

Gerbera Cultivation and Postharvest Management Practices in Kathmandu Valley

A. K. Acharya Msc¹, D. R Baral PhD², D. M. Gautam PhD² and U. K. Pun PhD³

ABSTRACT

A field survey was carried out to find out production and postharvest handling practices of gerbera adopted by the growers of Kathmandu, Bhaktapur, Lalitpur and Kavre districts during September to December, 2009. About 68 varieties of gerbera were found to be grown by the entrepreneurs. It was noticed that the production and handling practices differ with the growers and localities. Better quality gerbera flowers were produced with the abundant use of compost and organic matter rather than chemical fertilizer. It was necessary to raise the bed height above 2 feet in low lands whereas about 1 foot was enough in the uplands. Besides, timely adequate sanitation measures were needed for better quality and quantity production of the flower. Red and pink flowers were highly preferred in the market, while the purple color had the lowest preference. Total production of gerbera in Kathmandu valley was found to be 6,21,200 sticks per year. Out of total production, summer, autumn, spring and winter shared 32.03%, 29.38%, 24.50% and 14.09% respectively. Price of the cut flower highly varied with respect to the seasons. During winter, price of the flower was the highest. The postharvest loss was found higher (3.3%) in winter than in summer (2.9%). The major causes of postharvest losses were due to inappropriate handling of the cut flower and varietal characteristics of gerbera.

Key words: Cut flower, gerbera, postharvest, seasons, varieties, vase-life

INTRODUCTION

Nepal has predominantly an agriculture-based economy where floriculture sub-sector holds a great export potential. In Nepal, commercial flower production has been expanded to 34 districts throughout the country. Also, the production area under floriculture is gradually increasing throughout the country. This sector provides employment opportunities to about 2,500 people among which 60% of them are women (FAN, 2007). Floriculture in Nepal has been converted into an established business over a period of one and half decade. It was observed that the total turn over of this sector in 2006 was about 230 million rupees (FAN, 2007). In a recent estimation this value has increased to 560 million rupees in 2010 (FAN, 2010). Nepalese cut flowers stands at one of the most prioritized position in international market as compared to other agricultural products in terms of export market potential (UNCTAD/WTO, 2007).

Gerbera (*Gerbera jamesonii*) also known as Transvaal daisy or Barberton daisy, is a member of the Composite family. Flowers of gerbera are available in a wide range of colors, including yellow, orange, pink, crimson, red, purple and white. Gerbera is most commonly used worldwide as a cut flower (Emongor, 2004). Gerbera is one of the ten most popular commercial cut flowers in the world and according to the global trends in floriculture; it occupies the fourth place among cut flowers (Choudhary and Prasad, 2000).

¹ Horticulture Development Officer, DADO, Nawalparasi e-mail: anil-acharya@hotmail.com

² Professor, Institute of Agriculture and Animal Science, Rampur

³ Himalayan Flora Enterprises Pvt. Ltd., Lalitpur

The blooms are attractive, suitable for any type of floral arrangements and are available in different shades and hues. Besides floral arrangements, gerbera is widely used in bouquets and in dry flower crafts (Nair *et al.*, 2003).

Gerbera is one of the most important cut-flower species in Nepal which shows considerable demand in domestic and export markets. The daily demand of gerbera in Kathmandu is 1500-3000 sticks and cost of per stick gerbera is Rs.15.50. The area of gerbera cultivation in Nepal is 0.25 ha (5 Ropanies) (MOAC, 2009). Since the past 2-3 years, the domestic supply could not fulfill the total demand of gerbera and about 65% of the total demand was supplied by importing from India.

Generally gerbera is grown in Falgun-Chaitra or Shrawan-Bhadra in Kathmandu valley and production starts after 3 months of planting. In winter, especially, from October–February (Kartik-Falgun), there is high demand and low supply of cut flowers. Flower growers bring most of their domestic products (gerbera, carnation, gladiolus, Dutch rose) in the market after March–April (Chaitra-Baisakh) and do not get high price due to large supply. Besides, the problem with gerbera cut flowers is the short postharvest life (Wernett *et al.*, 1996). Low production due to fungal disease and high postharvest losses due to lack of postharvest treatment are the burning problems of the gerbera production and marketing in Nepal. Keeping quality is an important parameter for evaluation of cut flower quality, for both domestic and export markets (Nair *et al.*, 2003). The survey was carried out to know the existing situation of gerbera production and postharvest handling practices in Kathmandu valley.

