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# High Value Flower Cultivation Under Low Cost Greenhouse In NW Himalayas

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**Abstract:** Despite the availability of ample natural resources for successful flower cultivation, our share in world flower trade is meagre. This is because most of the cut flowers need to be grown under protected conditions to meet stringent quality control regimes of global flower trade and thus require high cost which is not feasible in our country where most of the farmers are small and marginal. Moreover, the present era of global climate change looks for energy efficient system for intensive farming which has less demand for fossil fuels. Keeping these in view, an experiment was laid out with the objective to identify suitable genotypes and practices for production of high value cut flowers like carnation, gerbera and alstroemeria under zero energy greenhouses in NW Himalayas. All the genotypes differed significantly for yield and quality traits and we could identify four promising genotypes viz. Master, Laurella, Charmant and Crimson Tempo in carnation, seven in gerbera and one in alstroemeria suitable for cut flower production under naturally ventilated polyhouse made of bamboo poles or locally available wood and UV stabilised polythene sheets. This gives an added advantage to small and marginal farmers who wish to take up floriculture for more profit but could not venture due to high initial cost. They can send their produce to nearby tourist places like Nainital, Dehradun, Rishikesh, Mussoorie *etc* and can get good premium price of their produce without the involvement of middlemen. It may open new avenues for increasing the acreage under intensive production and ultimately to increase the floricultural exports from our country.
**Keywords**: low cost polyhouse, carnation, gerbera, alstroemeria.

## Introduction

Floriculture industry is fast emerging as a commercial venture throughout the world with increasing per capita consumption of flowers due to globalization and its effect on income generation. Rising demand has resulted in new production centres in Latin America, Africa and Asia, which were traditionally in USA, Japan, the Netherlands and Columbia. The floriculture industry has annual growth potential of 25-30% and is capable of earning foreign exchange 20-25 times more than cereals or other agricultural crops. Export of floricultural products such as cut flowers, cut greens, dried flowers, seeds, bulbs and live plants including tissue cultured plants has assumed much importance in our foreign trade. The export of various floricultural products shares about 6.9% of total horticultural produce. Among floriculture products, the growth of fresh cut flower sector has been very significant. This shows the potential and vast opportunities that exist for production and export of cut flowers. Despite our potential as a major production centre our share in the world trade of fresh flowers is meagre (0.40-0.50%) as compared to Netherlands (65%), Columbia (12%), Italy (6%), Israel (4%), Kenya (1%) and other countries (20%). This is because most of the cut flowers need to be grown under protected conditions to meet stringent quality control regimes of global flower trade and thus require high cost which is not feasible in our country where most of the farmers are small and marginal. Moreover, the present era of global climate change compel us to look for energy efficient system which has less demand for fossil fuels. According to the Kyoto protocol of 1997, greenhouse horticulture must contribute to a reduction in $CO_2$ emissions, which can be realised by reducing fossil fuel consumption. For the Dutch greenhouse industry the goal is a reduction $CO_2$ emission of 48% by 2020, compared to 1990 levels[1]. Earlier in our country most of the greenhouse technologies were imported from Dutch and Israelis but recently the trend is changing and we are coming forward with zero energy concepts with the primary aim of reducing energy consumption. Moreover, due to high cost involved in installation and maintenance small and marginal flowers are not coming forward to take up the advantages of protected cultivation. At this stage low cost technology of quality flower production can serve as a boon to farming community particularly of hilly areas.

North western Himalaya of India including Uttarakhand hills, being bestowed with quite a favourable climatic condition for most of the commercial cut flowers, has great potential to serve as a hot spot for commercial flower cultivation. On the hills most of the crops are cultivated during summer season in open field condition but winter season is usually out of any crop. Protected structures are known for protecting the crop from natural vagaries of weather and thus it could be opted for year round crop production. Moreover, abundant sunshine throughout the year especially in winter and autumn is perhaps the first blessings for greenhouse cultivation without the need for artificial light and related cost escalation due to additional energy inputs. Due to greenhouse effect the crop can be maintained even in the low temperature of winter season. Keeping these in view, experiments were laid out with the objective to identify suitable genotypes and practices for production of high value cut flowers like carnation, gerbera and alstroemeria and their feasibility to meet stringent quality control regimes of global flower trade.

