 than G_2, G_3, $G\text{-}_4$ and G_5, but was statistically at par with $G\text{-}_4$. Plants grown in G_5 showed significantly lower results than other media.

Keywords: *Brahmi, Hydroponics, Growing media, Soil.*

Introduction

Consumption of herbal medicines is widespread and increasing. Harvesting from the wild, the main source of raw material, is causing loss of genetic diversity and habitat destruction. Domestic cultivation is a viable alternative and offers an opportunity to overcome the problems that are inherent in herbal extracts: misidentification, genetic and phenotypic variability, extract variability and instability, toxic components and contaminants. The excessive use of chemical fertilizers, herbicides and pesticides leaves residues in the crops which is one of the major drawbacks of conventional farming especially in case of medicinal plants. The medicinal plants containing residues of these harmful chemicals causes more harm than any benefit. Thus, medicinal plants contaminated with chemicals fail to obtain quality clearance test for their export. The use of controlled environments can overcome cultivation difficulties and could be a means to manipulate phenotypic variation in bioactive compounds and toxins (Giurgiu *et al.*, 2014). Medicinal plants are increasingly cultivated on a commercial scale to satisfy the large demand for natural remedies. Hydroponic technology may be applied to produce high-standard plant material all year-round in consideration of the possibility to control growing conditions and to stimulate secondary metabolism by appropriate manipulation of mineral nutrition (Maggini *et al.*, 2012).

Hydroponics is a method of growing plants in different types of substrates like cocopeat, vermiculite, rockwool, clay pebbles, perlite, etc., in which nutrients are added and no soil is used. Hydroponics is about enriching water with the very same nutrient salts as found in nature i.e. creating and maintaining a "nutrient solution" that is perfectly balanced for our plants (George and George, 2016). This system is considered as an efficient water use system due to possibility of recycling the water and getting maximum use efficiency. Hydroponics provides a controlled environment inherently free from pests and disease problems that increase the production and productivity per unit area as compared to open field conditions (Putra and Henry, 2015). The system eliminates the use of chemical fertilizers and pesticides which enhances the quality of plants and make them superior than those plants grown in soil. This system uses less space and it can be installed anywhere like on rooftops, balconies and kitchen gardens in urban and peri urban areas. The goal of cultivating medicinal plants in hydroponic system is to attain unequalled growth allied with excelled crop quality and high bioactive substance (Giurgiu *et al.,* 2014).

Brahmi (*Bacopa monnieri* (L.) has been used as a nootropic herb in Ayurvedic medicine for thousands of years. It is one of the most popular herbs in Indian Pharmacopeia and is also known as safed kami, jalnim, Indian penny-wort, herb of grace, water hyssop and thyme leafed. Brahmi is one of the oldest traditional ayurvedic medicines in India. *B. monnieri* has been used as a brain tonic and mind freshner in Ayurvedic, Homeopathis, Siddha and Folk medicines. Besides this, it is also used in the treatment of cardia and neuropharmalogical disorders like insomnia, depression, stress etc. (Mukherjee and Dey, 1966). Highly concentrated, full spectrum extracts of brahmi can be safely used in anxiety and stress reduction and in enhancing the overall well-being of stressed adults. Furthermore, *B. monnieri* extracts have the ability to safely boost cognitive abilities during aging (Patnaik, 2015). Drug prepared from brahmi has potential use in cancer prevention and treatment (Koczurkiewicz *et al.,* 2017). Besides this, brahmi also has good potency in controlling cough, fever, diabetes and snakebite (Smitha *et al.,* 2020). The objective of this investigation is to study the response of brahmi cultivars to different growing media in hydroponic system and its effects on growth and herb yield of brahmi.