MATERIALS AND METHODS

A field survey was carried out to analyze the existing situation of production and postharvest technology of gerbera in Kathmandu valley. Field survey was based on preliminary information regarding gerbera cultivation sites, type of promising varieties, cultural practices, types of soil, marketing system, and postharvest management aspects. The survey was conducted during September to December, 2009 in the existing 12 growers of different locations of Kathmandu valley. The surveyed locations were Dhulikhel, Bhaisepati, Kamalbinayak, Sipadole, Bajrabarahi, Godawari, Tokha, Sankhu, Bishalnagar, Kirtipur, and Dadhikot.

Besides the survey of growers' field, the questionnaires were filled and discussions were made with the retailers and wholesalers. Information was also gathered about sapling distribution, marketing, and postharvest aspects of the flower. The collected data from different sources like discussion, cultivation guide, questionnaires were entered in Microsoft Excel software. The data were analyzed by using SPSS 16.0 software package for descriptive and correlation analysis.

RESULTS AND DISCUSSION

During field observation, discussions with growers, retailers, wholesalers and from the questionnaires, following facts were found.

Shed house and field preparation

There was wide variation on shed house preparation, bed size, and planting system of gerbera. Sixty seven percent growers were using full closed shed house where as 33% growers had half closed shed house. It was observed that higher quality and production of gerbera could be obtained from full closed shed house system. Biradur and Khan (1996)

reported that it is very difficult to get good quality cut bloom of gerbera under open field condition. Similarly Emongor (2004) pointed out that cultivation of gerbera and other high valued horticultural crops (floriculture) under controlled environment (greenhouses) should be promoted.

There was a quite variation on plant spacing in the gerbera field. Plant spacing with 1x1 feet, 1.5x1 feet, 0.83x0.5 feet and 1x0.5 feet were observed at 33%, 25%, 25% and 17% in growers' field. It was recommended that space the plants 12 to 18 inches apart, being careful to plant the crown at or slightly above soil level (Tjia *et al.*, 2008).

Due to soil borne fungal problem in gerbera field, beds were raised in most of the plot but there was variation ranging from 0.3 to 2.5 feet. From the discussion, it was found that in low lands (Khet), due to high level of water level, there must be above 2 feet height of bed. If the field is in up lands (Bari), bed height might be 1 feet. This is for the precaution of root rot due to water level in the field. Growing gerberas in raised beds, mounds or containers is suggested during rainy season as excessive moisture would increase root rot incidence where drainage is a problem (Tjia *et al.*, 2008). The optimum bed height is shown in fig.1.

Fig.1: Optimum bed height in gerbera field

Variety and planting material used by gerbera growers

It was found that different varieties from different companies of gerbera were grown in Kathmandu valley. In Kathmandu, there were three agents supplying planting materials of gerbera. These agents were Flora Incorporated Trade, Tripureshwor; Crop Pro-Tech Nepal, The Standard Nursery, Bansbari; and Flora Nepal Pvt. Limited, Kupandole and were selling the plants of different companies Florist, Florist De Kwakel B.V., Holland; Schreurs, The Netherlands and Preesman India Breeding Pvt. Ltd., Mumbai, India respectively. Out of 12 respondents, 6 growers were using varieties of only Florist, 4 growers were using varieties of only Schreurs, and 1 grower was using varieties of both Florist and Schreurs, whereas another one grower was using varieties of both Florist and Preesman. Gauchan *et al.* (2009) reported that generally two types of gerbera i.e., single and double were found in Nepali market and its demand was around 1,500-2,500 sticks per day. They also reported that around 3,000 plants could be grown per ropani.

There was big variation in growing number of varieties, ranging from 4 to 20. The mean and standard deviation of adopting varieties for cultivation were 10 and 5.12 respectively.

