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Research Article

Effect of Different Levels of NPK fertilizer On Vegetative Growth and Flowering of Wedelia (*Wedelia trilobata* L.) Plants

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ABSTRACT

During March 2018 to August 2019, an experiment was conducted to investigate the effect of NPK fertilizer on the growth and flowering of Wedelia trilobata L. plants in Shambat, College of Agricultural Studies, Sudan University of Science and Technology, Khartoum, Sudan. In black polyethylene bags, NPK was tested as a soil application to the potting media at rates of 0, 1, 2, 4, and 8 g/plant. Each treatment was replicated four times in this study, which followed a completely randomized design. Treatments were repeated every 40 days, and data was collected on six parameters at 40, 125, 215, and 300 days after application. In comparison to the control, the results revealed significant variation in growth parameters due to NPK application. 8g NPK/plant produced the highest values of measured parameters.

Keywords: *NPK, Wedelia, Ornamental plant, Flowering plant*

INTRODUCTION

Ornamental plant production has grown in importance, and a lack of proper fertilization recommendations has emerged as a major obstacle to their successful cultivation (Ahmad et al., 2017).

The flowering plant *Wedelia trilobata* (L.) belongs to the Asteraceae family. Wedelia is a tropical perennial medicinal herb used in the landscape as an interesting groundcover for warm locations (Keerthiga et al., 2012). It comes from tropical America and can be propagated by division, seeds, or tip cuttings (Swaefy & Basuny, 2011).

The plant's nutritional requirements were investigated as part of a commercial crop evaluation (Lewis et al., 2010). Compound fertilizer (NPK) (Abd El Gayed & Attia, 2018) influences all the nutritional status, growth development, and flower production of ornamental plants.

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The primary goal of using nutrients is to replenish nutrients that have been depleted in the soil because of leaching or plant uptake (Ahmad et al., 2017). The primary soil nutrients required for all plant growth are nitrogen, phosphorus, and potassium (NPK). External application of major nutrients, including saponin content, is beneficial for better growth and phytochemical composition of various plants (Rivai et al., 2017).

Fertilizers are necessary for the growth of healthy ornamental pot plants. NPK fertilization positively affects the various biochemical processes that occur within the plant, allowing it to grow and develop normally. Various NPK fertilization treatments have positively impacted the growth of several foliage plants (Ashour et al., 2020).

NPK fertilizers that have been processed for soil application have also produced positive results (Baloch et al., 2010). Ahmed et al. (2017) discovered a strong positive relationship between flower production and soil N and P contents, observing maximum flower size and number with 15 kg N and 8 g P m-2. For optimal cut flower production, both N and P should be applied at a rate of 10 g m-2. Nitrogen has a greater impact on plant growth, quality, and yield than any other nutrient, and its use promotes vegetative growth. The availability of P has been linked to early crop maturity and root development. Potassium is involved in peptide bond synthesis, protein and carbohydrate metabolism, as well as rapid cell division and differentiation. Phosphorus and potash content resulted in a maximum increase in nutrient uptake by virtue of more photosynthesis through increased chlorophyll formation with increased leaf area (Ahmed et al., 2017).

The goal of the study was to see how different levels of NPK nutrition affected the growth and flowering of *Wedelia trilobata*. L in Khartoum.

MATERIALS AND METHODS

Location:

The experiment was carried out and studied at Sudan University of Science and Technology's Department of Horticulture, College of Agricultural Studies. During the growing season, the average maximum and minimum temperatures were 36.9°C and 21.2°C, respectively, with an average relative humidity of 19% and an annual rainfall of 0.0 mm.

Experiment:

The nursery experiment took place from March 2018 to August 2019 to see how different levels of NPK fertilizer affected the growth and flowering of *Wedelia trilobata*. Wedelia plants were laid out in a completely randomized design with five treatments and four replications, and each plant in a bag was considered a replicate. Under the sun, the culture was grown and maintained using vegetative cuttings with a length of 20- 30 cm in each black polyethylene bag 30-60 cm, filled with a soil mix of 1 sand: 2 river Nile sedimentary soil (Gureira).

Treatments:

From 12 March 2018 to 15 January 2019, NPK was applied in eight doses every 40 days after planting in concentrations of 0, 1, 2, 4, and 8 g/plant. A 0.5 g/plant sulphur basal dressing was applied to each plant. Irrigation was applied as required.

