

The Response of *Portulaca oleracea* L to Different Concentration of Nitrogen Fertilizer

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To cite this article:

Taha Mohammed Sharief Mohammed, Fathia Suliman Omer Suliman. The Response of *Portulaca oleracea* L to Different Concentration of Nitrogen Fertilizer. *American Journal of Bioscience and Bioengineering*. Vol. 7, No. 1, 2019, pp. 19-21. doi: 10.11648/j.bio.20190701.14

Received: February 27, 2019; Accepted: April 3, 2019; Published: April 29, 2019

Abstract: The growing responses of *Portulaca oleracea* L. to nitrogen fertilizer stress caused by different concentration of urea applications were studied. The study was to determine not only the most appropriate nitrogen form but also the effect of these forms on growth, yield, element content and nitrate accumulation of cultivated purslane (*Portulaca oleracea* L.) when the usual N dose was applied. For this purpose, 20 seeds of mentioned species were placed on plastic pots in each replicate and irrigated with (control), N1, N2, and N3 of urea fertilizer. The results indicated that urea effects were significant ($P < 0.05$) for seed germination and plant height and number of leaves. The greater amount of fertilizer application reduced the plant height and number of leaves that means *P. oleracea* L. is very sensitive to urea as salt causing salinity. Considering the nitrate accumulation in leafy vegetables is harmful for human health, therefore, the usual dose of ammonium sulfate is firstly suggested that it should be applied to not only have better yield and agronomic traits but also produce healthy crops for human nutrition in cultivated purslane. However, when the highest yield was taken into consideration, ammonium nitrate was also suggested as a fertilizer for purslane.

Keywords: Salinity Stress, Urea, *Portulaca oleracea* L

1. Introduction

Portulaca oleracea L. is a warm-climate, herbaceous succulent annual plant with a cosmopolitan distribution belonging to the Portulacaceae family. It is commonly known as purslane (USA and Australia), pigweed (England), pourpier (France), rigla (Sudan), and Ma-Chi-Xian (China) [1]. It is distributed widely in the tropical and subtropical areas of the world including many parts of the United States and is eaten extensively as a potherb and is added to soups and salads around the Mediterranean and tropical Asian countries [2]. *Portulaca oleracea* also provides a source of nutritional benefits owing to its rich omega-3 fatty acids and antioxidant properties [3]. *Portulaca oleracea* has been used as a folk medicine in many countries, acting as a febrifuge, antiseptic, vermifuge, and so forth [4]. It exhibits a wide range of pharmacological effects, including antibacterial [5], anti ulcerogenic [6], anti-inflammatory [7], antioxidant [8], and wound-healing [9] properties. It is listed by the World Health Organization as one of the most used medicinal

plants, and it has been given the term “Global Panacea” [10]. The Chinese folklore described it as “vegetable for long life” and it has been used for thousands of years in traditional Chinese Medicine [11, 12]. Nitrogen is an essential mineral fertilizer for plant growth and development and is the world’s largest agricultural chemical. Nitrogen forms are widely used in vegetable production in Turkey and other countries [13, 14]. It has important role as a basic element of protein, nucleic acids, chlorophyll and growth hormones [15] and is essential in periods of rapid growth. However, farmers have increased application of N fertilizers to their land year by year without considering the response of different species to N rate and forms. A major drawback of fertilizer use, particularly in the case of N is excessive use beyond the crop’s needs leads to negative implications for the environment, especially groundwater pollution and its associated health hazards [16]. Adequate supply of nitrogen (N) can promote plant growth and increase crop production, but under excessive application of nitrogen fertilizer, especially, vegetables can accumulate high levels of nitrate

and, upon being consumed by living beings, pose serious health hazards.

1.1. Botanical Description

P. oleracea is a succulent annual herb. Stems sometimes flushed red or purple, not articulated, prostrate or decumbent, less often erect, diffuse, much branched; leaf axils with a few inconspicuous stiff bristles. The leaves are alternate or occasionally subopposite, petiole short, leaf blade flat, obovate, 10-30 × 5-15 mm, base cuneate, apex obtuse, rounded, and truncated. The flowers are in clusters of 3-5, 0.4-0.5 cm in diameter, surrounded by involucre of 2-6 bracts. Sepals are green, helmeted, ca. 4 mm, apex acute, and keeled. Petals 5, yellow, obovate, 3-5 mm, slightly connate at base, apex retuse. Stamens 7-12, ca. 12 mm; anthers are yellow. Ovary is glabrous. Stigma is 4-6-lobed. Capsule ovoid, ca. 5 mm. Seeds glossy black when mature, never iridescent, obliquely globose-reniform, 0.6-1.2 mm; testa cells stellate, usually with central peg like tubercle, sometimes without and then surface granular. Seed production of these plants is very high (one plant can introduce up to 10,000 seeds to the environment. It has a slightly sour and salty taste. The stems, leaves and flower buds are all edible [17].

1.2. Health Values

Beta-carotene: medium; vitamin E: low; riboflavin: low; folic acid: low; ascorbic acid: medium; calcium: low; iron: high; protein: 1.3%. Edible portions contain coumarins, flavonoids, and oxalic acid (ca.1%). Purslane contains omega-3 fatty acids that are available to the human diet mainly through animal sources such as fish; it may have a protective effect against cardiovascular disease [3].

