INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
ISSN Print: 1560–8530; ISSN Online: 1814–9596
08–028/AUM/2009/11–4–498–500
http://www.fspublishers.org

Short Communication

Response of Some New Hybrids of *Gladiolus grandiflorus* to Different Corm Storage Temperatures

TARIQ RIAZ, SALIK NAWAZ KHAN AND ARSHAD JAVAID[1]
Institute of Mycology and Plant Pathology, University of the Punjab, Quaid-e-Azam Campus Lahore, Pakistan
[1]Corresponding author's e-mail: arshadjpk@yahoo.com

ABSTRACT

Effect of storage temperature on corm germination and various vegetative and reproductive growth parameters of six gladiolus (*Gladiolus grandiflorus* sect. Blandus) varieties namely Peter pear, Rose supreme, Oscar, Pricilla, Princess Margaret Rose and Jester Ruffled Yellow was studied. Corms were stored at 8°C in a potato store house, at 12°C in a fruit store house and at 27±3°C in a farmer's store house. Increase in storage temperature concomitantly declined corm weight losses during storage, delayed germination and flower initiation, declined in germination percentage, reduced root, shoot and spike length, number of flowers, corm weight after harvest and number and biomass of cormlets. With few exceptions, adverse effect of increase in storage temperature was substantial. However, the effect of highest storage temperature of 27±3°C was more adverse significant for germination and various plant vegetative and reproductive growth parameters in all the varieties as compared to lower temperatures. Thus for better germination, plant vegetative and reproductive growth, corms of different varieties of gladiolus should not be stored at 8°C.

Key Words: *Gladiolus grandiflorus*; Flowering; Germination; Growth; Storage; Temperature; Varieties

INTRODUCTION

Gladiolus hybrids are among the preferred cut flowers due to their different sizes, shades and excellent vase life (Bose *et al*., 2003). *Gladiolus* is native of South Africa and has been cultivated globally. Many growers of developing countries are converting towards the floral crops from conventional cropping system and area under *Gladiolus* cultivation is increasing in these countries. Therefore, after roses, it has also become the highest priced cut flower in Pakistan (Anonymous, 2003). Like other bulb crops, corms of the *Gladiolus* also undergo a period of dormancy (Cohat, 1993) and thus are stored before cultivation in the next season. In countries newly progressing in floriculture, proper facilities for storage of germplasm are lacking. Therefore, growers of different regions store corms according to situations available in their countries. In Pakistan, corms are stored during months of April to August at various storage temperature conditions. Growers usually store corms in the potato cold storages, where temperature is kept at 8°C. Others corms were stored at the temperature 12°C by using air conditioners along with various fruit storage. Some growers keep them in muddy ventilated rooms considering them naturally cool places for storage. Proper crop storage plays vital part in ensuring quality spike production. The effect of storage temperature on the growth, formation of floral organs and the timing of flowering of the bulbous crops and other cut flowers has been well documented (Bonnier *et al*., 1997; Shin *et al.*, 2002; du Toit *et al.*, 2004; Gross *et al.*, 2004; Roh & Hong, 2007). However, in case of *Gladiolus* hybrids cultivated in Pakistan, effect of various storage conditions have been hardly studied. The present study was undertaken to investigate the effect of storage temperature conditions on germination, growth, flowering and corm yield in six varieties of *Gladiolus grandiflorus.*

MATERIALS AND METHODS

Plant material. Fresh corms of six *Gladiolus grandiflorus* varieties viz. Peter pear, Rose Supreme, Oscar, Pricilla, Princess Margaret Rose and Jester Ruffled Yellow were obtained from Sunny View Seed Store and Nurseries Lahore, Pakistan. All the varieties were originally imported from Holland.

Storage conditions. Two thousand corms were stored in each of the three storage conditions viz. 8°C in a potato cold storage, 12°C in a fruit cold storage and 27±3°C in a farmer's muddy storage room. Corms were packed in groups of 30 corms in nylon stocking sacs and were placed on a wooden shelf 2.5 m above the ground in the room. A digital thermometer (ZDR-11, Zheda Electric Equipment Co., China) was used to monitor the temperature. Corms were stored from May 20, 2006 to August 01, 2006.