Data Collection:

After 40, 125, 215, and 300 days from planting, a random sample of each plant was taken and used to calculate growth and flowering parameters. The following are the six characters that were used to record the observation: Leaf chlorophyll measurement (mg/g) with the help of Plant Chlorophyll Fluorometer (Oakoch OK-Y104, made in China) (Li-Cor, Lincoln, NE, USA) was used to measure the leaf chlorophyll (Chl) content (SPAD) and leaf NPK contents (A A S. 1994). The means were separated using Duncan (1955) Multiple Range Test (DMRT) at P0.05, and the data were analyzed statistically using Gen Stat (Computer Program) Version 4. (Gomez & Gomez, 1984).

RESULTS

Number of leaves/plant:

Analysis of variance revealed a highly significant difference between the treatments

at all ages, with the high level (8 g/plant) obtaining the highest number of leaves (343.0) compared to the control (table 1).

Number of flowers/ plant:

At all ages, analysis of variance revealed a highly significant difference between the control and treatments, but no significant difference among treatments at 125 and 300 days (table 2). The highest number of flowers was obtained by level (8 g/plant).

Total number of flowers/ treatment and chlorophyll test:

Table (3) shows a significant difference in a total number of flowers between the control and NPK levels, with the highest total number of flowers recorded by the highest level of NPK. In addition, there was a significant difference in chlorophyll levels between NPK levels (4 and 8 g/plant), while there was no difference between the other levels.

Weight of fresh and dry mass (g)/ plant:

Table (4) shows that the different levels of NPK increased the shoot, root fresh weight, and root dry weight equally, indicating a significant difference from the control. The highest levels (4 and 8 g/plant) recorded a significant difference in root fresh and dry weight, while the lowest levels (4 and 8 g/plant) recorded a significant difference in shoot fresh and dry weight.

Analysis of leaf plant tissue (g) (dry ashing):

The uptake and accumulation of macro elements represented in N, P, and K percent were significantly higher in level 8 g/plant compared to the control, according to leaf analysis (table5).

Table (1): Effect of NPK levels on number of leaves /plant of wedelia plants

NPK level (g/plant)	Plant age (days)			
	40 day	**125 day**	**215 day**	**300 day**
0	109.8 d	136.2 b	138.0 d	147.0 e
1	149.5 c	158.2 b	167.2 c	193.8 d
2	191.0 b	208.0 a	207.8 b	261.0 c
4	198.5 ab	207.8 a	293.0 a	312.8 b
8	211.5 a	218.2 a	296.0 a	343.0 a
LSD	19.37	22.65	22.52	29.17
CV %	7.5	8.1	6.8	7.7

* Means with the same letter within each column are not significantly different, according to Duncan's Multiple Range Test.

Table (2): Effect of NPK levels on number of flowers /plant of wedelia plants

NPK level (g/plant)	Plant age			
	40 day	**125 day**	**215 day**	**300 day**
0	3.50 c	3.00 b	4.50 c	4.50 b
1	4.00 bc	5.50 a	7.00 b	8.00 a
2	4.50 bc	6.00 a	8.00 ab	9.50 a
4	5.00 ab	6.00 a	9.00 a	9.50 a
8	6.00 a	6.50 a	8.50 ab	9.50 a
LSD	1.35	1.56	1.56	1.65
CV %	19.4	19.1	14.0	13.4

* Means with the same letter within each column are not significantly different, according to Duncan's Multiple Range Test.

Table (3): Effect of NPK levels on total number of flowers and chlorophyll of Wedelia plants

NPK level (g/plant)	Total No. of flowers/ treatment	Chlorophyll (mg/g)
0	2.00 c	38.05 b
1	3.50 b	38.77 b
2	4.50 ab	40.15 b
4	5.00 ab	42.67 a
8	6.00 a	43.10 a
LSD	1.46	2.26
C.V.	23.0	3.7

* Means with the same letter within each column are not significantly different, according to Duncan's Multiple Range Test.

Table (4): Effect of NPK application on shoot fresh and dry, root fresh and dry weights of wedelia plant

NPK level (g/plant)	shoot fwt (g/plant)	shoot dwt (g/plant)	Root fwt (g/plant)	Root dwt (g/plant)
0	25.1 d	6.10 d	5.08 d	2.43 c
1	111.6 c	44.00 c	18.62 c	10.47 b
2	254.1 b	75.50 b	35.90 b	19.05 a
4	285.9 a	95.70 a	58.45 a	20.80 a
8	271.8 ab	76.10 b	60.45 a	21.25 a
LSD	28.52	7.84	4.77	2.29
C.V.	10.0	8.7	8.9	10.2

* Means with the same letter within each column are not significantly different, according to Duncan's Multiple Range Test.

