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Shoot Elongation Response of Bougainvillea Plant to Pruning and Slow- Release Fertilizer

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Abstract

Potted bougainvillea plants (one-year old) were pruned to have one or two-branches and fertilized once a season with slow –release NPK fertilizer (17-17-17) at the rates of 0, 10 and 20 g/pot. Data cleared that plants with one-branch showed more pronounced increases in plant height, root- shoot ratio, fresh and dry weights of flower- bracts, leaf pigments (chlorophylls a & b) and carotenoids content than those with two- branches which produced higher number of shoots and dry weight of aerial parts. Numbers of leaves and flower-bract, total leaf area and leaf nutrients content (N, P and K) were not affected with pruning type treatments. Plant height, number of shoots per plant, total leaf area, leaf nutrients content (N, P and K) and carbohydrates content were significantly increased with increasing fertilizer rate, but low fertilizer rate (10g/ plant) was the most pronounced dose for increasing number of leaves and total leaf area, and fresh and dry weights of aerial parts. Since a rate of 20 g/plant was more effective in stimulating flower –bract parameters and chlorophylls. The interaction between pruning and NPK- fertilizer treatments indicated that the favorable growth and flowering were obtained from the combination of plants with one- branch and fertilized with 20g/ plant. This combination is desirable for hedges, fences and pergola purposes.

Keywords: *Bougainvillea glabra, slow release fertilizer, pruning, hedge, fence.*

Introduction

Bougainvillea are popular ornamental plants in most areas with warm climates. In the landscape, it makes an excellent hot season plant, and its drought tolerance makes it ideal for warm climates year-round. Its high salt tolerance makes it a natural choice for color in coastal regions. It can be pruned into a standard, but is also grown along fence lines, on walls and as a hedge or an accent plant because of its long arching thorny branches.

Pruning requirement is considered the most important cultural practice through which bougainvillea shrub can develop a desired size or form to promote a bushy appearance, as well as stimulate healthy growth and flowering. The overall analysis of both physiological and ecophysiological factors which influence photosynthesis leads to enhance plant growth and quality; Gilman and black (1989), Kobayashi *et al*. (2007), Saifuddin *et al*. (2010) and Ghosh *et al*. (2011).

Growth and quality of landscape shrubs are usually improved by NPK-fertilization at suitable formulations and rates. Numerous investigators declared the favorable and stimulator effects of NPK-fertilization on growth, flowering and nutritional status of several shrub species such as

Abdul-Ghaffor *et al.* (2002) on *Rosa spp*., Korkar (2003) on *Jasminum sambac* and *Bougainvillea glabra*, EL-Mahrouk *et al*. (2009) on *Cestrum aurantiacum*, and EL-Sallami *et al.* (2013) on *Cestrum noctrunum*. They reported that plants were differed greatly in their responses depending on the optimum amounts and regimen of fertilizer which is dictated by their inherent growth rates, the duration of their growth periods, their ages, the types of root system they have and their ability to absorb nutrients according to species. In this connection, Opik *et al*. (2005) advised to avoid a fertilizer high in nitrogen because it will often cause the shrub to produce abundant foliage but very few flowers. Using a fertilizer of high phosphorous content as it encourages the flowers to grow and bloom healthily. They also advised to look for NPK-fertilizer at adequate formulations to encourage the growth and blossoms and quality of different landscape shrubs.

Recently, some researchers used controlled release fertilizers which are notable for their very slow-release of nutrients to promote vegetative growth and flowering such as Graca and Hamilton (1981) on *Cotoneaster divaicata*, Schwemmer (1985) on *Euphorbia pulcherrima, Dracaena marginata* and *Coadiaeum variegatum*, Chase and Poole (1989) on *Codiaeum variegatum*, and Mousa *et al*. (2004) on *Scindapsus aureus*. In addition. Kobayashi *et al*. (2007) demonstrated that bougainvillea needs regular fertilizing. At planting, amend the soil with controlled-release fertilizers with formulation having NPK ratio of 1:1:1 for long-term culture, topdressing with controlled-release fertilizer, once a year is needed.

