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Research Article

Impact of Argel (*Solennostemma argel* Del Hayne) applications on growth of lime's (*Citrus aurantifolia* Swingle) seedlings

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Abstract:

To enhance growth of lime's seedlings, Argel was tested for its bio-stimulating potential in this study as soil dressing in doses of 0, 5, 10, 15 and 20 g per seedling. Each seedling was planted in 40X20 cm plastic bag. The complete randomized block design was used with 4 replicates each composed of 2 seedlings. Treatments were repeated every 3 months after data recording. According to the final reading, the 15 and 20 g treatments enhanced seedling height substantially and the reverse was true for the number of branches per seedling. The 10 g treatment resulted in best circumference, while the 20 g resulted in the highest number of leaves. The 15 g treatment was the best enhancer for leaf length and width. The overall growth of seedlings was stimulated by Argel applications.

Keywords: -

Argel (Solennostemma argel); lime (Citrus aurantifolia); Seedling growth; Nursery.

Introduction

Nurseries are the critical step for the provision of the transplants of the desired cultivars in the required amounts and time. The awareness of nurserymen about the standard practices would enhance the growth of transplants and in consequence would shorten the marketing cycles. No attention is given for growth enhancing factors like fertilizers, hygiene and plant growth regulators in Sudan's fruit nurseries. Previous studies on mature fruit trees revealed the need of these crops for diversity of fertilizers in adequate amounts for enhanced growth, yield and quality (Idris *et al*., 2011). Besides, the few studies on growth regulators proved the advantages of such practices as tools for improving propagation and growth at the nursery Stage (Abdorabo *et* al., 2012; Omer *et al.,* 2016). In the last decade, Sudan's government perceived the importance of the horticulture crops as sources of foreign currency upon export, and it therefore encouraged expansions in this agricultural sector. This situation necessitates genuine efforts to improve propagation methods, cultural practices and observation of hygiene at the nursery stages for the provision of the required types of fruit transplants in sufficient quantities and sound vigor.

Sudan grows a diversity of citrus species and varieties for local consumption and limited exports, but the agro-climatic conditions are largely in favor of lime (*Citrus aurantifolia* Swingle) and grapefruit (*Citrus paradisi*)(Dawoud and Ahmed, 2017). The

yield of lime in Sudan is low (6-7 tons / hectare) compared to the actual potential (Ahmed, 2004). This might be attributed to low nutritional inputs, inadequate cultivation, the use of infected planting materials, use of non- budded lime planting material, planting of unimproved cultivars of scions and rootstocks(Elamin, 2004) and inadequate use of chemicals for pest and disease control(Dafalla, 2004). However, within the last 5 years, epidemic spread of the citrus bacterial canker in different states of Sudan had been observed on lime. Deterioration in yield had been reflected on the price of this commodity. Renewal of lime grooves might be a need (Prof. Dafalla, G.; Pathologist; University of Gezira, Sudan; personal communication, 2019). Such move requires hygienic planting material with desired vigor and excellent agronomic traits.

In conformity with global trend to avoid or minimize the use of synthetic agricultural chemicals, the use of botanicals as bio-pesticides or growth stimulants had been frequently reported under the conditions of Sudan (Sidahmed *et al.,* 2009; Idris *et al.,* 2014). Argel (*Solennostemma argel* Del Hayne) had been proposed as a potent bio-pesticide (Eldoash *et al.,* 2011; Taha *et al.,* 2012) and a growth enhancer for numerous horticultural genotypes (Hamid, 2016; Eisa, 2016). Based on these research claims, this study was designed to investigate the stimulating potential of Argel on the growth lime's seedlings.

Materials and Methods:-

The experimental area was located within the nursery of the Plant Tissue Culture Laboratory of the College of Agricultural studies, Sudan University of Science and Technology at Shambat, Khartoum North (latitudes 15° 40' N, longitude 32° 32' E, and altitude 375 meters above sea level). Two months after germination, lime seedlings were planted in 25x40 cm plastic bags containing alluvial River Nile silt with a pH of 7.8.They were used a month later as plant materials for the test. In effort to examine the growth stimulating potential of Argel on lime's seedlings, an experiment was carried out in June 2015.The dry leaves of Argel were tested as soil dressing in doses of 0, 5.0, 10.0, 15.0 and 20.0 g/ seedling. The complete randomized block design was used as seedlings were placed outside the shaded area of the nursery. Each treatment was replicated 5 times and each replicate was composed of two seedlings. Data were recorded every three months to determine the plant height from soil level to shoot tip, circumference, the number of branches and leaves, and leaf length (from tip of mid-rib to base of lamina above the degenerating leaflets) and width at the center of lamina. The treatments were repeated after each reading, the final data were recorded in March 2016. In all readings, data were subjected to analysis of variance, and means were separated by Duncan's multiple range tests with the aid of Mstat-C computer program.