To cite this paper: Riaz, T., S.N. Khan and A. Javaid, 2009. Response of some new hybrids of *Gladiolus grandiflorus* to different corm storage temperatures. *Int. J. Agric. Biol.*, 11: 498–500

Afterward, all the corms were placed in laboratory till cultivation on August 26, 2006. Weight of individual corms was taken before and after storage and percentage weight losses during storage at different temperature were calculated.

Field experiment. Field experiment was carried out in experimental station, Institute of Mycology and Plant Pathology, University of the Punjab, Lahore (latitude 31.57°N & longitude 74.31°E), Pakistan from end of August to December 2006. The physiochemical characters of the soil were: pH 7.8, organic matter 0.69%, N 0.05%, available P 6.3 mg kg^{-1} and exchangeable K 100 mg kg^{-1}. The micronutrients namely boron, manganese, iron, copper and zinc concentrations were 1.06, 22.8, 10.8, 1.9 and 1.3 mg kg^{-1}, respectively. The mean daily temperature was 15.1-30.5°C and relative humidity 63-74% during the experimental period.

Corms of six gladiolus varieties stored at different temperature conditions were cultivated in field plots in a split plot design on August 26, 2006. Gladiolus varieties were grown in main plots and subplots were taken as storage temperature. In each subplot, there were six ridges of 18 cm height and 3 m long. Six gladiolus corms of each treatment were planted in planting holes on each ridge with inter and intra row spacing of 50 and 60 cm, respectively. Each treatment was replicated three times. Data regarding days to sprouting of corms, shoot length, spike length and number of flowers per spike were collected on November 8, 2006. Underground parts were uprooted on December 6, 2006 and data regarding root length, corm weight and number and weight of cormlets were taken.

Statistic analysis. All the data were analyzed by applying analysis of variance followed by Duncan's Multiple Range Test to separate the treatment means (Steel & Torrie, 1980).

RESULTS AND DISCUSSION

Corm weight losses during storage at different temperatures. Corm weight losses occurred during storage at all temperatures. However, weight losses were increased with the rise in storage temperature. Corm weight loss at 27±3°C was significantly higher as compared to losses during storage at lower temperatures in all the six test gladiolus varieties. There was 2.3-3.8%, 2.8-8.0% and 42.9-66.8% reduction in corm weight during storage at 8, 12 and 27±3°C, respectively in different test gladiolus varieties. Variety Rose Supreme was found to be the highly susceptible to higher storage temperature of 27±3°C with 66.8% reduction in corm weight during storage that was significantly greater than the weight losses in all other test gladiolus varieties except Princess Margaret Rose at the same storage temperature conditions. Lowest weight loss (42.9%) was recorded in Peter Pears that was significantly ($P \leq 0.05$) as compared to rest of the varieties (Table I). Storage at 27°C resulted in attack of storage fungi especially *Aspergillus niger* that reduced the corm weight significantly.

Effect of storage temperature on germination. Days to sprouting showed variable response to storage temperature in different gladiolus varieties. However, in general storage at high temperature delayed the corm sprouting. It took 14-20, 17-23 and 27-31 days to sprout the corm stored at 8, 12 and 27±3°C, respectively in different gladiolus varieties (Table I). The difference of storage at 27±3°C was significant as compared to other two lower storage temperature conditions. The cold treatment of gladiolus corms has long been known to accelerate the breaking of dormancy (Cohat, 1993).

Corms stored at 8 and 12°C showed 100% germination in all the varieties. Storage at 27°C significantly reduced the final germination to 20% in Peter Peer, Rose Supreme and Princess Margaret Rose and 13% in rest of the test gladiolus varieties (Table I). The poor germination after storage at higher temperature of 27°C may be attributed to significant weight losses during storage.

Effect of storage temperature on plant vegetative growth. Shoot length was adversely affected by higher storage temperature. There was a gradual decrease in shoot length in all the test varieties as the storage temperature increased. Shoot length in different gladiolus varieties ranged from 59.4-90.9 cm at 8°C storage that was reduced to 56-86 cm and 34.9-66 cm at 12°C and 27±3°C, respectively. The difference of shoot length at 27°C storage temperature to that at two lower temperatures was significant for all gladiolus varieties except Peter Pears (Table I). Root length indicated a reduction similar to shoot, where a gradual decrease in this attribute was recorded with increased temperature. Root length in the six test varieties was invariably and significantly lowered at 27±3°C as compared to other two storage temperature conditions (Table I).