There is a few information on pruning young bougainvillea so they have good branch structure under NPK-fertilization to grow tall by selectively removing or shortening branches on a young plant. So this study aimed to define the most pronounced pruning technique combined with the optimum amount of slow-release fertilizer requirements to produce branches and better growth and flowering for hedges, fence and pergola purposes.

Materials and Methods

Bougainvillea glabra cv. Snow white plants were grown under full sun-light conditions at the Floriculture Nursery, Faculty of Agriculture, Assiut University, Egypt during two successive seasons of 2013/2014 and 2014/2015.

In April 1st of 2013/2014, healthy and vigorous plants (one-year-old) were carefully selected as being uniform in their size. Plants were grown singly in 30 cm plastic pots contained clay soil (pH 7.9). After transplanting, plants were pruned to have one or two branches, each 30 cm long. In addition, slow-release granules fertilizer "multicote 4" NPK 17-17-17 (manufactured by Sinclair Horticulture, Chemical Company Limited) was applied to the soil once at rate of 0 (control), 10 and 20 g/pot. A split plot experimental design was used including 6 treatments (2 branching X 3 fertilizer) pruning as main plots and fertilizer as sub plots. The treatments replicated 4 times, each experimental unit (replicate) contained 4 plants (pots).

In mid-November of both growing seasons, leaf samples were taken and washed immediately with distilled water and dried at 70^0C for 24 hours and ground into homogenous fine powder to determine nutrient elements content. Total nitrogen was estimated by semi-micro Kjeldahl method as described by Black *et al.* (1965). Phosphorous was determined colorimetrically as phosphor-molybdate according to Jackson (1978). Potassium was determined in the digested solution according to Jackson (1978) using Flame-photometer with acetylene. Photosynthetic pigments was determined according to Vernon (1960). Total soluble carbohydrates in leaves was estimated colorimetrically using anthron sulphoric acid method according to Hansen and Moller (1975). Data were recorded on vegetative growth and flowering parameters and statistically analyzed using Statistix 8.1 analytical software and the mean were compared using a least significant differences (L.S.D) test according to Snedecor and Cochran (1989).

Results and Discussion

Effect of pruning on growth and flowering

Data cleared that shoot and root growth were influenced by both pruning styles. Obviously, plants with one-branch showed more pronounced increases in plant height, while number of shoots increased with two-branches (Table 1). These results were consistent with those obtained by Avilan *et al*. (2003) and Srilatha *et al*. (2015) on *Mangifera indica* seedlings. In relation to leaf characteristics, the type of pruning did not appear significant increase in leaves number, and total leaf area (Table 1). These results agree with earlier observations by Ghosh *et al*. (2011) on *Jatropha Curcas*, they demonstrated that early removal of side shoots is advisable. Gilman and Black (1989) reported that there is more satisfactory system of primary determine the production of vigorous branches which will bear more or less leaves and encourage it to develop. Kramer and Kozlowski (1979) suggested that an increase in photosynthesis occurs when leaves are reduced might be due to compensate for the reduction in the leaf area. Although dry weight aerial parts of plants with two-branches were heavier than those with one- branch (Table 2), they showed insignificant increase in leaves and root dry weight in both seasons. These results are in harmony with those reported by Mediene *et al*. (2009) on *Prunus persica* seedlings. This relationship reflecting on the ratio of roots/ shoots since plants with one- branch had higher ratio than those with two branches. Several authors attributed the different physical relationships of the shoots, to the roots and to each other. Mertens and Wright (1978) explained that the rhythmic growth of Japanese holly was occurred by root absorption of nitrogen which reacts with carbohydrates to promote its development. Subsequently, more nutrients absorption by roots, then transported to the shoot since it combines with carbohydrates to form protein led to stimulate shoot growth. Bentz *et al*. (1985) stated that the root absorbs inorganic nutrients which are used to make the structural and enzyme proteins and other components required for the photosynthesis which takes place primarily in leaves. The products of photosynthesis will export mainly towards the roots. Inorganic ions also move through the plant during its growth. The large increase in the nutritional flow to the aerial parts increased export, but in this case the increase is largely exported to roots and stems.

