Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.4, No.6, 2014

Effects of Growing Media and Irrigation Interval on Flower Production of Amaryllis (*Amaryllis Belladonna)*

Nadia Bostan[1], Muhammad Sajid[1], Fazal Rabi[1] and Muhammad Munir[2]
1. Department of Horticulture, The university of agriculture, Peshawar – Pakistan.
2. Department of Agronomy, University of Haripur – Pakistan.
Corresponding author's email: <nadia.bostan11@gmail.com>

ABSTRACT

Four combinations of various growing media i.e. garden soil, canal silt, farm yard manure, mushroom compost, leaf mold and poultry manure and four irrigation intervals (i.e. 5, 10, 15 and 20 days) were trailed to investigate their effects on growth and flowers production of Amaryllis belladonna, at Horticulture Nursery of University of Agriculture, Peshawar during 2012.Growing medium composed of garden soil, canal silt, and mushroom compost resulted in maximum number of flowers (5.42) per plant, length of flower stalk (44.00 cm) and flower diameter (11.58 cm). While the medium composed of garden soil, canal silt, and leaf mold resulted in maximum flower persistency (7.58 days) whereas earlier flowering (43.50 days) was observed in amaryllis plants grown in the medium composed of garden soil, canal silt, and farm yard manure. Quick flowering (47.83 days), maximum flowers (4.50) per plant, flower stalk length (44.08 cm), flower diameter (11.67 cm), flower persistency (8.25 days) was noted at irrigation interval of 10 days. Since Mushroom compost growing media and 10 days irrigation interval interaction showed significant result among most of the parameters observed hence for better flower production growing media garden soil + canal silt + mushroom compost with 10 days irrigation interval is recommended.

Keywords: Flower production, flower stalk length & diameter

INTRODUCTION

Amaryllis belladona is a bulbous plant of family Amaryllidaceae and subfamily Amaryllidoideae with basic chromosome number 11 (Brandham and Bandhol, 1997 and Arroyo, 1981). Its common name is Belladonna Lily and March Lily. The name Amaryllis is derived from Latin amarysso means "to sparkle". Its origin is South Africa, especially the rocky South West region near the Cape. Its cultivation started at the beginning of 18th century (Wyman, 1997).

Amaryllis represents pride, magnificent beauty. Its prominent beauty in full blossom is often compared to a gorgeous, stylishly outfitted woman. The word amaryllis indicates glory in Greek language. (Pamela *et al.*, 1993).

It has big and eye-catching flowers with many bright colors and is one of the most brilliantly colored spring bulbs (Zandbergen, 1980). It can be grown under diverse environmental conditions, ranging from tropical to subtropical to temperate climate (Okubo, 1993).

Amaryllis is a bulbous plant with each bulb having 5-10 cm in diameter. It has several green strap-shaped leaves with 30–50 cm length and 2–3 cm width, arranged in two rows. The leaves are produced in the autumn or early spring in warm climates depending on the onset of rain and eventually die down by late spring. The bulbs grow well in areas with warm dry summer. Although it prefers warm temperature (70-75°F) but once the plant flowers, cooler temperature (65°F) can extend the length of bloom. Each bulb produces one or two leafless stems 30–60 cm tall, each of which bears a cluster of 2-12 funnel-shaped flowers at their tops. Each flower is 6–10 cm diameter with three outer sepals, three inner petals with similar appearance to each other. The usual color is white with crimson veins, but pink or purple also occur naturally (Wyman, 1997).

Amaryllis can be used in beds, low borders, patio, pots or planters, ground cover, mass planting, naturalizing and also as indoor house plants. Amaryllis is most effective when grown in clumps of 10 plants or more of the same color (Black, 2000). Now a days, it is also used as a cut flower even undeveloped floral axis occasionally are sold as cut flowers, the retail value of one floral axis being roughly equal to that of a mature ready-to-flower bulb (DeHertogh, 1992).

