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Influence of Different Treatments of Nutrition, Putrescine and Media on Corm, Cormel Production and some Biochemical Parameters of two Cultivars Gladiolus under Soilless Condition

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***Abstract*:** *—This experiment was conducted to evaluate the effects of Nutrition (Hoagland solution and calcium nitrate solution), putrescine (50 and 100 ppm) and coco peat: perlite medium with three ratios (v/v) (1:1, 3:1 and 1:3) on some corm, cormel parameters and some biochemical parameters of two cultivars of gladiolus (Strong and White) under soilless condition in 2016. Data indicated that most criteria of corm and cormel parameters expressed as number of corms (2.18), number of cormels (45.00), corm diameter (6.02 cm), fresh weight of corm (60.59 g), and biochemical parameters expressed as leaf soluble sugar (6.23 mg/g F.W), leaf phenols content (37.01 mg/100g F.W) and flower ascorbic acid content(11.71 mg/100g F.W) significantly increased by the application of Hoagland solution + putrescine 100 ppm, while days to corm sprouting decreased (7.46 day). In terms of media the same traits ((1.59), (33.33), (5.93 cm), (60.14 g), (4.58 mg/g F.W), (28.91 mg/100g F.W) and (8.13 mg/100g F.W) respectively) significantly increased by the coco peat: perlite medium with ratio (1:3), while days to corm sprouting decreased (7.90 day). In terms of cultivars also white cultivar was superior ((1.56), (32.33), (5.94 cm), (59.16 g), (4.87 mg/g F.W), (28.56 mg/100g F.W) and (8.36 mg/100g F.W) Respectively), to strong cultivar, while days to corm sprouting decreased in white (7.09 days). Interaction between cultivars, media and treatments in term of number of cormels was significant and the highest number of cormels (48.00) obtained by white cultivar, coco peat: perlite medium with ratio (1:3) and application of Hoagland solution + putrescine 100 ppm le)*

Keywords: *Calcium nitrate, Gladiolus, Hoagland solution, Putrescine, Soilles.*

1. Introduction

Gladiolus is a flower of glamour and perfection which is known as the queen of bulbous flowers due to its flower spikes with florets of massive form, brilliant colours, attractive shapes, varying size and excellent shelf life. Gladiolus stands fourth in the international cut flower trade after carnation, rose and chrysanthemum. Commercial floriculture is one of the most profitable agro industries in the world (Ezhilmathi et al., 2008). Gladiolus (*Gladiolus grandiflorus* L.) is one of the most cultivated, economically important and common flowering plant world-wide including Iran and is among the elite cut flowers due to different shapes, hues and prolonged vase life (Bose et al., 2003). Gladiolus, a member of family Iridaceae and sub-family Ixidaceae, originated from South Africa, is a prominent bulbous cut flower plant. Production of healthy and vigorous corms and cormels depend on many factors, of which nutrient supply is an important one. Gladiolus requires nutrients throughout the period of growth, corm development, and flowering. So, application of suitable nutrients in an optimum amount is important. Gladiolus cormels responded better to heavy doses of fertilizers compared to corms (Mukhopadhaya, 1995). The growers do not have any recommended doses of chemical fertilizers for quality corm and cormel production. Even the flower producers multiply their seeds without applying any

