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Studies on bulb size and Benzyladenine for production and quality in Chincherinchee (*Ornithogalum thyrsoides*)

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Abstract
The influence of three levels of BA on Ornithogalum was carried out at the experimental farm of the Division of Vegetable Science and Floriculture, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, India during the year 2014-15. The results revealed that BA and bulb size significantly regulated the growth, flowering and bulb production in Ornithogalum. The treatment 100 ppm BA with 3-4 cm bulb size recorded maximum vase life (16.66 days) and maximum number of daughter bulbs per plant (5.10) respectively compared to control.

Keywords: Chincherinchee, Ornithogalum, bulb size, growth regulator, sprouting

Introduction
Ornithogalum (*Ornithogalum thyrsoides*) is an important ornamental bulbous plant of high commercial value, belongs to family Hyacinthaceae and is a native of South Africa. The generic name Ornithogalum came from Greek words 'Ornis' meaning bird and 'Gala' meaning milk i.e. 'Bird's milk'. The characteristics sound produced by the dry stalks of *Ornithogalum* rubbing in the wind has coined its common name 'Chincherinchee'. The white *Ornithogalum thyrsoides* is a tall stemmed species and has been used for cut flower production since the early 1900's (Littlejohn *et al.*, 2000) [10]. It is also suitable for herbaceous borders, naturalized wild gardens and rockeries besides using in bouquets and flower arrangements. Spikes even if cut after complete drying on the plant, remained presentable for much longer duration and can be used for dry decorations profitably. It is pertinent to note that cut flower of Ornithogalum last relatively for much longer duration than the vase life of most of the cut flowers. In most of the bulbous crop including *Ornithogalum,* the size of bulb plays an important role for obtaining good vegetative growth, quality flowers and bulb production. There is direct relation among corm size, flower production as well as corm/cormel yield (Misra, *et al.*, 1985; Ogele *et al.*, 1995). Plant growth regulators are the organic substances that are known to modify and regulate various physiological processes applicable in an appreciable measure in plants. in plants. The application of plant growth regulators is reported to have positive effects on growth, yield and flowering attributes of various ornamentals (Padmalatha *et al.*, 2013) [12]. Considering the importance of bulb size and growth regulators on crop production of Ornithogalum and lack of information regarding general cultivation and behaviour of *Ornithogalum* crop under Jammu conditions, the present study was undertaken to look into the appropriate concentration of BA and most suitable bulb size for improving growth flowering and bulb production in chincherinchee.

Material Method
The present investigation was carried out at Floriculture Research Farm, Division of Vegetable Science and Floriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha Jammu, during the year 2014-15. The experiment farm is located at 33° 55' North latitude and 74° 58' East longitude at an altitude of 296 meters above mean sea level. The climate is generally sub-tropical with hot dry summer and cool winter. The maximum temperature rises up to 45 ^{0}C - 46 ^{0}C during summer (May-June) and minimum dipping down to 2° C during winter. Mean annual rainfall range between 1000-1200mm The soil is sandy loam in texture, slightly alkaline in reaction, low to medium in electrical conductivity, low in organic carbon and available nitrogen and medium in phosphorus and potassium. Three levels of BA @ 50, 75 and 100 ppm as represented by G_1, G_2 and G_3 whereas control is represented by G_0 were tested on three levels of bulb size viz. 1-2, 2-3 and 3-4 cm as represented by S_1, S_2

and S_3, respectively. Required amount of BA was taken using electronic balance and a stock solution of BA was prepared by dissolving in ethanol. The plots were prepared in the form of raised beds and as per the specifications. Well decomposed FYM @ 5kg/m^2 was incorporated into the soil at the time of bed preparation. NPK through Urea, DAP and MOP was applied uniformly to all the experimental plots @ 20:10:10 g/m^2. According to the treatment combinations, different grades of bulbs were soaked overnight prior to planting in different concentrations of BA while the control was soaked in distilled water. The treated bulbs were planted on 28th October, 2014 at a depth of 3 cm, maintaining a spacing of 20 cm×20 cm thus accommodating 25 bulbs per plot of 1m × 1m dimensions. Five plants were randomly selected from each unit plot for collecting data and the mean values of all the parameters were analysed by analysis of variance and means separation was estimated by Duncan's Multiple Range Test (DMRT) at 5% level of probability. The experiment comprises of 12 different treatment combinations laid out in Randomized Block Design (factorial) replicated thrice.