Amaryllis plantation can be done between September and January. For new plantation the bulbs are dug and reset every year. However, it is better to separate and replant each year which helps in better flowering and yield. This practice also enables to remove young offsets (bulb-lets), properly preparation of soil bed and thus helps in reducing diseases by removing unhealthy bulbs at this time. Bulbs are planted at a distance of 12 to 15 cm with top of the bulb is just covered with soil. Immediately irrigate the new planted amaryllis bulbs and keep them moist till full establishment of plant. (Black, 2000)

Amaryllis prefers light shade and well-drained soil. Heavily shaded sites leads the plants to grow thin and flower poorly. Ideal site for growing amaryllis is the light level under pine trees. Raised beds having good

drainage properties can also be used. Soil for an amaryllis bed should be ploughed with 3 to 4 inch layer of organic media. The bed should be levelled and moistened. Same specie or even the same variety gives different results to different growing media. It is due to difference in the physical and chemical properties of the media which are very important for the growth and development of plant. So to get the ideal growing media different mixtures with different physical and chemical properties are used. Different constituents have different properties like silt, sand, perlite, vermiculite and sphagnum mass allow leaching while clay soil allow water passage slowly. Poultry manure is a rich source of nitrogen while mushroom compost is rich in phosphorus. (Larson, 1980).

The size of soil particle also effects plant growth i.e. big soil particles could be one of the hindrances to prevent better root and ultimately plant growth, while the small soil particles can be easily displaced by roots causing better root growth (Kambooh, 1984).

Just like growing media, irrigation is also very important for plant growth. First of all water helps in plant germination; act as a solvent for uptake and transport of materials. It is a good medium for biochemical reactions. It keeps the plant turgid and helps in photosynthesis of the plant to keep it alive (Hebrank, 1997). Irrigation interval and timing differs according to plant need and type (Anonymous, 2004.)

The growing media should be of good quality. It should be well drained to provide proper root aeration and avoid water logging. It should be able of proper nutrient and water retention (Jacob *et al.*, 2009).

In Pakistan the growers are unaware of the production technologies as well as the planting media and irrigation intervals of amaryllis. They are also unaware of the storage techniques of amaryllis bulbs. Keeping in view the importance of amaryllis in cut flower industry this experiment was planned with the following aims to;

- Study the response of growth and flower production of amaryllis to different media and irrigation intervals.
- Determine the best media and irrigation interval for better growth and flower production of amaryllis.

METHODS AND MATERIALS

Media preparation and bulb plantation

The media used in this experiment was prepared by thoroughly mixing garden soil, canal silt and respected media at 1:1:1. Amaryllis bulbs were planted in black polythene bags of size 8x12 inches with the required media. Seven bulbs per treatment were planted and replicated three times thus total 336 bulbs were planted for four different types of growing media and irrigation interval.

Experimental Design

The experiment was carried out in Randomized Complete Block Design (RCBD) with two factors (growing media and irrigation interval), factorial arrangement replicated three times. There were 16 treatments in each replication. Experiment was based upon following two factors i.e. Growing media and Irrigation intervals.

Factor A (Growing Media)

M_0: Garden soil + Canal Silt + Farm Yard Manure (1:1:1) (control)
M_1: Garden soil + Canal Silt + Mushroom Compost (1:1:1)
M_2: Garden soil + Canal Silt + Leaf mold (1:1:1)
M_3. Garden soil + Canal Silt + Poultry Manure (1:1:1)

Factor B (Irrigation Interval)

I_1: 5 days
I_2: 10 days
I_3: 15 days
I_4: 20 days.