Materials and Methods

Layout of the experiment

The field experiment was conducted at the Students' Research Farm, Khalsa College, Amritsar during *kharif* season 2019-20. There were total 10 treatment combinations comprised of two cultivars CIM-Jagriti and Subodhak and five growing media i.e. Cocopeat, Sawdust, Vermiculite, Mixture (Cocopeat + Sawdust + Vermiculite in 1:1:1) and Soil (control).

Hydroponic structure

The hydroponic system was made in an area of 150 sq. ft. and it was covered with rain shelter (green shade net). A 85% mesh green shade net to cover top and 75% mesh green shade net to cover remaining sides were used. The system was established using Nutrient Film Technique (NFT). The system was made up of 24 PVC pipes of 2 inch diameter. Desired size of holes to place net pots, were made in the pipes with a spacing of 5 cm. The pots were filled with four different types growing media. The pipes with net pots were placed on A-shaped iron frame and one cultivar was placed on one side of frame and the second cultivar on the other side of the frame. The height of frame was 6 feet and it had 12 pipes placed vertically on each side. Half-strength Hoagland Solution (Hoagland and Arnon, 1950) was used in the hydroponic system to carry out the experiment.

Raising of crop

The brahmi plant cuttings of 5-6 cm length with 2-3 nodes were taken and planted in net pots containing growing media in hydroponic system as well as in soil. The net pots were then placed in the PVC pipes and a shallow depth of nutrient solution was allowed to flow through the PVC pipes. The cuttings were planted at a spacing of 20 X 10 cm in soil and a recommended dose of fertilisers was applied to the soil grown crop. In soil, the cultural operations were performed according to the package of practices. In hydroponics system, the net pots were placed in the pipes parallel to the stream of nutrient solution. These pipes were connected with the connection pipe of 6 mm and these 6mm connector pipes were attached to input and output connection pipe of 16 mm. The nutrient solution was kept in tank and inlet and outlet pipes were connected to the tank. The nutrient solution kept in the tank was pumped by a water pump. The inlet connector pipes of 16 mm were used to supply the solution to the PVC pipes. The solution flows through the pipes and the pipes were connected to the main outlet pipe through which the solution was collected back in the tank. A shallow depth of nutrient solution was continuously cycled through the pipes for 20 minutes and 10 minutes off. The flow rate of solution was controlled by a timer. Fresh solutions were added into the main tank whenever the TDS value drops below 750 ppm and pH values rise above the 6.5.

Analysis of bacoside A

For the determination of bacoside-A content in *Bacopa monnieri*, the samples of cultivars from hydroponic system and soil were sent to Khalsa College of Pharmacy, Amritsar. The quantification was done by drying the extract and the dried extract containing bacoside-A was hydrolysed to release the aglycon which was then quantified using UV spectrophotometer at 278 nm. (Pal and Sarin, 1992) and results were expressed on percent basis.

Statistical analysis

All the observations of growth attributes were recorded at 30 days interval till harvest and expressed on per plant basis. The data was statistically analysed by using CPCS 1 software developed by Punjab Agricultural University, Ludhiana. The comparisons were made at 5% level of significance.

Results and Discussion

The data pertaining to growth attributes obtained at 90 DAP is presented in Table 1. The results showed that main shoot length, number of shoots, number of leaves and leaf area were found to be higher in cultivar Subodhak (C_2) than cultivar CIM-Jagriti (C_1) butthere was non-significant difference between the treatments C_1 and C_2. Thus, both the cultivars execute same results. The nature of growing media significantly influenced growth attributes. Plants grown incocopeat (G_1) showed significantly higher results when compared to treatments sawdust (G_2), vermiculite(G_3), mixture (G_4) and control (G_5). The highest main shoot length (113.47 cm), number of shoots (83.50 per plant), number of leaves (571.67 per plant) and leaf area (494.29 cm^2 plant^{-1}) were found in treatment G_1 and lowest main shoot length (99.40 cm), number of shoots (42.83 per plant), number of leaves (405.83 per plant) and leaf area (365.62 cm^2 plant^{-1}) were found in the treatment G_5. This might be due to the positive effects of higher aeration and nutrient holding capacity of the cocopeat, which perhaps improved the shoot growth (Putra and Henry, 2015). The superiority of cocopeat over media may be due to cocopeat characteristics viz. favourable water holding capacity, higher organic carbon, low bulk density, higher total pore space and low shrinkage. Similar results were observed by Surendran *et al.* (2017) in *Mentha spicata* and Yahya *et al.* (2010) in *Celosia cristata*.

