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

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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 early emergence (18.66 days), maximum leaf length (47.87cm), leaf width (2.44 cm), number of leaves (13.55). Maximum leaf length (48.16cm), leaf width (2.36 cm), number of leaves per plant (13.55), 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 growth growing media garden soil + canal silt + mushroom compost with 10 days irrigation interval is recommended.

Keywords: Emergence, leaf length & width,

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

Data was recorded on different parameters i.e. Days to emergence, leaf length (cm), leaf width (cm), number of leaves per plant.

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

Data recorded on the above parameters are presented in Tables 1-4. The results are briefly described as under.

Days to emergence

The data noted for days to emergence is given in Table-1. The analysis of variance showed a significance variation of growing media on days to emergence while the effect of irrigation and interaction between growing media and irrigation was found non-significant. Early emergence (18.66 days) of amaryllis bulbs was observed in mushroom compost, closely followed by bulbs planted in control medium (18.93 days) and late emergence (25.65 days) was recorded in poultry manure. Quick emergence in mushroom compost is due to proper water supply to the bulbs, which helped in quick rooting and bud sprouting. Late emergence of bulbs in poultry manure is due to the excess nitrogen concentration in this medium because high nitrogen produces toxic effect which delay emergence of bulbs or even burn the plants. The results are also in similarities with the findings of (Tahir *et al.*, 2011) who observed quick emergence of freesia in mushroom compost media.

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

Irrigation interval	Growing media				
	FYM (Control)	Mushroom	Leaf mold	Poultry manure	Mean
5 days	13.77	24.11	28.00	22.67	22.14
10 days	16.55	13.43	21.10	24.07	18.78
15 days	25.47	17.67	26.53	23.10	22.19
20 days	19.93	19.44	25.40	32.78	24.38
Mean	18.930b	18.66b	25.26a	25.652a	

LSD for media at 5% level of probability = 4.18

Means of the same category by different letters are different statistically at 5% level of probability.

Leaf length (cm)

The data recorded for leaf length is presented in Table-2. The analysis of variance showed that leaf length was significantly influenced by growing media and irrigation interval, while their interaction had a non-significant effect on leaf length of amaryllis. Maximum leaf length (47.87cm) were produced by the plants grown in mushroom compost, which was significantly at par with leaf mold (46.48 cm) and control treatment (43.45 cm). While the poultry manure produced shorter leaves (31.75 cm). The means recorded for irrigation interval showed that more leaf length (48.16 cm) was produced by the plants grown under irrigation interval of 10 days, closely followed by plants grown under irrigation interval of 15 days (44.26 cm) and 5 days interval (43.50cm). While the 20 days irrigation interval produced the minimum leaf length of 33.62 cm. Maximum leaf length at mushroom compost is due to the fact that mushroom compost is a mixture of agricultural products, such as straw from horse stables, hay, ground corn cobs, cotton seed hulls, cocoa shells, peat moss, wheat straw and other natural organic substances. These products are formed into a rich organic media that serves as the nutrient source for micro nutrients like magnesium (0.35 percent) and iron (1.07 percent) along with macro nutrients. The amount of carbon nitrogen ratio is the key indicator of nitrogen availability for plant growth. Mushroom compost has an excellent C: N (13:1), showing better nutrient availability (Fidanza, 2006). Similar findings were also founded by El-Naggar and El-Nasharty (2009) who observed more leaf length in composted leaves media than in

clay media. Best results of 10 days irrigation interval might be due to the sufficient supply of water which facilitate proper aeration and proper nutrient uptake, while at 20 days irrigation interval the plant was in water deficit stress and thus do not perform well (Kramer *et al.,* 1995). Similar findings were also founded by Mateenul *et al.,* (2005) who reported that there was a significant decrease in leaf length of onion with increasing the irrigation interval.

Table 2: Leaf length (cm) of amaryllis as affected by irrigation interval and growing media

	Growing media				
Irrigation interval	FYM (Control)	Mushroom	Leaf mold	Poultry manure	Mean
5 days	47.14	48.99	44.91	32.95	43.50a
10 days	48.40	50.91	50.66	42.69	48.16a
15 days	45.73	50.03	49.56	31.73	44.26a
20 days	32.52	41.53	40.80	19.61	33.62b
Mean	43.45a	47.87a	46.48a	31.75b	

LSD for media and irrigation at 5% level of probability = 5.91

Means of the same category by different letters are different statistically at 5% level of probability

Leaf width (cm)

