International Journal of Applied Home Science ***RESEARCH PAPER***
Volume 4 (7&8), July & August (2017) : 519-524 ISSN : 2394-1413 (Print)
Received : 05.07.2017; Revised : 12.07.2017; Accepted : 20.07.2017

Cultivation of *Solanum nigrum* under controlled environment using organic fertilizer

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ABSTRACT

Many herbal plants remain unknown for their antioxidant potentials and nutraceutical properties. *Solanum nigrum* (black nightshade) is a medicinal plant of the Solanaceae family and is a wild herb distributed throughout India which is high in antioxidant content and can cure various ailments. With this in view, the researcher aimed to study the effect of environmental factors and organic fertilizer in the cultivation of *Solanum nigrum*. The investigators selected plant species duly certified by a taxonomist which grows as a wild weed and not consumed as a green leafy vegetable in Idukki District of Kerala. The seeds of the certified *Solanum nigrum* species were planted in 20 pre-prepared mud pots in a greenhouse at the Avinashilingam University for Women, Coimbatore. Soil and water quality in the controlled (green house) and uncontrolled (natural habitat) were tested. A mixture of organic compounds namely cow dung, ground nut cake, neem cake, green gram powder and banana in the proportion 8:2:2:1:1 were prepared and used as an organic fertilizer for the plants cultivated in the controlled atmosphere once in a week and watered twice a day. Even though the soil and water used for the cultivation in controlled condition had some growth hindering factors such as salinity, high sodium concentration and low nitrogen, phosphorus and potassium concentration, the plant grow with the same growth rate of that in its natural habitat due to application of organic fertilizer. The study paved way to prove scientifically the influence of environmental factors such as soil condition, water quality and availability, climate and fertilizers on the nutraceutical potential of the wild weed for consumption.

Key Words : *Solanum nigrum*, Cultivation, Environmental factors, Organic fertiliser

INTRODUCTION

Recent researches found out many herbal plants which are very rich in antioxidants remains as unknown without recognized their antioxidant potentials through researches. The herbal drugs are considered to be less toxic than their synthetic counterparts and they have fewer adverse effects (Pari and Umamaheswari, 2000)

Solanum nigrum (black nightshade) is a medicinal plant of the Solanaceae family (Jain *et al.,* 2011). It is commonly known as Makoi or black nightshade (Kiran *et al.,* 2009). Black

Cite this Article: Sabu, Samja and Kalpana, C.A. (2017). Cultivation of *Solanum nigrum* under controlled environment using organic fertilizer. *Internat. J. Appl. Home Sci.,* **4** (7 & 8) : 519-524.

nightshade or *Solanum nigrum* is a fairly common herb or short-lived perennial shrub found in many wooded areas as well as disturbed habitats which have a height of 30-120 cm (Turner and Aderka, 2008).

Solanum nigrum possesses various compounds such as glycoalkaloids, glycoproteins, and polysaccharides and polyphenols such as gallic acid, catechin, protocatechuic acid (PCA), caffeic acid, epicatechin, rutin etc. that are responsible for diverse nutraceutical properties (Sikdar and Dutta, 2008). It's leaves contains around 82.1 g of moisture, 5.9 g of protein, 410 mg of Calcium, 20.5 mg of iron and 11 mg of vitamin C (Gopalan *et al.,* 2011). The juice of the leaves can be mixed with mediums like coconut water, coconut milk, buttermilk, cow's milk and fruit juices (Deshpande, 2010).

The ethno medical information sited that the plant has various properties such as antidiabetic, antiviral, antipyretic, anticonvulsant and sedative, antimalarial, antispasmodic, antimolluscicidal, anti-bronchitis and antigastritic activities (Maharana *et al.,* 2011). Present study is an effort to find out the effect of controlled and uncontrolled environmental factors on the growth of *Solanum nigrum* plants. More scientific researches about the antioxidant potential of this beneficial plant may become a boon for the treatment of cancer and other degenerative diseases in future. With this in view, the study was conducted with the following objectives.

- Cultivate *Solanum nigrum* under controlled environment using organic fertilizers.
- Analyze the quality of soil and water used for the cultivation of *Solanum nigrum.*
- Compare the growth pattern of the plant in controlled and uncontrolled conditions.

METHODOLOGY

Methodology of the study consists of following steps as :

Preparation of the soil for cultivation :

The researcher used the green house at Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu (where she is pursuing the study) for cultivation of *Solanum nigrum* plant, the soil from university campus were used for cultivation. Soil was prepared for cultivation by removing all debris and stone and filled in 20 mud pots and watered once a day for 2 days. No fertilizers were mixed with soil in initial stage. The soil sample and water used for irrigation purpose in both controlled condition (green house) and uncontrolled condition (natural habitat where the plant is growing naturally) were collected in polythene cover and plastic bottles, respectively. The collected samples of soil and water were tested for routine soil and water test in the Faculty of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore.