Likewise, there was big variation in cultivating number and type of plants. In Kathmandu valley, 43235 plants were cultivated in different locations. Out of them, there were 61.6% tissue cultured and 38.4% desuckered (division) plants. Aswath and Choudhary (2004) reported that most of the commercial varieties of gerbera are multiplied through tissue culture. Also they stated that this method enables a million fold expansions per year of a desired plant. Likewise Shailaja *et al.* (2004) reported that due to a great deal of variation, seed propagation of gerbera is not always satisfactory and multiplication through division of clumps or rhizomes is common. The lists of growers, variety and number of plants are given in Table 1 and 2.

Table 1: No. of plants, production and price variation in different seasons

Respondent/Gerbera grower	No. of plants
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	Tissue culture	Sucker	Total
Bishwo Mani Pokharel, Kamalbinayak, Bhaktapur	10285		10285
Iora Nepal Pvt.Ltd, Bajrbarahi, Lalitpur		2500	2500
Achyut Dhungana, Bakhundole, Kavre	500		500
Govinda Dhungana, Bakhundole, Kavre	1000	1500	2500
Rajan Thapa, Bans tole, Bhaisepati, Kavre	2000	3000	5000
Mandir Shrestha, Kitani, Godawari, Lalitpur	4500		4500
Prabindra Maharjan, Tokha, Kathmandu	2000	4000	6000
Shreedhar Karki, Indrayani, Kathmandu	3500	1500	5000
Gyanendra Thapa, Sipadole, Bhaktapur		600	600
Khem Raj Sharma, Chundevi, Kathmandu	2000		2000
Mandhoj Thapa Magar, Chanlakhel, Kritipur, Kathmandu		350	350
Sushil Khadka, Gamcha, Dadhikot, Bhaktapur	850	3150	4000
Total	26635	16600	43235
Percentage	61.6	38.39	100

Table 2: Lists of grown varieties and their vase life

S.N.	Varieties	Vase life (days)	S.N.	Varieties	Vase life (days)	S.N.	Varieties	Vase life (days)
1	Aisha (mini)	17	24	Excellence	17	47	Quote	11
2	Ambiance	11	25	Explosive (mini)	15	48	Rosalin	11
3	Amulet	13	26	Fiction	17	49	Salvadore	17
4	AvantGarde	11	27	Fiorella	15	50	Samada	15
5	AveMaria	13	28	Flyer	15	51	Samson	13
6	Aventura	15	29	Foske		52	Sarinah	13
7	Bellezza	11	30	Fusion	15	53	Savannah	13
8	Bismarck	13	31	Golianth	15	54	Scope	14
9	Bison (mini)	15	32	Guarda	13	55	Shayna (mini)	15
10	Blessing		33	Illusion (mini)	15	56	Sunglow	13
11	Bonbons	13	34	Junkfrau	13	57	Sunway	13
12	Cacharelle	14	35	Kayak		58	Suri (mini)	17
13	Candella	15	36	Luxuria	15	59	Tambre	15
14	Carambol	15	37	Malibu	11	60	Tresor	13
15	Carmen	17	38	Marquis	15	61	Valletta	13
16	Crystal Kimsey (mini)	17	39	Mexx	17	62	Viper (mini)	15
17	Dalma	11	40	Paco	0	63	Viviane	13
18	DanaEllen	15	41	PalmBeach	11	64	Vulcan (mini)	15
19	Doni	13	42	Paradox	13	65	WinterQueen	13
20	DoubleDutch	11	43	Picobello	12	66	Wintergold	13
21	Ebony	15	44	Popov	15	67	Woman	15
22	Ecco	13	45	Primrose	11	68	Yanara	13
23	Essence	13	46	PurplePrince	13			

Age of plants and color preference of gerbera growers

Gerbera growers were cultivating plants of different age ranging from 4 to 96 months and on an average 24.5 months. Standard deviation 26.82 showed that there was big variation of age in the cultivated plants.

White, yellow, pink, orange, red and purple flowers of gerbera were mostly found in growers' field. It was found that there was variation of varieties and color of flowers grown by farmers. About 8.3% growers were cultivating 20 varieties with all 6 types of colors whereas 25% growers had only 3 types of colors (white, pink and red). Similarly, 50% and 16.7% growers were cultivating 5 and 4 types of colors respectively. Out of 6 colors, red had dominance over others having 34 scores, followed by pink, white, yellow, orange and purple having 30, 22, 21, 12 and 2 scores respectively. Thus, red and pink color varieties

were highly preferred by growers, whereas purple had the lowest preference. The flower colors variation observed in growers' field are shown in Table 3. FAN (2009) also reported that in Chitwan and Pokhara, red color was mostly accepted by the buyers in all types of flower including gladiolus, rose, gerbera and carnation. In addition, orange mixed with white which is very common variety of gladiolus was also liked by many consumers.