Although number of flower-bracts per plant was not affected by pruning treatments, their fresh and dry weights were greatly affected (Table 3). However, plants with one-branch were markedly heavier in fresh and dry weights of flower-bracts by 59.7 and 35.5% higher than those with two- branch, respectively (as an average of two seasons). These results are in agreement with those obtained by Avilan *et al*. (2003), Oliveira *et al*. (2015) and Srilatha *et al*. (2015) on *Mangifera indica* seedlings.

Effect of fertilization on growth and flowering

Regarding the effect of slow release fertilizer on the vegetative growth, it was observed that plant height, number of shoots per plant and total leaf area were significantly increased with increasing fertilizer rate (Table 1). These results are in harmony with those obtained by Schwemmer (1985) on *Euphorbia Pulcherrima, Dracaena marginata* and *Codiaeum Variegatum,* Chase and Poole (1989) on *Codiaeum Variegatum*, and Mousa *et al*. (2004) on *Scindapsus aureus*. Meanwhile, low fertilization rate (10g/ plant) was the most pronounced dose in increasing number of leaves and total leaf area per plant resulting in significant increase compared to high fertilizer rate (20g/ plant) or control. The increase resulted from a rate of 10g/ plant were 24 and 25% for leaf number, as well as 15 and 18% for total leaf area over the level of 20g/ plant also when it is compared to unfertilized plants recorded 130 and 91% for leaf number, as well as 160 and 107% for total leaf area in the first and second seasons, respectively.

Apparently, both fertilizer levels significantly increased dry weight of the aerial parts and roots compared to control (Table 2). Whilst, low fertilizer rate was more effective than the high level resulting in 115 and 81% increase for dry weight of aerial parts, as well as 78 and 48% for root dry weight over control in the first and second seasons, respectively.

These results are in accordance with the findings of Abdul- Ghaffar *et al*. (2002) on rose, Korkar (2003) on *Jasminum Sambac* and *Bougainvillea glabra* and El- Sallami *et al*. (2013) on *Cestrum nocturmum*.

As for root- shoot ratios, it was noticed that both fertilizer levels significantly decreased it compared to control in both seasons. These results are in conformity with those reported by Graca and Hamilton (1981) on *Cotoneaster divericata*.

The stimulation effects of NPK fertilizer on the vegetative growth could be due to its role in supplying the plants with nitrogen, phosphorus and potassium required for promoting plant metabolism and activating the physiological processes leading to enhance the growth and development as explained by Noggle and Fritz (1989). Furthermore, Kramer and Kozlowski (1979) stated that NPK fertilizers with equal percentages are often needed for woody ornamentals because it will produce abundant foliage with dense flowers.

As for flowering (Table 3), number of flower- bracts and their fresh and dry weights were significantly increased with increasing fertilizer rate. Hence, a rate of 20g/ plant recorded 37 and 46% increase for flower- bract number, 63 and71% for fresh weight of flower- bracts, and 58 and 69% for dry weight of flower- bracts over control in the first and second seasons, respectively. These results are parallel to the results of Graca and Hamilton (1981) on *Cotoneaster divericata*, Schwemmer (1985) on *Euphorbia pulcherrima*, Auda *et al*. (2004) on *Bougainvillea glabra* and El- Mahrouk *et al*. (2009) on *Cestrum aurantiacum*.

From the above mentioned results, it could be noticed that there was a close relationship between the flower production and leaf formation. Raghavan (2000) reported that the photosynthetic capacity of the whole plant is the result of the various individual capacities of its leaves. However, in general the rate of photosynthesis seems to be related to the metabolic activities of the plant and hence its requirements. This seems to apply both individual leaves, in relation to the activities of limited regions of the plant, and to the plant. Opik *et al*. (2005) demonstrated that variations in photosynthesis were found related to the leaf area. Leaves usually have a low or a high rate of photosynthesis depending on leaf area of the whole plant which correlated with the amount of carbohydrate produced that play essential roles in flowering. Hence, the speed of flowering, number of flowers formed and flower weight increase as carbohydrates increase.

