Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(3): 1467-1474
Received: 22-03-2020
Accepted: 26-04-2020

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

Anju Pal
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

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

Standardization of protected condition for quality flower production of oriental lily

Sunita Kumari, Santosh Kumar, Anju Pal and CP Singh

DOI: https://doi.org/10.22271/phyto.2020.v9.i3x.11519

Abstract
The present investigation entitled "Standardization of Protected Condition for Quality Flower Production of Oriental Lily" was conduct at Model Floriculture Center of G. B. Pant University of Agriculture and Technology, Pantnagar during the year 2016-17 and 2017-18. The experiment was layout in completely randomized design with two treatments and fifteen replications under polyhouse and shade net conditions. The vegetative characters like plant height at 60 days after bulb sprouting, fresh weight of plant, stem & leaves, dry weight of plant, stem & leaves were record superior under shade net house conditions. Most of the flowering attributes like number of buds per plant, duration to bud initiation and spike harvest, length and width of basal and upper bud, diameter of basal and upper flower as well as early spike harvesting were found superior under polyhouse conditions as compared to shade net house conditions. The physiological traits like Chlorophyll a, chlorophyll b & total chlorophyll (mg/g fresh weight), nitrogen, phosphorus and potassium content in leaves were found maximum under polyhouse conditions as compared to shade net house conditions. So, based on two year data as well as pooled data, polyhouse conditions is recommended for early flower production with good flower quality of oriental lily cv. White Cup.

Keywords: Polyhouse, shade net house, flowering and physiological

Introduction
Lilium is a genus of a bulbous beautiful flowering plant with basic chromosome number 12. Most of Lilium species are originated from the northern Hemisphere (Lim and Van, 2006). In northern and western Himalayan regions have more than 100 species (Pelkonen and Pirttila, 2012) [21] are found but Asiatic, eastern and Oriental hybrid lily grown at a commercial level for cut flower production (Marasek-Ciolakowska *et al*., 2018) [19] and (Van Tuyl *et al*., 2011) [24]. In the world, the lilies are mainly grown in the temperate and moist region & at commercial level lilies are cultivated in Netherlands, Israel, U.S.A., South Africa, Japan, Chile, Italy, New Zealand and Mexico in the world. In India, lilies are grown at Himachal Pradesh, Jammu and Kashmir and Upper Himalayan region of Uttarakhand, Manipur, Meghalaya, Nagaland, Arunachal Pradesh and Sikkim in natural field conditions. Now-a- day, lilies are grown in Maharashtra, West Bengal, Odisha, Karnataka, Uttar Pradesh, Haryana and Punjab under protected conditions (Kumari *et al*., 2019) [14]. The oriental hybrid lily belongs to family Liliaceae and native to Japan and derived from *L. auratum*, *L. speciosum*, *L. japonicum* & *L. rubellum*. They have large beautiful white, pink, & cream colours flowers with pleasant aroma (Grassotti and Gimelli, 2011) [6] and used as cut flowers in India as well as in the world. In the world, approximately 570 million farms have small or family farmers. Small farmers cultivated 12 per cent & family farms cultivated 75 per cent are of agricultural land (Lowder *et al*., 2016) [18]. About 70 per cent populations are live in rural areas in India. They have depended on agriculture as a primary source for their livelihood, in which 86.06 per cent land holding by small and marginal categories & 46.06% share in agriculture operations (Anonymous, 2016) [2]. So, we have the need to "increased production per unit area" to increase income for the better livelihood of small & marginal farmers. Although, protected cultivation has great potential to increase production per unit area with good quality of flowers without affected adverse climatic conditions. There is a need to standardize protected conditions for production of quality flowers according to the demand of consumers & standards of national and international markets.

Materials and Methods
The present experiment was conducted at Model Floriculture Centre, G. B. Pant University of Agriculture and Technology, Pantnagar (U.S. Nagar) Uttarakhand during the year 2016-17 and

2017-18. This experiment was laid out in completely randomized design with two treatments (i.e., T_1- Polyhouse conditions and T_2- Shade net house conditions) with fifteen replications. One replication had eight plants inside both environmental conditions. The planting of treated bulbs (i.e., Bavistin WP @ 2g/litre water) was done on raise bed and at 30 x 30cm spacing in the last week of October during both years. The crop was cultivated with standard cultural operation in polyhouse and shade net house conditions. Five plants were selected for observations per replication per treatment. The microclimate data like maximum & minimum temperature & relative humidity were observed daily inside polyhouse & shade net house conditions during both experimentation years & the average pooled difference between minimum temperature & relative humidity were shown in figure 1. The observations like percentage of bulb sprouting, vegetative characters (i.e., plant height at 60 days after bulb sprouting, fresh weight of plant, stem & leaves, dry weight of plant, stem & leaves), flowering characters like days taken to spike harvesting, days taken to bud initiation to spike harvesting, length & diameter of basal & upper buds, diameter of upper & basal flowers & physiological characters i.e., chlorophyll a, chlorophyll b & total chlorophyll content in leaves by DMSO method (Hiscox and Israelstam, 1979) [9] & macronutrients (like nitrogen, phosphorus & potassium per cent in leaves by Jackson, 1973) [10] have been recorded during experimentation. All the data have been analysed statistically by SPSS software.

Results and Discussion

A perusal of data of two years (i.e., 2016-17 and 2017-18) and pooled mean data of this experiment are presented in table 1-2 & figure 2-10. The protected conditions were significantly affected vegetative, flowering and physiological characteristics of oriental lily during both years as well as pooled data of both years.