Soil Analysis

Samples were taken from all the growing media before bulb plantation and were analyzed in the Soil Laboratory at the Department of Soil and Environmental Sciences, University of Agriculture, Peshawar. The results from laboratory analysis of media used in trials are given here under:

Media	pH	Organic Matter(%)	N (ppm)	P (ppm)	K (ppm)
Farm Yard Manure	7.9	2.9	740	52.2	70.1
Mushroom compost	7.9	4.9	910	59.0	54.4
Leaf Mold	8.0	3.9	820	58.0	47.1
Poultry manure	7.7	7.5	10860	72.6	89.7

Studied Parameters

The following parameters were studied during the experiment.

Days to flowering

Days to flowering of five sample plants were counted from date of planting to the date of first blossom and average was calculated.

Number of flowers per plant

Data on number of flowers per plant of five randomly taken plants from each treatment in each replication was counted and mean was computed.

Flower stalk length (cm)

For data on flower stalk length (cm) from each replication in each treatment select five plants randomly and measured with measuring tape from base to the tip of the plant and then average was calculated.

Flower diameter (cm)

The diameter of the flower plant^{-1} in centimeters at the time of full bloom was measured with the help of measuring tape and average was calculated.

Flower persistency

The data was recorded for flower persistency by counting days of individual plants when 2-3 petals of the buds opened till the blossom started to change their color and average was carried out.

Statistical procedure

All the data noted on plant growth parameters was subjected to analysis of variance process to confirm differences among various growing media, irrigation interval and their interactions. Least significant difference (LSD) test was used for mean differences where the results were significant. Computer statistical software MSTATC was applied for calculating both ANOVA and LSD (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The results are briefly described as under.

Days to flowering

The data recorded for days to flowering is presented in Table-1. The analysis of variance showed that growing media, irrigation interval and their interaction had a significant effect on days to flowering of amaryllis. Data regarding growing media showed a significant variation among the different media in which early flowering (43.50) was observed in controlled bulbs followed by the bulbs grown in mushroom compost (47.50) and leaf mold (53.00). The bulbs grown in poultry manure resulted in late flowering (56.58). From the findings of irrigation interval, it is cleared that the earliest flowering (47.83 days) was observed in bulbs grown under irrigation with an interval of 10 days followed by irrigation interval of 15 days (49.33 days) while late flowering (52.83 days) was observed in irrigation interval of 20 days. The interaction of growing media and irrigation interval also significantly influence the days to flowering of amaryllis. However, less number of days (40.00) to flowering was noticed in bulbs planted under control treatment with 10 days irrigation interval. While the maximum number of days (59.67) to flowering was recorded in bulbs irrigated with 20 days interval grown in poultry manure medium. Late flowering in poultry manure is due to late emergence of bulbs in this medium and the antagonistic effects of the high concentration of nitrogen and excess nitrogen which prolong the vegetative phase and delay flowering. This result confirmed the previous studies of Khan *et al.* (2012) who reported early flowering in control nitrogen application as compared to nitrogen treatment at 40 and 60 kg N ha^{-1}. Ten days irrigation interval might be best due to the fact that proper water supply enables the plant to function properly and completes its vegetative and reproductive both cycles on time. The present results are in line with findings of Hong (1970) who reported early flowering in amaryllis at the irrigation intervals of 10 days.

Table 1: Days to flowering of amaryllis as affected by irrigation interval and growing media.

Irrigation interval	Growing media				Mean
	FYM (Control)	Mushroom	Leaf mold	Poultry manure	
05 days	44.33	53.33	47.67	57.00	50.58b
10 days	40.00	50.00	47.67	53.67	47.83d
15 days	43.00	52.67	45.67	56.00	49.33c
20 days	46.67	56.00	49.00	59.67	52.8a
Mean	43.50d	53.00b	47.50c	56.58a	

LSD Value for media and irrigation at 5% level of probability = 0.98
LSD Value for growing media x irrigation interval at 5% level of probability = 1.97
Means of the same category by different letters are different statistically at 5% level of probability.