Mean data for leaf width is presented in Table-3. The analysis of variance revealed that growing media and irrigation interval had a significant, while their interaction had non-significant effect on leaf width of the plant. Maximum leaf width (2.44 cm) was produced by the plants grown in mushroom compost, followed by plants grown in leaf mold (2.34 cm). While the poultry manure produced lower leaf width of 1.88 cm. The means recorded for irrigation interval showed that more leaf width (2.36 cm) was produced by the plants grown under irrigation interval of 10 days, followed by plants grown under irrigation interval of 15 days (2.33 cm) and 5 days (2.20 cm). While plants irrigated at 20 days showed the least leaf length (1.95 cm). Maximum leaf width in plants of mushroom compost is due to sufficient amount of organic matter which contributes to high water and nutrient holding capacity and thus effects the plant growth positively. Similarly sufficient N concentration helped the plants to grow more vigorously, which resulted in maximum leaf width of the plants, while very high concentration of N may create toxic effect, resulted in less leaf width (Wazir, 2005). Tahir *et al.* (2011) also found maximum leaf width in freesia grown in mushroom compost media. Maximum leaf width at 10 days irrigation interval might be due to the sufficient supply of water which facilitate proper aeration and proper nutrient uptake, while at 20 days irrigation interval the plant was in water deficit stress and thus do not perform well (Kramer *et al.,* 1995). The present results are in line with the findings of Mateenul *et al.* (2005) who reported reduction in leaf width in onion with increased irrigation interval.

Table 3: Leaf width (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	2.17	2.44	2.27	1.90	2.20ab
10 days	2.31	2.56	2.43	2.16	2.3a
15 days	2.31	2.53	2.40	2.07	2.3a
20 days	1.91	2.23	2.26	1.39	1.95b
Mean	2.18a	2.44a	2.34a	1.88b	

LSD for media and irrigation at 5% level of probability = 0.27

Means of the same category by different letters are different statistically at 5% level of probability.

Number of leaves per plant

The data recorded for number of leaves per plant is presented in Table-4. The analysis of variance showed that growing media, irrigation interval significant while their interaction had non-significant effect on number of leaves per plant. Data regarding medium indicated that more number of leaves (13.55) per plant was found in bulbs planted in mushroom compost, which was at par with those planted in leaf mold (12.38) and control treatment (11.33), while less number of leaves (5.43) per plant was produced by those grown in poultry manure. The data for irrigation interval showed that higher number of leaves (14.30) per plant were found in bulbs grown under 10 days irrigation interval, which significantly varies from the rest of the treatments, followed by those grown under 15 days irrigation interval (10.79), while minimum number of leaves (7.19) per plant were produced by those grown under 20 days irrigation interval. Minimum leaves in poultry manure might be due to the fact that excess amount of P block the translocation of zinc (Millikan, 1963; Watanabe *et al.,* 1965) which is necessary for the production of growth promoting hormone auxin. This result confirmed the studies of Zhang *et al.* (2004) who reported less number of leaves in fan flower with high phosphorus application. A significant variation among the different irrigation interval might be due to the fact that decrease in water content inhibits photosynthesis and usually reduces the rate of respiration and other enzyme-activated processes. Kramer *et al.* (1995) proposed that water should be regarded as a major factor in the regulation of plant growth (plant height, number of leaves per plant) along with some effects of hormones which are controlled through water. Similar were the results of Ahmed *et al.* (2010) who observed maximum number of leaves at 7 days irrigation interval in sunflower.

Table 4: Number of leaves per plant of amaryllis as affected by irrigation interval and growing media

Irrigation interval	Growing media				
	FYM (Control)	Mushroom	Leaf Mold	Poultry Manure	Mean
05 days	10.77	13.66	12.33	4.99	10.44b
10 days	16.00	16.43	15.00	9.76	14.30a
15 days	12.36	13.88	12.22	4.66	10.79b
20 days	6.22	10.23	10.00	2.33	7.19c
Mean	11.33b	13.55a	12.38ab	5.43c	

LSD for media and irrigation at 5% level of probability = 1.71

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 media composed of garden soil+ canal silt + mushroom compost at 1:1:1 showed good results in most of the plant growth parameters as compared to media composed of garden soil +canal silt + leaf mold at 1:1:1, garden soil+ canal silt + poultry manure at 1:1:1 and garden soil+ canal silt+ farm yard manure at 1:1:1.
- In case of irrigation interval most of the growth parameters showed good results at 10 days interval as compared to 5, 15 and 20 days interval.

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 of amaryllis for Peshawar region.

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