

RESPONSE OF FREESIA CULTIVARS TO DIFFERENT GROWING MEDIA UNDER PESHAWAR CONDITIONS

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ABSTRACT

The experiment “Response of freesia cultivars to different growing media” was conducted at Ornamental Horticulture nursery, Department of Horticulture, Agricultural University, Peshawar during 2005-2006. Four cultivars of freesia i.e. Valentino, Jessica, Golden Wave and White Wings were planted in four different planting media i.e. control, leaf mold, mushroom compost and poultry manure. The experiment was laid out in randomized complete block design with split plot arrangement. Media were used as main plots while cultivars as subplots. Media mostly affected the parameters studied during the experiment. Early emergence (25.22 days), maximum number of leaves (10.44), maximum lamina length (22.7 cm), maximum leaf area (310.54 cm²), maximum number of florets plant⁻¹ (41.71), maximum number of spikes plant⁻¹ (7.67) and maximum plant height (36.18cm), was recorded in plants grown in mushroom compost, while late emergence (62.23 days), less number of leaves (8.14), less lamina length (18.16cm), less leaf area (205.55 cm²) plant⁻¹, late flowering (153.39 days), less number of florets plant⁻¹ (21.33), less number of spikes plant⁻¹ (3.93), less spike persistence (8.01 days) and less plant height (28.28 cm) was obtained in poultry manure. Early flowering (142.66 days) occurred in control, while maximum spike persistence (9.89 days) was observed in leaf mold. Among the cultivars, some parameters showed significant variation. Early emergence (33.90 days) and early flowering (145.84 days), and spike persistence (9.24 days) was recorded in cv. White Wings, while minimum leaf area plant⁻¹ (221.42 cm²), late flowering (147.04), less florets plant⁻¹ (28.46), and minimum plant height (30.19 cm) was produced by the cv. Golden Wave. Maximum leaf area per plant (275.68 cm²) and maximum plant height (34.01 cm) was given by cv. Valentino, while late emergence (36.33 days), minimum spikes per plant (6.06) and less spike persistence (9.03 days) were recorded for cv. Jessica. Non significant interactions were observed between the planting media and cultivars.

Key Words: Freesia hybrida, Cultivars, Growth, Flowering, Growing Media

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INTRODUCTION

Freesia (*Freesia hybrida*) is a well known cut flower belongs to the family Iridaceae. It was originated in South Africa and was named after the German physician, Friedrich Heinrich Theodor Freese in 1830 AD. Over 300 cultivars are known to be cultivated as cut flowers. Freesia flowers come in different colors such as, white, yellow, lavender, orange, golden, pink, red and violet. Out of the total world production, Holland is the largest producer of freesia, with over 280 hectares under cultivation. The plant growing medium must be porous for root aeration and drainage and also capable of water and nutrient retention. Oxygen, of course, is required for all living cells. The coarse-textured media often meet these requirements. Mushroom compost, leaf mold, farmyard manure and other amendments may fulfill these requirements. Leaf mold is a bulky and fibrous soil conditioner. Bulbs, corms and tubers do well in media amended with organic manures (Arora, 2004). In Pakistan the growers are not familiar with the production technology of freesia as well as the use of planting media and other production and storage techniques. In addition growers are unable to produce their own corms of freesia. In this experiment an effort was made to investigate the proper medium for its cultivation and other factors such as proper temperature requirements, proper amount of NPK and organic matter content.