Results and Discussion

Results and Discussion

Days taken for sprouting of bulb, Spike emergence and Opening of first floret

Numbers of days to sprouting, spike emergence and opening of first floret were significantly affected by bulb size and growth regulator application, larger size bulb 3-4 cm treated with 100 ppm BA was effective than other as it took minimum number of days to sprouting and spike emergence (18.20 and 130.50 days), whereas larger size bulb treated with 75 ppm BA took minimum number of days to opening of first floret (182.60days) With the increase in bulb size, the numbers of days for sprouting of bulb were significantly decreased. Minimum days for sprouting of bulb, spike emergence and opening of first floret were recorded with 3-4 cm bulb size which might be attributed to higher amount of food component that help in early emergence. More endogenous food material available in large size bulbs could be the reason why larger size bulbs sprouted significantly earlier than the smaller ones.it is reported that large corm had comparatively shorter dormancy period than small ones which helps to quick emergence of plant (Bhat *et al.* 2009) [3]. However, among growth regulator treatments, 100 ppm BA recorded minimum number of days to sprouting, spike emergence and opening of first floret. BA stimulate cell division

Number of leaves per plant and Plant spread

Perusal of data clearly shows differences in number of leaves per plant and plant spread due to bulb size. Among three different bulb sizes, larger size bulb 3-4 cm recorded maximum number of leaves (27.50) and plant spread (19.45 cm). This could be explained on the basis of food material that allows more growth of additional vegetative shoots in case of large size bulbs as compared to smaller size bulbs. However, among growth regulator treatments, 100 ppm BA recorded maximum number of leaves (22.80) and plant spread (19.57 cm). Cytokinins are known to increase the nutrient sink activity. They are also known to promote lateral bud development thereby increasing the number of vegetative shoots, number of leaves and inturn plant spread. Similar results were also obtained by Mahesh and Misra (1993), Baskaran and Misra (2007**)**.

Plant height, Spike length, Rachis length and Floret diameter

Among different bulb sizes, 3-4 cm recorded maximum plant height (46.22 cm), spike length (40.57), rachis length (18.85 cm) and floret diameter of 2.98 cm. reason being that in larger sized corm there is more food reserve which make corm physiologically potential and this might due to large size storage tissue of the bulb. Floral parameters are directly related with the leaf area which will be greatly reduced by smaller sized bulbs due to production of narrow leaves (Tehranifar and Akbari, 2012). Among different treatments of growth regulators , 100 ppm BA recorded maximum plant height, spike length and rachis length (45.70 cm, 40.06 cm and 18.90 cm) respectively. This increase might be due to rapid intermodal elongation as a result of increase in cell division and cell elongation in the intercalary meristems. Among growth regulators, 50 ppm BA recorded maximum floret diameter of 3.06 cm. The appropriate justification of such results might be that BA promotes vegetative growth and increases the photosynthetic and metabolic activities causing more transport and utilization of photosynthetic products.

Flowering duration, Fresh weight of spike at harvest and Vase life

Maximum flowering duration (31.85 days), fresh weight of spike at harvest (30.37 g) and vase life (15.54 days) were recorded in 3-4 cm bulb size. As there is more food reserve in larger sized bulbs, therefore large size bulbs sprouted earlier, had more vigorous and healthier plants which might have lengthen the said parameter. Among growth regulators 100 ppm BA recorded maximum flowering duration (31.45 days) and vase life (15.86 days) which might be due to their protective effect on cells and proteins that ultimately led to delayed senescence. BA is inhibitor of respiratory kinase in plant and can increase sugar availability in the cell by increasing amylase and invertase enzyme activity. Faraji *et al.*, (2011) [4] and Yadav and Tyagi (2007) [15] also recorded similar results.

