



## Response of carnation (*Dianthus caryophyllus*) cv Master to water soluble fertilizer Sujala (19:19:19 NPK)

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### ABSTRACT

The present investigation was conducted at the Research Farm of The Department of Floriculture and Landscaping, Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during the year 2010 and 2011 to ascertain the response of carnation (*Dianthus caryophyllus* L.) cv Master to different doses and methods of application of water soluble fertilizer Sujala (19:19:19 NPK). The plants receiving treatment of 250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar spray through Sujala once a week (T<sub>13</sub>) showed significant increase in the vegetative growth characteristics (plant height and stem length) as well as stimulated flowering parameters, viz. reduced the number of days to bud formation, first flowering, enhanced both the number of flowers per plant and flower size, reduced the number of days to harvesting stage, increasing the duration of flowering, weight of cut flower stem per plant and vase life in comparison to the recommended practices.

**Key words:** Carnation, Fertigation, Foliar application, Sujala, Water soluble fertilizer

Carnation (*Dianthus caryophyllus* L.) is one of the most important commercial cut flower in the global florist trade. Balanced fertilization is very essential for obtaining optimum plant growth and higher yield of good quality flowers. Carnation being a shallow rooted crop needs a regular supply of nutrients throughout its life cycle. 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). Fertigation is a noble approach that has gained importance now a days due to availability of better quality water soluble fertilizers for commercial flower production in various greenhouse programmes. Keeping in view importance of this crop in floriculture industry the present investigation was carried out with the objectives to optimize the dose of Sujala fertilizer as fertigation and foliar application and their effect on growth and flowering traits of carnation cv 'Master'.

### MATERIALS AND METHODS

The experiment was laid out in Completely Randomized Design (CRD) with 16 different treatments, viz. T<sub>1</sub>

(Recommended practice, i.e. basal doses of NPK @10g/m<sup>2</sup> each plus biofertilizer mixture (VAM+ Azospirillum +PSM) @5g/plant applied at the time of planting. In addition to this, 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 ), T<sub>2</sub>(75 ppm NPK fertigation through Sujala on alternate days in a week), T<sub>3</sub> (150 ppm NPK fertigation through Sujala twice a week), T<sub>4</sub> (300 ppm NPK fertigation through Sujala once a week), T<sub>5</sub> (100 ppm NPK fertigation through Sujala on alternate days in a week), T<sub>6</sub> (200 ppm NPK fertigation through Sujala twice a week), T<sub>7</sub> (400 ppm NPK fertigation through Sujala once a week), T<sub>8</sub> (125 ppm NPK fertigation through Sujala on alternate days in a week), T<sub>9</sub> (250 ppm NPK fertigation through Sujala twice a week), T<sub>10</sub> (500 ppm NPK fertigation through Sujala once a week), T<sub>11</sub> (150 ppm N and K fertigation through urea and MOP + 150 ppm NPK foliar spray through Sujala once a week), T<sub>12</sub> (200 ppm N and K fertigation through urea and MOP + 200 ppm NPK foliar spray through Sujala once a week), T<sub>13</sub> (250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar spray through Sujala once a week), T<sub>14</sub> (150 ppm N and K fertigation through urea and MOP + 150 ppm NPK foliar spray through Sujala fortnightly), T<sub>15</sub> (200 ppm N and K fertigation through urea and MOP + 200 ppm NPK foliar spray through Sujala fortnightly), T<sub>16</sub> (250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar

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spray through Sujala fortnightly) 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 2010 at a spacing of 20 cm × 20 cm accommodating 25 plants per bed inside a naturally ventilated polyhouse. Judicious watering was done initially at regular intervals till the plants get established. 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 AM) with the help of Knap-sack sprayer. Teepol (0.05%) was used as a surfactant. The plots receiving foliar application were sprayed till runoff point (2.5 l/m<sup>2</sup>). The fertigation treatments were done during the evening hours. Each plot was fertigated with 5 litres of nutrient solution as per the treatments. All the cultural operations, viz. pinching, disbudding, staking, hoeing were performed routinely. The data was recorded for three consecutive flowering flushes. The data pertaining to first two flushes were recorded in 2010 and the third flush was recorded in 2011.

