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Growing media, GA_3 and thiourea stimulates growth and rooting in gladiolus cormels cv. Tiger Flame

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Abstract
An experiment was carried out to find out effect of different growth regulators and different media on shoot and root growth in cormels of gladiolus cv. Tiger Flame in a Completely Randomized Design (CRD) with three replications in the Research Laboratory of Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, and Varanasi during November 2017. Treatment consisted of soil, sand and hydroponic media in combination with distilled water, GA_3 (50 ppm) and thiourea (0.2%). Thus there were nine treatment combinations. A significant effect was observed on growth pattern due to use of various media and growth regulators for propagation of gladiolus cormels except length of sprout at 10, 15 days, leaf length at 30 days and width of leaf which possess non-significant effect with the use of various growth regulators. Pre-soaking treatment of cormels with GA_3 (50 ppm) and thiourea (0.2%) for 24 hours was significantly more influencing over distilled water treatment in terms of growth, root and biomass characters of gladiolus cormels. From various growth regulators, thiourea (0.2%) retained maximum sprout length at 10 and 15 days after planting. No significant effect of growth regulators was observed on width of leaf. Use of hydroponic resulted maximum length of sprout at 10 and 15 days after planting and maximum leaf length at 20 days and maximum width of leaf which found statistically significant to sand and soil media. Thiourea (0.2%) resulted maximum number of roots and maximum fresh biomass of both shoots and roots, however GA_3 (50 ppm) resulted maximum length of roots which found statistically significant to control (distilled water).

Keywords: cormels, hydroponic, ga_3, thiourea, sand, soil

Introduction
Gladiolus is also known as sword lily is a very popular ornamental crop among all the bulbous crops having great economic value for cut flower production. It is commercially perpetuated by using underground storage organ known as corm which is naturally multiply into number of cormels. One mother corm normally generates 1 or 2 daughter corms and about 25 cormels each season (Singh and Singh, 2000a; Singh and Singh, 2000b; Sinha and Roy, 2002) [14, 15, 16]. Cormels are good source for multiplication of gladiolus (Singh and Sisodia, 2017) [17]. However, daughter cormels developed from the axillary buds of the mother corm after one month of planting (Teixeira da Silva, 2003) [19], require three to four seasons to attain standard size of flowering spike and daughter corms. The dormancy of the corms and cormels is another problem in this regard (Priyakumari and Sheela, 2005) [8]. To overcome this barrier, various growth regulator supplements like GA_3, thiourea are required which helps in breaking dormancy and enhances growth as well as rooting only at lower concentration (Ford *et al*., 2002; Shamsa *et al*., 2003) [5, 6]. Thiourea was known to enter the seeds at much the same as water. Substitution of thiourea converted it from a stimulatory to a strongly inhibitory substance (Mayer, 1956). It helps in stimulating germination in seeds. GA_3 is primitively known as growth promoter hormone as it regulates and enhances the division and elongation of cells. Gladiolus cormels are well grown in sand medium as compared to soil. However, many research studies revealed that planting material grown through hydroponic gives successive result as compared to sand and other media as it supplies and controls specific nutrients distribution to plants (Dinpanah and Zand, 2001) [4]. It have adequate ventilated system, have a good water holding capacity, free from other harmful substances, and be affordable in a reasonable price (Cantliffe *et al*., 2007) [1]. Therefore an experiment was conducted to find out influence of growth promoting chemicals i.e. GA_3 and thiourea and various growing media i.e. soil, sand and hydroponic on growth of cormels in gladiolus.

Materials and Methods

The experiment was carried out in the Research Laboratory of Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India during the period of November, 2017. Gladiolus cormels of cultivar Tiger Flame were taken for this experiment. Tunicless cormels were treated with 50 ppm GA_3 and 0.2% thiourea solution for 24 hrs. Well levelled sand and soil beds were prepared in plastic trays in the laboratory condition with maintained temperature upto 20°C. Soil less media (hydroponic) was also prepared with the help of small plastic stands. This system was devised to improve the root zone area of aeroponics with supplementation of distilled water in the lower part of the bed and again distilled water was sprayed in the upper part intermittently. Cormels in hydroponic media placed in such way that the lower surface of cormels did not get in contact with water (aerohydroponics). Treated cormels with distilled water, GA_3 and thiourea were planted in sand, soil and hydroponic media during 14th November, 2017 to observe different characters of cormels. The experiment was laid out in Completely Randomized Design (CBD) with 3 replications. Various parameters were observed at 10, 15, 20, 30 and 50 days of planting i.e. length of sprout, leaf length, leaf width, number of roots per cormel, length of root, diameter of root, fresh and dry biomass of cormels were analyzed statistically.

