



Research Article

Volume 20 Issue 3 - March 2019
DOI: 10.19080/ARTOAJ.2019.20.556131

Agri Res & Tech: Open Access J

Copyright © All rights are reserved by Stepanyan BT

Productivity and Content of Pharmaceutical Indices of *Sedum aizoon* L. At Different Ratios of N, P, K



Mairapetyan SKh, Tadevosyan AH, Aleksanyan JS, Tovmasyan AH, Stepanyan BT* and Galstyan HM

GS Davtyan Institute of Hydroponics Problems, Armenia

Submission: October 01, 2019, Published: March 18, 2019

*Corresponding author: Stepanyan BT, GS Davtyan Institute of Hydroponics Problems, NAS-RA, Yerevan, Armenia

Abstract

In the experiments of mineral nutrition optimization of valuable herb *Sedum aizoon* L. grown in open air hydroponic conditions it was revealed the significant influence of N, P, K ratio in nutrient solution on productivity and content of physiological-biochemical, pharmaceutical indices of plant. Moreover, the optimum ratio of N, P, K was 10:40:50 atom% for the output of medicinal raw material, and in the roots it was 16:23:61; 17:22:61; 15:25:60; 21:21:58; 15:43:42 and 26:18:56 atom% for biologically active compounds saponins, arbutin, β -sitosterol, oleanic acid, tannins and extractives, accordingly.

Keywords: Nutrition optimization; Hydroponics; *Sedum aizoon* L., Physiological-pharmacological indices; Productivity

Introduction

Medicinal herb *Sedum aizoon* L. have been introduced to soil-less culture taking into consideration the unique properties and high demand of stimulating and adaptive plant species. Long-term researches approved high productivity and possibility of hydroponic cultivation of *Sedum aizoon* L. and revealed its agro-radiochemical, physiological-biochemical characteristics in conditions of hydroponics and soil culture [1-4]. At the same time, in the Institute of Hydroponics Problems of NAS RA scientific experiments were done for optimization of the mineral nutrition of some medicinal, essential oil bearing, dye-bearing crops, also mathematical models of plant productivity increase have been received, and the influence of N, P, K ratio of the nutrient solution on productivity of plants and on stimulation of bioactive compounds' biosynthesis has been confirmed [5-8].

The aim of research was to study the influence of N, P, K different ratios on the plant productivity taking account above mentioned and medicinal specificities and prospects of *Sedum aizoon* L.

Material and Method

Sedum aizoon L. is a perennial herb with 25-45cm height that belongs to the Grassulaceae family. The root and over ground parts of the plant are used for medical purposes. In the roots of plant there were found carbohydrates, oleic acid, β -sitosterol, phenols and their derivatives (arbutin), tannins, triterpenoid saponins that have stimulating properties. In the leaves of plant there were found vitamin C, carotenoids, tannins and negligible amounts of

arbutin and saponins. The plant is used for treatment of pneumonia, hepatitis, kidney diseases and other diseases. It has also abilities to reduce temperature, heal wounds and raise vitality [9-11].

The experiments were done with the 8 repeats in hydroponic vegetative vessels with 0.16m² surface, where the mixture of volcanic slag and gravel with 1:1 ratio was used as a substrate. Plants were nourished two times during a day with the Davtyan's 1N nutrient solution [12] with the following three proportions of N, P, K: N₇₀P₁₅K₁₅, N₁₅P₇₀K₁₅ and N₁₅P₁₅K₇₀ atom %. The methods of Homes's Systematic variations [13] and Vakhmistrov's "correlation probing" [14] were used to clarify the optimal ratio of N, P, K, and to count correlation coefficient between plant productivity and N, P, K ratio in nutrient solution. Physiological-biochemical and medicinal analyses of experimental plants were done during vegetation: water-holding forces, the sap osmotic pressure in the leaves were measured according Gusev [15], the content of photosynthetic pigments was estimated according Wettstein [16], the content of vitamin C was determined according Yermakov [17] and the content of tannins, extractive compounds and humidity in the dry medicinal raw material was defined according SPh XI [18]. The amount of saponins, arbutin, β -sitosterin, oleic acid in the roots was determined by the method of preparative thin layer chromatography. The samples of "Sigma Aldrich" firm were used as standards.