Number of daughter bulb per plant, Bulb size and Bulb weight

Data in table reveal that among different bulb size 3-4 cm recorded maximum number of daughter bulb per plant (4.55), maximum bulb size (3.36 cm) and bulb weight (10.95 g). It might be due to availability of more food material stored in bigger size mother bulb that helped in better plant growth, bulb and bulblets production. Our results are in conformity with the findings of Islam *et al.*, (2000) [7], Arya *et al.*, (2006) [2], Bhat *et al.*, (2009) [3], Hossian (2011) [6], Amin *et al.*, (2013) [1], Reddy *et al.* (2013) [12], and Sarkar (2014) [14]. Among different treatments of growth regulators, 100 ppm BA recorded maximum number of daughter bulbs per plant, bulb size and bulb weight (4.50, 3.33 cm and 11.03 g) which might be due to general depression of vegetative growth rather than direct effect on tuberization. Benzyl adenine hastens the growth of the new emerging shoots. This larger photosynthetic area furnishes sugars which are trans located to underground storage organs which in turn resulted in more number of daughter bulbs as has been observed. The results of our study are in accordance with the study of Levy *et al.*, (1993) [9], Devi *et al.*, (2007) [4] and Kumar *et al.*, (2008) [8].

Number of spikes per bulb and number of floret per spike

Perusal of data clearly shows differences in number of spikes per bulb and number of floret per spike. Among three

different bulb sizes, larger size bulb, 3-4 cm recorded maximum number of spikes and number of florets per spike (6.03 and 58.62). This might be based on the size storage tissue of the bulb. Early flowering and high yield was due to vigorous vegetative growth and sufficient supply of essential nutrient by bigger bulbs as compared to the smaller sized bulbs. Among seven different growth regulators, 100 ppm BA recorded maximum number of spike per plant (5.42), which may be due to fact that cytokinins promote lateral bud development. The results are in conformity with the findings of Reddy *et al.*, (2013) [12] 100 ppm BA recorded maximum number of spike and florets per spike (6.63 and 59.73).

Conclusion: Larger size bulbs S_3 (3-4 cm) performed best in terms of vegetative growth, bulb production and quality as compared to other treatments. BA (100 ppm) performed better with respect to other treatments particularly in, number of leaves per plant, plant spread, number of spikes, flowering duration, vase-life and number of bulbs harvested per plant, where as 50 ppm BA proves best in recording maximum flower diameter and flowering duration. Also higher B:C ratio of 3.06:1 was recorded with treatment combination of S_3 (3-4 cm) bulb size with 100 ppm BA.

Table 1: effect of bulb size and growth regulators on growth and flowering in chincherinchee.

Treatments	Days to sprouting of bulb	Days to opening of first florets	Days to spike emergence	Plant height (cm)	Spike length (cm)	Rachis length (cm)	Plant spread (cm)	Floret diameter (cm)	Flowering duration
Smallbulb + control (no treatment)	25.40	186.90	134.53	39.00	34.03	15.96	16.66	2.11	27.60
Small bulb + 50 ppm BA	24.14	185.66	133.63	40.43	35.23	16.70	17.86	2.26	28.86
Small bulb + 75 ppm BA	23.60	185.93	133.23	41.30	36.53	17.16	17.60	2.40	29.66
Small bulb + 100 ppm BA	23.70	185.06	132.53	43.56	37.26	17.20	18.46	2.38	29.90
Medium bulb + control (no treatment	22.73	185.26	133.60	44.23	39.36	17.26	17.83	2.62	29.86
Medium bulb + 50 ppm BA	22.46	184.36	132.10	44.02	39.00	17.66	18.43	2.55	30.90
Medium bulb + 75 ppm BA	21.40	184.26	131.46	44.63	39.36	18.40	18.69	2.51	31.46
Medium bulb + 100 ppm BA	21.96	183.76	131.90	44.65	39.90	18.16	19.23	2.66	31.83
Large bulb + control (no treatment)	20.43	184.10	132.13	44.30	39.90	18.53	18.16	2.79	31.46
Large bulb + 50 ppm BA	19.23	183.60	131.70	44.80	39.86	18.43	19.70	3.06	31.93
Large bulb + 75 ppm BA	18.33	182.60	131.73	44.68	39.53	18.53	20.13	2.93	31.56
Large bulb + 100 ppm BA	18.20	183.73	130.50	45.70	40.66	18.90	21.03	3.03	31.63
C.D $_{0.05}$	0.98	1.04	0.91	1.12	0.67	0.62	1.01	0.14	1.05