Result and Discussion

Growth parameters

A significant effect was observed on growth pattern due to the exercise of various media such as soil, sand, hydroponic and growth regulators namely GA_3 (50 ppm), thiourea (0.2%), distilled water for propagation of gladiolus cormels except length of sprout at 10, 15 days, leaf length at 30 days and width of leaf which possess non-significant with the use of various growth regulators (Table 1). A perusal of the result clearly shows that the different media and various growth regulators significantly influenced the leaf length at 20 and 50 days of planting cormels (table 3). Maximum leaf length at 20 and 50 days was recorded under sand media with thiourea (0.2%) treatment and minimum was observed in soil medium with all the three treatments i.e. control (distilled water), GA_3 (50 ppm) and thiourea (0.2%). From various media, growth regulators and chemicals used, thiourea (0.2%) enhanced the growth of cormels in sand and hydroponic media than soil medium. Maximum length of sprout at 10 days, leaf length at 20 days and width of leaf were found with the use of hydroponic medium which was statistically significant to other two media (sand and soil) (Fig. 1). While, use of sand medium dominated maximum sprout length at 15 days and leaf length at 30 and 50 days, found statistically significant to soil and hydroponic media. The result was in conformity with the findings of Virtanen and Tuomisto (2017) [20] who observed hydroponic media was found a successful media for growing tuber crops like potatoes over other conventional media. From various growth regulators, thiourea (0.2%) retained maximum sprout length at 10, 15 days and maximum width of leaf which had no significant effect on the growth trend of gladiolus cormels. Although, growing cormels with the use of thiourea (0.2%) showed maximum leaf length at 20 and 50 days which was statistically significant to GA_3 (50 ppm) and control (distilled water). The present experimental finding also lent credence to the finding of Mayer (1956) who evidenced that the molecule of thiourea must be effective as a stimulator which stimulates vegetative growth of plant and act as enzyme activator. Use of distilled water (control) in soil medium exhibited minimum effect on growth of gladiolus cormels. A significant effect on leaf length at 20 and 50 days was evidenced owing to the interaction of different media (sand soil and hydroponic), various growth regulators (GA_3, thiourea) and distilled water (control).

Table 1: Growth parameters of gladiolus cormels cv. Tiger Flame in various medium and chemical treatments.

Medium	Length of sprout at 10 days (cm)	Length of sprout at 15 days (cm)	Leaf length at 20 days (cm)	Leaf length at 30 days (cm)	Leaf length at 50 days (cm)	Width of Leaf (cm)
Soil	0.10	0.36	0.10	0.68	0.70	0.10
Sand	0.48	3.03	0.82	11.36	14.04	0.20
Hydroponics	0.55	2.68	0.87	5.42	6.29	0.24
C.D. at 5%	0.37	1.54	0.05	3.30	1.72	0.08
Growth regulators						
Control (Distilled water)	0.23	1.79	0.40	5.22	4.45	0.19
GA_3 (50 ppm)	0.32	1.94	0.43	6.23	7.26	0.17
Thiourea (0.2%)	0.58	2.33	0.95	6.01	9.33	0.18
C.D. at 5%	NS	NS	0.05	NS	1.72	NS

Root and biomass parameters

There was significant difference in number of roots, length of root and fresh biomass was marked due to the use of various growth regulators and different media on rooting structure and biomass character of propagating gladiolus cormels. However, these growing media, growth regulators and chemicals fail to exert any significant effect on dry biomass character of cormels (Table 2). Interaction between media and growth regulatory chemicals were also found superior on number of roots/cormels, length of root and fresh biomass of propagating cormels (Table 3). Cormels grown in hydroponic medium with thiourea (0.2%) treatment resulted maximum number of roots and fresh biomass whereas minimum was observed in soil media with GA_3 (50 ppm) treatment (Fig. 1). Maximum length of root was noticed under sand medium with GA_3 (50 ppm) (Fig. 3) and minimum under soil medium with control (distilled water) condition (Fig. 4). A significant effect was observed on diameter of roots due to the use of various media but failed to exhibit any significant effect due to the application of various chemicals and growth regulators. Hydroponic medium was found the most preferred media for propagating gladiolus cormels, which amounted maximum number of roots and maximum fresh biomass which was statistically significant to sand and soil culture. The present experimental finding also lent credence to the finding of Shojaei *et al*. (2016) [10] who observed maximum root length of Ammodendron, Milk Thistle and Silybummarianus in hydroponic media as compared to soil culture. In hydroponic system there is more availability of dissolved O_2 in water which enhances the root growth. Soffer *et al*. (1991) [17]