2. Material and Methods

P. oleracea is grown in a wide range of soils and different climatic zones.

2.1. Effects of Nitrogen Application on Growing

To evaluate the effect of this salt on growing, 20 seeds of Purslane were placed on plastic pots and irrigated after adding urea fertilizer (N0, N1, N2 and N3 kg/fed urea). Experiment was performed in a completely randomized design with 4 replicates in the laboratory of the Department of Horticulture, Faculty of Agriculture, University of Zalingei. Germination and growing measurement were made weekly and were considered to have germinated when the radicle emerged. At the end of the growing period collected data were analyzed.

2.2. Statistical Analysis

A multivariate ANOVA was used to evaluate the effects of nitrogen application on growing performance. Data were analyzed using Statistix 8 for windows. When significant main effects existed, differences were tested by a multiple

comparison LSD test at 0.05% confidence.

3. Result and Discussion

The effect of nitrogen forms on plant growth in purslane was presented in Table 1. It was seen that nitrogen forms had plant height in purslane increased significantly. While the lowest plant height values were determined in control (17.2 cm), the highest plant height value was obtained from nitrogen application (N2) is (41 cm). However; when we add nitrogen in the biggest dose (N3) reduced the plant height. Significant differences were shown in the 4th and 6th weeks. There were no significant effects on plant height by nitrogen in the other weeks of the experiment.

Table 1. Table shows the effect of nitrogen application on plant height.

n	1week	2	3	4	5	6
0	3.30A	6.10A	12.25A	18.25B	28.50A	17.27B
1	3.50A	6.50A	16.55A	26.95AB	36.20A	32.05AB
2	3.80A	7.50A	14.55A	20.10AB	26.80A	41.05A
3	3.70A	7.10A	16.00A	32.5A	35.15A	23.75AB
Alpha	0.05	0.05	0.05	0.05	0.05	0.05
CV	1.64	3.16	8.1	13.6	28.3	22.1

Data represented in Table 2 showed a significant effect in the last week of the experiment on number of leave according to nitrogen application. The experiment indicates that the greater amount of nitrogen did not mean a greater yield.

Table 2. Table shows the effect of nitrogen application on plant leaves.

n	1week	2	3	4	5	6
0	1.26A	1.71A	2.089A	4.64A	9.62A	8.45B
1	0.62A	2.45A	3.71A	6.44A	11.16A	14.80AB
2	0.84A	2.08A	3.40A	6.80A	10.54A	15.92A
3	0.75A	1.95A	3.25A	6.84A	11.30A	11.05AB
Alpha	0.05	0.05	0.05	0.05	0.05	0.05
CV	0.81	0.95	1.69	3.30	6.86	6.55

Responses of purslane plants to nitrogen fertilizers were consistent in both experimental years. The results indicated that there were significant differences among (N1 and N2) in terms of the plant height and number of leaves. Thus, [18] reported that plant height of purslane changed according to the varieties and average plant height ranged from 27.4 cm to 55.0 cm. Similarly, according to [19, 20] reports plant height changed between 20 and 30 cm. On the other hand, [21] declared that plant height was affected by the stage of harvest and it was ranging between 27.4 cm and 44.3 cm. And also, dry matter content of plant affected by the stage of harvest as in plant height and dry weights of leaves and shoot were ranged between 0.5 g and 2.2 g, and 0.9 g and 4.2 g, respectively. For all that, although there were no detailed reports about the root length and root dry matter of cultivated purslane, [19, 20] reported that the biggest parts of cultivated purslane roots were spread under the 20 cm of soil. Results of our work were similar and verified agronomic traits those obtained by other researches.

4. Conclusion

Consequently, the results of this study suggest that cultivated purslane had increased the growth characteristics such as yield with the application of different N forms. When considering the nitrate accumulation in leafy vegetables is harmful for human health, therefore, the usual dose of ammonium sulfate is firstly suggested that it should be applied to not only have better yield and agronomic traits but also produce healthy crops for human nutrition in cultivated purslane (*Portulaca oleracea* L.). Moreover, it can be said that nitrate accumulation on purslane was low and under the critical values across N forms. With this reason, although urea was firstly suggested, when the highest yield was taken into consideration, urea was also suggested as a fertilizer for purslane. The levels of nitrates in purslane were similar to or even lower than the values obtained in other vegetables. Therefore, nitrates consumed from purslane are concluded to be harmless to human health.

