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Economic Returns and Enhanced Quality in Orchid (Dendrobium Sonia 17) Using Biosafe Compound-Chitosan

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Abstract

Increasing consumer demand and buoyant world market have promoted the status of orchid growing to an industry in our country which has led to higher focus on developing techniques to improve orchid quality and economics. Environment friendly inputs based on efficient use of natural resources are the need of present day planning, chitosan is one such compound. The present experiment was conducted under factorial completely randomized block design (Factorial CRD) with three factors replicated thrice at a net house to study the effect of chitosan foliar spray on orchid Dendrobium cv. Sonia. Results showed that chitosan significantly affected the yield, quality and thus the economics of orchid production. Chitosan treated plants yielded more number of spikes per meter square, greater spike length, increased internodal length, enhanced diameter of flower and more number of florets per spike. 7.5ppm chitosan chlorohydrate applied thrice yielded 100 percent A grade spikes. The economics calculated showed the highest benefit cost ratio (B:C) in 7.5ppm chitosan acetate applied four times and 7.5ppm chitosan acetate applied thrice (3.22 and 3.16, respectively). Apart from all these effects of chitosan, the chitosan treated plants showed lesser disease and pest infestation and also resulted in better overall appearance of spikes. Thus chitosan can play an important role in designing a sustainable production technology for orchids.

Keywords: Dendrobium; Chitosan; Biosafe; Quality improvement

Introduction

Orchids are accepted to be the world's most exotic and fascinating flowers, with extraordinary variety of sizes, shapes, colours and markings and are cosmopolitan occurring in almost all parts of world. The orchid cut flower industry is growing at an annual rate of 10-20% [1] and have immensely contributed to the economy of several developed and developing countries. With the increasing health consciousness and concern for environment, organic substitutes have drawn attention all over the world. Recently, role of Chitosan (a partially N-acetylated polymer of β-(1-4)-linked glucosamine) in improving production and quality of orchids has been indicated [2,3]. It is gaining popularity as it is environment friendly and bio degradable. Chitosan is yet to receive scientific evaluation in India. Hence the present study was undertaken to evaluate and standardize the chitosan application for quality improvements of orchids and make orchid cultivation more profitable by reducing cost of cultivation.

Materials and Methods

Present experiment was carried under partially controlled net house at Department of horticulture, Indira Gandhi Agricultural University, Raipur for two consecutive years during 2010-12. Two-year-old tissue culture plants of Dendrobiumcv. Sonia was used as experimental material. The experiment was laid in Factorial Completely Randomized Design with additional control, with total thirty-three treatment combinations. The treatment combinations consisted of two different formulations of chitosan (CP1 and CP2) at four different concentrations (C1-2.5ppm, C2-5ppm, C3-7.5ppm, C4-10 ppm) and four different number of applications (A1-one spray, A2-two spray, A3- three spray). Foliar application of chitosan was carried out until run off, using a manual sprayer, at monthly interval. Observation on various yield and quality parameters were taken and subjected to suitable statistical analysis.

Results

Results showed that chitosan significantly affected the yield and quality parameters under study and improvement was recorded with all the treatments as compared to control. Also significant variation was observed among chitosan formulation, their concentrations and application frequencies. Data are presented in Table 1.

Table 1: Effect of chitosan foliar spray on yield and quality of *Dendrobium cv*. Sonia 17.

