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Sunita Kumari
Department of Horticulture, College of Agriculture G. B. Pant University of Agriculture and Technology, Pantnagar (U.S. Nagar), Uttarakhand, India

Santosh Kumar
Department of Horticulture, College of Agriculture G. B. Pant University of Agriculture and Technology, Pantnagar (U.S. Nagar), Uttarakhand, India

CP Singh
Department of Horticulture, College of Agriculture G. B. Pant University of Agriculture and Technology, Pantnagar (U.S. Nagar), Uttarakhand, India

Correspondence
Sunita Kumari
Department of Horticulture, College of Agriculture G. B. Pant University of Agriculture and Technology, Pantnagar (U.S. Nagar), Uttarakhand, India

Economics of oriental lily under protected conditions

Sunita Kumari, Santosh Kumar and CP Singh

Abstract
The investigation was conducted at Model Floriculture Center of G. B. Pant University of Agriculture and Technology, Pantnagar during 2016-17 and 2017-18. This experiment was laid out in three factorial completely randomized design with eighteen treatment combinations under two protected conditions i.e., polyhouse (PC_1) and shade net house (PC_2) conditions, three irrigation levels i.e., V Epan (I_1), 0.8 V Epan (I_2) and 0.6 V Epan (I_3) and three fertilizer levels i.e., 120 (F_1), 100 (F_2) and 80 (F_3) per cent of RDF. The results based on the year 2016-17, 2017-18 and pooled data. The maximum cost of cultivation (Rs. 376.75 only) was estimated in treatment combination $PC_2I_1F_1$. The maximum gross return (Rs. 660.00 only) was estimated in treatment combinations $PC_1I_1F_1$, $PC_1I_1F_2$, $PC_1I_1F_3$, $PC_1I_2F_1$, $PC_1I_2F_2$ and $PC_1I_2F_3$while, minimum cost (Rs. 495.00) of cultivation was noted in treatment combinations $PC_1I_3F_1$, $PC_1I_3F_2$, $PC_1I_3F_3$, $PC_2I_3F_1$, $PC_2I_3F_2$ and $PC_2I_3F_3$ during both years and pooled data. The maximum net return (Rs. 310.99, 317.27 and 314.13 only, respectively) was found in treatment combination $PC_1I_2F_3$ however, the lowest net return (Rs. 157.81, 166.38 and 162.09 only, respectively) was calculated in treatment combination $PC_2I_3F_3$. The maximum benefit-cost ratio (1.89, 1.93 and 1.90) was recorded in treatment combination $PC_1I_2F_3$ while, minimum benefit-cost ratio (1.45, 1.48 and 1.46) was noted in treatment combinations $PC_2I_3F_1$.

Keywords: Protected cultivation, polyhouse, shade net house, economics and oriental lily

Introduction
At present, floriculture has 308 million hectare area and total production is 2510 MT in which loose flowers share 1806 MT and cut flowers share 704 MT in 2017-18 (NHB, 2018) [8]. The cut flowers *viz.* rose, chrysanthemum, gerbera, carnation, lily and anthurium cultivated under open and protected conditions. In India, Maharashtra, Karnataka, Andhra Pradesh, Haryana, Tamil Nadu, Rajasthan, West Bengal, Himachal Pradesh, Uttarakhand are leading states for flower cultivation and export destinations from India are U S A, Netherland, United Kingdom, Germany and the United Arab Emirates. According to APEDA during the year 2017-18 India exported 20703.46 MT floriculture products of worth were Rs. 507.31 crores. The major problem for export of flowers from India is quality of flowers and lack of knowledge of grade and quality standard at international market. North Indian conditions have high temperature, relative humidity, wind velocity, sunlight, nutrient deficiency, carbon dioxide concentration and biotic and abiotic stress. Protected cultivation has a potential to grow high quality and yield in off season to the marginal and small farmers of urban and peri-urban areas with high profit also in adverse climatic conditions (Singh *et al*., 2015) [11]. In present scenario, the demand of cut flowers is increasing. So, protected cultivation is the best alternative option to cultivate flowers round the year with utilizing small and medium farms. The oriental lily is most important cut flower, which grown in hill region of Himalaya and adjoining areas of Himalayan region. Now-a-days, in India oriental lily was grown under protected conditions like shade net house, normal ventilated polyhouse and fan pad polyhouse but we don't know which protected condition suitable for oriental lily conditions with high profit and less cost of cultivation. So, we have needed to study that economics of oriental lily under different protected conditions.