## Materials and methods

Experiments were conducted in naturally ventilated polyhouses of 600 $m^2$ (12 m × 5 m) and 1000 $m^2$ (20 m x 5 m) made of wooden and bamboo poles, oriented east–west and covered with UV stabilised polyethylene film (200 μm), located at the Central Institute of Temperate Horticulture-Regional Station, Mukteshwar farm ($29^0$ N latitude, $79^0$ E longitude, 2200 m amsl) on the Kumaon hills, Uttarakhand, India. The greenhouse was 3.5 m high at the centre and 2.0 m at the side, and had four windows (60cmx40cm) and two doors at both the end. The roof was covered with green shade net during summer season for cooling effect. A total of 16 genotypes of carnation (Firato, Prado Mint, Master, Liberty, Charmant, Niva, Laurella, Tabor, Dark Rendezvous, Raggio de sole, Frivote, Tempo, Farida, Vienna, Crimson Tempo and Cool), 50 of gerbera (G1-G50) and 2 of alstroemeria (Cv Serena and Aladin) were evaluated for different characters suitable for cut flower production during 2008-2010. Plant geometry for carnation, gerbera and alstroemeria was 20x30 $cm^2$, 25x50 $cm^2$ and 50x50 $cm^2$, respectively. Planting was done during Aug-September and plants started producing flowers from February onward. Monthly maximum and minimum temperature and rainfall (Table 1) were recorded during the experimental period. The experiments were laid out in RBD with three replications. Various growth and flowering parameters were recorded and analysis of data was done by SPSS 13.0 software.

**Table 1. Average temperature observed during different periods of year in Kumaon hills**

| Month | Avg maximum temp ($^0$C) | Avg minimum temp ($^0$C) |
|---|---|---|
| January | 14.9 | 2.6 |
| February | 12.4 | 2.8 |
| March | 17 | 5.2 |
| April | 22.4 | 10.5 |
| May | 23.6 | 13.2 |
| June | 23.1 | 14 |
| July | 20.6 | 15.2 |
| August | 21.3 | 14.5 |
| September | 21.8 | 12.5 |
| October | 20.5 | 10 |
| November | 17.4 | 6.4 |
| December | 14.8 | 4.5 |

**Table 2: Growth and flowering characters of different genotypes of carnation under low cost polyhouse**

| Sr. No. | Var. | Days to Flower induction | Plant Height (cm) | Stalk length (cm) | Flower diameter (cm) | Vase-life (days) | Yield/m$^2$ |
|---|---|---|---|---|---|---|---|
| 1. | Firato | 138.00 | 58.66 | 26.33 | 8.06 | 7.00 | 159.33 |
| 2. | Frivote | 162.00 | 66.00 | 26.66 | 8.10 | 7.00 | 202.0 |
| 3. | Prado Mint | 135.33 | 70.00 | 31.33 | 6.50 | 7.66 | 351.3 |
| 4. | Raggio de Sole | 177.33 | 66.00 | 32.33 | 11.33 | 8.33 | 299.0 |
| 5. | Tempo | 170.00 | 56.66 | 22.00 | 7.00 | 6.33 | 101.3 |
| 6. | Laurella | 171.66 | 79.33 | 41.00 | 7.26 | 8.33 | 242.0 |
| 7. | Dark Rendezvous | 141.33 | 71.33 | 34.00 | 7.03 | 7.66 | 228.3 |
| 8. | Tabor | 138.33 | 66.33 | 35.00 | 7.16 | 8.33 | 315.3 |
| 9. | Liberty | 146.66 | 42.33 | 35.00 | 8.53 | 8.00 | 356.6 |
| 10. | Master | 143.66 | 48.00 | 40.33 | 8.63 | 16.00 | 386.6 |
| 11. | Farida | 146.66 | 57.66 | 27.66 | 8.33 | 10.00 | 335.3 |
| 12. | Vienna | 180.66 | 41.00 | 21.66 | 5.83 | 7.33 | 148.0 |
| 13. | Niva | 146.33 | 48.33 | 22.66 | 6.83 | 12.00 | 400.6 |
| 14. | Charmant | 159.33 | 47.33 | 41.33 | 7.30 | 14.00 | 349.3 |
| 15. | Cool | 130.52 | 70.68 | 35.25 | 6.54 | 7.25 | 340.58 |
| 16. | Crimson Tempo | 135.68 | 71.58 | 45.25 | 7.87 | 8.24 | 345.74 |
| | $CD_{0.05}$ | 12.48 | 7.32 | 5.22 | 1.30 | 1.79 | 35.01 |
| | SEM | 4.293 | 2.521 | 1.796 | 0.446 | 0.621 | 12.04 |