Table 3: Flower color variation in growers' field.

Color	Frequency in different respondents											
	1	2	3	4	5	6	7	8	9	10	11	12
White	4	1		1	2	2	2	4	2	2	1	1
Yellow	5	1	2	2	1	3	1	3				3
Pink	4	1	5	1	3	2	4	6	1	1	1	1
Orange	2	1	1		2	3		2				1
Red	4	2	2	3	1	2	2	5	3	5	2	3
Purple	1		1									
Total variety	20	6	11	7	9	12	9	20	6	8	4	9

Soil treatment, fertilizer and irrigation application

Soil treatment: During the field observation, three growers (25%) were not aware about the soil treatment practice and did not disinfect the soil. One grower (8.3%) had used *Trichoderma* while eight growers (66.7%) had used formalin for disinfection of soil. The dose of formalin application was varied in their field. It showed that growers were not sincere about the dose of formalin for disinfection of the soil.

For successful cultivation of gerbera, disinfection of soil is prerequisite (Kumar Florists, 2007). In particular, the fungus is a menace to gerbera. The various methods of sterilization are sun, steam, and chemical. In chemical, use of formalin @7.5-10 lit./100 square meter is recommended. The pure chemical should be diluted 10 times in water and then sprayed or drenched on beds and then covered with plastic for 7 days, after that, flushed the soil approximately with 100 liter of water per square meter to drain the traces.

Fertilizer and irrigation application: There was wide variation in the use of fertilizer in gerbera field. It was found that fertilizer calculation was very difficult for most of the growers and they were using fertilizers in their own practical way. DAP, urea, potash for the fulfillment of NPK; bone meal; oil cake; CaNO₃; ash; and micronutrients having Ca, Zn, B were extensively used in the field of gerbera, but doses and time of application varied among growers. According to the growers, 0.56 kg/plant (on an average) compost was applied in the gerbera field although ranges were 0.2 to 1 kg per plant. After planting, regular foliar spray of 20:20:20: NPK were applied at fortnight or a monthly interval in the gerbera's field. From the grower's view and observation, good quality flower could be produced with the abundant use of compost and organic matter rather than chemical fertilizer. According to cultivation guide, during vegetative growth, N:P:K::20:20:20@0.4 gm/plant every alternate day for first three months and once flowering commences, N:P:K::15:8:35@0.4 gm/plant every alternate day were recommended (Kumar Florists, 2007). Gurav *et al.* (2004) suggested that the application of 20:20:15 g N, P and K /m²/month was found effective in producing good quality and high number of flowers in gerbera while Sekar *et al.* (2003) reported that application of 300 and 200 mg N and K each per week resulted in production of superior and higher flowers in gerbera.

Six growers had their well for irrigation; others had water collection pond and canal. It was found that watering to foliage part had negative effect on quality production, so irrigation on furrow with the help of pipe was preferred. Kumar Florists (2007) recommended excessive watering is not good for gerbera production.

Cultivated variety and their vase life

There were 68 varieties cultivated in Kathmandu valley. Out of these, 9 varieties were mini type and 59 varieties were standard type (Table 2). The average vase life of the 68 varieties were 14 (13.8594) and minimum-maximum vase life ranges from 11 to 17 days according to variety catalogue of different companies (Preesman, 2007; Florist, 2007; Schreurs, 2007).

Insects pests, diseases and disorders

White fly, mites and aphids were major insects in gerbera where as Fusarium, root rot, crown rot, botrytis diseases were observed as major disease in the growers' field. Physiological disorders observed in the field were leaf folding, pseudo flower, twins flower, scape pitting or cracking and stem bending. Tjia *et al.* (2008) reported that gerberas are often attacked by insects like leaf miner, caterpillars, cutworms, spider mites and thrips. They also reported that a number of fungal diseases like gray mold (*Botrytis cinerea*) and powdery mildew (*Erysiphe cichoracearum*) occurs during periods of prolonged cloudy weather and high humidity in gerberas. The visual symptoms observed in gerbera field are shown in Fig.2.

