Tikrit Journal for Agricultural Sciences (2022) 22 (3):113-119
https://doi.org/10.25130/tjas.22.3.13

IRAQI Academic Scientific Journals
العراقية المجلات الأكاديمية العلمية

ISSN:1813-1646 (Print); 2664-0597 (Online)
Tikrit Journal for Agricultural Sciences
Journal Homepage: http://www.tjas.org
E-mail: tjas@tu.edu.iq

TJAS
Tikrit Journal for Agricultural Sciences

Angham Ayad Kamaluddin *
Riyadh Mannaa Mohsin
Ashjan Nazar Kamil

Department of Horticulture and Landscape, College of Agriculture, Tikrit University, Iraq

KEY WORDS:

Kalanchoe blossfeldiana, nano fertilizers, NPK..

ARTICLE HISTORY:

Received: 10/08/2022
Accepted: 24/08/2022
Available online: 30/9/2022

Effect of NPK nano fertilizer on vegetative, flowering, and content traits of *Kalanchoe blossfeldiana*

ABSTRACT

This experiment was conducted in a greenhouse at the department of Horticulture and Landscape, Tikrit University, during spring 2021. The aim was to investigate the effect of NPK nano fertilizers on growth, flowering, and mineral content characteristics of *Kalanchoe blossfeldiana*. basic and nano NPK fertilizers were applied to the plant. The experiment was designed according to randomized complete block design (RCBD) with three replicates. The results showed positive effects of nano NPK form on growth and flowering as well as leaf content of minerals and chlorophyll. The effects were higher than those of basic NPK and control treatments. The positive influences included most of characteristics studied. Number of leaves, plant diameter, and number of flowers were significantly increased to 15.00, 16.66 cm, 71.00 respectively. In addition, chlorophyll content recorded 1.97 under nano fertilizer treatment.

INTRODUCTION

Gardens are significant part of sustainable urbanization (Mohsin, 2019). Succulent plants, are one of the types used in landscapes specially in dry regions. They provide gardens with variant size, form, and texture to strengthen the space esthetic (Brickell, 1999). Recently, they have been planted for gardening purposes. They are suitable to characteristics of Mediterranean countries (Thakur, 2021). Of succulents, kalanchoe is one of the most popular genus. Its ornamental importance is highly noted (Foxcroft et. al., 2008; Hurrell et.al., 2012). Many species of kalanchoe were used as houseplants or in landscape (Smith, 2004; Poppenga and Gwaltney-Brant, 2011). Domestic to Madagascar and Africa and belongs to the family of Crassulaceae, this genus is marketed for its ornamental importance (Solmon, 2019; Vargas et. al.,2022). *K. blossfeldiana* is potted succulent that is common to be used indoor. It needs only small container for shoot and shallow root system. Substrates aerated by compost and sand makes the growing container very convenient to transfer. The plant can be described as a rounded shrublet with little upright branches. The leaves are flat, shiny, succulents with green color, and toothed margin. The flowers are borne erectly on flat-topped and dense inflorescences (Smith, 2019).

Kalanchoe blossfeldiana is perennial succulent plant with dens branches. In wide range, it can be described as from herbal to shrublet, with potential to develop woody tissues in long-lived plants. It grows slowly up to 30-40 cm with round-like, thick leaves (Gilman and

* *Corresponding author: E-mail*: riyadhmannaa@tu.edu.iq

Edward, 2013). Flowers are various in color (red, pink, orang etc.) and set off during fall to the beginning of winter. Protecting the plant from frost and less than 10 °C temperature as well as add nutrition are of consideration (Romhold, 2000).

