Response of Periwinkle (*Catharanthus roseus*) to urea applications

Howida T. Jepreel[o], Tagelsir I. M. Idris,[2] Mohamed Osman A. Warrag[3] and Fakhereldin Awad. Hussien

[o123]Department of Horticulture, Sudan University of Science and Technology

Abstract:

This study aimed to investigate the response of *Catharanthus roseus* to various rates of urea applications under nursery conditions at Shambat, Khartoum North, Sudan. Five levels of urea (0, 2.5, 5, 7.5 and 10 g/plant) were tested as soil dressings in 25X30 cm plastic pots. The study was arranged in complete randomized design where each treatment was replicated seven times. Data were collected 4 months after applications. The high urea doses enhanced vegetative growth parameters, while flowering and fruiting of the plant were boosted by the lower urea doses. These results elucidated the beneficial response of Periwinkle to nitrogenous fertilizers and might be accompanied in efforts towards economical large scale production of the plant under the field conditions.

Keywords: Periwinkle; Urea; Growth; Flowering

Introduction:

Periwinkle (*Catharanthus roseus*) was introduced to Sudan by the British colonizing authority during the early years of the 20th century. It performed well under the prevailing agro-climatic conditions and had been considered one of the best domesticated ornamentals in the country. However, beside its ornamental value, this plant is of considerable value as a medicinal plant due to its leaf alkaloids that have anti-cancer property. The principal alkaloids of the plant include vinblastine, vincristine, catharanthine, ajmalacine and vindoline (Abdolzadeh *et al.,* 2006). According to (Van der Heijden *et al.,* 2004), the *Catharanthus* alkaloids comprise a group of about 130 terpenoid- indole-alkaloids. Wide differences were noted in the composition of aerial and root tissues of the plant and the root was characterized by high contents of ajmalacine and serpentine which are important in medicines for high pressure and cardiac maladies (Mishra *et al*., 2009). Leaf-specific bisindole alkaloids are vinblastine and vincrestine which are indispensible constituents for most cancer chemo-therapy (Gupta, 1977). Nevertheless, the outstanding performance of the plant even under

minimum human attention throughout the various regions of Sudan is a valid justification for large scale commercial production of periwinkle for export. However, the implementation of this claim necessitates intensive research on the agronomy of the plant. As research efforts on nutrition of Periwinkle and other medicinal plants is meager in Sudan, this study aimed to explore the impact of urea (46% N) applications on growth attributes of Periwinkle under Khartoum State conditions.

Materials and methods:

This study was conducted in complete randomized design in the nursery of the Department of Horticulture, Sudan University of Science and Technology, at Shambat, Khartoum North, Sudan, to determine the impact of urea (46% N) applications on growth attributes of *Catharanthus roseus* (L). Seeds of the white color cultivar of the plant were employed in this study. Initially they were sown directly in flat beds under open field conditions. Forty five days after sowing, the germinated seedlings were transplanted in 18 inch plastic pots containing a soil mix of 1 sand: 2River Nile sedimentary silt. They were accommodated in a lath-house providing 50% shade. A month after establishment, they were used as experimental plant material. Urea (46% N) soil application was tested in rates of: 0.0, 2.5, 5.0, 7.5 and 10.0 g/plant. Treatments were arranged in completely randomized design and each treatment was replicated 7 times where each plant in a pot was considered a replicate. Irrigation was applied according to need. Final data were collected 4 months after treatments for the number of leaves, plant height, number of branches, length and width of leaves, number of flowers, number of fruits, seeds weight, shoot fresh and dry weights. Data were subjected to analysis of variance and means were separated at 95% confidence limits according to Duncan's Multiple Range Tests with the aid of MStatC computer program.

Results:

All urea treatments increased plant height significantly over the control, but without significant difference between them. The 10 g urea treatment increased the number of branches per plant significantly when compared to the control while the other urea treatments were statistically equal to the control for this parameter. The highest number of leaves per plant was recorded for the 7.5 g urea treatment which excelled the control, the 2.5 and the 5 g urea treatments but it did not differ significantly from the 10 g treatment. All urea treatments increased leaf length significantly over the control. The longest leaves were obtained from the low urea doses (2.5 and 5 g treatments). Reduction in leaf length was observed in plants treated with the high urea doses (7.5 and 10 g). However, when compared to the control only

the 2.5 and 5 g urea treatments induced significant increase in leaf width at statistically equal level (Table 1).