Certification of plant and collection of specimen for cultivation :

The black berried variety of *Solanum nigrum* was selected for the study. Since the plant is growing as a weed in different parts of Kerala, the investigator collected plant material from Idukki District, Kerala. It was thoroughly examined by an expert taxonomist and certified. After completion of certification process, the specimen for cultivation purpose was collected from Idukki district of Kerala. The ripe fruits from the plant were hand-picked

and mashed by adding water to separate seeds and fruits. The filtrate were dried in sunshine for one day and kept it in dry polythene covers.

Cultivation of plant and analysis of growth pattern :

The collected seeds of certified *Solanum nigrum* species were planted in 20 pre-prepared mud pots in greenhouse at Avinashilingam University for women, Coimbatore. After one month of germination, plants were replanted in pots as numbers of plants were limited as from 4 to 5 plants per pot. After one week of replantation, a fermented mixture of organic compounds such as cow dung, ground nut cake, neem cake, green gram powder and banana in the ratio 8:2:2:1:1 were prepared. The mixture were diluted with water in the ratio 1:9 and used as an organic fertilizer for plants once a week. The plants were watered twice a day. No extra manure was added for the plants grown in natural habitat. Growth rate of plant in controlled atmosphere in green house and in its natural habitat assessed for a period of 6 months.

RESULTS AND DISCUSSION

The results of the study discussed under the following heads.

Assessment of soil quality used for cultivation :

Table 1 explains the quality of soil used for cultivation in controlled condition (green house).

Table 1 : Quality of soil used for cultivation in controlled condition (green house)

Sr. No.	Parameters	Value	Comments
1.	pH	7.96	Slightly alkaline
2.	Available nitrogen	180 Kg/ha	Low
3.	Available phosphorus (Olsen's Method)	11.0 Kg/ha	Medium
4.	Available potassium	177 Kg/ha	Medium
5.	Electrical conductivity	0.16 dS/m	Non-saline

Table 1 depicts various parameters of soils used for cultivation of *Solanum nigrum* in controlled condition. It was calcareous reddish brown type with sandy loam texture which was slightly alkaline in nature. The available nitrogen in soil was very low and it contained phosphorus and potassium in medium amount. Since the soil is slightly alkaline in nature, the available Phosphorus was estimated by Olsen's method. The electrical conductivity (EC) is the measure of amount of salts present in soil, indicate that soil used for cultivation is non-saline in nature. According to Maharana *et al.* (2011), *Solanum nigrum* usually grows as a weed in moist habitats in different kinds of soils, including dry, stony, shallow, or deep soils, and can be cultivated in tropical and subtropical agro climatic regions by sowing the seeds during April-May in well-fertilized nursery beds; it can be used for reclaiming the degraded land as well.

The quality of soil used for cultivation in uncontrolled condition (natural habitat) was depicted in Table 2.

Table 2 : Quality of soil used for cultivation in uncontrolled condition (Natural habitat)

Sr. No.	Parameters	Value	Comments
1.	pH	5.55	Strongly acidic
2.	Available nitrogen	303 Kg/ha	Medium
3.	Available phosphorus (Bray Method)	105.0 Kg/ha	High
4.	Available potassium	311 Kg/ha	High
5.	Electrical conductivity	0.13 dS/m	Non-saline

Table 2 depicts various parameters of soils from the natural condition where the *Solanum nigrum* is growing abundantly. The soil was non-calcareous reddish brown type with clay loam texture which was strongly acidic in nature. The available nitrogen in soil was medium and it contained high amount of phosphorus and potassium. Since the soil is strongly acidic in nature, available Phosphorus was estimated by Bray method. The electrical conductivity value of soil indicated that soil from the natural environment is non-saline in nature. According to Ahmed (2009), salinization of soil is one of the major factors limiting crop production particularly in arid and semi-arid regions of the world.

Assessment of water quality used for cultivation :

The quality of water used for irrigation purpose of cultivation is depicted in Table 3. Water used for the irrigation purpose for the cultivation of *Solanum nigrum* in Controlled condition (green house) was mentioned as W1 and that used for the same in uncontrolled condition (natural habitat) was mentioned as W2 in the following tables and figures.

Table 3 : Water quality used for irrigation in controlled and uncontrolled conditions

Sr. No.	Parameters	W1	W2
1.	pH	7.58 (Neutral water)	6.72 (Neutral Water)
2.	Electrical Conductivity (dS/m)	1.98 (Medium saline water)	0.13 (Non-saline water)
3.	Calcium (meq/L)	3.12	0.18
4.	Magnesium (meq/L)	4.50	0.38 (No Mg hazard)
5.	Sodium (meq/L)	12.04 (Severe sodium hazard)	0.24 (No Na hazard)
6.	Potassium (meq/L)	0.14	0.50
7.	Carbonates (meq/L)	1.60	-
8.	Bicarbonates (meq/L)	4.00	0.80
9.	Chloride (meq/L)	2.80	0.80

Table 3 revealed that the pH of both W1 and W2 were neutral in nature. Comparing other parameters, electrical conductivity of W1 was 1.98 which was medium saline water but that of W2 was 0.18 which was non-saline. Even though W1 was medium saline water, the use of biofertilizer for the cultivation of *Solanum nigrum* in controlled condition may help to reduce the salinity of water which affects the plant growth. Almeida Machado and Serralheiro (2017) stated that biofertilizers have the potential to increase salt tolerance of vegetable crops and reduce soil salinization.