Fig.2: Insect pests, diseases and disorders; a. *Fusarium*, b. Pseudo flower, c. Leaf folding, d. White fly, e. Mites, f. Twins flower

Chemicals and pesticides use in gerbera farming

Fungicides like Carbendazim, Mancozeb, Cupper oxychloride, Captan, Hexaconazol, Polyram, Calixin, Acrovat were being used by the growers in their field. Similarly, insecticides like Prime (Acetaprimide); Endosulphan; Larvine(Teodicarp) for cotton caterpillar; Interprit; Vertimex; Omite; Rogor; Nuvan; Kalmyte for mites, thrips and white fly; Flebendioxide; Admire; Chloropyriphos; Cypremethrin; Malathion; Victor; Fersa were being used. Besides this, some growers were also using antibiotics like Korsing Ag (Streptomycin sulphate+Tetracycline hydrochloride), Antibak, Biomycin (Kasugamycin 3%). There was no any scientific application of pesticides for plant protection measures. It was found that growers were applying different chemical pesticides without knowing their benefit and hazards. The common practices of pesticide application were found to be based on farmers' experiences and consultation with agrovets and pesticides sales agents. FAN (2007) reported that neither grower nor the pesticide dealers are aware of specific pesticides requirement of flower crops and for specific conditions

Crop stage and time of harvesting

Growers were well acquainted that the gerbera flowers should be harvested when the outer two rows of disc florets were opened which is important for the longevity of the cut flower. But practically, farmers do not practice it due to varying in demand which determined the amount to be harvested and package of transportation. Salunkhe *et al.* (1990) reported that the optimum time for harvesting gerbera cut flower is when the outer two rows of disc florets were opened where as Reid (2004) recommended that most gerbera varieties should be harvested when the 2 outer rows of disk florets have begun to open.

Table 4: Variation in harvesting days after planting

Growers (Res.)	Post-harvest loss		Total loss	Harvesting days after planting	Age of plant (month)	Harvesting practice	Harvesting Time
	Winter	summer					
1	5	3	8		11	Twisting	Morning and evening
2				90	96	Twisting	Morning

3	4	2	6	75	4	Twisting	Morning and evening
4	5	2	7	80	4	Twisting	Evening
5	7	5	12	75	4	Twisting	Evening
6	5	2	7	60	24	Twisting	Evening
7						Twisting	Evening
8	5	2	7	75	17	Twisting	Evening
9	7	5	12		10	Twisting	Morning
10	5	1	6		40	Twisting	Morning
11	3	2	5	75	24	Twisting	Morning
12	7	5	12	70	36	Twisting	Morning and evening
Average	5.3	2.9	8.2	75	24.55		

The common planting materials of gerbera used by growers were either imported tissue cultured plantlets or desuckered 2-3 years' old plant. So, there was high variation on harvesting days after planting, it ranges from 60 to 90 days after planting (Table 4). About 42% growers harvested flowers in the evening, 33% farmers harvested in the morning whereas 25% farmers harvested flowers both in the morning and evening as per their time availability to send to wholesale market. All growers were found to be practicing twisting method for harvesting of the flower, not by cutting the stalk. Reid (2004) reported that gerbera flowers are harvested by twisting the stems off near the point of attachment to the rhizome; this is thought to encourage subsequent flower production.

Total annual production of gerbera in terms of money was calculated about 6.5 millions excluding post-harvest loss. The average postharvest loss was about 8.2% (Table 4).