Sn	Treatments	Spike Length	No. Floret/ Spike	Spike Diameter	Internodal Length	Vase Life	Yield / M.Sq.
1	Control	18.92	4.92	5	2.8	6.75	70.83
	Products						
2	P1	27.92	6.45	6.28	3.18	10.34	144.05
3	P2	30.78	7.48	6.97	3.14	9.73	124.64
	SE	0.21	0.08	0.05	0.04	0.07	1.22
	C. D	0.59	0.22	0.14	0.11	0.21	3.44
	Concentrations						
4	C1	24.91	5.94	5.21	3.1	9.25	128.44
5	C2	30.03	6.74	6.36	3.31	10.21	142.81
6	C3	32.87	8.45	7.92	4.5	10.81	151.25
7	C4	29.6	6.74	7	3.53	9.88	114.88
	S.E.	0.3	0.11	0.07	0.05	0.1	1.72
	C. D	0.83	0.31	0.2	0.15	0.3	4.87
	No. of Applications						
8	A1	28.5	6.7	6.36	3.47	9.75	129.54
9	A2	29.41	6.86	6.66	3.61	9.94	133.17
10	A3	30.23	7.11	6.9	3.75	10.17	139.27
11	A4	29.26	7.19	6.6	3.62	10.29	135.4
	S.E.	0.3	0.11	0.07	0.05	0.1	1.72
	C. D	0.83	NS	0.2	0.15	0.3	4.87
12	**Control vs rest**						
	S.E.	0.6	0.22	0.15	0.11	0.21	3.5
	C. D	1.69	0.63	0.41	0.31	0.6	9.89
	Interactions						
		S.E.	S.E.	S.E.	S.E.	S.E.	S.E.
13	P X C	0.42	0.15	0.1	0.08	0.15	2.44
14	P X A	0.42	0.15	0.1	0.08	0.15	2.44
15	C X A	0.59	0.22	0.14	0.11	0.21	3.45
16	P XC XA	0.83	0.31	0.2	0.15	0.3	4.88
	C.V.%	4.98	7.75	5.35	7.29	5.17	6.38

Among the two chitosan formulations, chitosan acetate (P1) recorded, more number of flowers per meter square (144.05) and significantly longer vase life of spike (10.34 days) and more internodal length (2.80 cm). While, P2 recorded significantly longer spikes (30.78cm), more florets per spike (7.48) and more flower diameter (6.97cm). Among all the chitosan concentrations applied, 7.5ppm (C3) was found to be beneficial for most characters and recorded maximum number of spike per plant (9.93), maximum number of spike per meter square (151.25), maximum spike length (32.87cm), maximum number of floret per spike (8.45), maximum diameter of flower (7.92cm), maximum internodal length (4.5cm) and maximum vase life of spike (10.81 days). Three applications were found beneficial in most of the cases, and further more applications resulted in detrimental effects in most of the parameters under study. Three applications (A3) recorded maximum spike length (30.23cm), maximum flowerdiameter (6.90cm), maximum number of spike per plant (9.32) and maximum yield per m. sq. (139.27). Four applications (A4) recorded maximum vase life but they were at par with three applications (A3) (Table 2).

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Table 2: Cost* of production of Orchid (*Dendrobium cv. Sonia*) excluding Chitosan treatment.

Details Of Area And Plant Population	
Total no. of plants @16 pt per m^2 (25cmx25cm)	21860
Total area of green house	= 2000 m2
Grossed planted area	= 1366.2 m 2
Items	**cost ***
A. Fixed cost	
1 Planting material @120per plant (3yrs life)	874400
2Net House @Rs. 1000per m^2 (life 25yrs)	80000
3 Shed net @ 30per msq (life 4 yrs)	15000
4 Repair and maintenance @2% of total fixed cost	19388
B. Cost of Cultivation	
5.Growing medium per plant @Rs 20/plant/year	437200
6. Chemicals (like fertilizer, pesticides except chitosan treatments) @ Rs 1.47per plant per year	32134.2
7 Labor (365 man days @ 20per day)	43800
8 Miscellaneous @2% of cost of cultivation	10262.684
Grand Total (A+B)	1512184.884
Total cost of production excluding Chitosan Treatment (X)	1512184.884= Rs. 1512185

The benefit to cost (B:C) ratio was highest in treatment combination P1C3A3 (7.5ppm chitosan acetate applied thrice) and P1C3A4 (7.5ppm chitosan acetate applied four times) and lowest in untreated control followed by P1C1A1 (2.5ppm chitosan acetate applied once) (Table 3). Apart from all these effects of chitosan, the chitosan treated plants showed lesser disease and pest infestation, especially lesser leaf spots and mites infestation and also resulted in better overall appearance of spikes.

Table 3: Economics of chitosan treatments.