Materials and methods
This experiment was conducted at Model Floriculture Centre, G. B. Pant University of Agriculture and Technology, Pantnagar during the year 2016-17 and 2017-18. This experiment was laid out in factorial completely randomized design with eighteen treatment combinations under two protected conditions i.e., polyhouse and shade net house conditions, three irrigation levels i.e., V Epan, 0.8 V Epan and 0.6 V Epan and three fertilizer levels i.e., 120, 100 and 80 per cent RDF per cent RDF. The treatment combinations are Polyhouse + V + 120% RDF

($PC_1I_1F_1$), Polyhouse + V+ 100% RDF ($PC_1I_1F_2$), Polyhouse + V + 80% RDF ($PC_1I_1F_3$), Polyhouse + 0.8 V + 120% RDF ($PC_1I_2F_1$), Polyhouse + 0.8 V + 100% RDF ($PC_1I_2F_2$), Polyhouse + 0.8 V + 80% RDF ($PC_1I_2F_3$), Polyhouse + 0.6 V + 120% RDF (PC_1I3F_1), Polyhouse + 0.6 V + 100% RDF ($PC_1I_3F_2$), Polyhouse + 0.6 V + 80% RDF ($PC_1I_3F_3$), Shade net house + V + 120% RDF ($PC_2I_1F_1$), Shade net house + V+ 100% RDF ($PC_2I_1F_2$), Shade net house + V + 80% RDF ($PC_2I_1F_3$), Shade net house + 0.8 V + 120% RDF ($PC_2I_2F_1$), Shade net house + 0.8 V + 100% RDF ($PC_2I_2F_2$), Shade net house + 0.8 V + 80% RDF ($PC_2I_2F_3$), Shade net house + 0.6 V + 120% RDF (PC_2I3F_1), Shade net house + 0.6 V + 100% RDF ($PC_2I_3F_2$) and Shade net house + 0.6 V + 80% RDF ($PC_2I_3F_3$). The recommended dose of fertilizer was 135:120:80 NPK/hectare for Oriental lily cv. White Cup. Urea, 17:50:0 and 0:0:50 kg/ha were used as source of nitrogen, phosphorus and potassium. The amount of irrigation water was applied by drip irrigation system and calculated the amount of irrigation by Shukla *et al*. (2001) [10] equation. The equation is "V - EP x KP x Kc x Sc x Wp". Here, V- Volume of water (litre /day /plant), Ep- Open pan evaporation (mm/day), Kp- Pan factor or pan coefficient (0.7 according to USDA), Kc – Crop factor (initial stage -0.6, mid stage – 0.1 and late stage 0.65 onion), Sc – Crop spacing (30 x 30 cm) and Wp – Wetted area (0.1). Amount of total applied water and water soluble fertilizers shown in table 1 & 2. The spike of oriental lily was harvested at first bud develop colour and after then grading of spikes was done according to length of spike and number of buds per spike. Total cost of cultivation had cost of bulbs, labour charges (i.e., bed preparation, planting of bulbs, weeding and hoeing etc.), electricity and fertilizer cost. The electricity cost was calculated by formula "Electricity = Power X Time" after then electricity converted in unit/day and calculated the price of total unit used during the cultivation of oriental lily cv. White Cup.

Table 1: Estimation of water requirement of oriental lily polyhouse and shade net house conditions during the year 2016-17 and 2017-18.

Irrigation level	Epan. (mm)	Effective rainfall (mm)	Water applied (litre/plant)	Water applied (litre/m^2)	Water applied (mm)	Total applied water (mm)
28, October 2016 to 30, March 2017						
Polyhouse conditions						
I_1	197.33	0.00	7.45	81.95	74.50	74.50
I_2	157.86	0.00	5.96	65.56	59.60	59.60
I_3	118.39	0.00	4.47	49.17	44.70	44.70
Shade net house conditions						
I_1	210.48	33.00	7.95	87.45	79.50	112.5
I_2	168.38	33.00	6.36	69.96	63.60	96.60
I_3	126.28	33.00	4.77	51.57	44.70	77.70
28, October 2017 to 30, March 2018						
Polyhouse conditions						
I_1	180.92	0.00	6.83	75.13	68.30	68.30
I_2	144.78	0.00	5.47	60.17	54.70	54.70
I_3	108.58	0.00	4.10	45.10	41.00	41.00
Shade net house conditions						
I_1	193.04	11.16	7.29	80.19	72.90	84.06
I_2	154.43	11.16	5.83	64.13	58.30	69.46
I_3	115.82	11.16	4.37	48.07	43.70	59.86

Table 2: Doses of water soluble fertilizer applied under polyhouse and shade net house conditions during both years.