Succulents are very important commercially. However, information about cultivation, particularly fertilizations, are still inadequate (Lessa et.al.,2009). NPK are macronutrient play crucial roles in plant growth and development. Many forms of such nutrients are exposed to loss from the soil (Dimkpa and Bindraban, 2016). They are exposed to leaching, evaporation, or fixation particularly in soils with high content of carbonates, which leads to increase pH value (Romhold, 2000; Khafaji, 2000). Fertilization is one of the common agricultural practices. When minerals are discontinuous and imbalanced, succulent can only remain alive at their natural habitat. Adding basic fertilizers can lead them to bloom (Hewitt,1997; Lessa et. al., 2009). Olmos (1978), reported that succulent responded well to fertilization with 15:20:30 of liquid NPK. Other formulations of NPK may also be used (Bell, 2001). Applying NPK enhanced plant emergence, increased number of survived plantlets, and plant height (Seixas 2001).

The technology of nano fertilizer has made significant changes (Al-Juthery et. al., 2021). In the sense of small surface area with ability to be stored for long time with no side effects considered (Mahanta, et.al.,2019). Nanoparticles are very small molecules (1–100 nm) with physiochemical properties differ from bulk particles (Reda et al. 2021). These molecules have high ratio of surface area to volume which improves their chemical, physical, and biological characteristics (Adhikari et al., 2010; El-Saadony et al., 2021). Nano fertilizers can be applied as a liquid or a powder to enhance plant growth and development (Josef and Katarína, 2015).

In developing countries, nanotechnology can be one solution towards agricultural sustainability (Naderi and Danesh-Shahraki, 2013). Applying 1 gm L^{-1} NPK with 10% of moringa leaves extract resulted in significant effects on *Gladiolus grandifloras*. The values of spike's dry and fresh weights and stem diameter, as well as flowering diameter were the highest. Each of nano-NPK treatment (0.5 ,1 g L^{-1}) was superior over treatments of traditional NPK and control in chlorophyll a, b, and carotenoids, and carbohydrates. The same nano treatment also recorded the higher percentages of N%, P%, K% compared to basic treatment or control (Sarhan et. al., 2022). Each of nano NPK or nano zeolite resulted outstanding outcomes comparing to basic NPK, or individual nano of N, P, or K. The vegetative growth of *Salvia officinalis* L. indexes including plant height, leaf area, branches number, and fresh and dry weight were increased under nano NPK. In addition, values of fresh weight of yield, total carbohydrates, macro and micro-elements were raised. Moreover, rate of photosynthesis, water use efficiency, and stomatal conductance were also involved (Mohamed and Swaefy, 2020). To current knowledge, information regarding fertilization forms on kalanchoe plants are still insufficient. Therefore, the main aim of this study was to investigate the effect of NKP fertilizers forms on growth, flowering, and chemical content of *kalanchoe blossfeldiana*.

MATERIALS AND METHODS

This experiment was conducted in a greenhouse at the department of Horticulture and Landscape, college of Agriculture- Tikrit University during spring season of 2021. Seedlings of kalanchoe plants were brought from local nursery on February 7th. Pots of 20 cm diameter and filled with loamy sand soil and peatmoss 1: 1 v: v were prepared. After acclimation period for a week, the plants were transplanted into the pots. Experiment on factor of three levels was implemented. The levels were basic form of NPK (1.5 gm L^{-1}), nano NPK (1 ml $L^{-1)}$, and only water without NPK (control). Each of the levels (treatments) was applied onto the substrate of the plants. The treatments were randomly assigned to experimental units.

The experiment designed with randomized complete block design (RCBD) in three replicates and three plants in each experimental unit. Agricultural practices including weeding, irrigation, and insects' investigation were implemented as basic ly. The parameters studied were vegetative (number of leaves pe plant, length cm, width cm, and thickness of leaf mm, and plant diameter cm), flowering (length cm, diameter cm, and weight of inflorescence gm, number of inflorescences per plant, number of flowers per plant) as well as leaf content (N, P, K%, and

chlorophyll). All data were collected and analyzed according to Duncan's multiple-range test at probability 5%.