**Table 3. International standard for stalk length and flower size in carnation, gerbera and alstroemeria as per recommendation of Aalsmeer Flower Auction Association**

| Flower character | Grade | Carnation | Gerbera | Alstroemeria |
|---|---|---|---|---|
| Stalk length (cm) | Fancy | >55 | >50 | >60 |
| | Standard | >42 | >40 | - |
| Flower diameter (cm) | Fancy | >7.5 | >9.0 | > 2 flowers /stem |
| | Standard | > 6.0 | >7.0 | - |

**Table 4: Growth and flower characters of promising genotypes of gerbera for cultivation under low cost polyhouse**

| Sr No. | Genotype | Days to flower induction | No. of leaves | Stalk length(cm) | Flower diameter(cm) | No. of flowers/ m2/year |
|---|---|---|---|---|---|---|
| 1. | G-6 | 90.5 | 11.50 | 38.54 | 7.5 | 216 |
| 2. | G-15 | 70.85 | 17.5 | 42.58 | 10.6 | 162 |
| 3. | G-16 | 98.54 | 18.65 | 56.25 | 13.5 | 224 |
| 4. | G-17 | 110.33 | 19 | 66.25 | 14.41 | 132 |
| 5. | G-18 | 69.68 | 21.52 | 45.33 | 13.44 | 248 |
| 6. | G-19 | 110 | 11.87 | 42.74 | 11.52 | 152 |
| 7. | G-20 | 90 | 12.85 | 69.23 | 14 | 258 |

## Results and Discussion

The success of any crop depends on proper choice of the cultivars. In carnation, the data revealed that all the genotypes differed significantly with respect to growth and flowering parameters (Table 2). Earliest flower bud induction was recorded in cv. Cool (130.68 days ) which was found at par with Firato (138 days), Prado Mint (135.33 days), Tabor (138.33 days) and Crimson Tempo (135.68 days) while Vienna (180.66 days) took maximum number of days for flower bud induction. Cultivar Laurella, Crimson Tempo, Dark Rendezvous and Cool recorded maximum plant height while Niva and Master were found to bear maximum number of flowers/$m^2$ .Cultivar Farida recorded largest flower diameter (10.23 cm) whereas stalk length was found to be maximum (45.25 cm ) in Crimson Tempo. The cv. Master was found superior with respect to vase-life of flowers. Variations in vegetative and floral characters may be due to their genetic makeup as well as varietal differences. As per the recommendation of Society of American Florist, fancy grade should have minimum diameter of 7.5 cm and a stalk length of 55 cm for fancy grade while standard grade requires minimum 6.0 cm diameter and > 42 cm stalk length (Table 3). The data suggest that 4 varieties *viz*. Master, Laurella, Charmant and Crimson Tempo could produce flowers of international standard suitable for export purpose.