Fertilizer level	Urea (g)		17:50:0 (g)		0:0:50 (g)	
	Per plant	Per square meter area	Per plant	Per square meter area	Per plant	Per square meter area
1st fertigation after 30 days of bulb planting						
F_1	5.88	64.66	4.15	45.70	3.45	37.95
F_2	4.90	53.95	3.46	38.11	2.88	31.68
F_3	3.90	42.90	2.77	30.52	2.74	30.19
2nd fertigation after 60 days of bulb planting						
F_1	5.88	64.66	4.15	45.70	3.45	37.95
F_2	4.90	53.95	3.46	38.11	2.88	31.68
F_3	3.90	42.90	2.77	30.52	2.74	30.19
3rd fertigation after 90 days of bulb planting						
F_1	7.84	86.24	5.54	60.94	4.60	50.60
F_2	6.54	71.94	4.62	50.82	3.84	42.24
F_3	5.20	57.20	3.70	40.70	3.66	40.26

Result and discussion

The data related to economics of cultivation of perusal study were compiled in table 3 & 4. Data indicated that the gross return (Rs.), B: C ratio varied according to treatment combinations. The maximum cost of cultivation (Rs. 380.99, 372.52 and 376.76, respectively) was recorded in treatment 100 application of irrigation water with 100 per cent recommended dose of fertilizers under shade net house conditions during 2016-17, 2017-18 and pooled data whereas minimum total cost of cultivation (Rs. 329.90, 325.15 and 327.52, respectively) was found in treatment 60 per cent application of irrigation water with 80 per cent application of recommended dose of fertilizer under polyhouse conditions during 2016-17, 2017-18 and pooled mean of both year. In terms of maximum gross return (Rs. 660.00) was calculated in the treatment combinations $PC_1I_1F_1$, $PC_1I_1F_2$, $PC_1I_1F_3$, $PC_1I_2F_1$, $PC_1I_2F_2$ and $PC_1I_2F_3$ during both years and pooled data while, minimum gross return Rs. 495.00 was calculated

in treatment combinations $PC_1I_3F_1$, $PC_1I_3F_2$, $PC_1I_3F_1$, $PC_2I_3F_1$, $PC_2I_3F_2$ and $PC_2I_3F_3$ during both years and pooled mean data. The maximum net return (Rs. 310.99, 317.27 and 314.13 only, respectively) was found in treatment 80 per cent application of irrigation water with 80 per cent application of recommended dose of fertilizers under polyhouse conditions, however, the lowest net return (Rs. 157.81, 166.38 and 162.09 only, respectively) was calculated in treatment 60 per cent application of irrigation water with 80 per cent application of recommended dose of fertilizers under shade net house conditions. In terms of B: C ratio (1.89, 1.93 and 1.90) was found maximum in treatment combination polyhouse conditions with 80 per cent application of irrigation water with 80 per cent application of recommended dose of fertilizers while, minimum B: C ratio (1.45, 1.48 and 1.46, respectively) was found in treatment combinations 60 per cent application of irrigation water with 120 per cent application of recommended dose of fertilizers under shade net house condition during both years and pooled data. The total cost of cultivation was different due to application of different amount of water soluble fertilizers, application of different amount of water (time of irrigation) and difference number of weed and hoeing. The difference in net return and benefit-cost ratio is due to the effect of protected condition with application of optimum amount of water and fertilizer at right time and right place with drip fertigation near the root zone. The similar results were recorded by Gill, 1984 in Rose and he reported that the export quality of rose was increased under modified environment. Dattu (2003) [2] recorded that higher yield and high returns were found under naturally ventilated poly house conditions. The results also confirm by Chandrashekar *et al*. (2016) [9] and Singh *et al*. (2006) in Asiatic lily cultivation under normally ventilated polyhouse conditions, Guttal and Takte (1993) [5], Maruti (1996) [7], Gaikwad *et al*. (2002) [3] in chrysanthemum**,** Malhotra and Kumar (2000) in rose**,** Singh and Ramachandran (2002) in gerbera, Tarannum and Naik (2014) [14] in carnation under protected conditions.

Table 3: Number of spike/m_2, cost of per spike, total cost of cultivation, gross return of oriental lily under protected conditions during 2016-17, 2017-18 and pooled data.