Table 2: effect of bulb size and growth regulators on yield and corm production in chincherinchee

Treatments	Number of florets per spike	Fresh weight of spike at harvest	Vase life	Number of daughter bulbs harvested per plant	Size 0f daughter bulb (cm)	Bulb weight	Number of leaves per plant	Number of spikes per bulb
Smallbulb + control (no treatment)	52.06	23.60	14.93	2.80	2.10	7.00	12.13	3.43
Small bulb + 50 ppm BA	52.86	23.90	14.70	3.40	2.16	8.03	12.60	4.06
Small bulb + 75 ppm BA	52.93	24.76	14.96	3.50	2.23	8.33	13.93	4.06
Small bulb + 100 ppm BA	54.76	25.23	15.80	3.80	2.35	8.21	15.93	4.20
Medium bulb + control (no treatment	55.30	26.80	13.66	3.56	2.56	8.70	15.13	4.40
Medium bulb + 50 ppm BA	55.06	26.26	15.93	4.20	2.93	9.33	15.33	5.10
Medium bulb + 75 ppm BA	55.96	26.80	15.10	4.46	2.96	9.40	16.87	5.00
Medium bulb + 100 ppm BA	58.60	28.86	15.13	4.60	3.03	9.50	19.33	5.43
Large bulb + control (no treatment)	56.30	29.00	14.13	4.23	3.13	9.83	26.87	5.40
Large bulb + 50 ppm BA	58.40	30.60	15.66	4.53	3.20	10.26	29.66	6.23
Large bulb + 75 ppm BA	59.16	30.53	16.23	4.66	3.20	10.47	31.73	6.46
Large bulb + 100 ppm BA	59.73	30.33	16.66	5.10	3.33	11.03	33.13	6.63
C.D $_{0.05}$	2.14	0.66	0.59	0.61	0.32	0.41	2.21	0.47

Table 3: Effect of bulb size and growth regulators on economics of chincherinchee.

S. No.	Total expenditure (Rs)	Gross returns (Rs)	Net returns (Rs)	B:C Ratio
Smallbulb + control (no treatment)	156.33	381.50	225.17	1.44:1
Small bulb + 50 ppm BA	165.04	431.50	266.46	1.61:1
Small bulb + 75 ppm BA	169.39	454.00	284.61	1.68:1
Small bulb + 100 ppm BA	173.75	488.00	314.25	1.80:1
Medium bulb + control (no treatment	156.33	487.00	330.67	2.11:1
Medium bulb + 50 ppm BA	165.04	530.00	364.96	2.21:1
Medium bulb + 75 ppm BA	169.39	561.00	391.61	2.31:1
Medium bulb + 100 ppm BA	173.75	595.00	421.25	2.42:1
Large bulb + control (no treatment)	156.33	587.25	430.92	2.75:1
Large bulb + 50 ppm BA	165.04	619.75	454.71	2.75:1
Large bulb + 75 ppm BA	169.39	646.00	476.61	2.81:1
Large bulb + 100 ppm BA	173.75	705.05	531.75	3.06:1

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