Table 2 represents data of yield attributes obtained at 90 DAP. The findings showed that cv. Subodhak yielded more than cv. CIM-Jagriti but both there was non-significant difference between them. It was observed that the yield parameters of brahmi were significantly higher in treatment G_1 than treatments G_2, G_3, G_4 and G_5 but was statistically at par with mixture ($G\text{-}_4$).

Table 1. Growth attributes of brahmi cultivars as influenced by different growing media during *kharif* 2019-20 (pooled data).

Treatments	Main shoot length (cm per plant)	No. of shoots (per plant)	Number of leaves (per plant)	Leaf area (cm^2 plant^{-1})
Cultivars				
CIM-Jagriti	109.86	71.13	511.00	451.77
Subodhak	110.39	72.47	518.07	457.95
SE ±	0.27	0.67	3.54	3.09
CD (P=0.05)	NS	NS	NS	NS
Growing media				
Cocopeat	113.47	83.50	571.67	494.29
Sawdust	112.09	74.00	513.83	463.01
Vermiculite	112.38	77.00	527.67	470.98
Mixture	113.35	81.67	553.67	480.39
Soil	99.40	42.83	405.83	365.62
SE ±	2.70	7.43	28.97	22.91
CD (P=0.05)	10.08	6.47	58.69	51.94
Interaction	NS	NS	NS	NS

Table 2. Fresh weight and dry weight of brahmi cultivars as influenced by different growing media during *kharif* 2019-20 (pooled data).

Treatments	Fresh weight (g plant^{-1})	Dry weight (g plant^{-1})
Cultivars		
CIM-Jagriti	69.95	11.38
Subodhak	71.02	11.60
SE ±	0.54	0.11
CD (P=0.05)	NS	NS
Growing media		
Cocopeat	84.83	13.87
Sawdust	72.05	11.65
Vermiculite	75.68	12.24
Mixture	80.03	13.18
Soil	39.82	6.51
SE ±	7.96	1.30
CD (P=0.05)	5.49	0.78
Interaction	NS	NS

Plants of treatment G_1 recorded highest fresh and dry biomass yield whereas lowest fresh and dry biomass yield was recorded in plants of treatment G_5. The fresh biomass of brahmi grown in G_5 was found to be 113.03, 80.94, 90.05 and 100.97 percent less than G_1, G_2, G_3 and G_4, respectively and dry biomass yield of brahmi grown in G_5 was found to be113.05, 78.95, 88.02 and 102.45 percent less than G_1, G_2, G_3 and G_4, respectively. The growth and yield attributes were found to be higher in plants under hydroponic system than in soil. This may be due to sunlight availability to the whole plant in hydroponic system as the plants were grown vertically whereas soil grown plants only upper portion of plants got exposure of sunlight. Hydroponically grown plants showed increment in yields because of optimum growing conditions and accurate supply of essential nutrients through nutrient solution. Similar findings were observed by Sharma and Vasundhara (2015) in coleus plants and Khayat *et al.* (2007) in pothos plants.

