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Effect of Mulching, Drip irrigation and Fertigation on Growth, Flowering and Yield parameters of Nerium (*Nerium oleander* L.)

K. Annasamy[1*], S. Muthu Lakshmi[1], K. M. Sellamuthu[2], T. Thangaselvabai[3], J. Kannan[2], T. L. Preethi[1] and P. Arularasu[1]

[1]Department of Floriculture and Landscape Architecture, [2]Department of Natural Resource Management, Horticultural College and Research Institute, Peroyakulam, India
[3]Horticultural Research Station, Thadiankudisai, India

**Corresponding author*

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A B S T R A C T

A field experiment was conducted to study the effect of mulching, drip irrigation and fertigation on growth, yield and quality of nerium (*Nerium oleander* L.) at Department of Floriculture and Landscape Architecture, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam during 2016-2020. The experiment was laid out in a split split plot design consisting of three factors, *viz.*, factor - I (M_1- Black polythene mulch, M_2-coir waste and M_3-without mulch, factor - II (I_1- 75 % WRc through drip irrigation, I_2 - 100 % WRc through drip irrigation and I_3 - 125 % WRc through drip irrigation) and factor - III (F_1-75 % RDF through fertigation, F_2-100 % RDF through fertigation, F_3-125 % RDF through fertigation)with twenty seven treatment combinations. The results of the study indicated that $M_1I_2F_3$ (black polythene mulch + 100 % WRc through drip irrigation + 125 % RDF through fertigation) recorded the highest plant height, number of primary branches, days taken to first inflorescence emergence and days to first flower opening and flower yield (kg) ha^{-1}.

Introduction

Nerium (*Nerium oleander* L) is an evergreen shrub belonging to Apocynaceae family and is native to North Africa. It is widely planted as an ornamental plant in warm temperate, tropical and sub tropical regions, survives drought well and is well suited for cultivation in even poor soils. This crop can tolerate salt sprays, brackish water and alkaline soil. It is commonly planted in highway medians as a no - maintenance plant. Oleander also does well as a quick growing screen or large specimen planting. Nerium flowers are commonly used for worship in home and temples and so is an important loose flower. In the present scenario of acute water shortage and unpredictable climatic conditions, effective and economic utilization of resources is essential and can be achieved through the use of improved techniques, *viz.*, drip irrigation, fertigation and mulching. Drip irrigation results in discrete and efficient water usage. The moderation of soil

hydrothermal regimes by application of mulching results in better nutrient uptake, water absorption, metabolite production and carbohydrate storage and is reflected in better growth and higher yield of crops. In addition, mulches control weed incidence, reduce nutrient losses and affect various physical, chemical and biological reactions involved in plant growth and development, besides considerable saving irrigation water. Fertigation ensures better quality water soluble fertilizers for commercial flower production in various situations (Muthu Kumar, 2013). Hence, mulching, drip irrigation and fertigation may prevent crop water stress and have considerable effect on growth, flower yield and quality of nerium. Therefore the present studies were undertaken to establish the effect of various mulches, drip irrigation and fertigation on nerium.

Materials and Methods

The experiment was conducted at Department of Floriculture and Landscape Architecture, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam in 2016-2020.The experimental field is situated at 77 E longitude, 10 latitude and at an altitude of 300 m above mean sea level (MSL). The treatments were randomly allocated in split split plot design and replicated three times. The experiment consisted of three factors, viz., factor - I (M_1- Black polythene mulch, M_2-coir waste and M_3-without mulch, factor - II (I_1- 75 % WRc through drip irrigation, I_2 - 100 % WRc through drip irrigation and I_3 - 125 % WRc through drip irrigation) and factor - III (F_1-75 % RDF through fertigation,F_2-100 % RDF through fertigation, F_3-125 % RDF through fertigation) with twenty seven treatment combinations. Four plants were selected randomly and data collected was subjected to statistical analysis as suggested by Panse and Sukhatme, 1985.

Results and Discussion

Effect of mulching drip irrigation and fertigation on growth characters

The results of the study on the effect of mulching, drip irrigation and fertigation on growth, yield and quality of nerium indicated that the individual as well as interaction effect had significant influence on morphological, flowering and yield characters. Among the three main plot treatments M_1 (Black polythene mulch) recorded the highest plant height (151.0 and 216.5 cm respectively) and number of primary branches plant^{-1} in pre flowering and flowering stages (6.02 and 8.28 respectively). Among the three sub plot treatmentsI_2 (100 % WRc through drip irrigation) recorded the highest plant height of (144.0 and 222.0 cm respectively) and number of primary branches plant^{-1} (5.67 and 7.31respectively) at pre flowering and flowering stages (Table 1a, 1b and 2 a and 2 b).

