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ECONOMIC ANALYSIS OF CARNATION CV. 'MASTER' CUT FLOWER PRODUCTION AS INFLUENCED BY FERTILIZER SCHEDULES UNDER NATURALLY VENTILATED POLYHOUSE

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Key words: Economic analysis, Carnation, Cost of cultivation, Gross income, Cut flower production

Abstract

The present investigation was carried out in naturally ventilated polyhouse during the year 2010 and 2011 to ascertain the effect of 16 different fertilizer doses and methods of application on cut flower yield and economics of carnation (*Dianthus caryophyllus* L.) cv. Master. The results revealed that the overall cost of cultivation as well as the economics of carnation cut flower production was significantly influenced by the fertilizer application. Carnation cv. Master plants fertigated with 250 ppm N and K through urea and MOP in combination with 250 ppm NPK foliar spray through Sujala (19 : 19 : 19 NPK) once a week produced maximum saleable flowers (517.25 nos./m^2) for three flushes over the recommended practice (437.50 nos./m^2). The same treatment also recorded maximum returns of 3470.33/m^2 with highest B : C ratio of 2.27 for three flushes.

Introduction

Carnation (*Dianthus caryophyllus* L.) is one of the most important commercial cut flower in the global florist trade owing to its excellent keeping quality, wide range of available colours and ability to withstand long distance transportation. Being a greenhouse crop, fertilizer applications play a key role in increasing quality and quantity of carnation flowers. It is well established fact that carnation plants make a good reserve of N at tufting stage which is utilized during flowering (Arora and Gill 1995). The deficiency of any one or more of the major nutrients can drastically limit the growth of the plants leading to reduction in productivity and quality of the flowers produced. Over feeding of the plants, on the other hand, results in the accumulation of salts in the soil which prevents the uptake of water and sometimes causes wilting of them. Master is a red colour standard cultivar of carnation and has been recommended by Dr. YS Parmar University of Horticulture and Forestry, Solan-Himachal Pradesh for commercial cultivation in the mid-hill zones of Himachal Pradesh. Comparatively, this cultivar is preferred by the consumers and its growers fetches better remuneratives in the market. It is very less prone to calyx splitting and is a good yielder. Hence, it necessitates for the standardization of the nutritional schedule for its commercial cultivation so that growers can obtain good yields and fetches better prices. The present investigation was therefore carried out with the thrust to optimize a cost-effective dose of fertilizers which will enhance the growth and flowering of carnation grown in naturally ventilated polyhouses under the mid-hill conditions of Himachal Pradesh.

Based on the part information of Ph. D. thesis of the first author (AV) submitted to Dr. YS Parmar University of Horticulture and Forestry, Solan-173 230, Himachal Pradesh in the year 2011. *Author for correspondence: <arvindersingh4601@yahoo.com>. [1]Division of Vegetable Science and Floriculture, Sher-e-Kashmir University of Science and Technology, Jammu.

Material and Methods

The present investigation was carried out at the Research Farm of Department of Floriculture and Landscaping, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan under naturally ventilated polyhouse during 2010 and 2011. The farm is located between 30°52'30" north latitude and 77°11'30" east longitude at an altitude of 1276 meters above mean sea level. The area falls in the mid-hill zone of Himachal Pradesh with sub-temperate to sub-tropical climate.

The experiment was laid out in completely randomized design (CRD) with 16 different treatments (Table 1) replicated thrice. Rooted cuttings of carnation cv. 'Master' were planted in a sterilized growing medium consisting of soil : FYM : coco peat (2 : 1 : 1, v/v) on 9th of March, 2010 at a spacing of 20 × 20 cm accommodating 25 plants per bed of 1 m × 1 m dimensions. Standard cultural practices were followed during the entire cropping season.

Nutritional treatments were started after 40 days of planting and continued up to the bud formation stage (5 mm size). Foliar spray was done during morning hours (8.00 - 9.00 a.m.). Teepol (0.05%) was used as a surfactant. The plots receiving foliar application were sprayed till runoff point (2.5 l/m^2). Fertigation was done during evening hours. Each plot was fertigated with 5 litres of nutrient solution as per the treatment requirements. University recommended practice comprising of basal doses of NPK @10 g/m^2 each + biofertilizer mixture (VAM + azospirillum + PSM) @5 g/plant applied at the time of planting and 100 ppm N (60 ppm through Multi-K and calcium nitrate, rest 40 ppm ammonical nitrogen in the form of urea) and 140 ppm K (through Multi - K) twice a week after 40 days of planting was taken as control.