Vegetative characters

The observations like plant height (71.26, 73.51 & 72.38cm) at 60 days after bulb sprouting, fresh weight of plant (146.42, 144.22 & 145.32g), leaves (38.57, 35.37 & 36.97g), stem (52.10, 54.03 & 53.06g), flowers (55.74, 54.82 & 55.28g) & dry weight of plant (26.19, 26.01 & 26.10g), leaves (9.19, 9.30, 9.24g), stem (8.57, 8.44 & 8.51g) & flowers (8.47, 8.26 & 8.37g) were recorded maximum under shade net house conditions as compared to polyhouse conditions during both years as well as pooled data, respectively (figure 2 & table 1). A shade net condition was increased plant height 12.50, 5.73 & 8.71% at 60 days after bulb sprouting over polyhouse conditions. Polyhouse conditions had increased fresh weight (like plant-11.97, 8.71 & 10.36%, leaves-16.51, 8.05 & 12.70%, stem-7.35, 3.77 & 5.22%, flowers-13.16, 14.02 & 13.58%) and dry weight (*viz*., plant-6.41, 6.49 & 6.47%, leaves-10.33, 11.07, 10.71%, stem- 6.88, 5.09 & 5.99%, flowers-2.95, 2.78 & 2.86%) over as compared to shade net house conditions. This might be due to difference in maximum & minimum temperature, maximum & minimum relative humidity and light intensity in both protected conditions (figure 1). In polyhouse conditions, the average maximum temperature is 1-2^{0}C less as compared to shade net house conditions but minimum temperature is 2-6 ^{0}C more as compared to shade net house conditions (figure 1). During winter season, the temperature gradually decreased (2-6 ^{0}C) from October to February, which is favourable for vegetative growth of oriental lily under shade net house condition but in polyhouse conditions having 2-6 ^{0}C more minimum temperature as compared to shade net house, which induced the early bud initiation due to decreased the length of plant with along with vegetative characters. The similar studies were conducted by Mohanty *et al*. (2011) [20] in rose & Kumar and Kumar (2001) [13] in gerbera and they noted that better plant growth was found with 50 per cent shade net conditions. Singh and Kumar (2018) observed that better plant growth of gladiolus was found under shade net house conditions as compared to polyhouse condition. Fatmi *et al*. (2018) [4] reported that shade net conditions had increased plant vegetative characteristic like plant height, leaf area, plant spread and stem length of Asiatic hybrid lily cv. Pollyanna. Inamoto *et al*., 2013 & 2016 [8, 11] & Ninomiya *et al*. (2012) [16] reported that the Oriental Hybrid Lily cv. Siberia was grown with low day temperature (i.e. 20^{0}C) during flowering stage have been increased the dry weight of plant, flowers, bulb, roots & long stem length but at low night temperature (i.e. 15°C) have been increased dry weight of plant and stem.

Time taken to spike harvesting

The significantly minimum days taken from bud initiation to spike harvesting (68.69, 71.28 & 70.61 days) & minimum days taken to spike harvesting (127.55, 128.96 &128.29 days) were observed under polyhouse conditions as compared to shade net house conditions during both years & pooled mean data, respectively (figure 3-4). The harvesting of spike was done 10 days earlier was recorded in polyhouse conditions as compared to shade net house conditions. The polyhouse conditions, also recorded 10-11 days early bud development (i.e. days taken from bud initiation to spike harvesting) as compared to shade net house conditions. This might be due to effect of constant temperature inside polyhouse conditions that was constant 2-6 ^{0}C more inside the polyhouse conditions as compared to temperature inside the shade net house conditions (Figure 1). Some researchers reported that high night temperatures (minimum 18 °C), delayed flower initiation and increased the number of leaves while low temperature (minimum 4.5°C), for one month promoted subsequent flower initiation and reduced the number of leaves of carnation flowers Harris & Juliet (1962). According to Vered & Jaime (2002) [25], the faster leaf production, early flowering and senescence were increases with increasing temperature in the range 17/12 to 32/27 °C in calla lily (*Zantedeschia*). Dahab (1967) [17] stated that the combination of high day temperature with low night temperature have been influenced the early flower initiation of carnation flowers.

Flowering & physiological traits

In polyhouse conditions, the flowering traits like length of basal bud (110.26, 110.29 & 110.28mm) & diameter upper bud (17.34, 21.34 & 19.34mm) were maximum recorded under polyhouse conditions as compared to shade net house conditions. While, higher length of upper bud (52.43, 66.20 & 59.32mm), diameter of basal bud (30.33, 30.88 & 30.60mm) and diameter of basal flower (18.04, 17.42 & 17.73cm) were observed maximum under shade net house conditions as compared to polyhouse conditions during both years as well as pooled data, respectively (figure 5-10).

The maximum chlorophyll content like Chl a- 0.713, 0.818, 0.765; chl b -0.368, 0.381 & 0.375 & total chl-1.214, 1.148 & 1.181mg/g fresh weight, respectively were found higher under polyhouse conditions as compared to shade net house conditions during both year as well as pooled data, respectively (table 2). Macronutrient content in leaf (like N-

3.21, 3.22 & 3.2; P-0.26, 0.26, 0.26 & K- 3.08, 3.05 & 3.06%, respectively) were found maximum under polyhouse conditions as compared to shade net house conditions during both 2016-17 & 2017-18 as well as pooled data, respectively (table 2). This may be due to more light intensity and temperature (2-6 ^{0}C) & maintained relative humidity under polyhouse conditions that was increase the metabolic activities of plants and directly affect the quality of flowers. High temperatures at vegetative stage, increased shorter stems & enhanced the early bud initiation at early vegetative stage (Ahmed *et al*. 2018) [1], however low temperature at vegetative stage, increased vegetative phase and late delay the bud imitation & development of bud of lily (Kamenetsky, 2014) [12]. Zhang *et al*., (2011 & 2015) [26, 27] reported that 75% density shade net was improved photosynthetic efficiency and enhanced the quality parameters like plant height, flower length, and flower diameter of oriental lily (*Lilium auratum* L. cv. Sorbonne). The similar results was reported by Teifel *et al*. (2007) [23] and reported that the best quality of flowers of carnation was produced under fan pad polyhouse as compared to shade net house. Fatmi *et al*. (2018) [4] reported that early bud emergence was reported under polyhouse conditions with good quality flowers as compared to shade net house conditions. The similar results were found by Gantait and Pal (2011) [5] in spray chrysanthemum; Mohanty *et al*. (2011) [20] in rose & Barik (2013) [3] in Asiatic lily and they reported that better quality of flower was found under polyhouse conditions.