The calcium and magnesium content of W1 was high (3.12 meq/L and 4.50 meq/L,

respectively) and that of W2 was minimum (0.18 meq/L and 0.38 meq/L respectively). W1 was severely sodium hazard water with sodium concentration of 12.04 meq/L and that of W2 was 0.24 meq/L, which was very minimum sodium content. The potassium concentration of W1 was minimum (0.14 meq/L) and that of W2 was high (0.50 meq/L). Carbonates were absent in W2 and its concentration in W1 was 1.60meq/L. Bicarbonate and chloride concentration of W1 was high (4.00 meq/L and 2.80, respectively) and that of W2 was 0.80 meq/L.

Presence of Salt species in water used for cultivation in controlled and uncontrolled conditions was representing graphically in Fig. 1.

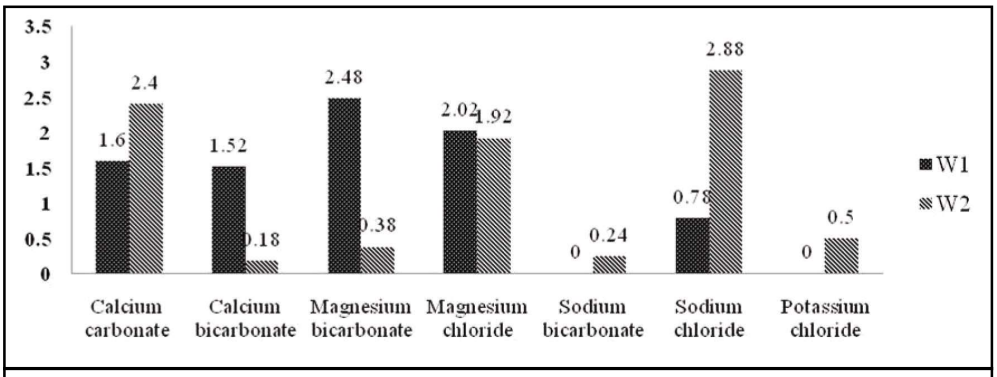

Fig. 1 : Presence of salt species in water used for cultivation in controlled and uncontrolled conditions

Fig. 1 exhibited that the salt species such as calcium bicarbonate (1.52 meq/L), magnesium bicarbonate (2.48 meq/L) and magnesium chloride (2.02 meq/L) were high in W1 as compared with W2. Sodium bicarbonate and potassium chloride were absent in W1 while it was present in W2 in trace amount (0.24 meq/L and 0.5 meq/L respectively). Other salt species such as calcium carbonate (2.4 meq/L) and sodium chloride (2.88 meq/L) were high in W2 as compared with W1.

Growth pattern of plants in controlled and uncontrolled environmental conditions:

The physical growth pattern of plants growing in both controlled and uncontrolled environmental conditions were analyzed and the result is given in Table 4.

Table 4 showed that in controlled conditions, the germination period was 5 days and flowering period was from 70 – 80 days whereas in uncontrolled conditions it was from 6-7 days and 65 - 70 days respectively. When considering the height of plant, the plant in controlled condition possess more height than that in uncontrolled condition. Even though the plant in its

Table 4 : Comparison of growth pattern of the plant in controlled and uncontrolled conditions

Sr. No.	Parameters	Plant in controlled Atmosphere (Green house)	Plant in uncontrolled Atmosphere (Natural habitat)
1.	Germination period	5 days	6-7 days
2.	Flowering period	70 – 80 days	65 - 70 days
3.	Height of the plant	80-110 cm	80 - 100 cm

natural habitat show less flowering time as compared with that grown in controlled condition in green house.

Conclusion :

Analyzing the results of present study, it can be stated that quality of soil and water used for cultivation and irrigation of *Solanum nigrum* in uncontrolled condition (natural habitat) was good as compare with that of controlled condition (green house cultivation). Concentration of Nitrogen, Phosphorus and Potassium concentration, which are essential for growth of plants, were low in soil used for cultivation in controlled condition while those elements were high in soil of natural habitat. Also water used for irrigation purpose in controlled cultivation was medium saline with high sodium concentration. While analyzing the growth rate of *Solanum nigrum* in controlled and uncontrolled conditions, the growth rate of plants in both conditions were almost equal irrespective of growth hindering factors of soil and water used in controlled condition. This might be able to achieve by the use of organic fertilizer. From this result, it can be concluded that the researcher was able to cultivate *Solanum nigrum* in controlled atmosphere as in the same growth rate of its growth in natural habitat by the use of organic fertilizers for further research work about the nutritional and phytochemical profile of plant.

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