The bacoside-A content was found to be higher in cultivar CIM-Jagriti than cultivar Subodhak. The total ethanolic extract and bacoside-A content observed in brahmi cultivars grown in hydroponics and soil is presented in Fig. 1. The calibration curve of the standard bacoside-A is prepared in concentrations ranging from 200- 1000 µg/ml and results are shown in Fig. 2. The results showed that cultivar CIM-Jagriti had 16.1% and 15.9% more bacoside-A in plants grown in hydroponic system and soil respectively, when compared to cultivar Subodhak. Hydroponically grown plants of both brahmi cultivars showed more percentage of ethanolic extract and bacoside-A content than soil grown cultivars of

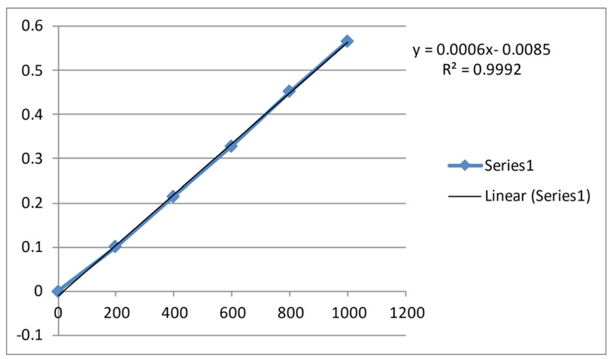

Fig. 2. Calibration curve of standard bacoside-A.

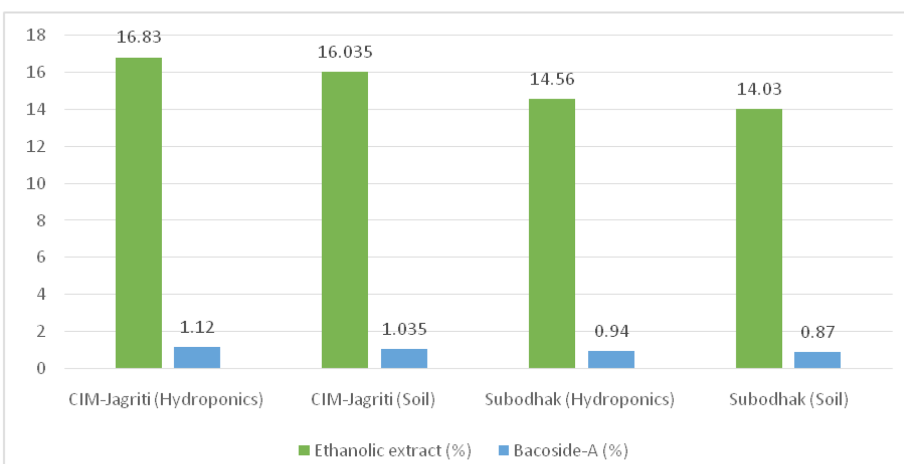

Fig. 1. Ethanolic extract (%) and bacoside-A (%) content of brahmi cultivars grown in hydroponic system and soil.

brahmi. Cultivars CIM-Jagriti and Subodhak had 7.59% and 7.44% respectively, more bacoside-A content in hydroponically grown plants than soil grown plants. Similar findings of increased bioactive compounds were observed by Surendran *et al.* (2017) in *Mentha spicata*, Buchanan and Omaye (2013) in lettuce, and Sgherri *et al.* (2010) in basil. High percentage of bioactive compounds found in hydroponically grown plants may be due to control over factors like temperature, humidity, light and pH of nutrient solution which helps in producing larger harvests with more consistent quality.

Conclusion

On the basis of present investigation, high fresh and dry biomass yield was obtained from cultivar Subodhak than cultivar CIM-Jagriti but bacoside-A content was found to be higher in CIM-Jagriti. Bacoside-A content was found to be 16.1 and 15.9 percent higher in CIM-Jagriti grown in hydroponic system and soil respectively, when compared to Subodhak. From this study, it can be concluded that plants grown in cocopeat performed better than other media used in hydroponics and plants grown in soil. The fresh biomass yield of brahmi grown in G_5 was found to be 113.03, 80.94, 90.05 and 100.97 percent less than G_1, G_2, G_3 and G_4, respectively and dry biomass yield of brahmi grown in G_5 was found to be 113.05, 78.95, 88.02 and 102.45 percent less than G_1, G_2, G_3 and G_4, respectively. Thus, the plants grown hydroponically showed better results and cultivar CIM-Jagriti is more profitable concerning quality.