Number of flowers per plant

The data recorded for number of flowers per plant is presented in Table-2. The analysis of variance showed that growing media, irrigation interval and their interaction had significant effect on number of flowers per plant. Data recorded for media showed that more number of flowers (5.42) per plant was produced by plants grown in mushroom compost, followed by leaf mold (3.00), and controlled plants (2.67), while less number of flowers (1.50) per plant was recorded in plants grown in poultry manure. A significant variation was observed among different irrigation interval where maximum number of flowers (4.50) per plant were produced by plants grown under irrigation interval of 10 days, followed by irrigation interval at 15 days (3.58), while minimum flowers (1.67) per plant were recorded in plants grown under irrigation interval of 20 days. The interaction also significantly affects the number of flowers per plant. More number of flowers (8.33) per plant were observed by bulbs planted in mushroom compost irrigated at 10 days interval while the minimum number of flowers (1.00) per plant were observed in bulbs planted in poultry manure with 20 days irrigation intervals. Optimum organic matter content and phosphorous concentration in mushroom compost is the reason of maximum number of flowers, since phosphorous helps in the formation of buds, roots and blooming, while in poultry manure less number of flowers might be due to presence of excessive concentration of phosphorus which retard the translocation and uptake of micro nutrients such as zinc (Millikan, 1963; Watanabe *et al*., 1965), iron (Rediske and Biddulph, 1953) or copper (Nus *et al*., 1993). Maximum number of flowers in mushroom compost and leaf mold might also be due to the maximum number of leaves in these media, which promote the photosynthesis and hence increased the number of flowers. These results are in line with Zhang *et al.* (2004) who reported less number of flowers in fan flower with high phosphorus application. The sufficient water availability at 10 days irrigation interval might have enabled greater root growth which leads to better nutrient uptake, thus produced maximum number of flowers per plant than that of other treatments. Minimum number of flowers per plant at irrigation interval of 20 days might be attributed to water stress which might have failed to fulfill the water requirement of the plant and thus resulted in minimum number of flowers per plant. This result is in the confirmation of previous studies of Hong (1970) who reported maximum flowering in amaryllis at irrigation intervals of 10 days.

Table 2: Number of flowers per plant of amaryllis as affected by irrigation interval and growing media.

Irrigation interval	Growing media				Mean
	FYM (Control)	Mushroom	Leaf mold	Poultry manure	
5 days	2.67	4.67	2.67	1.33	2.83c
10 days	3.33	8.33	4.33	2.00	4.50a
15 days	3.33	6.00	3.33	1.67	3.58b
20 days	1.33	2.67	1.67	1.00	1.67d
Mean	2.67b	5.42a	3.00b	1.50c	

LSD Value for media and irrigation at 5% level of probability = 0.72
LSD Value for growing media x irrigation interval at 5% level of probability = 1.43
Means of the same category by different letters are different statistically at 5% level of probability

Flower's stalk length (cm)

The data recorded for flower stalk length is presented in Table-3. The analysis of variance showed that growing media, irrigation interval and their interaction significantly affected flower stalk length (cm) of amaryllis. Persual of the data regarding media concluded that the maximum flower stalk length (44.00 cm) were observed in plants grown in mushroom compost, which was at par with those grown in leaf mold (41.00 cm). While bulbs grown in poultry manure produced the shortest flower stalks (26.58 cm). The means documented for irrigation interval indicated that more flower stalk length (44.08 cm) was observed in plants grown under irrigation interval of 10 days, followed by those grown under irrigation interval of 15 days (39.25 cm) which was at par with plants irrigated with 5 days interval (37.42cm), while less flower stalk length (27.75 cm) was observed for the plants that were grown under irrigation interval of 20 days. Interaction of growing media and irrigation interval significantly affects the flower stalk length (cm). Among various treatments used the maximum flower stalk length (55.00 cm) was observed in plants of mushroom compost with 10 days irrigation interval, while the minimum flower stalk length (22.67 cm) was observed in bulbs of poultry manure with 20 days irrigation interval. The reason for maximum stalk length in mushroom compost is the adequate amount of nitrogen, potassium and organic matter content in mushroom compost and leaf mold, which positively contributed towards the nutritional status of the plant and ultimately the flower stalk length. Minimum flower