chemical fertilizers. As a result, they are deprived to get optimum sized corms and cormels for flower cultivation. So, there is a good scope of increasing the yield and vigorous corm and cormel production of gladiolus from cormel by the use of appropriate amount of nutrition (F.N. Khan et al., 2002). Polyamine (PAs) namely putrescine (Put), spermine (Spm) and spermidine (Spd) in different plant developmental process (Martin, 2001). They modulate several growths and developmental processes viz., cell division, differentiation, flowering fruit ripening, embryogenesis, senescence and rhizogenesis (Kakkar et al., 2000). In all these, PAs have been ascribed various roles such as that of a new class of plant growth regulators, hormonal second messengers and as one of the reserves of carbon and nitrogen at least in cultured tissues (Slocum and Floree, 1991). PAs regulate root development and interaction between microbes and plant roots but this function is not yet well known (Hummel et al., 2002; Walters, 2000; Couee et al., 2004). It is reported that foliar application of PAs has increased some nutrients, particularly K uptake, which its vital role in photosynthesis by directly enhancing the growth and photosynthetic pigments and carbon dioxide absorption has been found (Salama, 1999). In recent years, some problems in soil culture (such as salinity and unsuitable soil characteristics) and limitation of water resources in many countries, especially in Iran, causes the expansion of soilless culture. Soilless cultures an artificial means of providing plants with support and a reservoir for nutrients and water. The use of soil in protected agriculture is facing many limitations in this country. After years of cultivation, deterioration in soil fertility and increase in soil salinity, in addition to the increase of soil-borne diseases and limited productivity of crops, have often been observed. Therefore, utilizing substrate-based agriculture is a logical alternative to the current soil-based production approach in the country. Hydroponic scientist with a lot of examination had resulted that the growth of plant have not needed soil if grower supply nutrient elements for plants by fertilization and fertigation (Papadopolus, 1994). Dobrzansks (1981) reported that the yield of gladiolus flower was highest in peat and lowest yield was found in lignite soil. Leinfelder and Rober (1989) used peat + clay, rockwool, foam, perlite and clay for raising gladiolus. They found that flower quality was similar in peat + clay, rockwool and foam, but was very inferior in clay. Sorokina et al. (1984) reported that bark and peat mixture was the best media for growing ornamental plants. Ahmed (1989) reported that sand + peat, sand + leaf mould enhanced the flowering, number of flower and flower size significantly. Magnani et al. (2003) reported that Lapillus was compared to a traditional substrate with perlite and alternative ones with coconut fibre, either single or in a mixture can give excellent productions for the bulbous species tested. Lapillus gave good results with gladiolus, similar to those with traditional perlite, with regards to the qualitative characteristics of the stem (fresh weight and height). Slight decrease in the qualitative characteristics of lily was observed when the lapillus was used singly, whereas it allowed us to obtain very satisfying results when used in a mixture with coconut fibre. Tribulato et al. (2003) reported that among substrates, lavic basalt mixed with peat led to higher values of stem length and thickness and fresh weight of cut flowers. The highest plant density slightly decreased product quality, thus it seems possible to grow a high number of plants per square meter and increase the yield. Tehranifar et al. (2011) reported that the effect of three soilless media on growth and development of two types of *Lilium* The media were 100% coco peat, 50% gravel + 50% sand and 40% peat + 60% perlite. In general, the media of 50% gravel + 50% sand was equal compared with two other media in most of the measured traits. In the present study, we investigated the effects of different treatments of putrescine, nutrition and media on some flowering parameters and macronutrients uptake of two cultivars of gladiolus under soilless condition.

2. Material and Methods

This experiment was conducted at the glasshouse of the Department of Horticultural Science and Landscape, Faculty of Agriculture, Ferdowsi University of Mashhad, Iran, in 2016 to study the effects of nutrition (Hoagland solution, calcium nitrate solution (1.26 g/L-1) and control (only water), putrescine (50 and 100 ppm) and two media (coco peat: perlite) with three ratios (v/v) (1:1, 3:1 and 1:3) on corm, cormels and some biochemical parameters of two gladiolus cultivars (strong and white) under soilless conditions. The corms used in the experiment were purchased from a local commercial in (Mahallat). The mean size of these corms was 2.5 cm in circumference. In the present study, two gladiolus cultivars, three ratios of coco peat: perlite and 9