Among the three sub plot treatments, highest plant height was recorded duringpre flowering and flowering stagesin F_3 (125 % RDF through fertigation) (152.5 and 196.3 cm respectively). Similarly highest number of primary branches plant^{-1} (5.99 and 7.39 respectively) was also recorded in this treatment.The interaction effect between mulching and drip irrigation significantly influencedplant height. The treatment combination M_1I_2 (Black polythene mulch + 100 % WRc through drip irrigation) recorded the highest plant height of (171.4 and 241.7cm) and number of primary branches plant^{-1} (6.20 and 8.72) at pre flowering and flowering stages respectively.

Significant difference was observed in plant height due to the interaction effect of mulching and fertigation. The highest plant height of 195.6 and 242.9 cm and number of

primary branches plant^{-1} of 6.63 and 8.79 were recorded in M_1F_3 (black polythene mulch + 125 % RDF through fertigation) at pre flowering and flowering stages respectively. The combined effect of drip irrigation and fertigation on plant height was highly significant. The result showed that I_2F_3 (100 % WRc through drip irrigation + 125 % RDF through fertigation) exhibited the highest plant height of 182.9 and 271.7 cm and number of primary branches plant^{-1} (6.31 and 7.68) at pre flowering and flowering stages respectively.

The interaction effect of mulching, drip irrigation and fertigation indicated that the treatment $M_1I_2F_3$ (black polythene mulch + 100 % WRc through drip irrigation + 125 % RDF through fertigation) registered the highest plant height of 244.8 and 277.0 cm and highest number of primary branches plant^{-1} (7.03 and 9.15) at pre flowering and flowering stages respectively and this was on par with $M_2I_2F_3$ (coir waste + 100 % WRc through drip irrigation + 125 % RDF through fertigation). This might be attributed to the fact that mulching resulted in favourable environmental conditions such as temperature, moisture and soil air, because of which the photosynthetic activity is increased. Application of drip irrigation and fertigation at frequent intervals provides a consistent moisture regime and nutrient pool in the soil and therefore, roots remain active for a longer period resulting in increased availability of nutrients to the plants and translocation of food materials which accelerate the vegetative growth of the plant besides maintaining the soil moisture as well as temperature at optimum level. This increases the yield as reported earlier by Chawla (2008) in african marigold, Yathindra (2009) in China aster; and Vijay Kumar (2012), Patel Bhaveshkumar Bharatbhai (2013), Vasanthakumari *et al.,* (2013) and Alak Barman *et al.,* (2015) in tuberose. Sufficient supply of nutrients at frequent intervals might have increased the production of IAA which consequently would have shown stimulatory action, in terms of cell elongation and thus resulting in increased plant height as mentioned by Jainag *et al.,* (2011). This finding is in consonance with Vinoth (2012); Jakadeeshkanth (2014) and Khalid Elhindi *et al.,* (2015).

Effect of mulching, drip irrigation and fertigation on days to first inflorescence emergence, days to first flower opening and yield characters of nerium

The results of the experiment indicated earliness in days to first inflorescence emergence and days to first flower opening under M_1- black polythene mulch (172.4) and (178.80) respectively (Table 3 and 4). Earliness was also observed in plants subjected to 100 % and 75% WRc through drip irrigation (I_2 and I_1). Similarly 125 % RDF through fertigation (F_3) also recorded early inflorescence emergence and first flower opening (174.2 and 181.86 days respectively).

The interaction effects of mulching and drip irrigation significantly influenced days taken to first inflorescence emergence. The treatment M_1I_2 (Black polythene mulch + 100 % WRc through drip irrigation) recorded early inflorescence emergence (172.1 and 178.02 days). The interaction effects of mulching and fertigation were significant with respect to days taken to first inflorescence emergence and days to first flower opening. The treatment M_1F_3 (black polythene mulch + 125 % RDF through fertigation) recorded the least days to first inflorescence emergence (172.3 and 178.07 days) and higher days taken to first flowering opening.

The interaction effects of irrigation and fertigation were significant with respect to days taken to first inflorescence emergence.