Calvin *et al.* (1991) worked on the effect of nutritional status of amended spent mushroom compost on the growth of eight woody ornamentals. They observed that shoot and root dry weight of dogwood, forsythia, ninebark, rose and weigela and shoot dry weight in Deutzia and Potentilla increased with increasing compost level. Henny (1981) recorded better development of foliage ornamental plants in spent mushroom compost, than those grown in the mixture of peat and pine bark. Brundert and Schmidt (1982) stated that plants with higher water requirements grew more vigorously in leaf mold medium. Fernandez (1984) observed that the plant height and leaf development

of foliage plants were best in leaf mold medium. Khan and Khan (1991) reported that the bulb of Dahlia was best developed in the leaf mold. Pasini and Aquila (1989) observed maximum plant height and number of leaves in plants grown in leaf mold medium. Grantz and Scharof (1984) observed largest and heaviest plants in bark compost as compared to the garden soil. Krause (1982) recommended the mixture of composted bark and peat at 1:1 ratio for raising tulips and other ornamental plants. It is important to bring and acclimatize more and more freesia cultivars in this area, because of its aesthetic and economic value. The use of environmentally friendly organic media is also important. Keeping in view these essential factors, the present study was carried out to know the best freesia cultivar(s) and the most appropriate growing media for their cultivation.

MATERIALS AND METHODS

The experiment "Response of Freesia Cultivars to different growing media under Peshawar conditions" was conducted at Ornamental Horticulture Nursery, Department of Horticulture, Agricultural University, Peshawar, Pakistan during 2005-2006. Before planting the freesia corms, four parallel trenches, each having 4m length, 0.3m width and 0.25m depth were dug out and then filled randomly with amended organic media. This represented one replication. Two more replications were prepared in a similar manner. After field preparation, five corms of each freesia cultivar were planted in each row consecutively so that each medium was having all the cultivars in equal proportion. The corm to corm distance was kept as 12.5cm and each corm was planted 5cm deep in the soil. The experiment was laid out in Randomized Complete Block Design (RCBD) with Split Plot arrangement. There were two factors i.e. media (main plots) and cultivars (sub plots). The experiment was replicated three times and the number of treatments per replication was 16. Five corms were used per treatment, thus total number of corms used in the experimental trail were 240.

The following four types of organic media were used

control {Silt + Garden Soil + FYM (1:1:1)}
 Silt + Leaf mold (1:1)
 Silt + Spent Mushroom Compost (1:1)
 Silt + Poultry Manure (1:1)

The following four cultivars were studied

Valentino (Red flowers)
 Jessica (Pink flowers)
 Golden wave (Yellow flowers)
 White wings (White flowers)

Samples were taken from all the growing media before planting the corms and then at an interval of 45 days, these samples were then analyzed in the soil laboratory, Department of Soil and Environmental Sciences, Agricultural University Peshawar for Nitrogen, Phosphorus, Potassium (NPK), Organic Matter content and pH.

Chemical analysis of the different growing media used in the experiment

Media	pH	OM (%)	N (ppm)	P (ppm)	K (ppm)
	7.9	2.9	740	52.2	70.1
	8.0	3.9	820	58.0	47.1
	7.9	4.9	910	59.0	54.4
	7.7	7.5	10860	72.6	89.7

To see whether the different organic media had any effect on the root zone heat, the temperature of all the media was noted daily (at 5 cm depth) with the help of soil temperature probe and the calculated means are given below.

Average temperatures of the media recorded at day time during the experiment.

Control	Leaf mold	Mushroom compost	Poultry manure
14.60C	14.20C	14.90C	17.30C

Data were recorded on different growth and flowering parameters including days to emergence, number of leaves plant⁻¹, lamina length, leaf area plant⁻¹, days to flowering, number of florets plant⁻¹, number of spikes plant⁻¹, spike persistence and plant height.

RESULTS AND DISCUSSION

The results obtained are discussed briefly as under. For most of the parameters, the main effects i.e. the different growing media and cultivars were found to have significant effects. However, the interactions between media and cultivars were non significant for all the parameters studied.

Days to Emergence

The data regarding days to emergence are presented in Table I. Planting media had a significant ($P \leq 0.05$) effect on freesia emergence, while variation among the cultivars and the interaction between the media and cultivars was found non significant. Comparing means of emergence for media, it is clear that quick emergence (25.22 days) of various freesia cultivars was observed in mushroom compost, closely followed by those planted in control medium (25.83 days) and late emergence (62.23 days) was recorded in poultry manure.