treatments including {T1 control (only water), T2 Put. 50 ppm, T3 Put. 100 ppm, T4 Hoagland solution, T5 Hoagland solution + Put. 50 ppm, T6 Hoagland solution + Put. 100 ppm, T7 Calcium nitrate solution (1.26 g/L-1), T8 Calcium nitrate solution (1.26 g/L-1)+ Put. 50 ppm and T9 Calcium nitrate solution (1.26 g/L-1) + Put100 ppm} were investigated. The pots were filled by the medium (10 kg/pot) with three ratios (v/v) (1:1, 3:1 and 1:3), and then three healthy corms were planted at the depth of 10 cm the size of pot was (25 cm X 40 cm) in May 2016 with an soilless open system. Plants were irrigated 2 times every day for 5 min (the amount of water was ½ litters per each pot per day). Four weeks after planting plants were sprayed with different levels of putrescine in related treatments at the rates of 50 and 100 ppm and sprayed again before two weeks of flowering. To facilitate putrescine absorption, a few drops of twin 20 (Merk) were added to spray solutions. Bed leaching was done weekly to prevent the salt accumulation. Hoagland solution, calcium nitrate solution were set for pH=6 and EC=2 dS/ m-1. The glasshouse day and night temperatures were 24/20°C during the experiment. Relative humidity was adjusted at 50% and the light intensity averaged 90 mmol/m2/s-1 during the day. The standard cultural practices were followed during the entire growing period of the crop. The experiment was laid out in factorial based on completely randomized design with three factors with three replications. The observations related to the corm, cormels and some biochemical parameters were recorded at the end of the experiment. Sprouting corm was account from planted to the day of sprouting. Diameter of harvested corm was measured by using slide calipers from three plants, averaged and expressed in centimeter. Corm fresh weight was determined by weighting the corm from three plants; their mean weight was calculated and expressed in grams. Total leaf soluble sugars (mg/g/ F.W) were determined in the methnolic extract by using the phenol – sulphuric method according to Dubois et al., (1966), leaf Phenols content (mg/100 g/ F.W) were determined colourimetrically by using Folin Ciocaltea reagent A.O.A.C. (1985) and flower ascorbic acid concentration (mg/100 g/ F.W) of gladiolus was determined by the method suggested by Hans (1992).

3. Results and Discussion

Sprouting corm: The results regarding sprouting corm showed the significant difference between cultivars, media and different treatments of nutrition and putrescine. Where the lowest day to sprouting corm was obtained by white cultivar (7.09 days), in comparison with strong cultivar (8.89 days). The lowest day to sprouting corm was obtained by coco peat: perlite media with the ratio of (3:1), (7.90 days). Furthermore, the lowest day to sprouting corm was in the treatment containing Hoagland solution + putrescine 100 ppm (7.46 days, (Table 1).

Number of corms: As can be seen in Table (1), there was significant difference between the two cultivars, media and different treatments of nutrition and putrescine in terms number of corms, so that white cultivar showed higher number of corms (1.56 per plant) than strong cultivar with (1.45 per plant). The highest number of corms was obtained by coco peat: perlite media with the ratio of (3:1), (1.59 per plant). In addition, Hoagland solution + putrescine 100 ppm resulted in the production of the highest number of corms (2.01) per plant.

Number of cormels: Data presented in Table (1) showed the significant difference between the two cultivars, media and different treatments of nutrition and putrescine in terms of number of cormels, where white cultivar showed higher number of cormels (32.33) than strong cultivar with number of cormels (30.32). Besides, coco peat: perlite medium with the ratio of 1:3 produced the highest number of cormels (33.33). Application of Hoagland solution + putrescine 100 ppm produced the highest number of cormels (45.00). As the results showed, significant interactions were found between cultivars and media, media and treatments, cultivars and treatments, and cultivars, media, and treatments. Where white cultivar, coco peat: perlite media with the ratio of 1:3 and application of Hoagland solution + putrescine 100 ppm showed highest number of cormels (48.00) (Fig. 1).

Corm diameter (cm): As can be seen in Table (2), the results showed that there was significant difference between the different treatments of nutrition and putrescine; the application of Hoagland solution + putrescine 100 ppm resulted in the largest corm diameter (8.17 cm) when compared with control (water only) with corm diameter (3.36 cm).