Treatments	Number of spikes/m^2	Price/spike (Rs.)	Total cost of cultivation (Rs.)			Gross income (Rs.)		
Year			2016-17	2017-18	Pooled mean	2016-17	2017-18	Pooled mean
Polyhouse + V + 120% RDF	11	60.00	374.55	366.62	370.58	660.00	660.00	660.00
Polyhouse + V+ 100% RDF	11	60.00	370.80	362.87	366.83	660.00	660.00	660.00
Polyhouse + V + 80% RDF	11	60.00	368.12	360.19	364.15	660.00	660.00	660.00
Polyhouse +V. 8 + 120% RDF	11	60.00	355.44	349.16	352.30	660.00	660.00	660.00
Polyhouse + V.8 + 100% RDF	11	60.00	351.69	345.41	348.55	660.00	660.00	660.00
Polyhouse + V.8 + 80% RDF	11	60.00	349.01	342.73	345.87	660.00	660.00	660.00
Polyhouse + V.6 + 120% RDF	11	45.00	336.33	331.58	333.95	495.00	495.00	495.00
Polyhouse + V.6 + 100% RDF	11	45.00	332.58	327.83	330.20	495.00	495.00	495.00
Polyhouse + V.6 + 80% RDF	11	45.00	329.90	325.15	327.52	495.00	495.00	495.00
Shade net house+ V + 120% RDF	11	55.00	380.99	372.52	376.75	605.00	605.00	605.00
Shade net house+ V + 100% RDF	11	55.00	377.24	368.84	373.04	605.00	605.00	605.00
Shade net house+ V + 80% RDF	11	55.00	374.56	366.09	370.32	605.00	605.00	605.00
Shade net house+ V.8 + 120% RDF	11	55.00	360.59	353.94	357.26	605.00	605.00	605.00
Shade net house+ V.8 + 120% RDF	11	55.00	356.84	349.89	353.36	605.00	605.00	605.00
Shade net house+ V.8 + 80% RDF	11	55.00	354.16	347.21	350.68	605.00	605.00	605.00
Shade net house+ V.6 + 120% RDF	11	45.00	339.62	335.05	337.33	495.00	495.00	495.00
Shade net house+ V.6 + 100% RDF	11	45.00	337.87	331.3	333.58	495.00	495.00	495.00
Shade net house+ V.6+ 80% RDF	11	45.00	335.19	328.62	332.90	495.00	495.00	495.00

Table 4: Net income (Rs.) and benefit-cost ratio of oriental lily under protected conditions during 2016-17, 2017-18 and pooled mean.

Treatments	Net income (Rs.)			B: C ratio		
Year	2016-17	2017-18	Pooled data	2016-17	2017-18	Pooled data
Polyhouse + V + 120% RDF	285.45	293.38	289.41	1.76	1.80	1.78
Polyhouse + V+ 100% RDF	289.20	297.13	293.16	1.77	1.81	1.79
Polyhouse + V + 80% RDF	291.88	299.81	295.84	1.79	1.83	1.81
Polyhouse +V. 8 + 120% RDF	304.56	310.84	307.70	1.85	1.89	1.87
Polyhouse + V.8 + 100% RDF	308.31	314.59	311.45	1.87	1.91	1.89
Polyhouse + V.8 + 80% RDF	310.99	317.27	314.13	1.89	1.93	1.90
Polyhouse + V.6 + 120% RDF	158.67	163.42	161.04	1.47	1.49	1.48
Polyhouse + V.6 + 100% RDF	162.42	167.17	164.79	1.48	1.50	1.49
Polyhouse + V.6 + 80% RDF	165.10	169.85	167.47	1.50	1.52	1.51
Shade net house+ V + 120% RDF	224.01	232.48	228.24	1.58	1.62	1.60
Shade net house+ V + 100% RDF	227.76	236.16	231.96	1.60	1.64	1.62
Shade net house+ V + 80% RDF	230.44	238.91	234.67	1.61	1.66	1.63
Shade net house+ V.8 + 120% RDF	244.41	251.06	247.73	1.67	1.71	1.69
Shade net house+ V.8 + 120% RDF	248.16	255.11	251.63	1.69	1.73	1.71
Shade net house+ V.8 + 80% RDF	250.84	257.79	254.31	1.70	1.74	1.72
Shade net house+ V.6 + 120% RDF	155.38	159.95	157.66	1.45	1.48	1.46
Shade net house+ V.6 + 100% RDF	159.13	163.70	161.41	1.47	1.49	1.48
Shade net house+ V.6+ 80% RDF	157.81	166.38	162.09	1.46	1.51	1.48

Conclusion

Based on results, it may concluded that the treatment combination 80 per cent application of irrigation water with application of 80 per cent of recommended dose of fertilizers under polyhouse conditions was found superior in terms of net return and B:C ratio during the year 2016-17, 2017-18 and pooled mean.

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