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Research article

EFFECT OF PRE-PLANTING SOAKING OF CORMS WITH CHEMICALS AND PLANT GROWTH REGULATORS ON DORMANCY BREAKING AND CORM AND CORMEL PRODUCTION IN GLADIOLUS

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ABSTRACT: The effect of thiourea (TU), salicylic acid (SA), potassium nitrate (KNO_3) and gibbrrellic acid (GA_3) with two corm soaking periods on dormancy breaking and corm and cormel production of two gladiolus cultivars Darshan and Dhiraj was investigated during 2008-09 and 2009-10. Cv. Darshan recorded significantly minimum number of days to sprouting and maximum percentage of sprouting over cv. Dhiraj. Pre-planting soaking of corms for 24 h was significantly more influencing over 12 h soaking in decreasing the number of days to sprouting and increasing corm sprouting percentage and number of buds sprouted per corm. TU 2% and SA 150 ppm were highly effective in reducing the number of days taken for sprouting over control. TU 2%, SA 150 ppm, KNO_3 1.5% and GA_3 150 ppm significantly increased sprouting percentage of corms over control and recorded maximum number of sprouts per corm. The cultivar Dhiraj recorded maximum corm size and weight, maximum number of small cormels and total number of cormels per plant over cv. Darshan. Cv. Darshan recorded higher number of big cormels. Soaking of corms for 24 h significantly improved corm and cormel attributes than 12 h soaking. SA 150 ppm and TU 2% were effective in increasing number of corms per plant. Maximum corm size and weight were recorded with SA 150 ppm and GA_3 150 ppm. Maximum number of big cormels per plant and cormel weight was recorded with TU 2%, GA_3 150 ppm and SA 150 ppm. Control recorded significantly more number of small cormels and total number of cormels per plant.

Key words: Gladiolus, corm, dormancy, soaking, SA, thiourea.

INTRODUCTION

Gladiolus also known as sword lily is one of the most beautiful and fascinating bulbous cut flower. It is grown all over the world for its majestic flower spike with brilliant coloured flowers and regarded as queen of the bulbous plants. Gladiolus with its magnificent inflorescence in a variety of colours is of widespread use in herbaceous borders, beddings, rockeries, pots and as cut flower. It occupies a prime position among commercial cut flower crops which has great demand in both domestic and international market. In India, gladiolus has become an important cut flower crop in the domestic flower markets of Delhi, Kolkata, Bangalore, Mumbai and Hyderabad. Gladiolus is commercially propagated by corms. Considering the importance of popularity of gladiolus both in Indian market and outside, increasing the availability of gladiolus flower in large quantities over a wider period of the year is important. However, dormancy of corms is one of the major hindrances in the year round cultivation of gladiolus and is more pronounced under warmer climatic conditions.

Though, the dormancy has physiological importance for gladiolus crop as it allows to overcome the unfavourable environmental conditions but still floriculturists are exploiting the potential of this crop to grow year round by breaking its dormancy. This is helpful in regulating the flowering season according to the need of the market. Cold storage of corms at 4-5^{o}C for 3-4 months is the widely followed practice for breaking dormancy which restricts their use to only one season (*i.e.* winter). There are few reports stating that the treatment with growth regulating chemicals like ethylene chlorohydrin, ethrel, gibberellic acid or kinetins breaks dormancy within shortest time [1] and [2]). Some of the easily available and inexpensive chemicals like thiourea (TU), salicylic acid (SA), potassium nitrate (KNO_3) etc., although have ability to break dormancy in certain crops, studies on the effect of these chemicals in gladiolus are very meagre. Pre-planting soaking of corms with chemicals was also proved effective in enhancing stock production in gladiolus [3] and Barman and [4]. Hence, an investigation was undertaken to study the effect of these chemicals along with the plant growth regulator GA_3 on breaking of corm dormancy and corm and cormel production of gladiolus cultivars Darshan and Dhiraj.

MATERIALS AND METHODS

The experiment was conducted at Herbal Garden, Rajendranagar, Hyderabad for two consecutive years, 2008-09 and 2009-10. In the study, a total of 36 treatment combinations comprising of two cultivars viz., Darshan and Dhiraj, two corm soaking periods viz., 12 h and 24 h and two concentrations each of TU (1 and 2%), KNO_3 (1.5 and 2.5%), SA (100 and 150 ppm) and GA_3 (100 and 150 ppm) along with control (water soaking) were replicated twice in Randomized Block Design with factorial concept.