RESULTS AND DISCUSSION

1-Vegetative parameters

Results in table 1 showed superiority of nano fertilizer NPK in most of the parameters studied. Number of leaves, leaf width, leaf thickness (mm), and plant diameter (cm) recorded higher number compared to basic NPK and control treatments. The values of nano NPK treatment were 15.00 leaf plant $^{-1,}$ 6.52 cm, 2 mm, and 16.66 cm respectively. The least values of these parameters were 10 leaf plant $^{-1}$, 5.46 cm, 1.16 mm, and 14.66 cm in the treatment of control. However, the treatment of basic NPK had higher value in leaf length (9.65 cm) compared to nano NPK (9.33 cm) or the least in control treatment (7.16 cm). The reason of positive effect of nano NPK may be due to its unique properties. It has higher surface area and smaller size than those of basic fertilizers. These qualities improve nano particles to be functional. This may have increased absorption and eased movement and transferring of these nutrients during plant tissues.

In addition, the release of this type of fertilizer is controlled, which means reduced or no loss with long last and more availability for the plant (Sing et. al., 2017). Consequently, plant vegetative characteristics were improved (Janmohammadi et. al., 2016). Increased vegetative parameters can be referred to increase with controlled quantities of N. This element contributed in increases in amino acids and proteins. In turn, plant cells and tissues were grown and developed (Haque et. al., 2011). Another reason can be resulted from applying P. This element has an essential role in the processes of photosynthesis which a is vital of the plant. It also involved in respiration and energy units storing and translating (AbuDahi and Arrays, 1988). These results were compatible to Alhasan et. al. (2021) who concluded that nano NPK increased growth characteristics in *Ocimum Basilicum*.

Table (1): Effect of basic and nano NPK on vegetative parameters of *kalanchoe blossfeldiana*

Parameters / Treatments	Number of leaves	Leaf length cm	Leaf width cm	Leaf thickness mm	Plant diameter cm
Control	10.00 c	7.16 c	5.46 b	1.16 c	14.66 c
basic NPK	13.00 b	9.65 a	5.65 b	1.62 b	16.00 b
Nano NPK	15.00 a	9.33 b	6.52 a	2.00 a	16.66 a

1-Flowering parameters

Results in table 2 displayed that addition of nano NPK affected flowering parameters significantly. The treatment was superior over each of basic NPK and control treatments. This treatment increased length, diameter, and weight of inflorescences, number of inflorescences, number of flowers. The values recorded were 15.45 cm, 14.35 cm, 15.88 gm, 13.00 inflorescence plant^{-1}, and 71.00 flower plant^{-1} respectively. The least values were 8.22 cm, 10.33 cm, 15.26 cm, 5 inflorescence plant^{-1}, and 57 flower plant^{-1} respectively recorded in control. The reason of these favorable effects on the flowering characteristics can be explained with the high advantages of this type of fertilizers. Features such as efficient surface area and small size are some of those advantages. That is, their functions are highly significant. Unlike of basic NPK, the majority of nano particles were released slowly and absorbed sufficiently by the plants (Brady and Weil 1999; Huiyuan et al., 2018). These results agreed with Mota et. al., (2008) who reported that number of flowers was in consistence with leaves number under P treatments. The outcomes were also in compatible with Sarhan et. al. (2022) who concluded an increase in flower diameter under nano NPK treatment.

Table (2): Effect of basic and nano NPK on flowering parameters of *kalanchoe blossfeldiana*

Parameters / Treatments	Length of inflorescence cm	diameter of inflorescence cm	weight of inflorescence gm	number of inflorescences	number of flowers
Control	8.22c	10.33c	15.26b	5.00c	57.00c
basic NPK	12.32b	12.31b	15.53ab	10.00b	63.00b
Nano NPK	15.45a	14.35a	15.88a	13.00a	71.00a