stalk length in poultry manure might be due the excess amount of nitrogen, which resulted in weaker plant structure and growth. The results are also in similarities with the findings of Singh (2000) who reported the maximum flower stalk length at application of 200 kg N ha^{-1} as compare to 3650 kg N ha^{-1}. Regarding irrigation it is due to sufficient water availability which result in proper nutrient uptake and thus positively affect flower stalk length. Similar findings were also presented by Ahmed *et al.* (2010) who reported maximum spike length at 7 days irrigation interval in sunflower.

Table 3: Flower stalk length (cm) of amaryllis as affected by irrigation interval and growing media

Irrigation interval	Growing media				
	FYM (Control)	Mushroom	Leaf mold	Poultry manure	Mean
5 days	36.33	41.00	39.67	32.67	37.42b
10 days	44.67	55.00	50.00	26.67	44.0a
15 days	41.00	45.00	46.67	24.33	39.25b
20 days	25.67	35.00	27.67	22.67	27.75c
Mean	36.92b	44.00a	41.00a	26.58c	

LSD Value for media and irrigation at 5% level of probability = 3.28
LSD Value for growing media x irrigation interval at 5% level of probability = 6.57
Means of the same category by different letters are different statistically at 5% level of probability.

Flower diameter (cm)

The data recorded for flower diameter (cm) is presented in Table-4 The analysis of variance showed that growing media, irrigation interval and their interaction had significant effect on flower diameter of the plant. Persual of the data regarding the media revealed that the maximum flower diameter (11.58 cm) was observed in plants grown in mushroom compost, closely followed by those grown in leaf mold (10.92 cm). While less flower diameter (7.33 cm) was observed for the plants that were grown in poultry manure. Data regarding irrigation interval concluded that the highest flower diameter (11.67 cm) was observed in plants grown under irrigation interval of 10 days, which was at par with those grown under irrigation interval of 15 days (11.00 cm), while minimum flower diameter (7.75 cm) was documented for the plants that were grown under irrigation interval of 20 days. Regarding interaction, the maximum flower diameter (13.67 cm) was recorded for plants grown in mushroom compost with irrigation interval of 10 days while minimum flower diameter (5.67cm) was recorded for bulbs of poultry manure irrigated at 20 days interval. The reason for maximum flower diameter is the adequate amount of nitrogen, potassium and organic matter content in mushroom compost and leaf mold, which positively contributed towards the flower diameter. Minimum flower diameter in poultry manure is due the excess amount of nitrogen, which resulted in weaker plant structure and growth. These results are in accordance with the findings of Riaz *et al*. (2008). who reported the maximum flower size of zinnia in coconut compost which contained medium amount of nitrogen among all the treatments. The significant response of irrigation interval is due to sufficient water availability resulted in proper nutrient uptake, proper aeration and thus positively affect flower diameter. Similar findings were also obtained by Fakhraei and Rahimi (2012) who preferred irrigation at 10 days interval over 7 and 15 days interval for better growth and bigger size of floral spike in gladiolus.

Table 4: Flower diameter (cm) of amaryllis as affected by irrigation interval and growing media

Irrigation interval	Growing media				
	FYM (Control)	Mushroom	Leaf mold	Poultry manure	Mean
5 days	7.33	11.67	10.33	7.33	9.17b
10 days	11.67	13.67	12.67	8.67	11.67a
15 days	11.00	13.00	12.33	7.67	11.00a
20 days	9.00	8.00	8.33	5.67	7.75c
Mean	9.75b	11.58a	10.92a	7.33c	

LSD Value for media and irrigation at 5% level of probability = 0.98
LSD Value for growing media x irrigation interval at 5% level of probability = 1.97
Means of the same category by different letters are different statistically at 5% level of probability