Table.1a Influence of mulching, drip irrigation and fertigation on plant height (cm) in nerium at pre flowering stage

Treatments	M_1				M_2				M_3				I x F			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	101.1	122.3	127.3	**116.9**	96.8	127.9	121.8	**115.5**	70.5	89.1	88.7	**82.8**	89.5	113.1	112.6	**105.1**
F_2	121.6	147.0	153.0	**140.5**	116.4	153.9	146.4	**138.9**	84.8	107.2	106.7	**99.6**	107.6	136.0	135.3	**126.3**
F_3	190.7	244.8	151.4	**195.6**	125.8	193.1	158.4	**159.1**	87.7	110.8	110.0	**102.8**	134.7	182.9	139.9	**152.5**
Mean	**137.8**	**171.4**	**143.9**	**151.0**	**113.0**	**158.3**	**142.2**	**137.8**	**81.0**	**102.4**	**101.8**	**95.1**	**110.6**	**144.0**	**129.3**	**128.0**
	M	**I**	**F**	**M x I**	**M x F**	**I x F**	**M x I x F**									
SE d	**0.844**	**0.955**	**1.079**	**1.593**	**1.744**	**1.800**	**2.969**									
CD (0.05) %	**2.343**	**2.081**	**2.189**	**3.738**	**3.844**	**3.729**	**6.115**									
CV %	**2.97**															

Table.1b Influence of mulching, drip irrigation and fertigation on plant height (cm) in nerium at flowering stage

Treatments	M_1				M_2				M_3				I x F			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	157.8	203.4	190.8	**184.0**	150.9	199.6	194.5	**181.7**	110.0	136.8	132.1	**126.3**	139.5	179.9	172.4	**157.8**
F_2	189.8	244.6	233.9	**222.8**	181.5	240.1	229.5	**217.0**	138.4	159.0	155.0	**150.8**	169.9	214.5	206.1	**189.8**
F_3	196.3	277.0	255.3	**242.9**	187.7	270.3	265.9	**241.3**	166.4	268.0	262.0	**232.1**	183.4	271.7	261.0	**196.3**
Mean	**181.3**	**241.7**	**226.7**	**216.5**	**173.4**	**236.7**	**230.0**	**213.3**	**138.3**	**187.9**	**183.0**	**169.7**	**164.3**	**222.0**	**213.2**	**181.3**
	M	**I**	**F**	**M x I**	**M x F**	**I x F**	**M x I x F**									
SE d	**0.468**	**0.367**	**0.534**	**0.699**	**0.889**	**0.841**	**1.409**									
CD (0.05) %	**1.300**	**0.800**	**1.085**	**1.711**	**1.988**	**1.730**	**2.888**									
CV %	**2.52**															

Table.2a Influence of mulching, drip irrigation and fertigation on number of primary branches plant^{-1} in nerium at pre flowering stage

Treatments	M_1				M_2				M_3				I x F			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	5.01	5.11	5.33	**5.15**	4.98	5.21	5.45	**5.21**	4.15	4.61	4.47	**4.41**	4.71	4.97	5.08	**4.92**
F_2	6.23	6.45	6.12	**6.27**	6.47	6.14	5.77	**6.13**	4.56	4.60	4.91	**4.69**	5.75	5.73	5.60	**5.69**
F_3	6.32	7.03	6.54	**6.63**	6.25	6.98	6.51	**6.58**	4.41	4.94	4.91	**4.75**	5.68	6.31	5.98	**5.99**
Mean	**5.85**	**6.20**	**6.00**	**6.02**	**5.90**	**6.11**	**5.91**	**5.97**	**4.37**	**4.72**	**4.76**	**4.62**	**5.38**	**5.67**	**5.55**	**5.53**
	M	**I**	**F**	**M x I**	**M x F**	**I x F**	**M x I x F**									
SE d	**0.0595**	**0.032**	**0.040**	**0.075**	**0.082**	**0.066**	**0.109**									
CD (0.05) %	**0.165**	**0.070**	**0.082**	**0.192**	**0.200**	**0.136**	**0.225**									
CV %	**2.71**															

Table.2b Influence of mulching, drip irrigation and fertigation on number of primary branches plant^{-1} in nerium at flowering stage