2-Leaf content

On Table 3, results illustrated significant effects of nano NPK over leaf content parameters. This treatment had the highest values of these parameters compared to basic NPK and control treatments. The highest records were N 3.10%, P 0.27%, K 0.71%, and chlorophyll content 1.97mg g^{-1}. The lowest records of these parameters were 2.05 %, 0.19 %, 0.42 %, and 1.01 mg g^{-1} respectively in control treatment. Increases in vegetative characteristics led to improve plant development. Consequently, production parameters were enhanced (Dimkpa and Bindraban, 2016). Because of their properties (Guru et al., 2015), the form of nano NPK added to the plants had increased the availability of these nutrients. The concentrations taken by the plants were adequate and production was induced (Josef and Katarína, 2015). This result is also agreed with Alhasan (2020) in study on basil plants. The lowest values were obtained under treatment of only distilled water. Inversely, the highest were observed under nano NPK treatment.

Table (3): Effect of basic and nano NPK on leaf content parameters of *kalanchoe blossfeldiana*

Parameters / Treatments	N %	P%	K%	Chlorophyll content mg g^{-1}
Control	2.05c	0.19b	0.42b	1.01c
Basic NPK	2.72b	0.23ab	0.62b	1.89b
Nano NPK	3.10a	0.27a	0.71a	1.97a

CONCLUSION

Succulents are important part of gardens and greenspaces. Kalanchoe is one of plants suitable for various landscapes and environmental conditions. Fertilizing this plant is one of the agricultural practices recommended. Investigation of applying NPK fertilizers effect was implemented. The results displayed significant effects of form of NPK added to the plant. Under nano NPK fertilizer, the growing, flowering and content traits were influenced positively.

REFERENCES

AbuDahi, Y. M. and M. A. Arrays. (1988). Guide of plant nutrition. College of Agriculture. Baghdad University.

Adhikari, T., Biswas, A.K., Kundu, S. (2010). Nano-fertilizer- A new dimension in agriculture. Indian J. Fertility 6, 22–24.

Alhasan, A. S. (2020). Effect of different NPK nano-fertilizer rates on agronomic traits, essential oil, and seed yield of basil (*Ocimum basilicum* L. cv Dolly) grown under field conditions, Plant Archives, 20:2, 2959-2962.

Alhasan, A. S., Al-Ameri, D. T., Jawad, A. H., and Talib, Q. J. (2021). Effect Of Foliar Application of Npk Nano-Fertilizer on Some Agronomic Traits and Essential Oil of

Sweet Basil (*Ocimum Basilicum* L.) Grown Under the Shade-Net House Conditions. Nveo-natural volatiles and essential oils journal| nveo, 2018-2024.

Al-Juthery, H. W., Lahmod, N. R., and Al-Taee, R. A. (2021). Intelligent, Nano-fertilizers: A New Technology for Improvement Nutrient Use Efficiency (Article Review). In IOP Conference Series: Earth and Environmental Science (Vol. 735, No. 1, p. 012086). IOP Publishing.

Bell, S. A. (2001). Growing cacti and other succulents in the conservatory and indoors. United Kingdom: GMC.

Brady, N.C., Weil, R.R., (1999). The Nature and Properties of Soils. 12th Edition, Prentice Hall Publishers, London. 1–9, 453–536.

Brickell, C. (1999): The Royal Horticultural Society New Encyclopedia of Plants and Flowers. Third Edition. Dorling Kindersley. London, New York. 453.

Dimkpa, C. O., and Bindraban, P. S. (2016). Fortification of micronutrients for efficient agronomic production: a review. Agronomy for Sustainable Development, 36(1), 1-27.

El-Saadony, M.T., Saad, A.M., Najjar, A.A., Alzahrani, S.O., Alkhatib, F.M., Selem, E., Desoky, S.M., Fouda, S.S., El-Tahan, A.M., Hassan, M.A.A., (2021). The use of biological selenium nanoparticles in controlling Triticum aestivum L. crown root and rot diseases induced by Fusarium species and improve yield under drought and heat stress. Saudi J. Biol. Sci. 28, 4461–4471.