Table (5): Effect of NPK levels on leaf NPK ash contents were analysis of plant tissue of Wedelia plant

NPK level (g/plant)	Nitrogen (N)%	Phosphorus (P)%	Potassium (K)%
0	1.43 d	0.33 e	14.25 e
1	1.53 d	0.42 d	21.04 d
2	1.73 c	0.51 c	23.11 c
4	2.11 b	0.58 b	24.44 b
8	2.31 a	0.77 a	26.18 a
LSD	0.198	0.018	0.223
C.V.%	6.0	1.9	0.6

* Means with the same letter within each column are not significantly different, according to Duncan's Multiple Range Test.

DISCUSSION

The number of leaves:

Wedelia plants with the highest NPK level of 8g per plant produced the highest number of leaves (343.0) in all ages, followed by NPK levels (4g) per plant (312.8g) at 300 days, where wedelia plants produced the highest number of leaves by the highest levels and also by 4g/plant, respectively. The control must protect a minimum number of leaves (table 1). Another study on Gerbera found that NPK levels had a significant impact on total leaves, as reported by Fayaz, Kh et al. (2016) and Ayemi et al. (2017).

The treatment yielded the greatest number of leaves (150-75-75) kg ha-1 NPK (Handayat & Sihombing, 2019). Sunawan et al. (2020) found that GA3 concentration treatments had a significant effect 30 days after application, and that the treatment dose of NPK fertilizer had a significant effect at 75 and 90 days after application. Large amounts of nitrogen are required during vegetative growth. The NPK nutrient combination is critical for orchid growth and development. NPK levels,

application of 60:30:30g NPK pot-1 (F3) recorded significantly higher number of leaves per plant (1.6, 3.2, 7.2, and 7.3) at 15, 30, 45, and 60 days after planting, respectively, and at par with 40:20:20 g NPK pot-1 (F2) over the rest of the treatments, according to Gajbhiye et al. (2013). Because nitrogen is the most important constituent of chlorophyll and is a component of amino acids and enzymes, it is possible that it increased meristematic activities, cell division, cell number, and cell enlargement in the plant with treatment F0 (control).

Another study of Dracaena marginata by Ashour et al. (2020) found that combining NPK with either BA or GA concentrations resulted in significant increases in most of the vegetative growth parameters in terms of number of leaves/plant, number of leaves/plant, number of leaves/plant, number of leaves/plant, number of leaves/plant, number of leaves/plant Khan and Ahmad, (2004) discovered that 10:10:5 g pot-1 NPK produced 12.6 leaves per plant, while 0:0:5 g pot-1 NPK (control) produced only 7.0 leaves per plant, demonstrating that a high dose of N and P resulted in the most leaves. Abd El Gayed and Attia, (2018) discovered that NPK fertilization had a significant impact on the number of leaves per plant, as shown in. In other words, increasing the NPK rate from 0.0 to 4.5 g/pot increased both growth parameters significantly in both seasons.

The number of flowers:

Table (2) shows that the highest number of flowers (9.50) was obtained by the highest level (8g) per plant in all observations, while the control obtained the lowest number of flowers (3.50) at all plant stages. These findings are backed up by the findings of Baloch et al. (2010), who discovered that Zinnia supplied with the highest NP rates of 50+20 g/1.5m2 produced a significantly higher number of flowers (12.66) plant-1, compared to 11.33 and 10.33 flowers plant-1, respectively. However, the lowest NP concentration of 10+10 g/1.5m2 resulted in the smallest number of flowers (6.00). NPK levels caused a gradual increase in mean flower number/plant and flower diameter (mm) of *Ixora coccinea* L. plants in two seasons, according to Arafa et al. (2019). Ahmed et al. (2017) discovered that the treatment T (N150 P75 K135 kg ha-1) had the highest number of flowers plant-1 (25.72, 23.02, and 24.37), flower diameter (7.78, 7.10, and 7.44 cm), and individual flower weight (6.05, 5.98, and 5.97 g) for the years, and it was statistically identical with treatment T. (N200 P75 K135 kg ha-1). Because the number of branches was higher in the NPK treatments, more photosynthesis and food accumulation occurred, possibly resulting in better growth and conversion of vegetative growth in early stages due to balanced nutrition and also having sufficient food material to produce the flower earlier, whereas the control treatments took longer to flower, possibly due to late emergence of flower buds.