Well decomposed farmyard manure at 10 t ha^{-1} was incorporated into all the experimental plots uniformly as basal application. N, P, and K @ 200:200:300 kg/ha were applied in the form of urea, single super phosphate and muriate of potash respectively. Urea was applied in 3 splits, the first dose as basal application and other two split doses at 30 and 60 days after planting. The entire dose of single super phosphate and muriate of potash were applied at the time of planting as basal dose.

Freshly harvested and uniform sized corms of the cultivars were soaked for 12 h and 24 h separately in the respective treatment solutions. The treated corms were planted at a spacing of 30 cm x 20 cm and at a depth of 5-6 cm in the month of November as per the lay out of the trial. Standard cultural practices were followed during the entire crop period for all the experimental plots**.** Observations on sprouting and corm and cormel attributes were recorded. Data were subjected to analysis of variance as applicable to factorial Randomized Block Design.

RESULTS AND DISCUSSION

Sprouting parameters

Perusal of data from Table 1 indicates that during both the years of investigation, cv. Darshan had taken minimum number of days for sprouting of corms and recorded higher sprouting percentage over the cv. Dhiraj which indicate that number of days to sprouting and per cent sprouting are genetic characters of cultivar. Genotypic variation in respect of days to sprouting was reported earlier by [5] and [6] in gladiolus. The results show that pre-planting soaking of corms for 24 h was significantly more influencing over 12 h soaking in decreasing the number of days to sprouting and increasing corm sprouting percentage and number of buds sprouted per corm over 12 h soaking. This might be due to optimum absorption of chemicals by corms, which might have been further utilized for physiological processes to influence favourably the sprouting parameters. Among the treatments, TU 2%) followed by SA 150 ppm were found to be highly effective in breaking the dormancy of corms with high percentage of sprouting and more number of buds sprouted per corm. These results are in accordance with the findings of [2] and [4] in gladiolus and [7] in tuberose. The effect of TU 2% and SA 150 ppm in reducing the number of days to sprouting and increasing the sprouting percentage can be attributed to two reasons. The first being their effect in reducing the levels of ABA, the prime factor for imposing dormancy in corms and cormels and thereby changing the hormonal balance in favour of promoters. Secondly, increase in quantum of alternate respiration in corms due to these treatments.

ABA is considered to be a principal endogenous regulator of dormancy in gladiolus corms and cormels [8] and [9]. A gradual decrease of inhibitors in the corms during storage has been shown to be an important factor allowing release from dormancy [10]. The occurrence of alternate respiration mediated by alternate oxidase (AOX) and its positive correlation during seed germination has been reported in several crops viz., chickpea [11], [12]), black gram [13] etc. It is proposed that alternative pathway of respiration provides something essential for the completion of the earlier stages of seed germination [14] and [15]. Promotion of alternate respiration with thiourea treatment was reported by [16] during germination of ber seed. Similar effect of thiourea in increasing the alternate respiration resulted in breaking of dormancy and increasing sprouting percentage at 2% concentration. Thus it can be concluded that there is strong positive correlation between alternate respiration and sprouting or dormancy release in gladiolus also. The possible action of SA in breaking the dormancy might be similar to that of TU. SA stimulates alternate oxidase (AOX) and in turn promotes alternate respiration [17]. On the other hand, SA was also found to reverse the physiological effects promoted by ABA in many plant species [18] and [19]. [20] stated that SA stimulated the activity of enzymes involved in nitrogen metabolism during germination of soybean and improved germination percentage. Probably, due to these reasons, SA significantly reduced the number of days for sprouting and also increased the sprouting percentage. Concentration of SA however, seems to be critical in breaking the dormancy and promoting alternate respiration. In the present investigations, SA at higher concentration (150 ppm) significantly recorded maximum corm sprouting and sprouting percentage. These results are confirming the findings of Rajani [16] who reported that SA at 150 ppm promoted seed germination in [21] in carrot. SA at 150 ppm was as effective as that of TU 2%.