Foxcroft, L.C.; Richardson, D.M.; Wilson, J.R.U. (2008). Ornamental Plants as Invasive Aliens: Problems and Solutions in Kruger National Park, South Africa. Environ. Manag. 41, 32–51.

Gilman, Edward. (2013)."FPS-309/FP309: Kalanchoe Blossfeldiana Kalanchoe". Electronic Data Information System. University of Florida. Archived from the original on 11 December. Retrieved 6 December.

Guru, T., Veronica, N., Thatikunta, R., Reddy, S.N., (2015). Crop nutrition management with nano fertilizers. Int. J. Environ. Sci. Technol. 1 (1), 4–6.

Haque ME, AK. Paul, and J. R. Sarker .(2011). Effect of nitrogen and boron on the growth and yield of tomato (Lycopersicon esculentum Mill). Int J Bio-resource and Stress Manag, 2(3), 277-282.

Hewitt, T. (1997). The complete book of cacti and succulents. London: Dorling Kindersley, 176 p.

Huiyuan, G., Jason, C.W., Zhenyu, W., Baoshan, X., (2018). Nano-enabled fertilizers to control the release and use efficiency of nutrients. Curr. Opin. Environ. Sci.Health. 6, 77–83.

Hurrell, J.A.; Delucchi, G.; Keller, H.A.; Stampella, P.C.; Guerrero, E.L. Bryophyllum (2012). (Crassulaceae): Especies Ornamentales Naturalizadas en la Argentina. Bonplandia 2012, 21, 169–181.

Janmohammadi, M., Sabaghnia, N., Dashti, S., and Nouraein, M. (2016). Investigation of foliar application of nano-micronutrientfertilizers and nano-titanium dioxide on some traits of barley. Biologija, 62(2).

Josef, J., Katarína, K., (2015). Application of nanotechnology in agriculture and food industry, its prospects and risks. Ecol. Chem. Eng. 22 (3), 321–361.

Khafaji, A. A., A. Alzubaidi, N. Shawqi, A. Alrawi, A. M. Salih, A. T. Hamadi, and K. B. Hamadi. (2000). Effect of potassium in agricultural production. Journal of Scinces. V. (111), p:15-25.

Lessa, M. A., Paiva, P. D. D. O., Alves, C. M. L., and Resende, M. L. (2009). Application of different fertilizers in substrate for Kalanchoe luciae Raym.-Hamet cultivation. Ciência e Agrotecnologia, 33, 950-955.

Mahanta, N., Dambale, A., and Rajkhowa, M. (2019). Nutrient use efficiency through nano fertilizers. Int J Chem Stud, 7(3), 2839-2842.

Mahmoud, M. A., and Swaefy, H. M. (2020). Comparison between effect of commercial and nano NPK in presence of nano zeolite on sage plant yield and components under drought stress. Zagazig Journal of Agricultural Research, 47(2), 435-457.

Mohsin, R. M. (2019). Landscape performance of Callistemon citrinus under environmental stress conditions. Mississippi State University.

Mota, j. H.; Melo, e. p. de; Soares, t.s.; Vieira, m. Do c. (2008). Crescimento da espécie medicinal tansagem (plantago major l.) Em função da adubação fosfatada e nitrogenada. Ciência e agrotecnologia , lavras, v. 32, n. 6, p. 1748-1753.

Naderi, M.R. and Danesh-Shahraki, A. (2013). Nano fertilizers and their roles in sustainable agriculture. Inter. J. Agri. and Crop Sci., 5(19):2229-2232.

Olmos, J. F. B. Los cactos e las (1978). outras plantas suculentas. Madrid: Floraprint,

Poppenga, Robert H., and Sharon M. Gwaltney-Brant, eds. (2011). Small animal toxicology essentials. Chichester: Wiley-Blackwell and Sons. p. 121–2.