Results:-

The progress in seedling height is illustrated in Figure (1), the impact of Argel application was most evident in the final reading as all Argel treatments resulted in significant enhancement of height compared to control. The highest doses (15 and 20 g) shared the top rank inducing 50 and 45% increments in this parameter respectively.

Regarding the number of branches per seedling, all Argel treatments increased this parameter significantly over the control in the first reading. In the second reading only the 10 g treatment was superior compared to the control that excelled all Argel treatments in the final reading. The deterioration was progressive with increase of Argel dose (Figure 2).

The progress in circumference of seedlings' stems and the number of leaves per seedling is presented in Table (1). Although the 15 g treatment resulted in about 33% increase of circumference in the first reading compared to control, no significant difference was observed among treatments in the second reading. However, the final reading revealed significant enhancements of this parameter by all Argel treatments in comparison with the control, and the 10 g treatment was the most enhancive. The values of the number of leaves per seedling were higher in Argel treated seedlings in all readings compared to control. The 10 g treatment ranked top in the first reading and also shared the top rank with the 15 g treatment in the second reading, but the highest value in the final reading was recorded for the 20 g Argel dose (Table 1).

Table (2) demonstrates the impact of Argel applications on the length and width of leaves. The differences in these parameters were quite clear in the final reading where the 15 and 20 g treatments resulted in best enhancements.