Table 1: Effect of protected conditions on fresh & dry weight of plant, leaves, stem & flowers of oriental lily cv. White Cup

Treatments	Fresh weight (g)				Dry weight (g)			
	Plant	leaves	Stem	Flowers	Plant	leaves	Stem	Flowers
2016-17								
T_1	146.42	38.57	52.10	55.74	26.19	9.19	8.57	8.47
T_2	128.88	32.20	48.27	48.40	24.51	8.24	7.98	8.22
C.D. at 5%	5.06	4.72	0.49	0.50	0.23	0.15	0.15	0.06
Sem±	1.74	1.62	0.17	0.17	0.081	0.05	0.05	0.021
2017-18								
T_1	144.22	35.37	54.03	54.82	26.01	9.30	8.44	8.26
T_2	131.65	32.52	51.99	47.13	24.32	8.27	8.01	8.03
C.D. at 5%	0.90	0.27	0.65	0.40	0.14	0.13	0.05	0.07
Sem±	0.31	0.09	0.22	0.13	0.04	0.045	0.01	8.02
Pooled mean data								
T_1	145.32	36.97	53.06	55.28	26.10	9.24	8.51	8.37
T_2	130.26	32.36	50.13	47.77	24.41	8.25	8.00	8.13
C.D. at 5%	2.66	2.36	0.44	0.28	0.14	0.10	0.07	0.05
Sem±	0.91	0.81	0.15	0.09	0.04	0.034	0.001	0.01
Here, Polyhouse conditions -T_1 and Shade net house conditions - T_2								

Table 2: Effect of protected conditions on physiological characteristics of oriental lily cv. White Cup.

Treatments	Chlorophyll content in leaves (mg/g fresh weight)			Macronutrients (%) in leaves		
	Chlorophyll a	Chlorophyll b	Total chlorophyll	Nitrogen	Phosphorus	Potassium
2016-17						
T_1	0.713	0.368	1.214	3.21	0.26	3.08
T_2	0.703	0.303	1.025	3.09	0.20	3.11
C.D. at 5%	0.004	0.011	0.010	0.009	0.005	0.005
Sem±	0.001	0.004	0.004	0.003	0.002	0.002
2017-18						
T_1	0.818	0.381	1.148	3.22	0.26	3.05
T_2	0.811	0.333	1.154	3.07	0.18	3.12
C.D. at 5%	0.004	0.009	0.005	0.004	0.003	0.007
Sem±	0.001	0.003	0.002	0.001	0.001	0.003
Pooled mean data						
T_1	0.765	0.375	1.181	3.21	0.26	3.06
T_2	0.757	0.318	1.089	3.08	0.19	3.11
C.D. at 5%	0.003	0.008	0.006	0.005	0.001	0.003
Sem±	0.001	0.003	0.002	0.002	0.000	0.001
Here, Polyho use conditions -T_1 and Shade net house conditions - T_2						