Reda, F.M., El-Saadony, M.T., El-Rayes, T.K., Attia, A.I., El-Sayed, S.A., Ahmed, S.Y.,

Madkour, M., Alagawany, M., (2021). Use of biological nano zinc as a feed additive in quail nutrition: biosynthesis, antimicrobial activity and its effect on growth, feed utilisation, blood metabolites and intestinal microbiota. Ital. J. Anim. Sci. 20, 324–335.

Romhold, V. and M.E.El -Fouly.(2000).Foliar Nutrient application ; challeng , and Limits in crop production . (Pub 1) 2nd. International work shop on Foliar Fertilizer, Bankkik Thailand P. 1- 32.

Sarhan, A. M., Habib, A. M., Fahmy, A., Noor El-Deen, T. M., and Selim, A. (2022). Effect of nano, bio, chemical fertilization and leaves extract of moringa plant on flowering and chemical constituents of gladiolus plant. Egyptian J. of Chemistry, 65(7), 5-6.

Seixas, E. S. Emergência e desenvolvimento de plântulas de Cactaceae em diferentes substratos com e sem adubação. (2001). 74 p. Thesis (Master in Agronomy Plant Production) - Universidade Estadual Paulista, Jaboticabal, 2001.

Singh MD, Chirag G, Prakash PO, Mohan MH, Prakasha G, Vishwajith. (2017). Nano fertilizer is a new way to increase nutrients use efficiency in crop production. Int. J Agric. Sci.; 9(7):3831-3833.

Smith, G. (2004) Kalanchoe Species Poisoning in Pets. Toxicology Brief. Vet. Med., 1, 933–936.

Smith, G. F., Figueiredo, E., and Van Wyk, A. E. (2019). Kalanchoe (Crassulaceae) in Southern Africa: classification, biology, and cultivation. Academic Press.

Solomon, Jessica L. (2019). Evaluation of chemical and physical control strategies across life history stages of the invasive Kalanchoe xhoughtonii. Thesis, University of Florida.

Thakur, Neelam. (2021). FLOWER PRODUCTION & GARDENING- Cacti and Succulent. Chapter 12.

Vargas, A., Herrera, I., Nualart, N., Guézou, A., Gómez-Bellver, C., Freire, E., and López-Pujol, J. (2022). The Genus Kalanchoe (Crassulaceae) in Ecuador: From Gardens to the Wild. Plants, 11(13), 1746.

تأثير سماد NPK النانوي على صفات النمو والتزهير والمحتوى لنبات الكلانشوا Kalanchoe blossfeldiana

أنغام أياد كمال الدين رياض مناع محسن أشجان نزار كامل

قسم البستنة وهندسة الحدائق / كلية الزراعة / جامعة تكريت / تكريت / العراق

الكلمات المفتاحية:
نبات الكلانشوا, الاسمدة النانوية, السماد الثلاثي المركب

الخلاصة

اجريت هذه التجربة في احد البيوت الزجاجية التابعة لقسم البستنة وهندسة الحدائق, كلية الزراعة, جامعة تكريت خلال فصل الربيع 2022. الهدف منها هو البحث في تاثير السماد المركب NPK على نمو وازهار والمحتوى المعدني لنبات الكلانشوا *Kalanchoe blossfeldiana*. تم استخدام السماد بشكلين : عادي ونانوي. وقد اظهرت النتائج تاثيرا موجبا للشكل النانوي على الصفات الخضرية والزهرية ومحتوى المعدني والكلوروفيل. كانت التاثيرات اعلى في النانوي عن تلك التي من السماد العادي ومعاملة المقارنة. وقد شمل التاثير المعنوي للسماد النانوي اغلب الصفات المدروسه. عدد الاوراق, , قطر النبات, وعدد الازهار سجلت زيادات معنوية وصلت الى 15.00, 16.66 و 71.00 على التوالي. بالاضافة الى ذلك, فقد سجلت صفة محتوى الكلوروفيل 1.97 تحت معاملة السماد النانوي.