According to Table 2, the highest number of flowers was obtained from the 5 g urea treatment while the 2.5 g treatment ranked second. The other urea treatments equaled the control. Regarding the number of fruits per plant, this parameter was highly enhanced by the 2.5 g urea treatment followed by the 5 g treatment while the higher urea doses were statistically equal to the control. The 5 g urea treatment resulted in the highest weight of seeds per plant with significant difference from the other urea treatments that equaled the control statistically.

All urea treatments increased shoot fresh weight significantly over the control. The highest values were recorded for the 10 and 7.5 g treatments that shared the top rank but were not significantly different from the 5 g treatment. All urea treatments resulted in significant increase in shoot dry weight compared with the control without significant difference between them (Table 3).

Discussion:

Macronutrients play very important roles in plant growth and development. Their functions range from being structural units to redox-sensitive agents. Generally, application of macronutrient increases, growth, yield and quality of crops. Nitrogen is required for plant growth and yield in adequate amounts as it comprises about 1.5–2.0 % of plant dry matter and approximately 16 % of total plant protein (Chen *et al.* 2003; Lima *et al.* 2007; Alvarez *et al.* 2012). Nitrogen is also regarded as the essential component of all proteins and enzymes and further performs in various metabolic processes of energy transformation (Street and Kidder, 1997). Nitrogen is also an essential constituent of chlorophylls, which is closely associated with photosynthetic process (Nursu *et al.*, 2014). However, soil nitrogen level has marked effect on vegetative and reproductive growth as sufficient amounts of N are required for growth, development and productivity of plants (Nadeem *et al.*, 2013). Also, increment of plant growth by increasing of nitrogen levels until special concentration has been reported by several investigators. However, this study revealed the benefit of the elevated nitrogen doses in increasing the shoot growth parameters while flowering benefited from the lower doses. This might be explained in terms of carbon to nitrogen ratio as high C: N favor flowering and the reverse enhances the vegetative biomass. Although alkaloids content was not performed in this study, increments in this parameter are expected with the increase of vegetative growth

based on the reports of Golamhosseinpour *et al.,* (2011) who claimed a positive correlation between nitrogen and vegetative growth coupled with an increase in alkaloids content of the Periwinkle plants. In conclusion this study revealed the need for nitrogen nutrition of the plant whatever the type of soil as growth enhancements were obtained by such application in River Nile sedimentary soil which is considered the most fertile and qualitative soil in Sudan. Nevertheless, this preliminary report needs further confirmation under field conditions and further biochemical tests are needed to determine the impact of urea application on Periwinkle's alkaloids content under Sudan's conditions.

Table 1. Impact of urea treatments on vegetative growth attributes of Periwinkle plants.

Urea treatments (g/plant)	Height of plant (cm)	No. of branches/ plant	No. of leaves/plant	Leaf length (cm)	Leaf width (cm)
0.0	45.86b	7.86b	91.57c	4.61c	2.29 b
2.5	67.71a	7.43b	109.9bc	7.23a	2.86a
5.0	70.00a	8.43b	107.7bc	7.86a	2.97a
7.5	67.14a	9.14b	137.7a	6.19 b	2.66ab
10.0	69.57a	12.00a	125.4ab	6.16 b	2.54ab
CV (%)	11.36	21.12	17.13	12.49	13.74

*Means within column with the same letter(s) are not significantly different at P≥0.05% according to DMRT.

Table 2. Impact of urea treatments on the number of flowers and fruits and the weight of seeds per periwinkle plant.

Urea treatment (g/plant)	No. of flowers/ plant	No. of fruits/ plant	Weight of seeds/ plant (g)
0.0	16.43c	13.71c	0.1857b
2.5	23.43b	27.43a	0.2286b
5.0	31.00a	24.71b	0.3143a
7.5	18.57c	16.14c	0.2429b

10.0	18.14c	14.57c	0.2000b
CV %	11.19	12.51	23.19

*Means within column with the same letter(s) are not significantly different at P≥0.05% according to DMRT.

Table 3. Impact of urea treatments on periwinkle shoot fresh and dry weights

Urea treatment (g/plant)	Shoot fresh weight (g)	Shoot dry weight (g)
0.0	24.21d	5.23 b
2.5	42.29bc	8.51 a
5.0	45.34ab	9.71 a
7.5	47.74a	8.20 a
10.0	48.49a	8.57 a
CV (%)	11.55	7.64

*Means within column with the same letter(s) are not significantly different at P≥0.05% according to DMRT.

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