The yield was calculated for one square metre (i.e. total number of saleable flowers obtained per m^2 for three flowering flushes) by multiplying the number of cut stems obtained per plant by the number of plants/m^2 and expresse in numbers. Carnation plants grown under naturally ventilated polyhouses produces flowers of marketable acceptability and quality for three flowering flushes afterwards the returns are not economical. Hence the data were recorded only for first three flowering flushes. The economics of the individual treatment were calculated based on the total cost of cultivation and gross income and were expressed in per m^2 basis. The expenditures both recurring and non recurring incurred during the cropping period were computed based on the investment on preparatory cost including planting materials. Cost of production was calculated by taking into account the cost of land preparation, material inputs, irrigation, harvesting and assembling expenses etc. with labour charges taken as `120/manday. Gross monetary returns (`/m^2) was worked out for different treatments as:

Gross monetary returns (Rs./m^2) = Total saleable flowers/m^2 × market rate

Net returns (Rs./m^2) = Gross returns/m^2 – total expenditure/ m^2

Benefit: Cost ratio: Net returns/total expenditure

Considering the stem length, cut flowers were graded as A (60 - 70 cm), B (50 - 60 cm) and C (40 - 50 cm). For calculating the gross monetary return, selling price of the cut flower according to different grades which were taken as Rs.7 for A-Grade, Rs.5 for B-Grade and Rs.3 for C-grade flowers.

Results and Discussion

Cost of cultivation is the most important single factor which decides the adoption of any improved practices by the grower. The cost-benefit ratio of treatments is another most important factor that determines its usefulness and acceptance by the grower. A treatment should not only be effective but also should be profitable proposition to be acceptance by a grower. In the present study, the different treatments showed clear impact on the comparative economics of the

production of cut flowers in carnation. The details pertaining to costs and returns are given in Table 1.

The pooled yield potentiality of different treatments as influenced by the different fertilizers doses and methods of application of fertilizers are given in Table 1. It is apparent from the data, that the treatment T_{13} comprising of 250 ppm N and K fertigation through Urea and MOP + 250 ppm NPK foliar spray through Sujala once a week recorded significantly highest yield of saleable cut flowers/m^2 (517.25) compared to other treatments followed by T_{12} recording 503.25 number of cut flowers/m^2 whereas the lowest yield of saleable flowers/m^2 (437.50) was recorded in T_0 (control). Treatment T_{13} recorded an increase yield of 18.23% over control as against the lowest increase of 2.06% in T_4. This increase in yield might be due to reduced leaching losses and improved fertilizer use efficiency through timely applications of N, P and K as a consequence of adequate soil moisture availability due to frequent fertigation that had led to increased photosynthetic rate. In addition foliar fertilization promoted better uptake of N, P and K by the roots and hence resulted in higher utilization and translocation (Beaton and Espinosa 1996; Romheld and El-Fouly 1999). The efficacy of foliar fertilization is higher than that of soil fertilization because of the supply of required nutrient directly to the location of demand in the leaves and its relatively quick absorption. The higher flower yield with the scheduled application of T_{13} may be ascribed to the fact that this treatment might have supplied higher amounts of N, P and K in available form and production of more flowering shoots in comparison to other treatments. Nitrogen increases the availability of cytokinins that are known to promote the development of more lateral branches/shoots per plant, which means more branching in a plant. The effect is manifested in the production of significantly higher number of shoots by the plants supplied with higher levels of NPK which in turn results in an increase in the number of cut flowers per plant. Different studies conducted have reported increased yield of cut flowers stems and quality cut flowers in various cut flower crops including carnation. Ashok *et al*. (1999) reported fertigation with ammonium nitrate at the rate of 150 ppm recorded the higher flower yield (153 flowers/m^2) compared to control. Sarkar and Roychoudhary (2003) reported that fertigation of N and P @ 200 ppm each twice a week recorded the highest flower yield per plant in carnation cv. 'Chaubad Mixed'. Kore *et al*. (2003) reported maximum flower yield with WSF (AQUAFERT, 19 : 19 : 19, NPK) at 75% of the RDF in China aster cv. 'Ostrich Plume Mixed'. Barman *et al*. (2006) recorded highest flower yield per metre square per annum in rose cv. 'First Red' with 200 and 300 kg N and K_2O/ha/year$^-$ through water soluble fertilizers. Verma (2001) observed highest number of cut flowers per plant in carnation cv. 'Impala' with the foliar application of 1500 ppm N. Verma (2003) also reported maximum cut flower yield per plant with foliar application of 1000 ppm N weekly and minimum with control in carnation cvs. 'White Candy' and 'Red Corso'. In another study, Qasim *et al*. (2008) ascertained the influence of two levels (500 and 250 ml) of NPK fertigation applied at 2, 4 and 6 days interval on plant growth and flowering in two rose (*Rosa hybrida* L.) cvs. 'Amalia' and 'Anjleeq' and recorded highest number of flowers/plant with fertigation @ 500 ml at 2 days interval. Foliar application of 0.6% Sangral (containing macro-nutrients (20% N, 20% P, 20% K, 0.12% Mg) and micro-elements (70 ppm Fe, 14 ppm Zn, 16 ppm Cu, 42 ppm Mn,72 ppm B and 24 ppm Mo) recorded the highest number of flowers per plant in carnation cv. 'Red Sim' (El-Naggar 2009). Verma (2001) found foliar application of higher dose of nitrogen (1500 ppm) to increase the percentage of maximum 'A'-grade flowers over control. Bhalla *et al*. (2007) recorded higher percentage of A-grade flowers (97.33%) with water soluble fertilizers in sand: soil: vermicompost (1 : 1 : 1, v/v) of carnation cv. 'Raggio-de-Sole' and 'Murcia'. Arvinder *et al.* 2013 reported highest number of cut flowers