Table 1: Effect of pre-planting chemical treatment of corms on sprouting parameters in gladiolus cultivars Darshan and Dhiraj

Treatment	Days to sprouting		Per cent sprouting (%)		Number of buds sprouted per corm	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Cultivars						
Darshan	30.08	31.47	85.11	83.72	1.54	1.52
Dhiraj	33.42	34.94	81.56	79.56	1.49	1.50
S.Em±	0.59	0.53	0.74	0.79	0.02	0.02
CD at 5%	1.69	1.52	2.11	2.26	N.S.	N.S.
Soaking time						
12 h soaking	36.97	38.72	78.56	76.94	1.46	1.46
24 h soaking	26.53	27.69	88.11	86.33	1.56	1.57
S.Em±	0.59	0.53	0.74	0.79	0.02	0.02
CD at 5%	1.69	1.52	2.11	2.26	0.05	0.05
Treatments						
TU (1%)	33.13	35.50	79.50	82.00	1.46	1.46
TU (2%)	18.37	19.13	95.00	94.50	1.68	1.74
KNO_3 (1.5%)	28.25	28.75	90.00	88.00	1.61	1.68
KNO_3 (2.5%)	37.75	40.63	78.00	76.00	1.42	1.40
SA (100 ppm)	35.50	37.50	77.50	73.75	1.37	1.38
SA (150 ppm)	20.88	21.63	88.50	89.00	1.67	1.72
GA3 (100 ppm)	34.38	35.88	83.00	80.00	1.43	1.41
GA3 (150 ppm)	29.00	30.13	88.00	86.50	1.62	1.68
Control (Water)	48.50	49.75	68.50	67.00	1.34	1.33
S.Em±	1.25	1.12	1.56	1.67	0.03	0.04
CD at 5%	3.58	3.22	4.48	4.80	0.10	0.10

Table 2: Effect of pre-planting chemical treatment of corms on corm and cormel parameters in gladiolus cultivars Darshan and Dhiraj

Treatment	Number of corms per plant		Corm size (cm)		Corm weight (g)		Number of big cormels per plant (≥ 1.0 cm)		Number of small cormels per plant (< 1.0 cm)		Total number of cormels per plant		Weight of cormels per plant (g)	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Cultivars														
Darshan	1.43	1.52	4.39	4.41	32.74	32.46	2.76	2.56	5.83	5.88	8.58	8.44	6.66	6.86
Dhiraj	1.31	1.33	5.26	5.21	35.49	35.61	2.17	2.38	6.57	6.63	8.74	9.01	5.88	6.31
S.Em±	0.02	0.03	0.06	0.06	0.26	0.31	0.04	0.05	0.11	0.12	0.19	0.17	0.18	0.13
CD at 5%	N.S.	N.S.	0.17	0.17	0.75	0.89	0.13	N.S.	0.31	0.34	N.S.	0.45	0.51	N.S.
Soaking time														
12 h soaking	1.31	1.31	4.62	4.58	33.44	33.51	2.23	2.32	5.88	6.01	8.11	8.42	5.89	6.21
24 h soaking	1.42	1.55	5.03	5.02	34.80	34.56	2.70	2.62	6.51	6.41	9.21	9.03	6.66	6.96
S.Em±	0.02	0.03	0.06	0.06	0.26	0.31	0.04	0.05	0.11	0.12	0.19	0.17	0.18	0.13
CD at 5%	0.06	0.09	0.17	0.17	0.75	0.89	0.13	0.14	0.31	0.34	0.55	0.45	0.51	0.37
Treatments														
TU (1%)	1.28	1.23	4.62	4.60	32.37	32.54	2.15	2.55	5.93	6.18	8.08	8.73	5.52	5.90
TU (2%)	1.68	1.80	5.04	4.99	35.27	34.22	2.95	3.10	5.05	5.00	8.00	8.10	7.20	7.67
KNO_3 (1.5%)	1.43	1.55	4.94	4.93	33.84	34.20	2.68	2.63	5.38	5.53	8.05	8.15	6.85	7.02
KNO_3 (2.5%)	1.02	1.23	4.62	4.53	34.48	34.01	1.93	2.05	6.53	6.90	8.45	8.95	5.19	5.37
SA (100 ppm)	1.15	1.25	4.66	4.61	33.79	33.53	2.03	2.10	5.80	5.68	7.83	7.78	5.82	5.89
SA (150 ppm)	1.83	1.88	5.11	5.11	36.34	36.74	3.13	2.78	4.90	4.95	8.03	7.73	7.26	7.70
GA_3 (100 ppm)	1.30	1.18	4.70	4.68	33.96	33.95	2.33	2.47	6.43	6.40	8.75	8.88	6.14	6.30
GA_3 (150 ppm)	1.65	1.53	5.24	5.29	36.27	36.14	3.15	2.98	5.72	5.70	8.88	8.68	7.63	8.01
Control (Water)	1.00	1.13	4.50	4.53	30.78	30.99	1.85	1.57	10.05	9.98	11.90	11.55	4.83	5.41
S.Em±	0.04	0.06	0.13	0.13	0.56	0.65	0.09	0.11	0.23	0.25	0.40	0.36	0.38	0.27
CD at 5%	0.12	0.18	0.37	0.36	1.60	1.86	0.27	0.32	0.66	0.72	1.16	1.03	1.10	0.77