Table 5: Seasonal variation on production of gerbera per plant

Description	Maximum	Mean	Std. Deviation
Production per plant in winter	3.75	1.5729	1.42898
Production per plant in summer	11.25	5.4091	2.95408
Production per plant in autumn	11.25	5.2972	3.14246
Production per plant in spring	7.50	2.9207	2.83660

Table 6: Gerbera cut flower production in Kathmandu

Respondents	Sticks production				Total	Annual/plant
	Winter	Spring	Summer	Autumn		
1	35000	45000	60000	60000	200000	19.45
2	6000	10000	15000	15000	46000	18.4
3			4000	4000	8000	16
4	5000	10000	17000	17000	49000	19.6
5	8000	10000	16000	16000	50000	10
6	10000	33000	20000	20000	83000	18.44
7	2500	4200	10000	6500	23200	4.64
8	0	0	2500	2500	5000	8.33
9	6000	10000	22500	22500	61000	30.5
10	0	0	2000	3000	5000	14.29
11	15000	30000	30000	16000	91000	22.75
Total	87500	152200	199000	182500	621200	
%	14.09	24.50	32.03	29.38		
Average						16.58

Cut flower transportation and selling

Gerbera flowers were harvested and each flower was fitted with plastic cap in order to protect flower from floret

Table 7: Means of cut flower transportation

Means	Frequency	Percent
Motorcycle	7	58.34
Own vehicle	3	25
Public bus	1	8.33
Motorcycle/Tata mobile	1	8.33
Total	12	100.0

destruction during handling. Then, flowers were bunched keeping 10 sticks per bunch with rubber band and wrapped with newspaper for transportation. It was found that 58.34% growers used motorcycle, 25% used own vehicle, 8.33% used public bus, and 8.33% growers (Table 7) used both motorcycle and Tata Mobile for transportation.

Four wholesalers were involved in supply of gerbera flower in Kathmandu. They were Flora Incorporated Trade, Tripureshwor; United Flora Pvt. Limited, Teku; Flora Nepal Pvt. Limited, Kupandole; and Bagmati Flora Pvt. Limited. 41.67%, 33.33%, 16.67% and 8.33% growers were found to be selling gerbera cut flowers in Bagmati Flora, United Flora, Flora Incorporated, and Flora Nepal respectively. From the market observation and discussion, it was found that there was variation in gerbera cut flower's price among the wholesalers. Each wholesaler has its own grading and pricing system for the cut flowers.

Seasonal variation in the cut flower prices

Price of the cut flower was highly varied with respect to the seasons (Table 8). During winter, price of the flower was found the highest. It was also reported by FAN (2007). It was due to the lower production and higher domestic demand in winter.

Post-harvest loss

The postharvest loss (Table 4) was found higher (3.3%) in winter than in summer (2.9%). The problem of stem breakage and bending was found higher during winter. The stem was more compact during winter. It might be due to the effect of low temperature (physical

Table 8: Price (per stick) of gerbera cut flower in different seasons

Seasons	Minimum	Maximum	Mean	Std. Deviation
Winter	11.00	15.00	12.91	1.37510
Spring	6.00	10.00	7.82	0.98165
Summer	8.00	13.00	10.67	1.66969
Autumn	8.00	13.00	10.67	1.66969
Average	9.00	12.75	10.46	1.26056

injury). Physiological loss was higher during summer possibly due to higher rate of respiration and transpiration. Salunkhe *et al.* (1990) explained that the flowers having higher specific weight at the time of cutting normally have better keeping quality which is reflected in press of petal tissues. They also stated that the summer crop produces flowers with long lasting qualities and performs better in the market than those produced in the winter. They found that summer flowers also had better keeping qualities than the autumn flowers.

It was observed that the major causes of postharvest losses were during handling and transportation of flowers. Unplanned production often causes selling problem in the market.

CONCLUSIONS

Based on the conducted survey, it can be concluded as

- Due to severity of soil borne disease in the gerbera field, soil treatment should be done for better production.
- Good quality flower could be produced with the abundant use of compost and organic matter rather than chemical fertilizer.
- It was necessary to raise the bed above 2 feet height in low lands (Khet) to avoid water lodging condition whereas in the up lands (Bari), bed height might be 1 feet.

- Regular picking of dry and diseased leaf, weeding, removal of crowded foliage were crucial sanitation and cultural practices for better quality production.
- Red and pink colors were highly preferred varieties of gerbera while the purple color had the lowest preference.
- The postharvest loss was found higher in winter than in summer. The problem of stem breakage and bending was found higher during winter. The major causes of postharvest losses were due to inappropriate handling and transportation of the cut flower. The varietal characteristics were also the cause of durability of the flower.

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