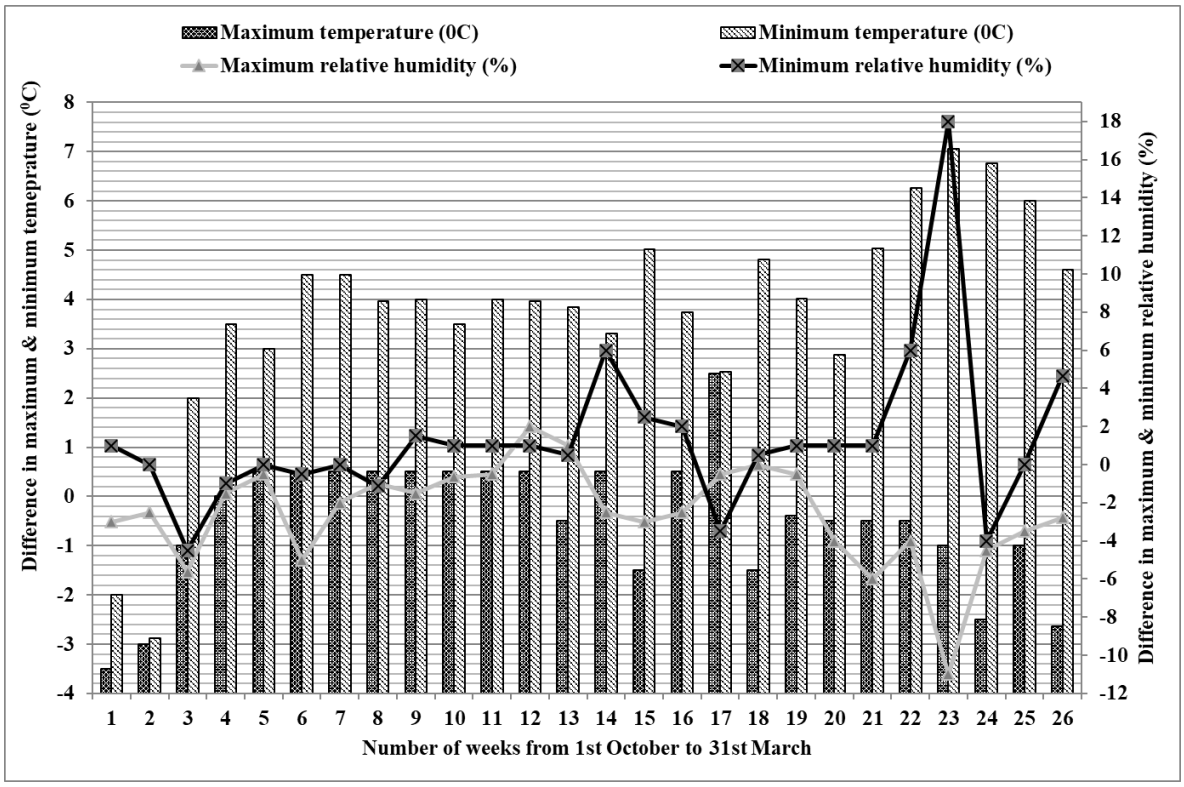

Fig 1: Average difference between pooled temperature (maximum & minimum) & relative humidity (maximum & minimum) of inside polyhouse & shade net house conditions during the year 2016-17 & 2017-18.

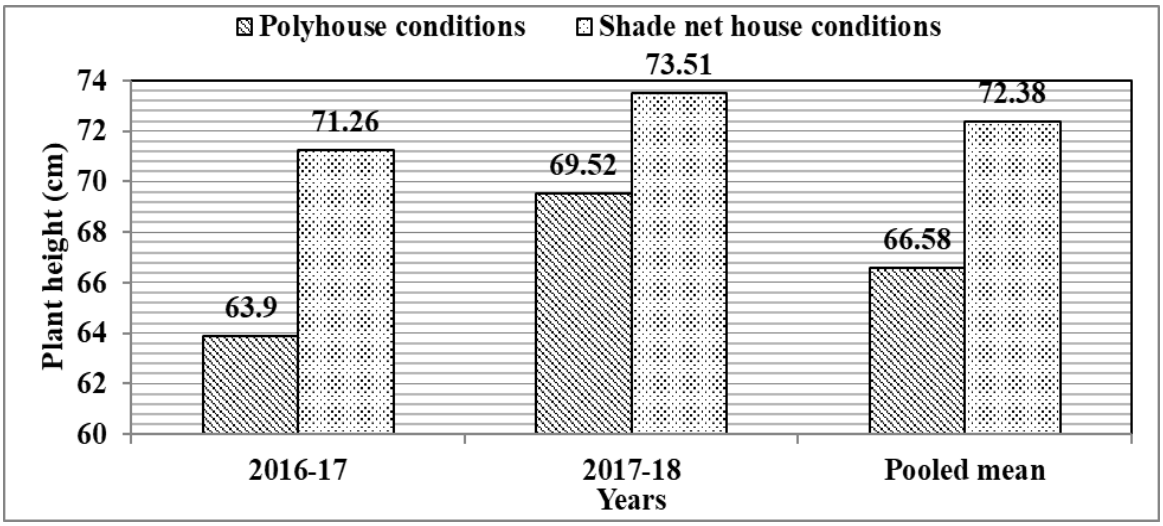

Fig 2: Plant height at 60 days after bulb sprouting of oriental lily under protected condition during both year as well as pooled data.

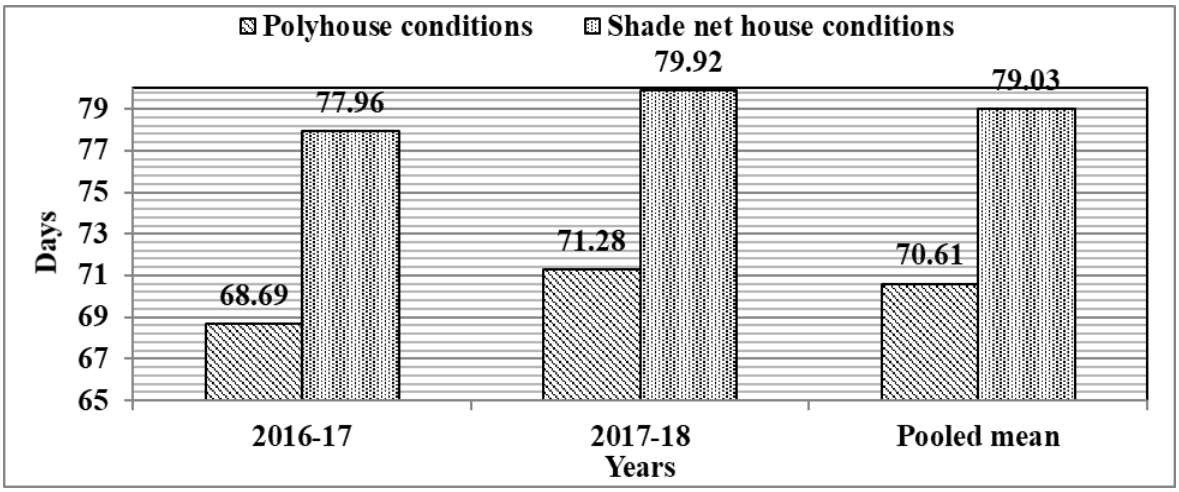

Fig 3: Days taken from bud initiation to spike harvesting of oriental lily under protected condition during both year as well as pooled data.