Effect of storage temperature on plant reproductive growth. Difference in days to initiate flowering in different test gladiolus varieties was insignificant, but the effect of storage temperature was significant. Increase in storage temperature delayed the onset of flowering (Table I), although the response of different varieties to storage temperature was variable. In Oscar, Princess Margaret Rose and Jester Ruffled Yellow increase of temperature from 8°C to 12°C significantly delayed the initiation of flowers, while in rest of the test varieties effect was insignificant. Effect of change of storage temperature was insignificant in variety Rose Supreme. Flowering initiation in all other varieties was significantly delayed, when storage temperature was increased from 8°C to 27±3°C (Table I). Gonzalez *et al*. (1998) reported that corms of *G. tristis* L. stored at 5°C for 3 and 6 weeks flowered 20 and 11 days, respectively as compared to the control stored at 18-25°C.

Spike length was adversely affected by increase in storage temperature in all the six test gladiolus varieties. Maximum shoot length of 36.3-48.8 cm was recorded in 8°C storage temperature treatment. Increase in storage

Table I. Effect of storage temperature on germination and growth of six *Gladiolus* genotypes

Gladiolus varieties	Treat-ments	Corm wt. losses during storage (%)	Germi-nation (%)	Days to Sprout-ing	Shoot length (cm)	Days to flower-ing	Spike length (cm)	No. of Flowers/ spike	Root length (cm)	Corm weight (g)	No. of cormlets	Weight of cormlets (g)
	T_1	3.4 e	100 a	20 ce	76.4 fg	86 d	46.2 ab	12 cd	20.6 b-d	58.0 bc	70 a	0.38 a
Peter pear	T_2	7.3 e	100 a	23 c	72.1 d-f	93 b-d	43.0 c	11 de	15.0 f-h	47.9 e-g	52 b	0.29 bc
	T_3	42.9 d	20 b	28 ab	63.3 fg	98 a-c	35.0 e	8 hi	9.6 j	27.6 h	5 gh	0.11 d
	T_1	3.3 e	100 a	15 gh	90.9 a	93 b-d	42.5 c	16 ab	24 ab	58.9 b	32 c	0.35 a
Rose Supreme	T_2	7.7 e	100 a	18 e-g	86.0 ab	90 cd	39.1 d	14 b	17.2 e-g	49.3 d-g	16 e	0.23 c
	T_3	66.8 a	20 b	30 ab	66.5 e-g	100 ab	25.6 g	9 fg	11.9 h-j	19.4 i	7 gh	0.11
	T_1	2.9 e	100 a	19 d-f	83.6 a-c	86 d	36.3 de	10 eg	21.0 b-d	50.3 c-f	15 ef	0.37 a
Oscar	T_2	8.0 e	100 a	23 c	79.0 b-d	96 a-c	31.6 f	9 eg	17.6 d-f	42.96 fg	15 ef	0.31 b
	T_3	60 b	13.3 b	28 ab	59.6 g	99 ab	22.3 h	6 j	15.3 g-i	19.6 i	10 f-h	0.27 bc
	T_1	3.8 e	100 a	14 h	59.4 g	85 d	42.3 c	14 b	25.6 a	53.4 b-e	15 ef	0.36 a
Pricilla	T_2	4.6 e	100 a	17 e-h	56.0 g	90 cd	38.6 d	10 ef	19.9 c-e	42.7 fg	11 eg	0.27 bc
	T_3	50.7 c	13.3 b	28 ab	34.9 h	96 a-c	17.4i	7 ij	14.3 f-i	20.13 hi	4 h	0.11 d
Princess Margaret Rose	T_1	2.5 e	100 a	16 f-h	81.6 a-d	87 d	48.6 a	15 b	24.6 a	68.4 a	37 c	0.40 a
	T_2	2.8 e	100 a	23 c	78.6 b-d	99 a-c	43.8 bc	9 c	14.9 f-h	56.3 b-d	24 d	0.30 b
	T_3	61.9 ab	20 b	31 a	63.8 fg	103 a	26.2 g	8 eg	11.0 ij	21.6 hi	10 e-g	0.15 d
Jester Ruffled Yellow	T_1	3.8 e	100 a	18 e-g	80.0 b-d	87 d	48.3 a	17 a	22.3 a-c	43.7 fg	32 c	0.37 a
	T_2	5.7 e	100 a	22 cd	74.9 c-e	97 a-c	43.8 bc	15b	14.3 f-i	41.6 g	13 e	0.29 b
	T_3	56.6 b	13.3 b	27 b	40.9 h	104 a	24.3 gh	8 gh	9.6 j	19 i	7 gh	0.12 d

In each column, values with different letters show significant difference as determined by Duncan's Multiple Range Test.