Results and Discussion

The experiment results for optimization of *Sedum aizoon* L. mineral nutrition is shown in the Tables 1-4. It was found that

high amount of potassium in the nutrient solution promotes the increase of plant productivity and improvement of some medicinal indices (Table 1,2).

The content of bioactive substances in the variant with high-

est content of K exceeded the variant with highest content of N, in average, 1.6-2.3 times and the variant with highest content of P 1.7-1.8 times. The high amount of nitrogen in nutrient solution had a negative influence on tannins content in the roots and accumulation of dry medicinal raw material.

Table 1: Influence of N, P, K different ratios in the nutrient solution on the productivity of *Sedum aizoon* L.

Variants, Atom/%	Mass of Dry Raw Material, g/plant				Proportion %		
	Leaf	Stem	Root	Σ	Leaf	Stem	Root
70:15:15	1.7	1.8	2.5	6	29	30	41
0.673784722	6.4	4.3	6.6	17.2	37	25	38
0.636226852	9.9	3.5	7.8	21.3	47	16	37

Table 2: Pharmacological indices (%) of *Sedum aizoon* L. roots at different N:P:K ratios in nutrient solution.

Indices	N:P:K Ratio, Atom%		
	70:15:15	0.673785	0.636227
Saponins	0.75	0.87	1.58
Arbutin	0.33	0.38	0.69
β-sitosterol	0.04	0.05	0.09
Oleic Acid	0.03	0.03	0.05
Tannins	3.3	6.1	5.9
Extractive Substances	12.5	10.8	19.6
Humidity	9.7	9.2	9

N, P, K effective ratios were calculated theoretically for dry medicinal raw material of *Sedum aizoon* L. using the method of “systematic variations” of Homes: 10:40: 50 atom % for output of over ground mass and total medicinal raw material and 11:40:49 atom % for roots. Also, correlation coefficients between the plant

productivity and N:P:K ratio in the nutrient solution was defined that were -0.998; -0.999 and -0.997, respectively.

Mathematical models of plant productivity enhancement were developed in form of regression equations (for over ground mass: $y=19.82-0.27x$; for roots: $y=11.79-0.157x$; for total medicinal raw material: $y=30.17-0.383x$). The analyses of equations allow to suppose that it is possible to receive maximum harvest of *Sedum aizoon* L. at nutrient solution with optimal N:P:K ratio: for over ground mass it equals to 19.82g/plant, for roots it is 11.79 g/plant, for total medicinal raw material it makes up 30.17g/plant and the 1 atom % shift from above mentioned values will bring to the decrease of yield on 0.270g/plant; 0.157g/plant; 0.383g/plant amount, respectively.

Similar calculations were done also for the definition of bioactive compounds (saponins, arbutin, β-sitosterol, oleic acid, tannins and extractive substances) content in the roots of *Sedum aizoon* L. (Table 3).

Table 3: N, P, K optimal ratio (atom %) and correlation coefficient (r) for the maximal content of bioactive compounds in the roots of *Sedum aizoon* L.

Indices	Optimal Ratio of N, P, K	Correlation Coefficient	Predicted Maximum Content of Bioactive Substances, %
Saponins	0.683345	-1	1.74
Arbutin	0.724317	-0.999	0.77
β-sitosterol	0.643056	-1	0.1
Oleic Acid	21:21:58	-0.987	0.06
Tannins	15:43:42	-0.999	8.7
Extractive Substances	26:18:56	-0.999	22.84

Mathematical models of plant productivity enhancement were brought out in form of regression equations for the content of:

- Saponins: $y=1.74-0.0185x$.
- Arbutin: $y=0.77-0.0081x$.
- β-sitosterol: $y=0.1-0.0011x$.
- Oleic acid: $y=0.057-0.00054x$.
- Tannins: $y=8.7-0.0983x$.
- Extractive substances: $y=22.84-0.223x$.