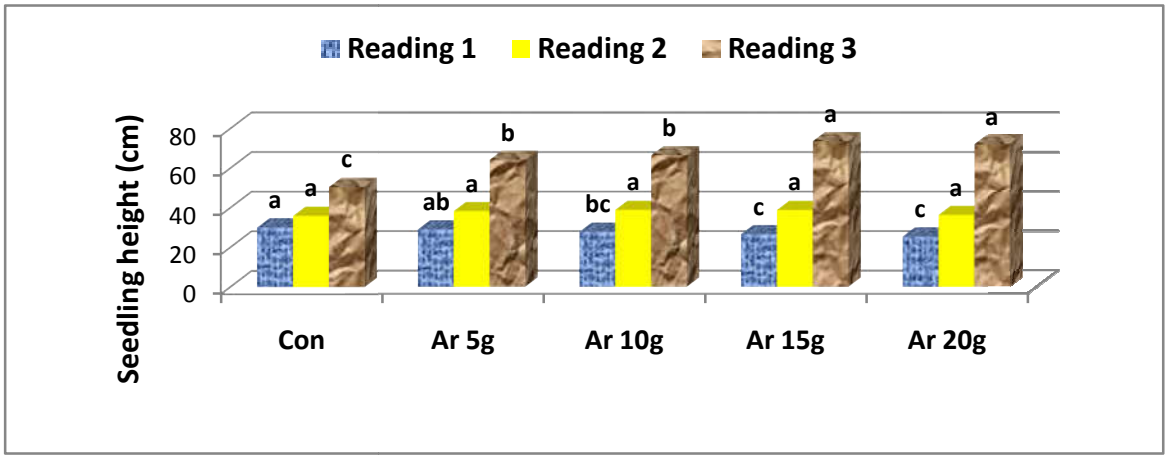

Figure (1). Impact of Argel treatments on the height of lime's seedlings

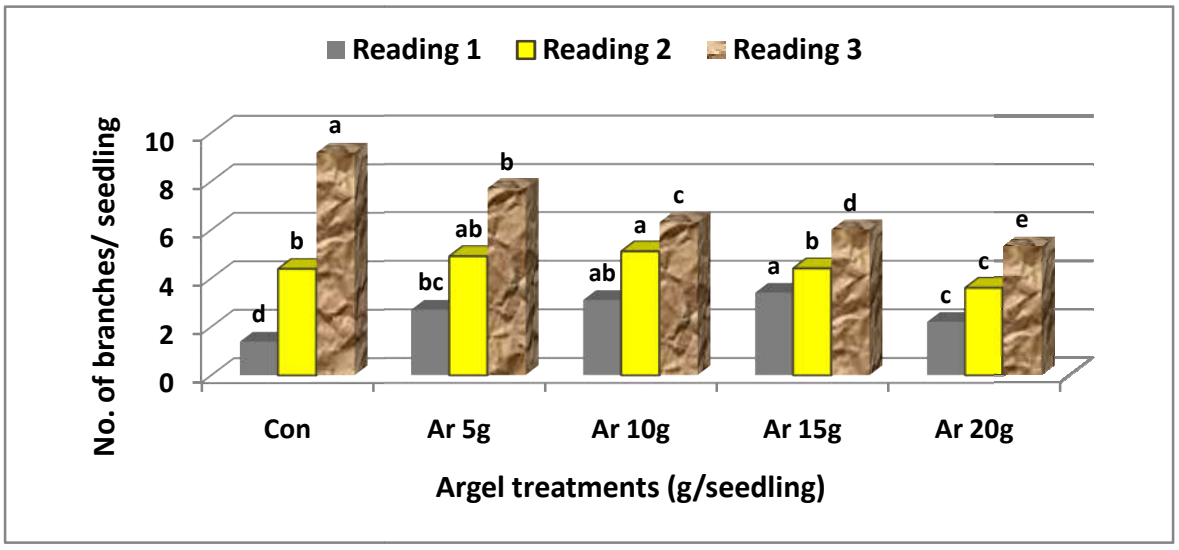

Figure (2). Impact of Argel treatments on branching of lime's seedlings

Table (1). Impact of Argel treatments on the circumference and number of leaves in lime's seedlings

Argel Treatments (g//plant)	Seedling circumference (cm)			Number of leaves/ seedling		
	Reading 1	Reading 2	Reading 3	Reading 1	Reading 2	Reading 3
Control	0.36d	0.46a	0.62d	22.5c	48.0c	100.0d
5	0.42bc	0.49a	0.72c	27.1b	53.4b	127.2c
10	0.45ab	0.51a	0.85a	30.3a	59.9a	126.9c
15	0.48a	0.49a	0.80b	25.7bc	60.2a	138.1b
20	0.39cd	0.47a	0.83ab	24.7bc	57.1ab	149.7a
CV%	12.8	16.06	5.45	12.99	7.65	5.39

**Means within a column with the same letter are not significantly different at 95% confidence limits.*

Table (2). Impact of Argel treatments on leaf length and width leaves in lime's seedlings

Argel Treatments (g//plant)	Leaf length (cm)			Leaf width (cm)		
	Reading1	Reading 2	Reading 3	Reading 1	Reading 2	Reading 3
Control	7.04a	7.31ab	7.32c	3.1b	3.3a	3.5b
5	6.36b	6.75b	7.72b	3.5a	3.5a	3.6ab
10	6.89a	7.08ab	7.92ab	3.5a	3.5a	3.7ab
15	6.86a	6.92b	8.21a	3.5a	3.5a	3.9a
20	6.24b	7.48a	8.09ab	3.4a	3.5a	3.9a
CV%	7.72	8.49	5.70	10.3	10.45	10.65

**Means within a column with the same letter are not significantly different at 95% confidence limits.*

Discussion:-

Sudanese lime growers prefer seedlings exceeding 50 cm in height to avoid drowning as flood irrigation is the most common practice. Besides, a good stem girth is among seedling quality factors. In this study clear gains in these parameters were achieved upon Argel applications coupled with improvements in the number of healthy leaves, and appreciable increments in their length and width. It is noteworthy to recognize the stimulation in the number of branches in the first reading while the reverse was true in the final reading. This may owe to supra-optimal accumulation of Argel with lime's tissues. However, contradictory explanations were reported on the type of hormone group within Argel tissues. Idris *et al,* (2010) overlaid ginger tissue cultures with high concentration of Argel extract and observed decline in tillering capacity of cultures coupled with elongation of shoots. They owed that to auxin constituentas auxins fortify the apical dominance and improve the expansion of cells walls. In contrast, Ahmed (2018) overlaid the *in vitro* cultures of sugarcane (*Saccharum officinarum*) with low concentration extract of Argel, and obtained striking increase in cultures prolific capacity. He claimed a cytokinin-like effect upon such application of Argel. Nevertheless, the targeted stimulations in this study were achieved but without solid interpretation of the active ingredients behind them other than the claims of Idris *et al.,*(2011 and 2014) that such enhancements might owe to growth regulator-like constituents in Argel. Yet, these results are confirmatory to the findings of preceding research reports claiming growth stimulations on different horticultural genotypes when treated with Argel (Eisa, 2016; Hamid, 2016; Idris and Modawi, 2016, Ahmed, 2018). A marginal remark can be added, as no symptoms of the bacterial canker were observed on the seedlings throughout the study period and thereafter, but the remark cannot be proposed as a means of control unless considered in future studies by pathologists.

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