## RESULTS AND DISCUSSION

### *Vegetative growth parameter*

The different nutritional treatments have significantly influenced the various growth and flowering parameters of carnation cv Master under study. Data presented in Table 1 revealed that treatment T<sub>13</sub> comprising 250 ppm N and K fertigation through urea and MOP + 250 ppm NPK foliar spray through Sujala once a week exhibited plants of maximum height (84.04 cm) and it was minimum (67.99 cm) in T<sub>2</sub> which proved statistically at par with T<sub>4</sub>, T<sub>6</sub> and T<sub>7</sub>. The more plant height in this treatment might be due to the fact that fertigation increases fertilizer use efficiency of applied nutrients, i.e. N, P and K, thus, increased nutrient contents might have accelerated the rates of various physiological and metabolic processes in the plant system that ultimately resulted in better plant growth (Hipps 1997 and Treder 2006). In addition, foliar application of NPK through water soluble fertilizer (Sujala) at higher concentrations promoted the vegetative growth and dry matter accumulation.

Increase in plant height with fertigation of 80% recommended water soluble fertilizer was reported by Munikrishnappa *et al.* (2002) in tuberose, Sujatha *et al.* (2002) in gerbera and Qasim *et al.* (2008) in rose. Minimum plant height (67.99 cm) was recorded with treatment T<sub>2</sub> (75 ppm NPK fertigation through Sujala on alternate day in a week) which may be ascribed to the reason that lower doses of NPK could not contribute for the better growth of plants thus acquired less plant height.

The maximum stem length (68.66 cm) was recorded in plants receiving treatment T<sub>13</sub> which was statistically at par with T<sub>11</sub> and T<sub>12</sub>. However, minimum stem length (57.35 cm) was registered with the treatment T<sub>10</sub>. Owing to the fact that treatment T<sub>13</sub> has produced longest plants, hence more stem

length has also been recorded in the said treatment. Fertigation helped in uniform distribution besides better timings for application of water and nutrients, i.e. N, P and K which ultimately enhanced the plant height and in turn the stem length (Raina *et al.* 2005, Raina 2002). In addition to fertigation, the foliar application of N, P and K supplemented the fertigation in terms of better fertilizer utilization by the roots and hence, an increase in stem length has been observed. These results are in consonance with the earlier findings of Bhalla *et al.* (2007) and El-Naggar (2009) in carnation.

### *Flowering parameters*

The maximum cut flower yield per plant (6.90) was obtained with application of treatment T<sub>13</sub>, whereas minimum number of cut flowers (5.83) was obtained with T<sub>1</sub>. 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). These results are in close conformity with the earlier findings of Verma (2003) and Sarkar and Roychoudhary (2003) who also found that fertigation is beneficial in producing higher flower yield per plant in carnation. 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).

The maximum flower size (7.00 cm) was recorded in treatment T<sub>13</sub> whereas cut flowers of minimum size (5.60 cm) were recorded with T<sub>2</sub>. The increase in flower size may be attributed to enhanced utilization and translocation of metabolites required for growth with increase in levels of applied N, P and K. Bhalla *et al.* (2007) and El-Naggar (2009) in carnation. An increase in weight of the cut stems (38.03 g) with treatment T<sub>13</sub> was noticed in comparison to the recommended practice. It might be attributed to stimulation of growth and photosynthesis and subsequent translocation of assimilates to sustain the growth of developing shoots. These results are in consonance with the findings of Sarkar and Roychoudhary (2003) in carnation.

Cut flowers with maximum vase life (12.32 days) were recorded in treatment T<sub>13</sub> and minimum (9.54 days) in T<sub>2</sub>. The cut flowers exhibited increase in vase life with the increasing doses of N, P and K but in actual there had been an increase in vase life only for 2.78 days if we compare T<sub>13</sub> and T<sub>2</sub>. As it is well documented that P and K generally act as protective elements and known to reduce the rate of flower senescence. The phosphorous is believed to be participated

Table 1 Response of carnation (*Dianthus caryophyllus*) cv Master to different doses and methods of application of water soluble fertilizer Sujala, 19:19:19 NPK (Data are the pooled means of three flowering flushes)