These equations prove, that in optimal conditions of nutrient

solution it is possible to receive maximum amount of saponins, arbutin, β-sitosterol, oleic acid, tannins and extractive substances in the roots of *Sedum aizoon* L.

Thus, relatively high accumulation of water’s more mobile fraction, chlorophyll (a+b) and vitamin C was observed in case of nitrogen and phosphorus high portions in nutrient solution, and an increase of sap osmotic pressure and osmotic bound water was recorded in variants with predominance of phosphorus and potassium. Relatively high portion of phosphorus in nutrient solution provided the increase of carotenoids content in the leaves (Figure).

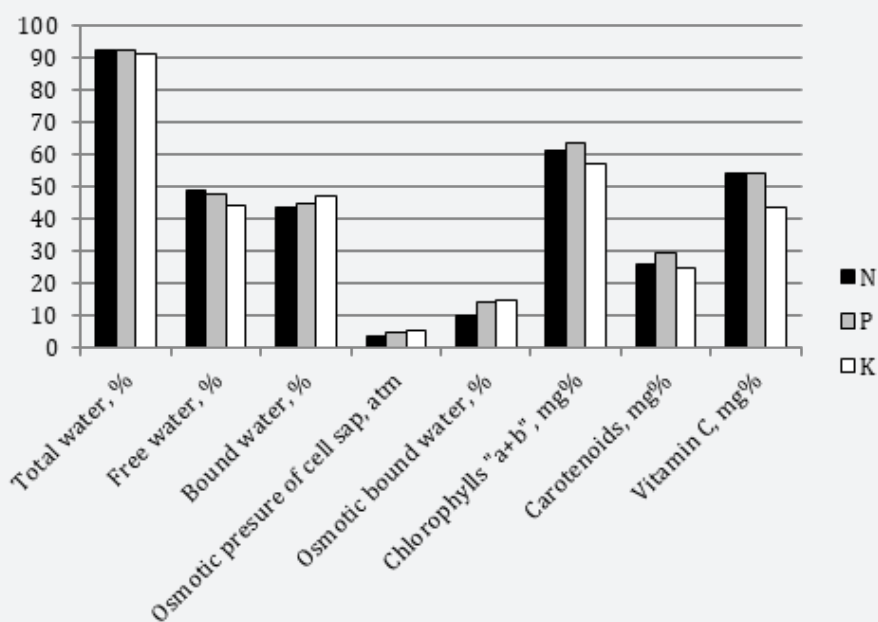


Figure 1: Different ratios of N, P, K in the nutrient solution has influenced also on a number of physiological-biochemical Indices of *Sedum aizoon* L.

Conclusion

The ratio of N, P, K in Davtyan's 1N nutrient solution sufficiently influences on the productivity and bioactive substances content of *Sedum aizoon* L. Whereupon, effective ratios of N, P, K are 10:40:50 atom% in the case of total medicinal raw material output, and are 16:23:61; 17:22:61; 15:25:60; 21:21:58; 15:43:42 and 26:18:56 atom % in the roots in the case of bioactive compounds saponins, arbutin, β -sitosterol, oleic acid, tannins and extractive substances, respectively.