Fresh weight of corm (g): According to the data exhibited in Table (2), there was significant difference between the two cultivars, media and different treatments of nutrition and putrescine in terms of corm fresh weight, so that white cultivar showed higher corm fresh weight (22.89 g) than strong cultivar with corm fresh weight (20.87 g). Moreover, plants in coco peat: perlite (with ratio of 1:3) showed the highest corm fresh weight (23.96 g). The results also showed that application of Hoagland solution + putrescine 100 ppm resulted in the highest corm fresh weight (35.73 g).

As the results showed, there was a significant difference between the two cultivars in terms of sprouting corm, number of corms, number of cormels and corm fresh weight which can be due to the genetic traits of the cultivars. These findings confirm the fact that the individual corm characteristics are cultivar specific.

TABLE I: Main Effects of Different Treatments of Putrescine, Nutrition and Media on Corm Sprouting (day), Number of Corms and Number of Cormels of two Cultivars of Gladiolus under Soilless Condition

Cultivars	(Corm sprouting(day	Number of corms	Number of cormels
Strong	b8.89	b1.45	b30.32
White	a7.09	a1.56	a32.33
Media			
Cocopeat: perlite 1:1	b7.98	a1.52	b31.29
Cocopeat: perlite 3:1	b8.09	c1.41	c29.35
Cocopeat: perlite 1:3	a7.90	a1.59	a33.33
Treatments			
Control	g8.64	cd1.16	i20.05
Put. 50 ppm	fg8.51	cd1.22	h22.00
ppm 00Put. 1	ef8.40	cd1.24	g23.00
Hoagland	b7.76	b1.88	c41.27
Hoagland + Put. 50 ppm	ab7.57	b2.01	b43.00
Hoagland + Put. 100 ppm	a7.46	a2.18	a45.00
Nitrate calcium	de7.96	cd1.27	f27.00
+ Nitrate calcium Put. 50 ppm	cd7.90	cd1.27	e29.33
+ Nitrate calcium t. 100 ppmPu	c7.72	c1.33	d31.27

Similar variation in varietal response with respect to corm attributes was reported by several workers (Seenivasan, 2001, Paswan, 1985). From the result, it was evident that where perlite rate used more than cocopeat rate (3:1), it caused sprouting easier and early. Whereas cocopeat rate used more than perlite rate (1:3) caused delay in sprouting. The possible reason related physical properties of these two media. In perlite particles are loose and more porosity and absorbs water sufficiently, which can be utilized by corm. The cocopeat particles are closely linked with very little space for aeration and high water holding capacity; hence it hinders the emergence (Khan et al., 2002). Coco peat is organic substrates and perlite is inorganic substrates and when mixed together become more effective in the composting process that can cause the mineralization of organic matter and change the organic forms of N and P to mineral forms (Michael and Heinrich, 2008). Coco peat has high water holding capacity which creates a poor relationship between air and water, leading to low aeration within the medium which affects oxygen diffusion to the roots (Abad et al., 2002). Perlite substrate with very low cation exchange capacity (CEC), and good capacity of water absorption and coco peat substrate, with its high water holding capacity and nutrients can be considered as good growing media in soilless culture (Djedidi et al., 1999). For these reasons also can obtain the maximum corms, cormels and corm fresh weight. Application of Hoagland + putrescine 100 ppm resulted in the supply of nutrition required for growth as well as the elongation of the cells, thereby enhancing corm and cormel production (Thompsond and Troeh, 1975; Kakkar et al., 2000).

:Significance levels						
Cultivars				**	*	**
Media				*	*	**
Treatments				*	*	**
Cultivars x Media				ns	ns	*
Media x Treatments				ns	ns	*
Cultivars x Treatments				ns	ns	*
Cultivars Treatments	x	Media	x	ns	ns	*
are significantly different at Column and main effect followed by different letters P<0.05, Duncan's multiple range .test. ns: not significant; *, **significant at P<0.05, P<0.01, respectively						