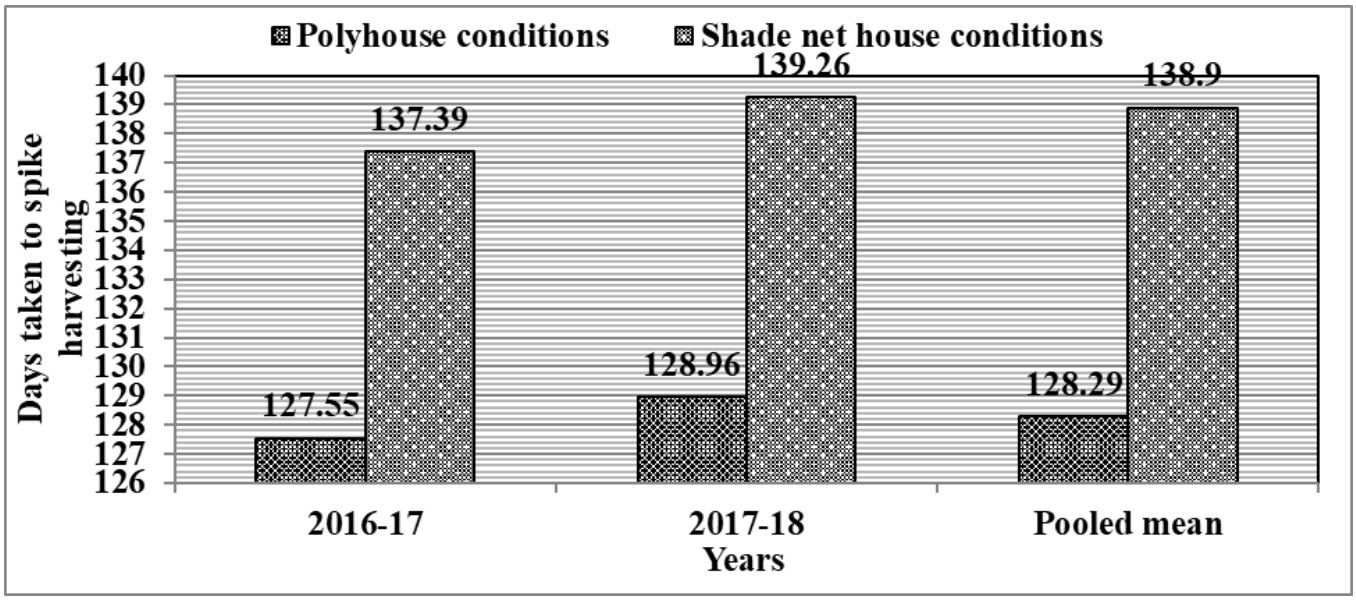

Fig 4: Days taken to spike harvesting of oriental lily under protected condition during both year as well as pooled data.

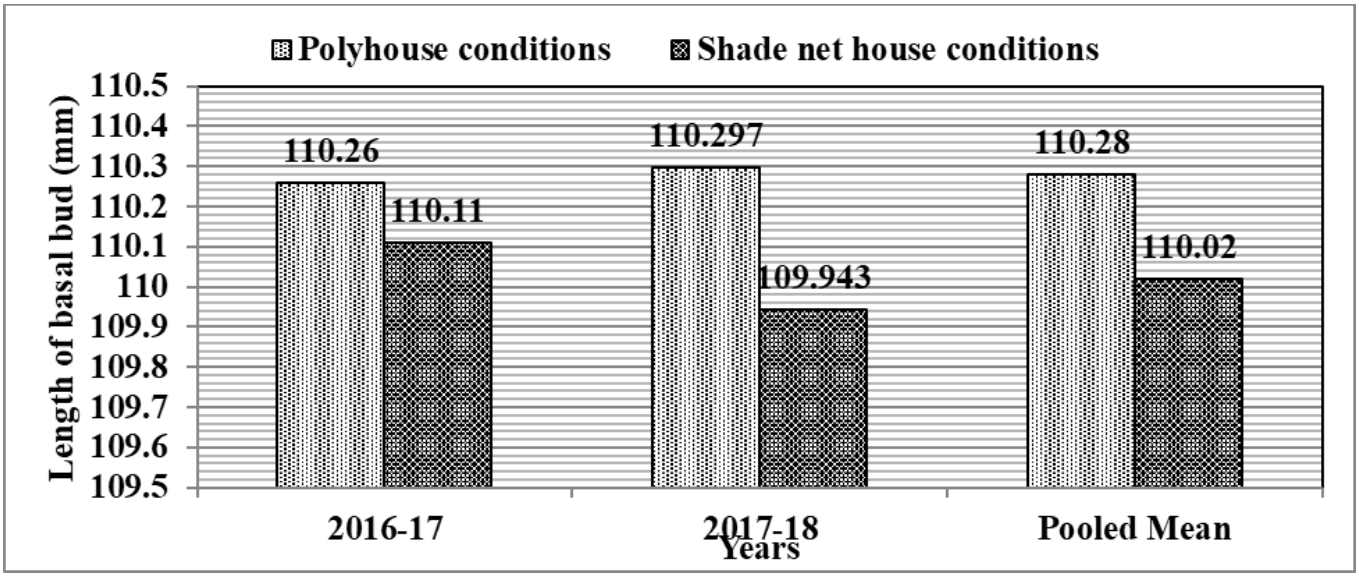

Fig 5: Length of basal bud of oriental lily under protected condition during both year & pooled data