T_1 Stored at 8 in a potato storage house.

T_2 Stored at 12 in fruit storage house.

T_3 Stored at 27±3 in farmer's storage house.

temperature to 12°C reduced the spike length to 31.6-43.8 cm in different gladiolus varieties. Increase in storage temperature to 27±3°C resulted in a very sharp decline in spike length to 17.4-35 cm. Spike length at 27°C was significantly lower as compared to shoot length at either of the two lower temperature treatments (Table I). Earlier Gonzalez *et al*. (1998) reported that storage of *G. tristis* L. corms at 5°C for 6 weeks increased spike length. In the present study, reduced spike length due to increase in storage temperature resulted in reduction of number of flowers per spike. The adverse effect of increase in temperature from 8°C and 12°C on number of flowers was significant for Pricilla, Princess Margaret Rose and Jester Ruffled Yellow and insignificant for rest of the test varieties. However, further increase in storage temperature to 27°C reduced the number of flowers invariably and significantly in all the test gladiolus varieties (Table I).

Weight of corms and number and weight of cormlets was markedly suppressed by increase in storage temperature. With few exceptions, effect of change in storage temperature from 8°C to 12°C was generally significant. However, effect of corm storage at 27±3°C invariably and significantly reduced the various studied parameters of corms and cormlets (Table I).

CONCLUSION

Germination, vegetative and reproductive growth in different varieties of *Gladiolus* is adversely affected by higher storage temperature. It is therefore, recommended that for better plant growth, flowering and corm yield, gladiolus corms should be stored at 8°C during the summer rest period.

REFERENCES

Anonymous, 2003. *Directorate of Floriculture*. Government of the Punjab, Lahore, Pakistan

Bonnier, F.J.M., F.A. Hoekstra, C.H.R. De Vos and Van J.M. Tuyl, 1997. Viability loss and oxidative stress in lily bulbs during long-term cold storage. *Plant Sci.,* 122: 133–140

Bose, T.K., L.P. Yadav, P. Pat, V.A. Parthasarathy and P. Das, 2003. *Commercial Flowers*,Vol. 2. Naya Udyog, Kolkata, India

Cohat, J., 1993. *Gladiolus*. *In*: De Hertogh, A. and M. Le Nard, (eds.), *The Physiology of Flower Bulbs*, pp: 297–320. Elsevier, Amsterdam

du Toit, E.S., P.J. Robbertse and J.G. Niederwieser, 2004. Temperature regime during bulb production affects foliage and flower quality of *Lachenalia* cv. Ronina pot plants. *Sci. Hort.,* 102: 441–448

Gonzalez, A., S. Banon, J.A. Ferandez, J.A. Franco, J.L. Cases and J. Ochoa, 1998. Flowering responses of *Gladiolus tristis* L. after exposing corms o cold treatment. *Sci. Hort.,* 74: 279–284

Gross, K.C., C.Y. Wang and M. Saltveit, 2004. *The Commercial Storage of Fruits, Vegetables and Florist and Nursery Stocks*. Agricultural handbook number 66, USA: Agricultural Research Service, USDA, BARC-WEST Beltsville, MD 20705

Roh, M.S. and D.K. Hong, 2007. Inflorescence development and flowering of *Ornithogalum thyrsoides* hybrid as affected by temperature manipulation during bulb storage. *Sci. Hort.,* 113: 60–69

Shin, K.S., D. Chakrabarty and K.Y. Paek, 2002. Sprouting rate, change of carbohydrate contents and related enzymes during cold treatment of lily bulblets regenerated *in vitro*. *Sci. Hort.,* 96: 195–204

Steel, R.G.D. and J.H. Torrie, 1980. *Principles and Procedures of Statistics.* McGraw Hill Book Co., Inc, New York, USA

(Received 28 January 2008; Accepted 22 January 2009)