Treatments	M_1				M_2				M_3				I x F			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	7.12	8.56	7.64	**7.77**	7.20	8.12	7.32	**7.55**	4.58	4.69	4.89	**4.72**	6.31	7.12	6.61	**6.68**
F_2	8.15	8.45	8.21	**8.27**	7.23	7.83	8.41	**7.82**	4.72	5.11	4.92	**4.92**	6.70	7.13	7.18	**7.00**
F_3	8.23	9.15	9.00	**8.79**	7.99	9.11	8.45	**8.52**	4.67	4.78	5.12	**4.86**	6.96	7.68	7.52	**7.39**
Mean	**7.83**	**8.72**	**8.28**	**8.28**	**7.47**	**8.35**	**8.06**	**7.96**	**4.66**	**4.86**	**4.98**	**4.83**	**6.66**	**7.31**	**7.10**	**7.02**
	M	**I**	**F**	**M x I**	**M x F**	**I x F**	**M x I x F**									
SE d	**0.057**	**0.051**	**0.053**	**0.092**	**0.094**	**0.091**	**0.149**									
CD (0.05) %	**0.159**	**0.112**	**0.107**	**0.223**	**0.217**	**0.189**	**0.307**									
CV %	**2.78**															

Table.3 Influence of mulching, drip irrigation and fertigation on days to first inflorescence emergence in nerium at flowering stage

Treatments	M_1				M_2				M_3				I x F			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	172.6	172.7	172.8	**172.7**	175.6	172.5	173.3	**173.8**	181.5	176.4	178.0	**178.6**	176.6	173.9	174.7	**175.1**
F_2	172.3	172.0	172.4	**172.2**	175.4	172.1	173.0	**173.5**	180.2	177.4	177.7	**178.4**	176.0	173.8	174.4	**174.7**
F_3	172.8	171.6	172.4	**172.3**	175.1	171.9	173.0	**173.3**	178.2	175.2	177.9	**177.1**	175.4	172.9	174.4	**174.2**
Mean	**172.6**	**172.1**	**172.5**	**172.4**	**175.4**	**172.2**	**173.1**	**173.5**	**180.0**	**176.3**	**177.9**	**178.1**	**176.0**	**173.5**	**174.5**	**174.7**
	M	**I**	**F**	**M x I**	**M x F**	**I x F**	**M x I x F**									
SE d	**1.407**	**1.067**	**1.415**	**2.063**	**2.446**	**2.268**	**3.781**									
CD (0.05)%	**3.907**	**2.325**	**2.870**	**5.069**	**5.568**	**4.676**	**7.760**									
CV %	**2.84**															

Table.4 Influence of mulching, drip irrigation and fertigation on days to first flower opening in nerium at flowering stage

Treatments	M_1				M_2				M_3				I x F			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	180.49	178.64	179.56	**179.56**	184.78	183.00	183.98	**183.92**	185.90	183.92	184.99	**184.94**	183.72	181.85	182.84	**182.80**
F_2	179.55	178.41	178.32	**178.76**	184.65	182.78	183.64	**183.69**	185.85	183.86	184.27	**184.66**	183.35	181.68	182.08	**182.37**
F_3	179.22	177.00	178.00	**178.07**	184.12	182.65	183.47	**183.41**	185.60	183.47	183.25	**184.11**	182.98	181.04	181.57	**181.86**
Mean	**179.75**	**178.02**	**178.63**	**178.80**	**184.52**	**182.81**	**183.70**	**183.67**	**185.78**	**183.75**	**184.17**	**184.57**	**183.35**	**181.52**	**182.16**	**182.35**
	M	**I**	**F**	**M x I**	**M x F**	**I x F**	**M x I x F**									
SE d	**0.267**	**0.308**	**0.534**	**0.267**	**0.308**	**0.547**	**0.500**									
CD(0.05)%	**0.554**	**0.640**	**1.108**	**0.554**	**0.640**	**0.557**	**1.112**									
CV %	**2.65**															

Table.5a Influence of mulching, drip irrigation and fertigation on cumulative flower yield ha^{-1}(kg) in nerium from January 2017 to March 2017 at flowering stage

Treatments	M_1				M_2				M_3				I x F			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	5425	6600	5300	**5775**	3975	5025	4250	**4417**	2100	2600	2325	**2342**	3833	4742	3958	**4178**
F_2	5700	6975	5774	**6150**	4987	6200	5874	**5687**	2200	2750	2375	**2442**	4296	5308	4674	**4759**
F_3	5925	13300	7800	**9008**	5550	8375	6350	**6758**	2245	3375	3150	**2923**	4573	8350	5767	**6230**
Mean	**5683**	**8958**	**6291**	**6978**	**4837**	**6533**	**5491**	**5621**	**2182**	**2908**	**2617**	**2569**	**4234**	**6133**	**4800**	**5056**
	M	**I**	**F**	**M x I**	**M x F**	**I x F**	**M x I x F**									
SE d	**47.37**	**37.61**	**36.63**	**71.23**	**70.20**	**64.01**	**104.31**									
CD (0.05) %	**131.5**	**81.95**	**74.30**	**174.03**	**166.30**	**133.17**	**215.65**									
CV %	**2.85**															