In the same way, gerbera showed significant differences for yield and quality parmeters and we could identify seven promising genotypes (Table 4) suitable for cut flower production under naturally ventilated polyhouse. The genotype G-15 and G-18 were earliest and started flowering after 70 days of planting. Farmers should go for a combination of early and late varieties to extend the flowering period. All the promising genotypes produced high quality flowers of international standard and we got flowering for about eight months in a year. There was continuous flowering starting from March to November with two peaks in May and October (Fig 1). Optimum temperature for growing gerbera is 22-25$^0$ C but if the temperature goes below 12$^0$ C flower bud initiation stops. Average minimum temperature during Nov-March was < 5$^0$ C but since the maximum temperature was 10-12$^0$ C outside and due to greenhouse effect it could have raised to at least 3-4$^0$ C there was good flush during November and March. In a closed polyhouse without artificial heating temperature can rise upto 4-8$^0$ C[2] that is why even below the suboptimal temperature high quality flowers with longer vase-life was produced. In cut flowers, air temperature influences the emission and growth of leaves, and early flowering, whereas soil temperature has a positive effect on head diameter and length of the flowering stem[3]. Vase-life of cut flowers produced during winter season was more for at least 7 days as compared to those produced during summer (Fig 2). This is due to the effect of pre-harvest growing conditions as well as post harvest conditions affecting the postharvest life of any produce. After harvest the flowers were kept at room temperature which was quite lower than summer. The postharvest life of gerbera flowers are highly influenced by season as well as genotypes and the vase-life was reported to be longest during winter season[4]. This could be due to high water uptake, high carbohydrate content[5] and low incidence of pest and diseases and low transpiration rate at low temperature.

In alstroemeria, Aladin was found very promising for yield and quality attributes. The growers must grade their produce as per the product specification of Association of Dutch Flower Auctions which recommends that alstroemeria must be graded according to length, maturity and weight of flowering stem. The stem must have a minimum of 2 flowers or coloured buds per flowering stem and a stem length of more than 60 cm. Under Uttarakhand conditions, stem length of more than 80 cm could be obtained very easily and number of florets per stem varies from 10-14 (Table 5).

**Table 5. Vegetative and floral characteristics of alstroemeria cultivar Aladin grown under low-cost polyhouses of Kumaon hills**

| Serial number | Plant/flower character | Value |
|---|---|---|
| 1. | Plant height (cm) | 80-100 |
| 2. | Number of shoots per plant | 30-40 |
| 3. | Stem length (cm) | 70-80 |
| 4. | Number of flowering shoots per plant per year | 50-80 |
| 5. | Number of flowers per flowering stem | 10-14 |
| 6. | Diameter of flowers (cm) | 5-6 |
| 7. | Weight of flowering shoot (g) | 60-80 |
| 8. | Vase-life (days) | 8-12 |

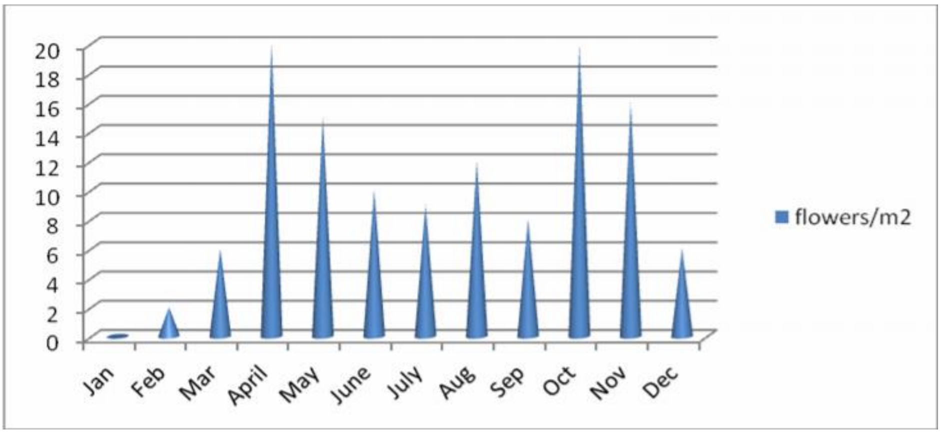


Fig 1. Flower yield of gerbera during different period of time under naturally ventillated polyhouse