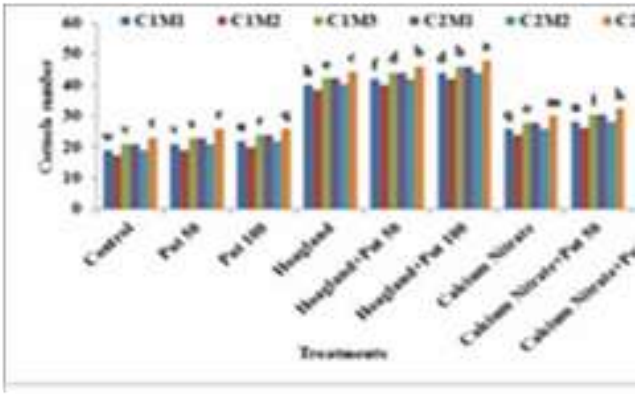

Fig. 1: Interaction effects interaction of different treatments of nutrition, putrescine and media on number of cormels of two of gladiolus under soilless condition, where C1M1= Strong cultivar and Cocopeat: perlite 1:1, C1M2= Strong cultivar and Cocopeat: perlite 3:1, C1M3= Strong cultivar and Cocopeat: perlite 1:3, C2M1= White cultivar and Cocopeat: perlite 1:1, C2M2= White cultivar and Cocopeat: perlite 3:1 and C2M3= White cultivar and Cocopeat: perlite 1:3.

TABLE II: Main Effects of Different Treatments of Putrescine, Nutrition and Media on Corm Diameter (cm) and Fresh Weight of Corm (g) of two Gladiolus Cultivars under Soilless Condition.

Cultivars	(Corm diameter (cm	Fresh weight (g) of corm
Strong	a5.88	b57.20
White	a5.94	a59.16
Media		
(Coco peat: perlite (1:1	a5.92	b58.19
(Coco peat: perlite (3:1	a5.89	c56.21
(perlite (1:3 :Coco peat	a5.93	a60.14
Treatments		
Control	f3.66	i33.33
Put. 50 ppm	ef3.82	h37.26
Put. 100 ppm	e3.95	g39.33
Hoagland	b7.90	c77.30
Hoagland + Put. 50 ppm	ab8.03	b79.33
Hoagland + Put. 100 ppm	a8.17	a81.37
Nitrate calcium	d5.75	f56.54
calcium + Put. 50 Nitrate ppm	cd5.92	e58.57
Nitrate calcium + Put. 100 ppm	c6.02	d60.59

:Significance levels		
Cultivars	ns	*
Media	ns	*
Treatments	*	*
Cultivars x Media	ns	ns
Media x Treatments	ns	ns
Cultivars x Treatments	ns	ns
Treatments Cultivars x Media x	ns	ns
Columns and main effects followed by different letters are significantly different at P<0.05, Duncan's multiple range test. ns: not significant; *, .significant at P<0.05, P<0.01, respectively**		

Biochemical parameters:

Total leaf soluble sugars (mg/g): The results in Table (2) showed that the two cultivars significantly differed from each other in terms of total soluble sugars, with white cultivar showing higher total soluble sugars content (4.87 mg/g) in comparison with strong cultivar with (3.89 mg/g). In addition, the highest total soluble sugars content (4.58 mg/g) was obtained in plants grown in coco peat: perlite media (1:3 ratios). The results regarding different treatments showed that application of Hoagland solution + putrescine 100 ppm resulted in the highest total soluble sugars content (6.23 mg/g).

Leaf Phenols content (mg/100 g): Results presented in Table (2) suggested that phenols content differed in the two cultivars. White cultivar with (28.56 mg/100 g) had higher phenols content than strong cultivar with (27.46 mg/100 g). Moreover, among the three media ratios, plants grown in coco peat: perlite (1:3) had the highest content of phenols (28.91 mg/100 g). The results also showed that treatment containing application of Hoagland solution + putrescine 100 ppm showed the highest phenols content (37.01 mg/100 g) among all the treatments.