References

- Mairapetyan S, Tadevosyan A, Alexanyan J, Buniatyan R, Galstyan H, et al. (2007a) Possibility of the cultivation of *Sedum aizoon* L. in open-air hydroponic conditions. Communications of IHP NAS RA, Yerevan 31: 24-29.
- Mairapetyan S, Tadevosyan A, Alexanyan J, Stepanyan B, Galstyan H, et al. (2007b) Influence of different concentrations of the nutrient solution on the productivity of Citric basil under open-air hydroponic conditions. Communications of IHP NAS RA, Yerevan 31: 36-39.
- Mairapetyan SKh, Tadevosyan AH, Alexanyan JS, Galstyan HM, Buniatyan RJ, et al. (2008) Influence of growing media on the productivity of *Aizoon* stoncrop under open-air hydroponic conditions. International Conference Biotechnology and health-2 & DAAD Alumni seminar, Armenia, p. 67-74.
- Mairapetyan KS, Tadevosyan AH, Alexanyan JS, Ghalachyan LM, Galstyan HM, et al. (2011) Some pharmacochimical and radiochemical indices of *Sedum aizoon* L. under soilless and soil conditions of the Ararat Valley. Electronic Journal of Natural Sciences 1(16): 12-16.
- Buniatyan R, Tadevosyan A (2007) Optimization of mineral nutrition of Lemonbalm under open-air hydroponic conditions. Communications of IHP NAS-RA, Yerevan 31: 64-67.
- Mairapetyan S, Tadevosyan A, Alexanyan J, Stepanyan B, Buniatyan R, et al. (2005) The feasibility and efficiency of Bur marigold soilless cultivation and its physiological, biochemical and pharmacochimical peculiarities. Communications of IHP NAS-RA, Yerevan30: 7-14.
- Mairapetyan S, Tadevosyan A (1999) Optimization of plants mineral nutrition in conditions of hydroponics. Publishing house Gitutyun, NAS-RA, Yerevan, pp. 230.
- Hovhannisyanyan L (1996) Phytotechnology of *Orthosiphon stamineus* in Ararat valley in conditions of hydroponics. Synopsis of dissertation, Yerevan, p. 20.
- Keusev P (2001) Full reference book of medicinal plants. EXMO-PRESS, Moscow, pp. 846-849.
- Lavrenov V, Lavrenova G (1999) Full encyclopedia of medicinal plants. St. Petersburg, publishing House Neva, Moscow, Olma-Press, pp. 637-641.
- Xu T, Wang Z, Lei T, Lv C, Wang J, et al. (2015) New flavonoid glycosides from *Sedum aizoon* L. Fitoterapia 101: 125-132.
- Davtyan GS (1980) Hydroponics. Reference book on chemicalization of agriculture. M Kolos, pp. 382-385.
- Homes MVL (1961) Alimentation mineral equilibree des Vegetaux, Wetteren, Universa, 1: 55.
- Vakhmistrov D, Vorontsov B (1994) The ratio of mineral nutrition elements in the environment and plants' growth. Form investigation of cupola response. Plant physiology 8: 425-430.
- Gusev N (1989) Investigation of methods of plants' water exchange. Kazan, publisher of Kazan University, p. 17-19.
- Wettstein D (1957) Chlorophyll lefle und der submicrobische formishe der Plastiden. Exp Cell Research 12: 427.
- Yermakov A, Arasimovich A, Smirnov-Ikonokova M, Murri I (1952) Methods of plants biochemical study. Moscow, p. 89.
- (1990) State Pharmacopoea of USSR, XI volume, (2nd edn), Moscow: Medicine, pp. 327-328.



This work is licensed under Creative Commons Attribution 4.0 License
DOI: [10.19080/ARTOAJ.2019.20.556131](https://doi.org/10.19080/ARTOAJ.2019.20.556131)

**Your next submission with Juniper Publishers
will reach you the below assets**

- Quality Editorial service
- Swift Peer Review
- Reprints availability
- E-prints Service
- Manuscript Podcast for convenient understanding
- Global attainment for your research
- Manuscript accessibility in different formats
(Pdf, E-pub, Full Text, Audio)
- Unceasing customer service

Track the below URL for one-step submission
<https://juniperpublishers.com/online-submission.php>