Leaf nutrients content

Clearly, N, P and K contents in leaves were not affected by type of pruning (Table 4). These results were attributed to the internal nutrients concentration of plants which greatly influenced by branching treatments whereas the uptake of these nutrients and their accumulations in leaves corresponding plant growth. As pruning occur, fully expanded new leaves formed cannot accumulate more nutrients in their tissues because of N, P and K contents in plants are closely correlated with leaf age and growth rate of plant as reported by Kramer and Kozlowski (1979) and Raghavan (2000). In this respect, Fageria (2001) concluded that there is positive interaction (synergistic effect) between N and P whereas N can increase P content in plant by increasing root growth, by increasing the ability of roots to absorb and translocate P. He also reported that increasing N concentration in the plant can increase or decrease K concentration in its tissue depending on K level.

On the contrary, N, P and K were significantly increased with increasing fertilizer rate. Similar observations were found by Cadahia *et al*. (1995) who revealed that N, P and K do not interfere with absorption of these ions and are evidently translocated by a different carrier or binding site, so are no competitive with one another. Such increases in leaf nutrients content could be due to supply with the essential three major elements in the slow- release fertilizer at adequate levels which have the ability of furnishing plants with these ions and accumulated them in leaves resulting in high contents which were apparently associated with the best growth.

Leaf pigments

It is quite clear that the photosynthetic pigments of chlorophylls (a & b) and carotenoids showed significant differences between pruning treatments (Table5). Plants with one-branch were considerably higher than those with two- branches. It can be referred that the pruning with one-branch was the most favorable type to keep the maximum contents of leaf pigments in bougainvillea. This finding agrees with the reports on the enhancement of the photosynthesis pigments through by Saifuddin *et al*. (2010) on *Bougainvillea glabra* and Ghosh *et al*. (2011) on *Jatropha curcas*. In this regard, Angeles *et al*. (2008) attributed this accumulation in chlorophylls (a & b) to the increment of cytokinin action which associated with pruning under natural sunlight conditions.

Concerning NPK- Fertilization effect, it was observed that fertilizer treatments significantly increased chlorophylls (a & b) compared to unfertilized control. However, a rate of 20g/ plant was more effective in increasing the chlorophylls (a & b) than in plants received the low level. These results are in agreement with those obtained by Abdul- Ghaffar *et al.* (2002) on rose, Korkar (2003) on *Jasminum sambac* and *Bougainvillea glabra* and El- Sallami *et al* (2013) on *cestrum nocturnum*. Obviously, the behavior of carotenoids content was in direct contrast to that of chlorophylls since carotenoids at low level were markedly higher than 20g/ plant. These results were similar to those obtained by Mousa *et al*. (2004) on *Scindapsus aureus* and El-Mahrouk *et al*. (2009) on *Cestrum aurantiacum*.

Taking into consideration the previous results of leaf nutrients content, it could be observe a positive relationship between the amounts of N, P and K absorbed by the plant and leaf pigments. According to Genchev *et al.* (1979), the leaf pigments content (chlorophylls and carotenoids) were accumulated in tomato leaves by using high concentrations of N, P and K ions in the nutrient solution.

Total carbohydrate

Result clearly indicated that total soluble carbohydrates content in the leaves was varied greatly depending on the style of pruning also from season to another (Table 5). In the first season, plants with one- branch significantly increased the carbohydrates compared to those with two-branches, but in the second one this effect was adversed. Previous researches proved that pruning had a material promoting the active biochemical constituents particularly the carbohydrates synthesis; Angeles *et al*. (2008) on Rose and Saifudin *et al*. (2010) on Bougainvillea. They concluded that the increase in total carbohydrates as a result of pruning might be attributed to increase in photosynthesis activity, consequently producing more photosynthetic products leading to more carbohydrates accumulation. Thus, the pruning causes a great amount of metabolic trap by forming new leaves. So the reductions of stored carbohydrates in leaves were noticed due to translocation of sugar to the new forming flowering shoots. Other assumption, Li *et al*. (2009) pointed out that pruning decreases the total of photosynthesizing area and reduces the amount of new carbohydrate resources. Mediene *et al*. (2009) demonstrated that the gathering of carbohydrate guides to both a reserving of photosynthesis and rising of respiration.

Regarding the fertilizer effect, total carbohydrates was significantly increased with increasing fertilizer rate in both seasons. These results are in harmony with those reported by Abdul- Ghaffar *et al*. (2002) on Rose, Korkar (2003) on *Jasminum sambac* and *Bougainvillea glabra*, Auda *et al*. (2004) on *Bougainvillea glabra* and El- Sallami *et al*. (2013) on *Cestrum nocturmum*.