Flower ascorbic acid content (mg/100 g): Regarding ascorbic acid content, there was significant difference between the two cultivars as shown in Table (3); white cultivar with (8.36 mg/100 g) had higher ascorbic acid contentnt in comparison with strong cultivar with (7.35 mg/100 g). Furthermore, coco peat: perlite (1:3) showed to have the highest ascorbic acid content were (8.13 mg/100 g) among all the three medium ratios. Regarding treatments, the results showed that application of Hoagland solution + putrescine 100 ppm resulted in the highest ascorbic acid content (11.71 mg/100 g).

Biochemical parameters showed that the culture medium including perlite rate more than cocopeat rate (3:1), results to higher leaf soluble solids, phenol and ascorbic content. The possible reason may be to large leaf area where also the rate of perlite: cocopeat (3:1) had been given (data was hidden), these results may be due to the increase in leaves expansion and size or both as a result the leaf area increased which can be effective for produce highest leaf soluble solids and phenol content in leaf. Ascorbic acid is an important non-enzymatic antioxidant, the most abundant antioxidant within plants (Bolkhina et al., 2003), plays a role to protect plants from oxidative damage and which also declines other stresses. It is also associated with in plant growth and development (Bedour et al., 2011) by acting a cofactor of several enzymes that metabolize the protein and carbohydrates synthesis, and also involved in photosynthetic process. These results are consistent with many researches (Shabani, 2011, Hamtiandehkordi et al, 2010 and Sami, 2004). In the present work the results obtained from application of nutrition and sprayed Put. are in agreement with the results by (El- Bassiuony and Bekheta, 2001) as they obtained increases in the total carbohydrates content in gladiolus plants treated with Put. These increments in total carbohydrates contents may be attributed to increase in photosynthetic process efficiency, which led to increase net assimilation of leaf CO2 which is known as the basic unit of carbohydrate. The present data are in agreement with the finding of (Youssef and Talaat, 2003) on rosemary plants, Abdel Aziz et al., (2006) on Khya senegalensis plants, (Abdel Aziz et al., 2007) on *Syngonium podyphyllum* L. plants, and (Farahat et al., 2007) on *Cupressus sempetrirens* L. they found that foliar application of nutrition and sprayed Put. caused an increase in photosynthetic pigments and total soluble sugars content, phenols content and ascorbic acid content.

TABLE III: Main effects of different treatments of putrescine, nutrition and media on soluble sugar (mg/g F.W), Phenols (mg/100 g F.W) and ascorbic acid content (mg/100 g F.W) of two cultivars of gladiolus under soilless condition.

Cultivars	(Soluble sugar (mg/g F.W		(Phenols (mg/100 g F.W	(Ascorbic acid (mg/100 g F.W
Strong	b3.89		b27.46	b7.35
White	a4.87		a28.56	a8.36
Media				
Cocopeat: perlite 1:1	b4.37		b28.00	b7.86
Cocopeat: perlite 3:1	c4.19		c27.11	c7.57
Cocopeat: perlite 1:3	a4.58		a28.91	a8.13
Treatments				

Control	i2.68		i18.81	fi4.66
Put. 50 ppm	h3.15		h20.70	h5.69
Put. 100 ppm	g3.28		g21.57	g5.86
Hoagland	c5.86		c35.21	c9.27
Hoagland + Put. 50 ppm	b6.07		b36.13	b10.49
Hoagland + Put. 100 ppm	a6.23		a37.01	a11.71
Nitrate calcium	f3.87		f26.65	f6.63
Nitrate calcium + Put. 50 ppm	e4.05		e27.55	e7.58
.Nitrate calcium + Put ppm 100	d4.23		d28.45	d8.78
Cultivars:**Significance levels**		**	*	*
Media		*	*	*
Treatments		**	**	**
Cultivars x Media		ns	ns	ns
Media x Treatments		ns	ns	ns
Cultivars x Treatments		ns	ns	ns
Cultivars x Media x Treatments		ns	ns	ns
:fferent letters are significantly different at P<0.05, Duncan's multiple range test. nsColumn and main effect followed by di .not significant; *, **significant at P<0.05, P<0.01, respectively				

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