Quick emergence in mushroom compost may be attributed to proper nutrient and water supply to the corms, which helped in quick rooting and bud sprouting. Late emergence of corms in poultry manure may be due the excess nitrogen concentration in this medium because high nitrogen may produce toxic effect which delay emergence of corms or even burn the plants (Wazir, 2005). Cultivars means were not significantly different, however maximum days to emergence (36.33) were taken by the cv. Jessica and minimum days to emergence (33.90) were taken by cv. White Wings.

Table I Days to emergence taken by different freesia cultivars grown in various amended organic media, values followed by different letters are significantly different at $P \leq 0.05$ level according to Least Significance Difference (LSD) test

Cultivars	Media				Mean
	Control	Leaf Mold	Mushroom Compost	Poultry Manure	
Valentino	25.44	26.11	24.33	63.11	34.75
Jessica	27.44	27.00	23.67	67.22	36.33
Golden Wave	26.22	28.67	26.33	61.55	35.69
White Wings	24.22	27.78	26.55	57.05	33.90
Mean	25.83b	27.39b	25.22b	62.23a	

LSD Value for Media = 20.64

Number of Leaves Plant⁻¹

The data pertaining to number of leaves are given in Table II. In this case too, planting media had a significant ($P \leq 0.05$) effect on number of leaves, while variation among the cultivars and the interaction between the media and cultivars was found non significant. The mean values for media reveal that maximum leaves (10.44) were found in plants planted in mushroom compost, closely followed by those planted in leaf mold (9.86 leaves), while minimum leaves (8.14) were produced by those grown in poultry manure. Maximum leaves in mushroom compost may be attributed to its water and nutrient holding capacity due to its high organic matter content. It also contains adequate concentration of NPK. The pH of this medium is also conducive for plant growth, which resulted in the preparation of more photosynthates and hence more leaves. Although poultry manure has optimum organic matter content but the less number of leaves may be due to its high concentration of nitrogen and phosphorous because excess of nitrogen and phosphorous create toxic effect, which may even burn the plant and also weakens the plant's structure (Wazir, 2005).

Among the cultivars, the non significant difference in mean values indicates that all the four cultivars behaved alike however maximum leaves (9.86) were produced by cv. Valentino and minimum leaves (9.13) were given by cv. Golden Wave. Similarity among the cultivars may be due to their similar genetic nature.

Table II Number of leaves plant⁻¹ produced by various freesia cultivars as affected by different amended organic media, values followed by different letters are significantly different at $P \leq 0.05$ level according to LSD test

Cultivars	Media				Mean
	Control	Leaf Mold	Mushroom Compost	Poultry Manure	
Valentino	9.38	10.73	10.32	9.02	9.86
Jessica	8.92	10.27	10.20	8.20	9.40
Golden Wave	9.00	8.80	11.27	7.43	9.13
White Wings	9.32	9.65	9.98	7.92	9.22
Mean	9.15ab	9.86a	10.44a	8.14b	

LSD Value for Media = 1.522

Lamina Length (cm)

The data regarding lamina (leaf) length are presented in Table III. The lamina length was significantly affected by the different media ($P \leq 0.01$), as well as, the cultivars ($P \leq 0.001$), while their interaction was non significant. The means recorded for lamina length showed that maximum leaf length (22.76 cm) was produced by the plants grown in mushroom compost, followed by plants grown in leaf mold (20.78 cm length). The rest of the two media i.e. control and poultry manure behaved alike producing minimum leaf length of 18.62 cm and 18.16 cm respectively. Keeping in view the laboratory analysis of mushroom compost, it is clear that due to adequate amount of organic matter, this medium has high water and nutrient holding capacity, which contributed positively to the growth of plants. Similarly adequate N and P concentration helped the plants to grow more vigorously, which resulted in maximum lamina length of the plants, while very high concentration of N and P may create toxic effect, resulted in less lamina length. Similar results were also achieved by El-Naggar and El-Nasharty (2009) who observed more leaf length in composted leaves media than in clay media.