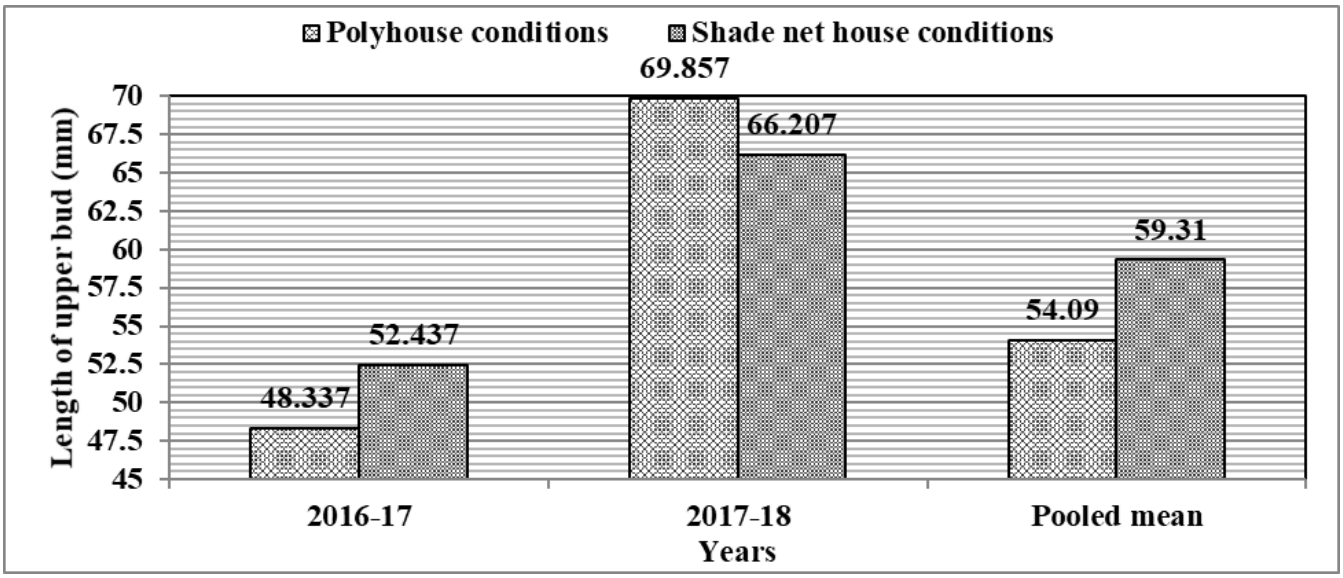

Fig 6: Length of upper bud of oriental lily under protected condition during both year & pooled data.

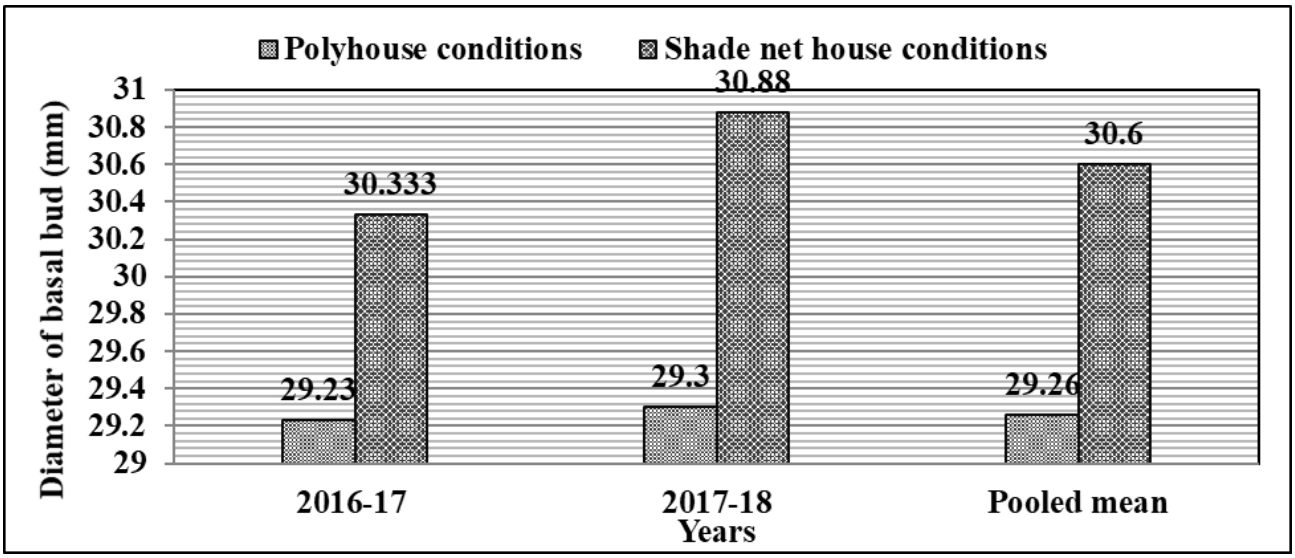

Fig 7: Diameter of basal bud of oriental lily under protected condition during both year & pooled data