Treatment	Plant height (cm)	Days taken to flower bud formation	Days taken to first flowering	Number of flowers/plant	Stem length (cm)	Flower size (cm)	Days taken to reach harvesting stage	Flowering duration (days)	Weight of cut flower stem (g)	Vase life (days)
T <sub>1</sub>	71.30	109.64	134.16	5.83	62.86	5.68	153.67	21.40	31.26	9.90
T <sub>2</sub>	67.99	105.28	134.77	6.06	61.17	5.60	151.80	20.10	30.17	9.54
T <sub>3</sub>	70.96	106.11	132.63	6.08	62.28	5.68	150.40	21.23	29.03	10.80
T <sub>4</sub>	69.31	105.78	132.21	5.96	59.84	5.80	149.30	20.24	29.57	10.03
T <sub>5</sub>	71.44	105.82	133.40	6.01	62.01	5.98	150.90	20.22	31.76	10.13
T <sub>6</sub>	69.23	105.38	134.48	5.97	59.07	5.91	152.10	20.17	31.61	10.51
T <sub>7</sub>	68.67	105.32	133.24	5.96	58.30	6.00	150.30	20.11	32.58	10.38
T <sub>8</sub>	69.43	106.18	133.25	5.90	59.32	6.09	151.30	20.90	31.78	10.08
T <sub>9</sub>	70.94	104.80	132.81	6.03	63.52	5.88	150.70	21.14	32.54	10.20
T <sub>10</sub>	69.81	105.78	132.63	6.12	57.35	5.89	151.00	21.40	33.37	10.94
T <sub>11</sub>	80.26	103.21	131.85	6.51	66.56	6.42	151.30	22.64	35.32	11.66
T <sub>12</sub>	81.87	102.63	131.21	6.71	68.18	6.72	150.70	22.90	36.01	11.80
T <sub>13</sub>	84.04	102.18	129.91	6.90	68.66	7.00	148.23	23.17	38.03	12.32
T <sub>14</sub>	76.53	104.46	132.40	6.20	64.45	5.95	150.70	21.21	32.78	11.23
T <sub>15</sub>	77.20	104.01	133.02	6.40	64.94	6.23	151.30	21.73	34.27	11.30
T <sub>16</sub>	78.00	104.90	133.42	6.52	65.59	6.40	150.97	22.20	34.80	11.57
CD <sub>(0.05)</sub>	1.43	1.64	0.89	0.16	3.12	0.15	1.23	0.49	0.69	0.33

in the skelton of plasma membrane, nucleic acid as well as co-enzymes and subsequently lower down the respiratory activities and degree of dehydration. Thus, increases vase life. Similarly, K is known to increase resistance of plants and flowers to the adverse conditions and also provide mechanical strength to the flower petals and stem tissues, so helps in increasing the vase life of gladiolus spikes (Dubey *et al.* 2010). These results got the support from the findings of Ogawa *et al.* (2005) and Bhalla *et al.* (2007) in carnation.

Time taken to flower bud formation, first flowering and harvesting stage was found to be influenced with NPK fertilizers and their methods of application. Lesser number of days to flower bud formation (102.18 days), first flowering (129.91 days) and harvesting stage (148.23 days) were recorded with the increasing dose of water soluble fertilizers applied through fertigation as well as through foliar application (T<sub>13</sub>). This might be due to the reason that with the increasing dose of N and P application, nitrogen uptake efficiency of the plants also gets increased due to which the respective growth stages (bud formation, first flowering and harvesting stage) were accomplished in advance as compared to the recommended practices and other treatments where lower doses of N and P were applied. In many species, phosphorous and nitrogen interact closely in affecting maturity, as excess nitrogen delaying and abundant phosphorous speeding maturity. If excess phosphorous is provided, root growth is often increased relative to shoot growth. This in contrast to effects with excess nitrogen causes low shoot-to-root ratios (Salisbury and Ross 1992). These

results are in conformity with the findings of Kumar (2001) in chrysanthemum and Kumar and Rana (2003) in carnation cv Chabaud Yellow.

The maximum duration of flowering (23.17 days) was recorded with T<sub>13</sub> and found to be at par with T<sub>12</sub> whereas minimum duration of flowering (20.10 days) was recorded with T<sub>2</sub>. It is quite obvious that an increase in nitrogen supply increases the duration of flowering due to vigorous vegetative growth which in turn prolongs the flowering duration (Mengel and Kirkby 1987). These results are in close conformity with the earlier findings of Pal and Biswas (2004) in carnation cv Desio (standard) and Super mix (spray), Kumar and Rana (2003) in carnation cv Chaubad Yellow.

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