Among the different cultivars, maximum lamina length (21.58 cm) was achieved by cv. White Wings, closely followed by cv. Jessica and Valentino producing 20.60 cm and 20.56 cm lamina lengths respectively. Minimum lamina length (17.60 cm) was recorded in cv. Golden Wave. This variation in lamina length might be due to the difference among the genetic potentials of these cultivars.

Table III Lamina length (cm) produced by various freesia cultivars as affected by different amended organic media. Values followed by different letters are significantly different at $P \leq 0.01$ level according to LSD test

Cultivars	Media				Mean
	Control	Leaf Mold	Mushroom Compost	Poultry Manure	
Valentino	19.31	20.82	23.04	19.05	20.56A
Jessica	18.06	21.63	23.39	19.30	20.60A
Golden Wave	17.17	17.73	20.46	15.03	17.60B
White Wings	19.95	22.92	24.17	19.27	21.58A
Mean	18.62C	20.78B	22.76A	18.16C	

LSD Value for Media = 1.523

LSD Value for Cultivars = 1.206

Leaf Area (cm²) Plant⁻¹

The data recorded for leaf area are given in Table IV. In this case the results followed a similar pattern like the lamina length. Leaf area also was significantly affected by the different media ($P \leq 0.05$), as well as, the cultivars ($P \leq 0.01$), while their interaction was non significant. Average values for media conclude that maximum leaf area plant⁻¹ (310.54 cm²) was achieved by the plants grown in mushroom compost, closely followed by leaf mold producing 268.18 cm² leaf area. Minimum leaf area plant⁻¹ (205.55 cm²) was produced by the corms grown in poultry manure. Maximum leaf area plant⁻¹ in mushroom compost was due to the fact that plants grown in this medium produced larger leaves with a greater in number.

Among the cultivars, cv. Valentino produced maximum (275.68 cm²) leaf area but also behaved alike with cv. White Wings and cv. Jessica which produced 268.61 cm² and 248.10 cm² leaf areas plant⁻¹ respectively. Minimum (221.42 cm²) leaf area plant⁻¹ was produced by cv. Golden Wave. Maximum leaf area per plant produced by cv. Valentino may be due to its higher leaf length and maximum number of leaves plant⁻¹ produced by this cultivar.

Table V Days to flowering taken by various freesia cultivars as affected by different organic media, values followed by different letters are significantly different at $P \leq 0.05$ level according to LSD test

Cultivars	Media				Mean
	Control	Leaf Mold	Mushroom Compost	Poultry Manure	
Valentino	143.55	145.99	145.22	153.05	146.96
Jessica	140.44	145.12	144.99	153.47	146.00
Golden Wave	143.88	144.17	144.77	155.33	147.04
White Wings	142.75	144.77	144.12	151.72	145.84
Mean	142.66b	145.01b	144.77b	153.39a	

LSD value for Media = 6.604

Days to Flowering

The data regarding days to flowering are presented in Table V. Growing media had a significant ($P \leq 0.05$) effect on freesia flowering, while variation among the cultivars and the interaction between the media and cultivars was found non significant. From the means for media, it is clear that the three media i-e control, leaf mold and mushroom compost behaved alike, however the earliest flowering (142.66 days) was observed in corms grown in control, closely followed by mushroom compost (144.77 days) and leaf mold (145.01 days). Poultry manure resulted in the most delayed flowering (153.39 days). This late flowering in poultry manure may be due to late emergence of corms in this medium and the antagonistic effects of the high concentration of nitrogen. These results are in line with El-Naggar and El-Nasharty (2009), who also reported early flowering in compost and composted leaves media compared to clay. The differences among the cultivars were non significant, however cv. Golden Wave took maximum (147.04) and cv. White Wings minimum (145.84) days to flowering.