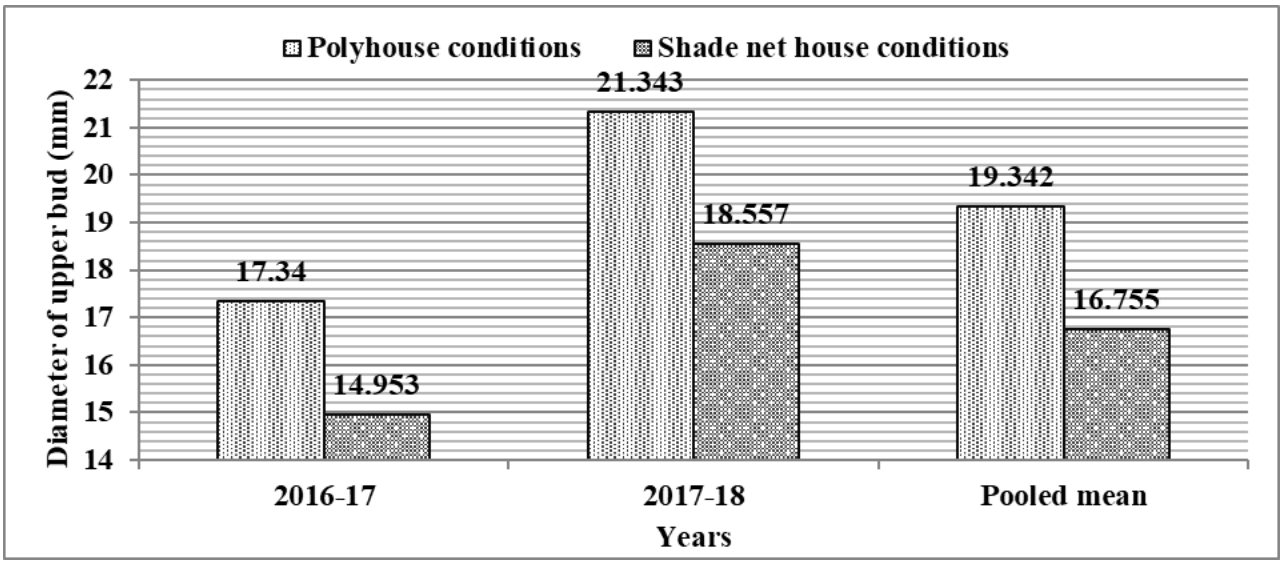

Fig 8: Diameter of upper bud of oriental lily under protected condition during both year & pooled data.

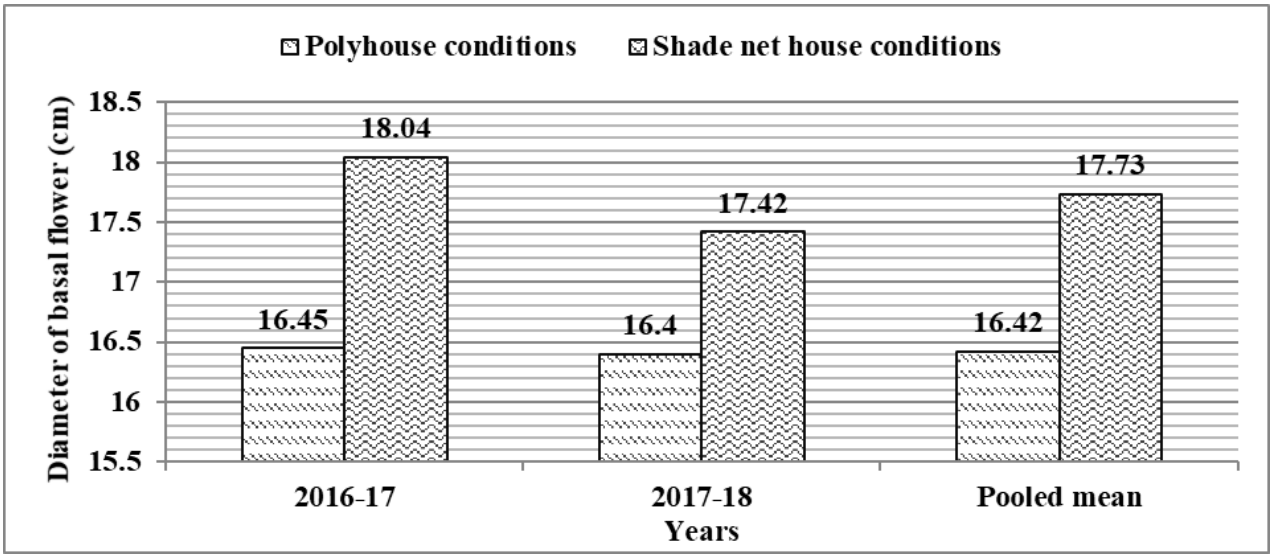

Fig 9: Diameter of basal flower of oriental lily under protected condition during both year & pooled data

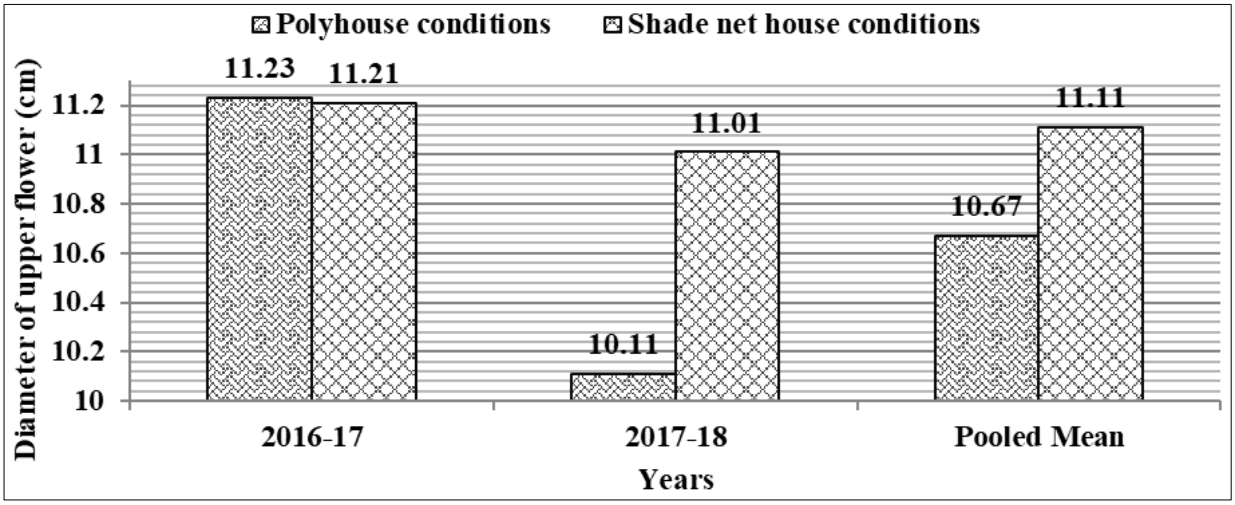

Fig 10: Diameter of upper flower of oriental lily under protected condition during both year & pooled data of both years

Conclusion

Based on two-year data (i.e., 2016-17 & 017-18) as well as pooled data of both year, it may conclude that vegetative parameters were found superior under shade net conditions while flower quality characters were found appreciable under polyhouse & shade net house conditions. Therefore, considering that a polyhouse conditions have recommended for early flower production with better flower quality of oriental lily.