Flower persistency (days)

The data recorded for flower persistency is presented in Table-5. The analysis of variance showed that growing media, irrigation interval and their interaction had a significant effect on flower persistency of the plant. Data for medium showed that more flower persistency (7.58 days) was observed in plants grown in leaf mold, followed by those planted in mushroom compost and in untreated plants (7.08days), while less flower persistency (5.75 days) was noted for the plants grown in poultry manure. The mean data for irrigation interval showed that maximum flower persistency (8.25 days) was observed in plants grown under irrigation interval of 10 days, followed by irrigation interval of 15 days (7.25 days), while the minimum flower persistency (5.33 days) was noted for the plants grown under irrigation interval of 20 days. Flower persistency is significantly affected by the interaction of irrigation interval and growing media. Among all the treatments maximum flower persistency (9.33 days) was observed by bulbs planted in leaf mold irrigated at 10 days interval while the minimum flower persistency (5.00 days) was noticed in bulbs of poultry manure with 20 days irrigation interval. This is due to the reason that leaf mold contain the minimum level of nitrogen; as nitrogen cause lodging of the plant (Muhammad, 2012). The results are also in similarities with the findings of Tahir *et al*. (2011) who reported the maximum flower persistency in plants of freesia grown in leaf mold. The best result at 10 days irrigation interval is due to the reason that at decreasing irrigation interval during reproductive stage makes the pedicle weak and cause flower drop while at very high irrigation interval like 20 days the flower die due to low water supply. Similar findings were also founded by Fakhraei and Rahimi (2012) who obtained significant results regarding flower persistency in gladiolus irrigated at 10 days interval over 7 and 15 days interval.

Table 5: Flower persistency (days) of amaryllis as affected by irrigation interval and growing media

Irrigation interval	Growing media				
	FYM (Control)	Mushroom	Leaf mold	Poultry manure	Mean
5 days	7.00	6.67	7.00	6.00	6.67c
10 days	8. 33	9.00	9.33	6.33	8.25a
15 days	7.33	7.67	8.33	5.67	7.25b
20 days	5.67	5.00	5.67	5.00	5.33d
Mean	7.08b	7.08b	7.58a	5.75c	

LSD Value for media and irrigation at 5% level of probability = 0.48
LSD Value for growing media x irrigation interval at 5% level of probability = 0.96
Means of the same category by different letters are different statistically at 5% level of probability

CONCLUSION AND RECOMMENDATIONS

Conclusions

Conclusions based on experimental results are as,

- Amaryllis bulbs grown in the medium composed of garden soil+ canal silt + mushroom compost at 1:1:1 ratio showed good results in terms of most of the plant growth parameters as compared to other growing media tested in present studies. .
- . Irrigation at 10-day interval resulted in better growth performance of amaryllis plants/bulbs in terms of their flower production parameters recorded during the course of this investigation, compared to other treatments.

Recommendations

Based on the above conclusion, the following recommendations are made

- Growing medium mushroom compost mixed with garden soil and canal silt at 1:1:1 with 10 days irrigation interval is the best for better growth and flower production of amaryllis for Peshawar region

LITERATURE CITED

Ahmed, M. E. and M. F. Ahmed. 2010. Effect of irrigation intervals and inter- row spacing on the vegetative growth characteristics in sunflower (*Helianthus annuus*L) hybrids in Shambat soil. J. of Appl. Sci. Res. 6(9): 1440-1445.

Anonumous. 2004. Drip Irrigation Made Easy! A Division of Strong Enterprises 308 Melville Court, Roseville. CA 95747 P: 7.

Arroyo, S. 1981. The chromosomes of amaryllis, hippeastrum and physella (amaryllidaceae), Serrano 661, 1414 Buenos Aires Argentina. P: 211.

Black, R. J. 2000. Amaryllis. Circular 1243, a series of the Environmental Horticulture Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Pp: 1-2.