Number of Florets Plant⁻¹

The data regarding number of florets plant⁻¹ are presented in Table VI. The number of florets plant⁻¹ was significantly affected by the different media ($P \leq 0.05$), as well as, the cultivars ($P \leq 0.05$), while their interaction was non significant. The mean values recorded for media revealed that maximum florets plant⁻¹ (41.71) were achieved by plants grown in mushroom compost, followed by leaf mold (34.22 florets plant⁻¹), while minimum florets plant⁻¹ (21.33) were recorded in plants grown in poultry manure. Optimum organic matter content and phosphorous concentration in these media could be attributed to the maximum number of florets, since phosphorous contributes to the formation of buds, roots and blooming, while in poultry manure less number of florets (21.33) may be attributed to the excessive concentration of nitrogen because, an excess of nitrogen weakens the plant structure. Maximum number of florets in mushroom compost and leaf mold may also be attributed to the maximum number of leaves in these media, which promote the photosynthesis and hence increased the number of florets. The mean values for cultivars show that maximum florets plant⁻¹ (35.96) were produced by cv. White Wings, followed by cultivars Valentino and Jessica producing 32.70 and 31.79 florets plant⁻¹ respectively. Cultivar Golden Wave produced minimum (28.46) florets plant⁻¹. This difference may be attributed to the genetic variation among these cultivars.

Table VI Number of florets plant⁻¹ produced by various cultivars as affected by amended media, values followed by different letters are significantly different at $P \leq 0.05$ level according to LSD test

Cultivars	Media				Mean
	Control	Leaf Mold	Mushroom Compost	Poultry Manure	
Valentino	31.28	34.31	41.66	23.55	32.70ab
Jessica	30.50	33.78	40.83	22.05	31.79ab
Golden Wave	27.78	30.86	40.78	14.44	28.46ab
White Wings	37.11	37.92	43.55	25.27	35.96a
Mean	31.66b	34.22ab	41.71a	21.33c	

LSD value for media = 9.733 LSD value for cultivars = 5.167

Number of Spikes Plant⁻¹

The data regarding the number of spikes plant⁻¹ are presented in Table VII. The different growing media had a significant ($P \leq 0.05$) effect on freesia number of spikes plant⁻¹, while variation among the cultivars and the interaction between the media and cultivars was found non significant. Maximum spikes plant⁻¹ (7.67) were found in the plants grown in mushroom compost, closely followed by leaf mold and control producing 6.93 and 6.27 spikes plant⁻¹ respectively, while minimum spikes plant⁻¹ (3.92) were produced by the corms grown in poultry manure. Maximum spikes plant⁻¹ in mushroom compost may be attributed to its water and nutrient holding capacity due to its high organic matter content. It also contain optimum amount of NPK. More number of spikes can also be attributed to maximum number of leaves plant⁻¹ in this medium to prepare more photosynthates and hence more spikes were produced. All the four cultivar behaved alike producing almost same number of spikes plant⁻¹, however maximum (6.39) spikes plant⁻¹ were given by cv. White Wings and minimum (6.06) spikes plant⁻¹ were produced by cv. Jessica.

Table VII Number of spikes plant⁻¹ produced by freesia cultivars as affected by different amended organic media, values followed by different letters are significantly different at $P \leq 0.05$ level according to LSD test

Cultivars	Media				Mean
	Control	Leaf Mold	Mushroom Compost	Poultry Manure	
Valentino	5.67	7.39	7.22	4.78	6.26
Jessica	5.99	7.00	7.61	3.64	6.06
Golden Wave	6.66	6.66	8.27	2.72	6.08
White Wings	6.77	6.67	7.58	4.55	6.39
Mean	6.27a	6.93a	7.67a	3.92b	