References

- [1] Elkhayat E. S., S. R. M. Ibrahim, and M. A. Aziz, "Portulene, a new diterpene from *Portulaca oleracea* L.," *Journal of Asian Natural Products Research*, vol. 10, no. 11-12, pp. 1039–1043, 2008.
- [2] Palaniswamy U. R., B. B. Bible, and R. J. McAvoy, "Effect of nitrate: ammonium nitrogen ratio on oxalate levels of purslane," *Trends in New Crops and New Uses*, vol. 11, no. 5, pp. 453–455, 2002.
- [3] Palaniswamy U. R., R. J. McAvoy, and B. B. Bible, "Stage of harvest and polyunsaturated essential fatty acid concentrations in purslane (*Portulaca oleracea*) leaves," *Journal of Agricultural and Food Chemistry*, vol. 49, no. 7, pp. 3490–3493, 2001.
- [4] Lee A. S., J. S. Kim, Y. J. Lee, D. G. Kang, and H. S. Lee, "Anti-TNF- activity of *Portulaca oleracea* in vascular endothelial cells," *International Journal of Molecular Sciences*, vol. 13, no. 5, pp. 5628–5644, 2012.
- [5] Zhang X. J., Y. B. Ji, Z. Y. Qu, J. C. Xia, and L. Wang, "Experimental studies on antibiotic functions of *Portulaca oleracea* L. in vitro," *Chinese Journal of Microecology*, vol. 14, no. 6, pp. 277–280, 2002.
- [6] Karimi G., H. Hosseinzadeh, and N. Ettehad, "Evaluation of the gastric antiulcerogenic effects of *Portulaca oleracea* L. extracts in mice," *Phytotherapy Research*, vol. 18, no. 6, pp. 484–487, 2004.
- [7] Chan K., M. W. Islam, M. Kamil et al., "The analgesic and anti-inflammatory effects of *Portulaca oleracea* L. subsp. *Sativa* (Haw.) Celak," *Journal of Ethnopharmacology*, vol. 73, no. 3, pp. 445–451, 2000.
- [8] Chen B. Chen, H. Zhou, W. Zhao, W. Zhou, Q. Yuan, and G. Yang, "Effects of aqueous extract of *Portulaca oleracea* L. on oxidative stress and liver, spleen leptin, PAR and FAS mRNA expression in high-fat diet induced mice," *Molecular Biology Reports*, vol. 39, no. 8, pp. 7981–7988, 2012.
- [9] Rashed A. N., F. U. Afifi, and A. M. Disi, "Simple evaluation of the wound healing activity of a crude extract of *Portulaca oleracea* L. (growing in Jordan) in *Mus musculus* JVI-1," *Journal of Ethnopharmacology*, vol. 88, no. 2-3, pp. 131–136, 2003.
- [10] Xu X., L. Yu, and G. Chen, "Determination of flavonoids in *Portulaca oleracea* L. by capillary electrophoresis with electrochemical detection," *Journal of Pharmaceutical and Biomedical Analysis*, vol. 41, no. 2, pp. 493–499, 2006.
- [11] Chen C.-J., W.-Y. Wang, X.-L. Wang et al., "Anti-hypoxic activity of the ethanol extract from *Portulaca oleracea* in mice," *Journal of Ethnopharmacology*, vol. 124, no. 2, pp. 246–250, 2009.
- [12] Jin R., Z. J. Lin, C. M. Xue, and B. Zhang, "An improved association- mining research for exploring Chinese herbal property theory: based on data of the Shennong's Classic of *Materia Medica*," *Journal of integrative medicine*, vol. 11, no. 5, pp. 352– 365, 2013.
- [13] Güvenç, I., 2002. Effect of Nitrogen fertilization on growth, yield, and nitrogen contents of radishes. *Gartenbauwissenschaft*, 67: 23-27.
- [14] Wang Z. H., S. X. Li and S. Malhi, 2008. Effects of fertilization and other agronomic measures on nutritional quality of crops. *Journal of the Science of Food and Agriculture*, 88: 7-23.
- [15] Barker, A. V., D. N. Maynard and H. A. Mills, 1974. Variations in nitrate accumulation among spinach cultivars. *Journal of the American Society for Horticultural Science*, 99: 132-134.
- [16] Korkmaz, K., H. Ibrici, J. Ryan, G. Buyuk, N. Guzel, E. Karnez, H. Oguz, T. Yagbasanlar, 2008. Optimizing nitrogen fertilizer-use recommendations for winter wheat in a mediterranean-type environment using tissue nitrate testing. *Communications in Soil Science and Plant Analysis*, 39: 1352 - 1366.
- [17] Riccieri C, Arrigoni PV. L'aggregato di P. oleracea L. (*Portulacaceae*) in Italia, in *Parlatorea IV*; 2000. p. 91-97.
- [18] Elmi, A. A., T. Mebrahtu, T. R. Omara-Alwala and M. Ezekwe, 1997. Environmental effects on yield and agronomic traits of purslane (*Portulaca* spp.). *Virginia Journal of Science*, 48: 203-209.
- [19] Vural, H., D. Eşiyok and Duman I., 2000. *Kültür Sebzeleri (Sebze Yetiştirme)*. İzmir, Turkey, 440 pp. (Tr).
- [20] Günay, A., 2005. *Sebze Yetiştiriciliği*. İzmir, Turkey, 531 pp. (Tr).
- [21] Palaniswamy, U. R., B. B. Bible and R. J. McAvoy, 2004. Oxalic acid concentrations in purslane (*Portulaca oleracea* L.) is altered by the stage of harvest and the nitrate to ammonium ratios in hydroponics. *Scientia Horticulturae*, 102: 267–275.