It can be cleared in such a way that the increased carbohydrates were associated with the highest leaf nutrients content that could be attributed to the role of N, P and K required for the photosynthesis that produced large amount of carbohydrates which may move rapidly from leaves to the newly developing tissues. Mantrova and Nikitima (1972) found that the optimum NPK ratios in the fertilizer and applied at a suitable rate raised the physiological activity of rose plants that stimulated carbohydrates synthesis which accumulated in leaves.

Generally, the interaction between pruning and NPK- fertilizer treatments indicated that the favorable growth and flowering were obtained from the combination of plants with one- branch supplied with slow release fertilizer (17-17-17) at a rate of 20g/ plant. This combination produced the most suitable plants for hedge purposes; tall, showy, with more essential nutrients (N, P and K) at adequate levels which they associated with the highest leaf carbohydrates and pigments.

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Table 1. Effect of branch number and NPK fertilization on vegetative growth characteristics of bougainvillea plants during 2013/2014 and 2014/2015 seasons

	1st Season				2nd Season			
	NPK (g)							
Branch/plant (B)	**0g**	**10g**	**20g**	**Mean**	**0g**	**10g**	**20g**	**Mean**
	Plant Height (cm)							
One	82.0	96.3	100.5	**92.9**	76.0	93.5	97.5	**89.0**
Two	69.2	82.1	86.8	**79.4**	62.8	74.4	81.5	**72.9**
Mean	**75.6**	**89.2**	**93.7**		**69.4**	**84.0**	**89.5**	
L.S.D. 0.05	**B:1.5**	**F: 4.7**	**BxF:6.6**		**B: 2.5**	**F:1.8**	**BxF:2.5**	
	No. of shoots/plant							
One	5.6	6.6	7.5	**6.6**	4.4	5.8	7.0	**5.7**
Two	6.8	8.3	9.2	**8.1**	5.5	7.7	8.5	**7.2**
Mean	**6.2**	**7.5**	**8.4**		**4.9**	**6.8**	**7.8**	
L.S.D. 0.05	**B:0.15**	**F:0.18**	**BxF:0.25**		**B: 0.13**	**F:0.21**	**BxF:0.29**	
	No. of leaves/plant							
One	82.8	199.8	166.8	**149.8**	90.0	169.3	148.3	**135.8**
Two	92.0	201.8	156.8	**150.2**	95.0	184.3	135.5	**138.3**
Mean	**87.4**	**200.8**	**161.8**		**92.5**	**176.8**	**141.9**	
L.S.D. 0.05	**B: NS**	**F: 4.4**	**BxF:6.2**		**B: NS**	**F: 7.1**	**BxF: 10.1**	
	Total leaf area/plant (cm^2)							
One	1194	3111	2871	**2392**	1328	2827	2637	**2264**
Two	1305	3382	2773	**2487**	1487	2988	2302	**2259**
Mean	**1250**	**3247**	**2822**		**1407**	**2908**	**2469**	
L.S.D. 0.05	**B:N.S**	**F:121**	**BxF:171**		**B: N.S**	**F:146**	**BxF: 207**	

Table 2. Effect of branch number and NPK fertilization on dry weights of leaves, branches, aerial parts and roots and root/shoot ratio of bougainvillea plants during 2013 /2014 and 2014/2015 seasons