Brandham, P. E. and P. S. Bhandol. 1997. Chromosomal relationship between the genera amaryllis and hippeastrum (amaryllidaceae) jordell laboratory, royal botanic gardens, Kew Richmond, Surrey, TW9, 3DS. U.K. P: 973.

DeHertogh, A. 1992. Bulbous and tuberous plants. Introduction to Floriculture,

2nd Edition. Roy A. Lawson (ed.). Academic Press, Inc., San Diego.

Fakhraei, L. M. and A. R. Midani. 2012. Effect of irrigation intervals and different mulches on some traits of gladiolus cv. Rose Supreme. 28 (2): 239-248

Hebrank, M. R. 1997. Reduce confusion about diffusion. Amer. Bio. 59: 160

Hong,Y. P. 1970. The effect of temperature treatments on flowering and growth in amaryllis, *Hippeastrum hybridum.* Rur. Dev., Suwon (Horticulture) 13: 57-63

Kambooh, C. M. 1984. “Desi khadeen” Zarat Nama. 23(24):9-28.

Khan, M. K., M. Sajid, A. Rab, I. Jan, H. Zada, M. Zamin, I. Haq, A. Zaman, S. T. Shahand and A. U. Rehman. 2012. Influence of nitrogen and phosphorus on flower and corm production of freesia. Afric. J. Biotech. 11(56): 11936-11942

Larson E. L. 1980. Introduction to floriculture. 607. Academic press London. New York.

Milllikan, C. R. 1963. Effect of different level of zinc and phosphorus on the growth of subterranean clover (*Trifolium subterranean*). Aust. J. Agri. Res.14:180-205

Muhammad, A.A. 2012. General agriculture, 6: 67

Nus, J. L., N. E. Christians and K. L. Diesburg. 1993. High phosphorus application influence soil availability potassium and Kentucky blue grass copper content. Hort. Sci. 28: 639-641.

Okubo, H. 1993. Hippeastrum (Amaryllis). In: The physiology of flower bulbs. A. DE Hertogh and M. LE Nard (Eds). Elsevier. 321-324.

Pamela, T. and I. Penny. 1993. Flowers; flower language; symbolism of flowers; folklore sentiments & plant lore from the language of flowers. 0821220004, 1: 192

Reduske, J. H. and O. Biddulph. 1953. The absorption and translocation of iron. Plant Physiol. 28:576-593

Riaz, A., M. Arshad, A. Younis, A. Raza and M. Hameed. 2008. Effects of different growing media on growth and flowering of *Zinnia elegans* cv blue point. Pak. J. Bot. 40(4): 1579-1585

Singh, K. P. 2000. Response of graded levels of nitrogen in tuberose (*Polianthes Tuberosa* L.) cultivar 'Single'. Advances in Plant Sciences 13(1): 283-285

Steel, R. G. D. and Torrie. (1980), *Principles and Procedures of Statistics*, Second Edition, New York: McGraw-Hill.

Tahir. A., A. M. Khattak, N. U. Amin and M. A. Khan. 2011. Response of freesia cultivars to different growing media under Peshawar conditions. Sarhad J. Agric. 27(1): 43-49

Watanabe, F. S., W. l. Lindsay, and S. R. Olsen. 1965. Nutrient balance involving phosphorus, iron and zinc. Soil Sci. Soc. Amer. Proc. 29:565.

Wyman. 1997. Wymans gardening encyclopedia. New York: Macmillian publishing. 37-38.

Zandbergen F. 1980. Alfabetische Lijst van de ir Nederland in cultuur zijnde Amaryllis (Hippeastrum) cultivars. Koninklijke Algemeene Vereeniging voor Bloembol lencultuur, Hillegom, The Netherlands, P: 81.

Zhang, D., R. E. Moran, and L. B. Stack. 2004. Effect of phosphorus fertilization on growth and flowering of *Scaevola aemula*. Hort Sci. 39(7): 1728-1731