Table 1. Details of economics of carnation cut flower production per square meter for three flower flushes as influenced by different fertilization treatments.

	Cost of different operations								
Treat-ments	Depreciation cost@10% of Rs. 300/m^2 of low-cost polyhouse constructed four years before (Rs.)	Labour cost (land preparation + planting + intercultural operations + harvesting and assembling in Rs.)	Cost of growing media (Rs.)	Cost of rooted cuttings (Rs.)	Fertilizer costs (Rs.)	Plant protection chemicals (Rs.)	Expenditure incurred on irrigation water, electricity (Rs.)	Marketing (transportation, grading, packing) (Rs.)	Total expenditure (Rs.)
T_1	30	490	33	150	19.09	139.25	121	65.62	1047.96
T_2	30	490	33	150	15.66	139.25	121	68.10	1047.01
T_3	30	490	33	150	17.54	139.25	121	68.36	1049.15
T_4	30	490	33	150	17.54	139.25	121	66.97	1047.76
T_5	30	490	33	150	17.54	139.25	121	67.61	1048.40
T_6	30	490	33	150	20.08	139.25	121	67.23	1050.56
T_7	30	490	33	150	20.08	139.25	121	67.16	1050.49
T_8	30	490	33	150	19.46	139.25	121	66.45	1049.16
T_9	30	490	33	150	22.48	139.25	121	67.87	1053.60
T_{10}	30	490	33	150	22.48	139.25	121	68.21	1053.94
T_{11}	30	490	33	150	16.86	139.25	121	73.23	1053.34
T_{12}	30	490	33	150	19.15	139.25	121	75.49	1057.89
T_{13}	30	490	33	150	21.43	139.25	121	77.59	1062.27
T_{14}	30	490	33	150	13.43	139.25	121	69.71	1046.39
T_{15}	30	490	33	150	14.57	139.25	121	72.00	1049.82
T_{16}	30	490	33	150	15.72	139.25	121	73.39	1052.36

Table 2. Comparative yield potentiality of different treatments and cost benefit ratio per square meter for three flower flushes.