Total number of flowers and chlorophyll:

Chlorophyll levels differed significantly by NPK level and increased (42.64 – 43.10) by level (4 and 8g) per plant. Nitrogen is an important macro element inorganic molecule in plants, including proteins, nucleic acids, purines, pyrimidines, co-enzymes (vitamins), and chlorophyll production. The combined NPK with either BA or GA3 significantly increased total chlorophyll content in the leaves and total carbohydrates in the leaves and stems when compared to untreated plants. This could be due to an increase in the synthesis of chlorophyll and the rate of photosynthesis. (Ashour et al., 2020). This is supported by the findings of Abd El Gayed and Attia, (2018) on *Celosia argentea*, who found that NPK fertilization increased total chlorophyll (SPAD) and total carbohydrates percent in both seasons when compared to untreated plants. At 4.5g/pot, the positive effect of NPK fertilizer rates was strongest, followed by 3 and 1.5g/pot.

Table 3 shows a significant difference in the total number of flowers between the control and NPK levels, with the highest flowers yield (6.00) obtained by the highest NPK level (8g) per plant. The flower yield on Chrysanthemum was also significantly

influenced by different levels of N, P, and K fertilizers, and it was increased to a maximum of 12.45, 11.80, and 11.63 ton ha-1, respectively, for the first, second, and third year with NPK fertilizer application, according to Ahmed et al. (2017). Discovered that the increase in flower number and yield with nitrogen application could be because applied nitrogen significantly increased growth parameters such as branch number, which could have resulted in the production of more plant metabolites and, in turn, increased flower production. Another study in Gerbera by Ayemi et al. (2017) and Fayaz et al. (2016) found that different doses of NPK influenced flower yield during the experiment period. The T6 (20:20:15 N.P.K.g/m2) treatment produced the highest flower yield, while the plants raised in the control plot produced the lowest flower yield. It could be due to the crop's availability of the necessary nutrients during the growth stage.

Shoot, root fresh and dry weight

According to table (4), the different NPK levels (4g) per plant resulted in significant differences from the control, whereas the root fresh and dry weight significant differences by the highest level (8g) per plant resulted in significantly increased compared to the control. The response of fresh, dry weights and Ixora coccinea L. plants to treatments of NPK combined different fertilization in the two seasons had the same trend of number flower and flower diameter, according to Arafa et al. (2019). On Chrysanthemum, Rajan et al. (2019) discovered that nitrogen application at 150 kg N/ha (N2) increased both fresh and dry weight of the plant (669.7 g) (163.20 g) after extensive testing, it was discovered that nitrogen, as a component of protein and nucleic acid, is beneficial to plant growth. The bulb root system of Lily was significantly better developed in lilies grown on cocopeat and NPK level, as reported by Treder, (2008), with the number of roots and total root length being 34 per cent and 118 per cent higher on media and nutrition, respectively than in the control treatment. The root development appeared to be aided by suitable physical and biological conditions in cocopeat and NPK.

Analysis of leaf plant tissue (g) (dry ashing):

In comparison to control plants, the values of macronutrients N, P, and K per cent increased steadily with increasing application rate of NPK concentration (table 5), the obtained results of increased N, P, or K per cent in plants application of NPK compared to other treatments. Ashour et al. (2020) on *Dracaena marginata* and Abd El Gayed and Attia, (2018) on *Celosia argentea* reported that increasing NPK rate from 0.0 to 4.5 g/pot significantly increased percentages of N, P, and K in leaves of both species. These findings are similar to those of Mokadem and Sorour, (2014). They found that using NPK fertilizer at a rate of 5g/pot resulted in the highest significantly values of leaf N, P, and K percent when compared to plants that were not fertilized.

CONCLUSION

NPK application improved various growth indices and increased the number of flowers per plant, according to the observation results. All parameters studied perform better with a high rate of NPK (8g/plant). Plants at 300 days are the best compared to other ages, and NPK nutrition should be applied by level (8g/plant).

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Author Contribution

The authors contributed equally to establishing the research and design experiment topic.

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