Branch/plant (B)	1st Season				2nd Season			
	NPK(F)							
	0g	10g	20g	Mean	0g	10g	20g	Mean
	Leaves dry weight (g/plant)							
One	6.5	25.6	22.9	**18.3**	7.1	22.4	20.8	**16.8**
Two	11.8	25.7	20.7	**19.4**	12.5	23.6	18.1	**18.1**
Mean	**9.2**	**25.6**	**21.8**		**9.8**	**23.0**	**19.5**	
L.S.D. 0.05	**B:N.S F:0.6 BxF:0.8**				**B:N.S. F:0.8 BxF:1.1**			
	Aerial part dry weight (g/plant)							
One	20.4	56.9	53.3	**43.5**	22.3	49.6	48.3	**40.1**
Two	33.7	59.8	52.9	**48.8**	35.6	54.8	46.3	**45.6**
Mean	**27.1**	**58.4**	**53.1**		**29.0**	**52.2**	**47.3**	
L.S.D. 0.05	**B:1.2 F:1.5 BxF:2.1**				**B:0.3 F:1.8 BxF:2.6**			
	Root dry weight (g/plant)							
One	7.7	14.1	10.6	**10.8**	7.3	11.9	13.2	**10.8**
Two	8.2	14.4	10.6	**11.1**	9.3	12.8	13.9	**12.8**
Mean	**8.0**	**14.2**	**10.6**		**8.3**	**12.3**	**13.6**	
L.S.D. 0.05	**B:N.S F:0.5 BxF:0.7**				**B:N.S F:0.5 BxF:0.7**			
	Root/shoot ratio							
One	0.38	0.25	0.20	**0.28**	0.33	0.24	0.28	**0.28**
Two	0.24	0.24	o.2o	**0.23**	0.26	0.23	0.30	**0.26**
Mean	**0.31**	**0.25**	**0.20**		**0.30**	**0.24**	**0.29**	
L.S.D. 0.05	**B:N.S F:0.015**				**B:0.003 F:0.014 BxF: 0.019**			

Table 3. Effect of branch number and NPK fertilization on flower bract parameters of bougainvillea plants during 2013 /2014 and 2014/2015 seasons

	1st Season				2nd Season			
	NPK (g)							
Branch/plant (B)	0g	10g	20g	Mean	0g	10g	20g	Mean
	No. of flower bracts/plant							
One	123	184	186	**164**	104	132	143	**126**
Two	144	153	182	**159**	97	131	150	**125**
Mean	**134**	**168**	**184**		**100**	**131**	**146**	
L.S.D. 0.05	**B:N.S F:8.3 BxF:11.8**				**B:N.S F:8.3 BxF: 11.7**			
	Fresh weight of flower- bracts (g/plant)							
One	22.4	33.6	38.2	**31.4**	19.0	23.9	30.5	**24.5**
Two	15.8	18.7	23.9	**19.5**	10.4	16.1	19.9	**15.5**
Mean	**19.1**	**26.1**	**31.1**		**14.7**	**20.0**	**25.2**	
L.S.D. 0.05	**B:0.65 F:1.29 BxF:1.82**				**B:1.01 F:1.61 BxF:2.27**			
	Dry weight of flower- bracts (g/plant)							
One	4.59	6.76	7.52	**6.29**	3.89	4.79	6.07	**4.92**
Two	3.66	4.57	5.54	**4.59**	2.46	3.95	4.64	**3.68**
Mean	**4.13**	**5.66**	**6.53**		**3.17**	**4.37**	**5.35**	
L.S.D. 0.05	**B:0.12 F:0.28 BxF:0.39**				**B:0.19 F: 0.33 BxF:0.47**			

Table 4. Effect of branch number and NPK fertilization on N, P and K contents in leaves of bougainvillea plants during 2013 /2014 and 2014/2015 seasons

Branch/plant (B)	1st Season				2nd Season			
	NPK(F)							
	0g	10g	20g	Mean	0g	10g	20g	Mean
	N%							
One	2.485	2.832	3.110	**2.809**	2.650	2.960	3.180	**2.930**
Two	2.590	2.925	3.080	**2.865**	2.730	2.960	3.173	**2.954**
Mean	**2.537**	**2.878**	**3.095**		**2.690**	**2.960**	**3.176**	
L.S.D. 0.05	B: NS	F:0.054	BxF:0.077		B:NS	F:0.039	BxF:0.0552	
	P%							
One	0.426	0.509	0.606	**0.514**	0.409	0.527	0.631	**0.522**
Two	0.346	0.558	0.619	**0.508**	0.449	0.531	0.636	**0.539**
Mean	**0.386**	**0.533**	**0.613**		**0.429**	**0.529**	**0.633**	
L.S.D. 0.05	B: NS	F:0.009	BxF:0.008		B:NS	F:0.007	BxF:0.010	
	K%							
One	2.372	2.645	3.152	**2.723**	2.243	2.765	3.280	**2.763**
Two	2.430	2.750	3.020	**2.733**	2.330	2.810	2.933	**2.691**
Mean	**2.401**	**2.697**	**3.086**		**2.286**	**2.788**	**3.106**	
L.S.D. 0.05	B:NS	F:0.051	BxF:0.073		B:NS	F:0.055	BxF:0.077	