indicated that O_2 was essential to root formation in both woody and herbaceous cuttings. The reason behind this is rapid decrease of solution EC with the increase of solution pH in the hydroponic system indicated active root growth which ultimately increases biomass of roots and shoots (Chang *et al*., 2012) [3]. However, no significant effect was noticed on dry biomass. Maximum length and diameter of roots resulted in sand media, which was statistically significant to soil and hydroponic media. Among various growth regulators, thiourea (0.2%) rated maximum number of roots and fresh biomass of cormels which found statistically significant to control (distilled water) and GA_3 (50 ppm) except diameter of roots and dry biomass which possessed a non-significant effect on root and biomass characters of cormels (Fig. 2). Similar result was observed by Swaminathan (1980) [18] who demonstrated that thiourea promoted larger bulk and deeper penetration of roots and consequently a greater uptake of nutrients from media. GA_3 (50 ppm) proceeded with maximum length of roots which found statistically significant to control (distilled water) and thiourea (0.2%). Similar results have been reported by Hansen (1976) [6] and Ford *et al*. (2002) [6, 5] who observed that low levels of GA_3 were suboptimal for stimulating rooting and shooting in peas and cherries and also by Singh and Jauhari (2005) [11] in zinnia and Singh and Karki (2003) [12] in balsam seeds.

Table 2: Rooting and biomass characters of gladiolus cormels cv. Tiger Flame in various medium and chemical treatments.

Medium	No. of roots/cormels	Length of root (cm)	Diameter of root (mm)	Fresh biomass (g)	Dry biomass (g)
Soil	1.33	0.93	0.04	0.24	0.07
Sand	2.72	5.56	0.12	0.18	0.08
Hydroponics	3.78	4.43	0.10	0.61	0.11
C.D. at 5%	0.43	0.90	0.03	0.04	NS
Growth regulators					
Control (Distilled water)	2.50	3.11	0.08	0.30	0.09
GA_3 (50 ppm)	2.17	4.40	0.08	0.31	0.08
Thiourea (0.2%)	3.17	3.40	0.10	0.42	0.10
C.D. at 5%	0.43	0.90	NS	0.04	NS

Table 3: Effect of interaction (Media × Growth regulator) on length of leaf at 20 and 30 days of propagating gladiolus cormels cv. Tiger Flame**.**

Growth regulators															
Media	**Length of leaf at 20 days (cm)**			**Length of leaf at 50 days (cm)**			**No. of roots/cormel**			**Length of root (cm)**			**Fresh biomass (g)**		
	Control	**GA_3 (50 ppm)**	**Thiourea (0.2%)**	**Control**	**GA_3 (50 ppm**	**Thiourea (0.2%)**	**Control**	**GA_3 (50 ppm**	**Thiourea (0.2%)**	**Control**	**GA_3 (50 ppm**	**Thiourea (0.2%)**	**Control**	**GA_3 (50 ppm)**	**Thiourea (0.2%)**
Soil	0.10	0.10	0.10	0.37	0.91	0.82	1.33	1.33	1.33	0.26	0.45	2.08	0.25	0.13	0.34
Sand	0.10	0.63	1.73	8.05	14.02	20.07	2.83	2.67	2.67	6.03	6.59	4.04	0.21	0.21	0.13
Hydroponic	1.00	0.57	1.03	4.90	6.87	7.12	3.33	2.50	5.50	3.04	6.17	4.08	0.45	0.60	0.79
C.D. at 5%	0.09			2.98			0.74			1.57			0.07		

Fig 1: Gladiolus cormels cv. Tiger Flame grown with Thiourea (0.2%) treatment in hydroponic medium

Fig 3: Gladiolus cormels cv. Tiger Flame grown with GA_3 (50 ppm) treatment in sand medium

Fig 2: Gladiolus cormels cv. Tiger Flame grown with Thiourea (0.2%) treatment in sand medium

Fig 4: Gladiolus cormels cv. Tiger Flame grown with distilled water in soil medium

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