References

1. Ahmed Z, Ganai NA, Nazir N, Kaur P. Response of flowering in lily to light and temperature: Advances. Rashtriya Krishi. 2018; 13(1):76-78.
2. Anonymous. All India report on number and area of operational holdings. Agriculture Census New Delhi: Ministry of Agriculture: 2015-16.
3. Barik D. Comparative performance of Asiatic Hybrid Lily (*Lilium* sp) varieties under open and protected environment. Master thesis, The Orissa University of Agriculture and Technology, Bhubhneswar, 2013.
4. Fatmi U, Singh D, Bharti S. Growth and flowering of *Asiatic lily* cv. Pollyanna as influenced by different growing environments, Plant Archives. 2018; 18(1):760-762.
5. Gantait SS, Pal P. Comparative performance of spray chrysanthemum cultivars under polyhouse and open-field cultivation at different dates of planting, Journal of Horticultural Science. 2011; 6(2):123-129.
6. Grassotti A, Gimelli F. Bulb and cut flower production in the genus Lilium: current status and the future. In II International Symposium on the Genus Lilium. 2011; 900:21-35.
7. Harris GP, Juliet EH. Effects of Environment on Flower Initiation in Carnation, Journal of Horticultural Science. 1962; 37(3):219-234.
8. Inamoto K, Nagasuga K, Yano T, Yamazaki H. Influence of growing temperature on dry matter accumulation in plant parts of 'Siberia' Oriental hybrid lily, Japan Agricultural Research Quarterly: JARQ. 2013; 47(4):435-441.
9. Hiscox JD, Israelstam GF. A method for the extraction of chlorophyll from leaf tissue without maceration, Canadian Journal of Botany. 1979; 57(12):1332-34.
10. Jackson ML. Soil Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi, 1973, 38-56.
11. Inamoto K, Nagasuga K, Yano T, Yamazaki H. The Effects of Day and Night Temperature on the Dry Matter Accumulation of Oriental Hybrid Lily 'Siberia'as they Relate to the Photosynthetic and Respiratory Characteristics, Japan Agricultural Research Quarterly: JARQ. 2016; 50 (2):143-152.
12. Kamenetsky R. Flower biology in Lilium: Achievements and research challenges, Acta Horticulturea. 2014; 1027:65-74.
13. Kumar D, Kumar R. Effect of modified environments on gerbera. Journal of Ornamental Horticulture. 2001; 4(1):33-35.
14. Kumari S, Kumar S, Singh CP. Comparative Performance of Oriental Hybrid Lily cv. White Cup under Protected Conditions, International Journal of Current Microbiology Applied Sciences. 2019; 8(1):2451-2455.
15. Lim KB, Van TJM. Lily. In Flower Breeding and Genetics, Springer, Dordrecht, 2007, 517-537.
16. Ninomiya C, Hamauzu K, Kadota T, Matsugi H. Effect of low night temperature management by heat-pump system on growth and flowering of oriental hybrid lily 'Siberia' in summer culture, Horticultural Research (Japan). 2012; 11(4):537-543.
17. Dahab AA. Effects of light and temperature on growth and flowering of carnation (*Dianthus caryophyllus* L.) (Doctoral dissertation, Veenman), 1967.
18. Lowder SK, Skoet J, Raney T. The number, size, and distribution of farms, smallholder farms, and family farms worldwide, World Development. 2016; 87:16-29.
19. Marasek-Ciolakowska A, Nishikawa T, Shea DJ, Okazaki K. Breeding of lilies and tulips-Interspecific hybridization and genetic background, Breeding science. 2018; 68(1):35-52.
20. Mohanty CR, Mohanty A, Das AB, Kar DS. Comparative performance of some rose varieties under open and protected environment, Asian Journal of Horticulture. 2011; 6(2):288-293.
21. Pelkonen V, Pirttila AM. Taxonomy and phylogeny of the genus Lilium, Floriculture and Ornamental Biotechnology. 2012; 6(2):1-8.
22. Singh S, Kumar S. Comparative performance of gladiolus cv. Forta Rosa under different environmental conditions on growth and flowering, International Journal of Chemical Studies. 2018; 6(2):2484-2488.

23. Teifel M, Barvak M, Ben Yaakou E, Gatken J, Tanny J, Cohen S. Comparing greenhouse natural ventilation to fan and pad cooling, Acta Horticulturae. 2007; 761:33-39.
24. Van TJM, Arens P, Marasek-Ciolakowska A. Breeding and genetics of ornamental geophytes. In: Kamenetsky, R. and H. Okubo (eds.) Ornamental geophytes: from basic science to sustainable horticultural production, CRC press, 2011, 131-158.
25. Vered N, Jaime K. Temperature affects plant development, flowering and tuber dormancy in calla lily (Zantedeschia), The Journal of Horticultural Science and Biotechnology. 2002; 77(2):170-176.
26. Zhang Y, Xie Z, Wang Y, Su P, An L, Gao H. Light intensity affects dry matter, photosynthesis and chlorophyll fluorescence of oriental lily, Philippine Agricultural Scientist. 2011; 94(3):232-238.
27. Zhang YJ, Yan F, Gao H, Xu YZ, Guo YY, Wang EJ *et al*. Chlorophyll content, leaf gas exchange and growth of oriental lily as affected by shading, Russian Journal of Plant Physiology. 2015; 62(3):334–339.