Table 5. Effect of branch number and NPK fertilization on photosynthetic pigments and total carbohydrates% in leaves of bougainvillea plants during 2013 /2014 and 2014/2015 seasons

Branch/plant (B)	1st Season				2nd Season			
	NPK (F)							
	0g	10g	20g	Mean	0g	10g	20g	Mean
	Chlorophyll a (mg/g)							
One	5.160	5.425	5.990	**5.525**	5.382	5.755	6.202	**5.780**
Two	4.820	5.322	5.760	**5.301**	4.965	5.452	5.930	**5.449**
Mean	**4.990**	**5.373**	**5.875**		**5.173**	**5.603**	**6.066**	
L.S.D. 0.05	B:0.045	F:0.078	BxF:0.111		B:0.022	F:0.115	BxF:0.163	
	Chlorophyll b (mg/g)							
One	3.382	3.762	4.077	**3.740**	3.170	3.720	4.272	**3.720**
Two	3.252	3.617	3.945	**3.605**	3.020	3.877	4.130	**3.675**
Mean	**3.331**	**3.690**	**4.011**		**3.095**	**3.798**	**4.201**	
L.S.D. 0.05	B:0.019	F:0.057	BxF:0.081		B:0.077	F:0.055	BxF:0.077	
	Carotenoids (mg/g)							
One	1.757	1.525	1.380	**1.554**	1.820	1.605	1.345	**1.590**
Two	1.722	1.470	1.292	**1.495**	1.750	1.555	1.370	**1.558**
Mean	**1.740**	**1.497**	**1.336**		**1.785**	**1.580**	**1.357**	
L.S.D. 0.05	B:. 0.027	F:0.035	BxF:0.050		B:.0.058	F:0.039	BxF:0.055	
	Total carbohydrates %							
One	12.80	15.50	16.30	**14.90**	11.90	15.40	16.30	**14.5**
Two	12.50	15.10	15.80	**14.50**	13.50	16.70	17.50	**15.9**
Mean	**12.60**	**15.30**	**16.00**		**12.70**	**16.00**	**16.90**	
L.S.D. 0.05	B: 0.14	F:0.71	BxF: 1.00		B:0.24	F:0.48	BxF:0.68	

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استجابة استطالة فروع نبات الجهنمية للتقليم والسماد بطئ الذوبان

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الملخص

أجريت الدراسة بمزرعة ابحاث نباتات الزينة – كلية الزراعة – جامعة أسيوط خلال موسمى ٢٠١٣/٢٠١٤ و٢٠١٤/٢٠١٥ على نباتات الجهنمية جلابرا صنف سنووايت للحصول على نبات طويلة الافرع لزراعتها فى الاسوار النباتية وتغطية البرجولات ، ولتحقيق هذا الهدف قلمت النباتات لكى تحتوى على فرع او فرعين وسمدت بالسماد ن فو بو (١٧-١٧-١٧) بطئ الذوبان بتركيز صفر ، ١٠و٢٠ جرام لكل اصيص ٣٠سم.

وكانت اهم النتائج ما يلى:

- ادى تقليم النباتات على فرع واحد الى زيادة كل من: ارتفاع النبات، نسبة الجذور الى الفروع، الوزن الرطب والجاف للازهار القنابية كما زاد محتوى الاوراق من الصبغات (كلوروفيل أ، ب والكاروتينيدات).
- تقليم النباتات على فرعين ادى الى زيادة عدد الأفرع والوزن الجاف للنمو الخضرى.
- لم يتأثر معنويا عدد الاوراق، المساحة الكلية للاوراق، عدد الازهار القنابية ومحتوى الاوراق من العناصر (ن – فو – بو) بالتقليم.
- ادى زيادة معدل التسميد الى زيادة جوهرية فى ارتفاع النبات، عدد الافرع، عدد الأوراق ومساحتها الكلية ومحتواها من النيتروجين والفوسفور والبوتاسيوم والكربوهيدرات .
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