Treatment	Cost of Cultivation		Gross Income	Net Return	Cost Benefit Ratio (CBR)
	Cost Of Chitosan Treatment (Y)	Total (X+Y)			
P1C1A1	11	1512196	3048334	1536138	1.02
P1C1A2	22	1512207	3256110	1743903	1.15
P1C1A3	33	1512218	3600506	2088289	1.38
P1C1A4	44	1512229	3665970	2153741	1.42
P1C2A1	22	1512207	3610943	2098736	1.39
P1C2A2	44	1512229	3840540	2328311	1.54
P1C2A3	66	1512250	4612823	3100572	2.05
P1C2A4	87	1512272	4764623	3252350	2.15
P1C3A1	33	1512218	5464800	3952582	2.61
P1C3A2	66	1512250	5382259	3870008	2.56
P1C3A3	98	1512283	6293059	4780775	3.16
P1C3A4	131	1512316	6386985	4874669	3.22
P1C4A1	44	1512229	3080212	1567983	1.04
P1C4A2	87	1512272	3335426	1823153	1.21
P1C4A3	131	1512316	3975263	2462946	1.63
P1C4A4	175	1512360	3443393	1931033	1.28
P2C1A1	6	1512191	2943023	1430831	0.95
P2C1A2	12	1512197	3207724	1695527	1.12
P2C1A3	18	1512203	3557813	2045609	1.35

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P2C1A4	25	1512209	4064445	2552236	1.69
P2C2A1	12	1512197	4098600	2586403	1.71
P2C2A2	25	1512209	4512255	3000046	1.98
P2C2A3	37	1512222	4732365	3220143	2.13
P2C2A4	49	1512234	4499921	2987687	1.98
P2C3A1	18	1512203	5165944	3653740	2.42
P2C3A2	37	1512222	5612805	4100583	2.71
P2C3A3	55	1512240	6147900	4635660	3.07
P2C3A4	74	1512258	5840505	4328247	2.86
P2C4A1	25	1512209	3441116	1928907	1.28
P2C4A2	49	1512234	3375653	1863419	1.23
P2C4A3	74	1512258	3256110	1743852	1.15
P2C4A4	98	1512283	3109054	1596771	1.06
Control	0	1512185	1532231	20046	0.01

Discussion

Flower quality parameters decide the significance of a particular variety suitable for commercial cultivation and the value it fetches in market. In addition to number of florets, the compactness and arrangement of florets in spike are the other two characters which govern the price of spike. Length of internode of spike should be optimum for proper display of flowers, ample clearance between successive florets is essential to prevent overcrowding of florets whereas more clearance leads to the ungainly, prominent exposure of spike. The length of internode of spike was more in in P1 treated plants. Chitosan acetate (P1) and C3 (7.5ppm) recorded better vase life as compared to chitosan chlorohydrate (P2), which depends on spike length, flower diameter and number of florets per spike. Increase in vase life may be attributed to more photosynthates accumulated in chitosan treated plants. Similar results were reported by Chandrkrachang et al. [2]. Wanichpongpan et al. [4] had earlier reported that chitosan significantly enhanced growth factors in terms of the average values of flower-stem length as well as the number of flowers per bush in gerbera plants. In addition, chitosan may enhance growth and development by some signaling pathway related to auxin biosynthesis via a tryptophan-independent pathway [3]. In case of quality parameters, higher concentration of chitosan was found to be detrimental and best treatment (7.5ppm) was followed by 5ppm (C2) rather than 10ppm except in case of flower diameter which recorded an increase with increase in chitosan treatment. Similar results were reported by Tantasawat et al. [5], who reported no stimulatory effect of chitosan at higher concentrations. In the present study P1 produced more number of spikes per plant and also higher yield per meter square. The increased flower yield might be attributed to enhanced accumulation of photosynthates due to chitosan application [6,7].

Since Dendrobium orchid cultivation is an upcoming business opportunity especially in tropical belts of India, it is essential to work out economics. In the present study chitosan application was found to be beneficial in increasing the profits. Similarly, Walkar et al. [8] found that the profit at different cost levels was maximum in case of orchid and the input-output ratio worked out to be 1: 1.30 in orchid. The economics is directly related to yield, thus the present results in economics may be attributed to higher spike yield per plant and per meter square area.

Thus present study proves Dendrobium cv. Sonia as a rewarding commercial crop, where cost of chemical can be reduced and quality can be significantly improved using chitosan application. These results are in accordance with that of Nagare & Pal [9]. Thus, chitosan is not only pollution safe, but nourishes the plant and less costly too Delphine et al. [10].

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