KNO_3 1.5% and GA_3 150 ppm were also found to be effective in improving the sprouting parameters significantly over control (Table 1). KNO_3 (1.5%) also increased the sprouting percentage (90.00 % and 88.00%) and number of buds sprouted per corm (1.61 and 1.68) significantly and was on a par with TU 2% and SA 150 ppm. This may be due to its accumulation in the embryo where it acts osmotically to increase water uptake. Besides water uptake, it has nutritional effect on protein synthesis [22]. GA_3 effect is not exactly determined, but, might be through alteration of hormonal balance in favour of promoters. Another hypothesis is that, free GA_3 is active in breaking down the reserve food material by hydrolytic enzymes which might have resulted in earlier sprouting. These results confirm the earlier reports of promotion effects of GA_3 on the sprouting of gladiolus corms [23] and cormels [24].

Corm and cormel parameters

Data presented in Table 2 shows that the two cultivars, Darshan and Dhiraj did not differ in respect of number of corms produced per plant. Cv. Darshan produced maximum number of big cormels per plant and weight of cormels. Cv. Dhiraj was however, superior in respect of individual corm characteristics. Corm size and weight, number of small cormels and total number of cormels were highest in the cv. Dhiraj during both the years. These findings confirm the fact that the individual corm characteristics are cultivar specific. Similar variation in varietal response with respect to corm attributes was reported by several workers (Paswan [25] and Seenivasan [6]).

Significant differences were observed between two soaking periods with respect to all corm and cormel parameters. Soaking of corms for 24 h before planting was found to produce highest number of corms and cormels per plant over 12 h soaking period. These results are confirming the reports by Pal and Choudhury [26]. SA 150 ppm, GA_3 150 ppm and TU 2% significantly improved the number of corms produced per plant over control. Soaking of corms for 24 h in SA 150 ppm recorded significantly maximum number of corms per plant. These treatments were also equally effective in improving the individual corm characteristics. It might be due to the availability of longer growing period as the days for sprouting were reduced significantly and congenial environmental conditions for growth and corm production after flower harvest. The number of big cormels per plant was increased significantly by GA_3 150 ppm, SA 150 ppm and TU 2%. Soaking of corms for 24 h in $GA_3$150 ppm, SA 150 ppm and TU 2% recorded significantly maximum number of big cormels per plant. However, number of small cormels per plant was recorded highest with control. Significantly maximum number of total cormels per plant was also observed in control whereas weight of cormels per plant was found maximum with GA_3 150 ppm, SA 150 ppm and TU 2%. Similar results with GA_3 were reported (Rajiv Kumar *et al*., 2002 [27] and Rajesh Bhalla and Ajay Kumar, 2007 [28]). Prevalence of high temperature after flower harvest might be a limiting factor in control.

The present investigation revealed that cv. Darshan was superior over cv. Dhiraj in respect of sprouting attributes. Cv. Dhiraj, however, recorded significantly maximum corm size and weight, number of small cormels and total number of cormels. Soaking of gladiolus cultivars for 24 h was most influencing over 12 h soaking for breaking dormancy, improving sprouting percentage and corm and cormel parameters under study. TU 2% and SA 150 ppm were highly effective in reducing the number of days taken for sprouting and increasing sprouting percentage of corms and recorded maximum number of sprouts per corm. SA 150 ppm was outstanding in terms of number of corms per plant and corm weight. Pre-planting soaking of corms for 24 h in TU 2% or SA 150 ppm for breaking dormancy saves season as it enables immediate planting of corms which would otherwise be in rest period for about 3-4 months. These chemicals also enables off-season gladiolus growing and in turn bulking up of planting material i.e. corms and cormels. Pre-planting soaking of corms in SA 150 ppm had favourable effect on gladiolus corm production in addition to breaking dormancy of corms. Hence, this chemical can be recommended for improving corm attributes in the dormant corms.

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