References

Buchanan, D. N. and Omaye, S. T. 2013. Comparative study of ascorbic acid and tocopherol concentrations in hydroponic and soil-grown lettuces. *Food and Nutrition Sciences*. 4(10) : 1047-1053.

George, P. and George, N. 2016. Hydroponics – (Soilless cultivation of plants) for biodiversity conservation. *International Journal of Modern Trends in Engineering and Science*. 3 : 97-104.

Guirgiu, R. M., Morar, G. A., Dumitras, A., Boanca, P., Duda, B. M. and Moldovan, C. 2014. Study regarding the suitability of cultivating medicinal plants in hydroponic systems in controlled environment. *Research Journal of Agricultural Science*. 46(2) : 84-92.

Hoagland, D. R. and Arnon, D. I. 1950. The water-culture method for growing plants without soil. *Circular-California Agricultural Experiment Station.* 347(2): 32.

Khayyat, M., Nazari, F. and Salehi, H. 2007. Effects of different pot mixtures on Pothos (*Epiremnum aureum Lindl.* And Andre 'Golden Pothos') growth and development.

Koczurkiewicz, P., Lojewski, M., Piska, K., Michalik, M., Wüjcik-Pszczola, K., Szewczyk, A., Halaszuk, P., Pêkala, E. and Muszyñska, B., 2017. Chemopreventive and anticancer activities of *Bacopa monnieri* extracted from artificial digestive juices. *Natural Product Communications.* 13(3) : 337-342.

Maggini, R., Kiferle, C., Guidi, L., Pardossi, A. and Raffaelli, A. 2012. Growing medicinal plants in hydroponic culture. *Acta Horticulturae*. 952 : 697-704.

Mukherjee, D. G. and Dey, C. D. 1966. Clinical trial on brahmi. *Journal of Experimental Medical Sciences.* 10(2): 5-11.

Pal, R. and Sarin, J.P. 1992. Quantitative determination of Bacosides by UV spectrophotometry. *Indian Journal of Pharmaceutical Sciences.* 54: 17-18.

Patnaik, N. 2015. Role of brahmi and ashwagandha in anti-aging. *Journal of Biosciences and Medicines.* 3: 102-104.

Putra, A. and Henry, Y. 2015. Soilless culture system to support water use efficiency and product quality, a review. *Agriculture and Agricultural Science Procedia.* 3 : 283-288.

Sgherri, C., Cecconami, S., Pinzino, C., Navari-Izzo, F. and Izzo, R. 2010. Levels of antioxidants and nutraceuticals in basil grown in hydroponics and soil. *Food Chemistry.* 123(2) : 416-422.

Sharma, Y. and Vasundhara, M. 2015. Influence of media and nutrient solutions on growth, yield and quality of coleus (*Plectranthus barbatus* Andr.) under soilless culture. *World Research Journal of Agricultural and Biosystems Engineering*. 4(1) : 53-58.

Smitha, G. R., Kalaivanan, D. and Ranjitha, D. 2020. Brahmi – Memory booster crop. *Agro India- The Ultimate Agri Business Magazine*. 28-30.

Surendran, U., Chandran, C. and Joseph, E. J. 2017. Hydroponic cultivation of *Mentha spicata* and comparison of biochemical and antioxidant activities with soil-grown plants. *Acta Physiologiae Plantarum.* 39(1) : 26.

Yahya, A., Anieza, S. S., Rosli, B. M. and Ahmad, S. 2010. Growth dynamics of *Celosia cristata* grown in cocopeat, burnt rice hill and kenaf core fibre mixtures. *American Journal of Agricultural and Biological Sciences.* 5(1) : 70-76.