Treatments		No. of flowers			Total yield of saleable flowers/ m^2 (Nos.)	Per cent yield increase over recom-mended practices	Total expen-diture (**Rs.**)	Gross returns (**Rs.**)	Net returns (**Rs.**)	Benefit: cost ratio
		A-Grade	B-Grade	C-Grade						
T_1	Recommended practices	362.78	53.77	20.96	437.50	-	1047.96	2871.14	1823.18	1.74:1
T_2	75 ppm NPK fertigation through Sujala on alternate days in a week	374.41	56.25	23.34	454.00	3.77	1047.01	2972.16	1925.15	1.84:1
T_3	150 ppm NPK fertigation through Sujala twice a week	371.85	57.88	26.02	455.75	4.17	1049.15	2970.40	1921.25	1.83:1
T_4	300 ppm NPK fertigation through Sujala once a week	369.70	51.88	24.91	446.50	2.06	1047.76	2922.07	1874.31	1.79:1
T_5	100 ppm NPK fertigation through Sujala on alternate days in a week	373.58	51.97	25.20	450.75	3.03	1048.40	2950.52	1902.12	1.81:1
T_6	200 ppm NPK fertigation through Sujala twice a week	374.78	51.37	22.10	448.25	2.46	1050.56	2946.62	1896.06	1.80:1
T_7	400 ppm NPK fertigation through Sujala once a week	371.72	52.03	24.00	447.75	2.34	1050.49	2934.20	1883.71	1.79:1
T_8	125 ppm NPK fertigation through Sujala on alternate days in a week	369.15	51.43	22.42	443.00	1.26	1049.16	2908.47	1859.31	1.77:1
T_9	250 ppm NPK fertigation through Sujala twice a week	380.55	51.13	20.82	452.50	3.43	1053.60	2981.98	1928.38	1.83:1
T_{10}	500 ppm NPK fertigation through Sujala once a week	382.35	51.07	21.33	454.75	3.94	1053.94	2995.80	1941.86	1.84:1
T_{11}	150 ppm N and K fertigation through urea and MOP + 150 ppm NPK foliar spray through Sujala once a week	421.26	46.97	20.02	488.25	11.60	1053.34	3243.74	2190.40	2.08:1
T_{12}	200 ppm N and K fertigation through urea and MOP + 200 ppm NPK foliar spray through Sujala once a week	438.98	46.50	17.76	503.25	15.03	1057.89	3358.69	2300.80	2.17:1
T_{13}	250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar spray through Sujala once a week	458.18	42.93	16.14	517.25	18.23	1062.27	3470.33	2408.06	2.27:1
T_{14}	150 ppm N and K fertigation through urea and MOP + 150 ppm NPK foliar spray through Sujala fortnightly	395.69	50.84	18.22	464.75	6.23	1046.39	3078.69	2032.30	1.94:1
T_{15}	200 ppm N and K fertigation through urea and MOP + 200 ppm NPK foliar spray through Sujala fortnightly	412.75	47.86	19.39	480.00	9.71	1049.82	3186.72	2136.90	2.04:1
T_{16}	250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar spray through Sujala fortnightly	421.24	48.68	19.33	489.25	11.83	1052.36	3250.09	2197.73	2.09:1

Multi-K is a water soluble fertilizer containing 13% N, 0% P and 45% K; Urea contains 46%N; Muriate of potash (MOP) contains 60% K; Sujala is a water soluble fertilizer containing 19% N, 19% P and 19% K.

per metre square in carnation cv. Master with the application of water soluble fertilizer sujala (19 :19 : 19 NPK) grown under polyhouse in mid-hill zones of Himachal Pradesh. The economics under various treatments were worked out on the basis of yield and presented in Table 2.

Among all the treatments, the highest total expenditure of Rs.1062.27/m^2 was incurred in T_{13} comprising 250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar spray through Sujala once a week followed by T_{12} (Rs.1057.89) and lowest of Rs.1046.39 in T_{14} comprising of 150 ppm N and K fertigation through urea and MOP + 150 ppm NPK foliar spray through Sujala fortnightly.

Treatment T_{13} comprising of 250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar spray through Sujala once a week recorded the highest gross returns /m^2 (Rs.3470.33) followed by Rs.3358.69 in T_{12} whereas lowest (Rs.2871.14) was recorded in control.

Treatment T_{13} comprising of 250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar spray through Sujala once a week recorded the highest net returns/m^2 (Rs.2408.06) followed by Rs.2300.80 in T_{12} whereas lowest (Rs.1823.18) was recorded in T_0 (recommended practices).

While evaluating the cost of production for different treatments, it was observed that the plants treated with T_{13} comprising of 250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar spray through Sujala once a week resulted in maximum benefit cost ratio (2.27 : 1) while the minimum benefit cost ratio (1.74 : 1) was recorded in the T_1 i.e. Recommended practices. The economic value of a crop is determined by its yield and quality. If growing conditions provide required microclimate and nutrition, plants exhibit full expression of the genetic potential, yield and quality for long period. In the present investigations, economic analysis of the best treatment revealed that application of T_{13} resulted maximum return over the recommended practices. This increase in monetary return may be attributed to higher cut flower yield. It could hence be concluded from the present studies that 250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar spray through Sujala once a week resulted in improvement for most of the economical parameters of carnation cv. 'Master' recording maximum economic returns and highest benefit-cost ratio to the farmers of the mid-hill zones of Himachal Pradesh.

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