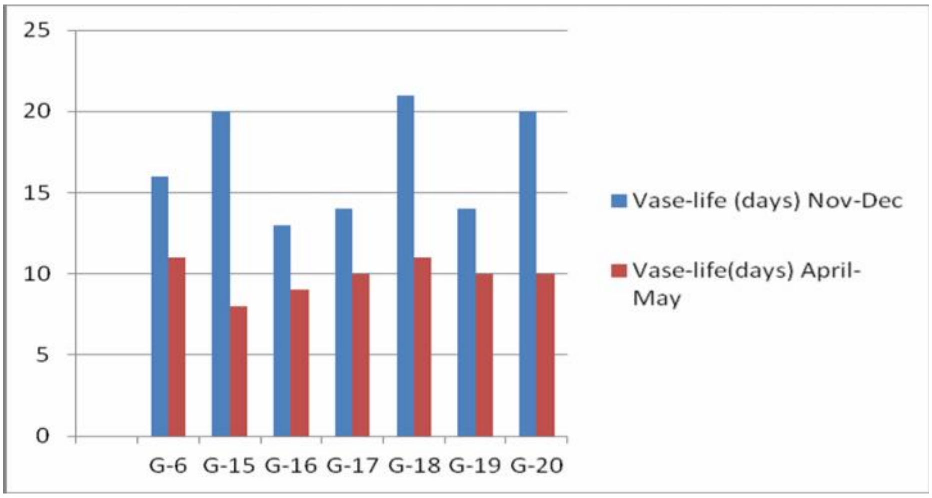


Fig 2: Vase-life of promising gerbera genotypes as affected by seasonal variation

Protected structures are meant for protection of crops from unfavourable environmental conditions, thereby extending the growing season. Improved growth conditions leads to increased product yield and quality[6]. In our experiment yield and quality of high value cut flowers like gerbera, carnation and alstroemeria was maintained almost throughout the year. The main reason behind this is microclimate inside protected structure is highly conducive. The most important climatic element is solar radiation, which affects all other factors, such as air and soil temperature, atmospheric pressure, relative humidity and rainfall. Solar radiation is important because it acts decisively in all life processes of the plants, such as: photosynthesis, transpiration, photoperiod, tissue growth, flowering, etc[7]. During winter season the mean day temperature was 6-$8^0$ C but inside the polyhouse it was about 8-$10^0$ C. For carnation cultivation a temperature range of 10-$15^0$ C is preferred. That could be the reason for high quality produce obtained from low cost polyhouse. However, during summer solar radiation is quite high, hence shade nets were used to minimise the effect of high temperatures, since these nets provide shading to the plants and have properties that improve microclimatic conditions in this environment[8]. Gerbera production under protected environment is highly recommended to achieve better productivity and quality of flowers as it protects against rain, wind and reduces the attack of pests and diseases[7]. Thus, low cost polyhouses could be a viable option for farmers of hilly areas. High value flower crops like carnation, gerbera and alstroemeria can be successfully grown in low cost polyhouses made of bamboo poles or locally available wood and UV stabilised polythene sheets, which gives an added advantage to even small and marginal farmers, who wish to take up floriculture for more profit but could not venture due to high initial cost. They can send their produce to nearby tourist places like Nainital, Dehradun, Rishikesh, Mussoorie etc and can get good premium price of their produce without the involvement of middlemen. It may open new avenues for increasing the acreage under intensive production and ultimately to increase the floricultural exports from our country.

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