LSD Value for Media = 2.157

Spike Persistence

The data regarding the spike persistence are presented in Table VIII. In this case, the results followed a similar pattern like number of spikes plant⁻¹. The different planting media had a significant ($P \leq 0.05$) effect on spike persistence, while variation among the cultivars and the interaction between the media and cultivars was found non significant. The means for media revealed that the three media i-e mushroom compost, leaf mold and control behaved alike, however maximum spike persistence (9.89 days) was observed in plants planted in leaf mold, closely followed by those planted in mushroom compost (9.51 days), while minimum spike persistence (8.01 days) was recorded for the plants grown in poultry manure. All the four cultivars showed almost similar spike persistence, however maximum spike persistence (9.24 days) was recorded in cv. White Wings and minimum (9.03 days) was given by cv. Jessica.

Table VIII Spike persistence (days) achieved by various freesia cultivars as affected by different amended organic media. Values followed by different letters are significantly different at $P \leq 0.05$ level according to LSD test

Cultivars	Media				Mean
	Control	Leaf Mold	Mushroom Compost	Poultry Manure	
Valentino	9.33	9.83	9.44	7.83	9.11
Jessica	8.67	10.22	10.00	7.22	9.03
Golden Wave	9.22	9.50	9.33	8.83	9.22
White Wings	9.55	10.00	9.25	8.17	9.24
Mean	9.19a	9.89a	9.51a	8.01b	

LSD value for Media = 1.040

Plant Height (cm)

The data regarding plant height are presented in Table IX. The plant height was significantly affected by the different media ($P \leq 0.01$), as well as, the cultivars ($P \leq 0.01$), while the interaction between the media and cultivars was found non significant. The means recorded for media conclude that maximum plant height (36.18 cm) was observed in plants grown in mushroom compost, followed by those grown in leaf mold (34.96 cm). Control produced plants with 31.28 cm height, while minimum plant height (28.28 cm) was recorded for the plants that were grown in poultry manure. The reason for this might be the adequate amount of nitrogen, potassium and organic matter content in mushroom compost and leaf mold, which positively contributed towards the plant height. Minimum plant height in poultry manure may be due the excess amount of nitrogen, which resulted in weaker the plant structure and growth. Among the cultivars, the three cultivars i-e Valentino, White Wings and Jessica behaved alike producing 34.01 cm, 33.75 cm and 32.75 cm plant heights respectively, while minimum plant height (30.19 cm) was attained by cv. Golden Wave. Comparing means for cultivars, it is evident that variation in plant height was mainly due to the genetic capability of cultivars to produce shorter or taller plants.

Table IX Plant height (cm) produced by freesia cultivars as affected by different amended organic media. Values followed by different letters are significantly different at $P \leq 0.01$ level according to LSD test

Cultivars	Media				Mean
	Control	Leaf Mold	Mushroom Compost	Poultry Manure	
Valentino	33.49	36.87	36.68	29.00	34.01A
Jessica	28.77	34.78	37.93	29.53	32.75A
Golden Wave	30.80	31.98	33.43	24.55	30.19B
White Wings	32.08	36.22	36.67	30.05	33.75A
Mean	31.28B	34.96A	36.18A	28.28C	

LSD Value for Media = 2.670

LSD Value for Cultivar = 2.083

CONCLUSION AND RECOMMENDATIONS

On account of the acquired results, it is concluded that both the planting media and the cultivars had significant effects on the vegetative growth and flowering of freesia cultivars. In terms of growth and flower production, cultivars Valentino and White Wings were slightly better than the others, although most of the parameters were non significant. As far as the different media are concerned, mushroom compost provided the best results, though leaf mold also offered better outcomes.

So, it is recommended that mushroom compost should be used for best growth and flower production. Leaf mold could be good alternative, if mushroom compost is not accessible. Cultivars Valentino and White Wings are recommended on the bases of better growth and florets production; however these cultivars produce red and white colour flowers respectively. The other two cultivars produce yellow (cv. Golden Wave) and pink (Jessica) flowers. So the flower colour selection is dependent upon customer choice, which may go for other cultivars in case they choose a colour otherwise.

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