Table.5b Influence of mulching, drip irrigation and fertigation on cumulative flower yield ha^{-1}(kg) in nerium from April 2017 to August 2017 at peak flowering stage

Treatments	M_1				M_2				M_3				I x F			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	7524	9150	7625	**8100**	5247	5775	5552	**5525**	3350	4875	4756	**4327**	5374	6600	5978	**5984**
F_2	7300	10050	8225	**8525**	5364	6457	5647	**5823**	3650	4987	4675	**4437**	5438	7165	6182	**6262**
F_3	6700	18300	11875	**12292**	5478	15850	6500	**9276**	4575	5124	5001	**4900**	5584	13091	7792	**8822**
Mean	**7175**	**12500**	**9242**	**9639**	**5363**	**9361**	**5900**	**6874**	**3858**	**4995**	**4811**	**4555**	**5465**	**8952**	**6651**	**7023**
	M	**I**	**F**	**M x I**	**M x F**	**I x F**	**M x I x F**									
SE d	**58.68**	**55.49**	**53.95**	**97.99**	**96.26**	**94.34**	**153.7**									
CD (0.05) %	**162.9**	**120.9**	**109.4**	**234.5**	**222.0**	**196.2**	**317.7**									
CV %	**2.86**															

Table.5c Influence of mulching, drip irrigation and fertigation on cumulative flower yield ha^{-1}(kg) in nerium from September 2016 to October2017 at lean flowering stage

Treatments	M_1				M_2				M_3				I x F			
	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean	I_1	I_2	I_3	Mean
F_1	5025	6400	5825	**5750**	3200	5825	3800	**4275**	975	2475	1650	**1700**	3067	4900	3758	**3908**
F_2	5325	6525	6000	**5950**	3375	6175	5426	**4992**	1075	2575	1975	**1875**	3258	5092	4467	**4272**
F_3	5525	7625	7100	**6750**	4001	7450	6965	**6139**	1375	2875	2725	**2325**	3634	5983	5597	**5071**
Mean	**5292**	**6850**	**6308**	**6150**	**3525**	**6483**	**5397**	**5135**	**1142**	**2642**	**2117**	**1967**	**3320**	**5325**	**4607**	**4417**
	M	**I**	**F**	**M x I**	**M x F**	**I x F**	**M x I x F**									
SE d	**27.59**	**24.83**	**27.90**	**44.66**	**48.15**	**46.62**	**76.85**									
CD (0.05) %	**76.62**	**54.11**	**56.60**	**107.5**	**109.5**	**96.57**	**158.2**									
CV %	**2.39**															

The treatment I_2F_3(100 % WRc through drip irrigation + 125 % RDF through fertigation) recorded the least days to first inflorescence emergence (172.9 days) and days to first flower opening(181.04 days respectively). The three way interaction effects of mulching, drip irrigation and fertigation were significant with respect to days taken to first inflorescence emergence and days to first flower opening. The treatment $M_1I_2F_3$ (black polythene mulch + 100 % WRc through drip irrigation + 125 % RDF through fertigation) recorded the least days to first inflorescence emergence and days to first flower opening (171.6 and 181.04 days) which was on par with treatments $M_2I_2F_3$. Higher levels of recommended dose of fertilizers reduced the time taken for flower initiation as compared to 100 per cent recommended dose of fertilizers. Early flower initiation may be due to the increased levels of potassium given to the plants in the water soluble form, better utilization of soil moisture, soil nutrients, less weed intensity throughout crop growth stage which might have enhanced the reproductive development of the plant (Yathindra, 2009) in china aster.

Similar results were reported by Chaitra (2006) in china aster and Ashutosh Sharma (2013) in tuberose. Early flower initiation may be due to the fact that plants got sufficient moisture for longer time and maintained turgidity resulting in better uptake of nutrients and lower weed intensity. Similar findings were reported by Vijay Kumar (2009) in China aster, Vasanthakumari *et al.*, 2013 in gladiolus; Alak Barman *et al.*, (2015) in tuberose; Adnan Younis *et al.*, (2012) in freesia; Pal and Ghosh (2010) and Iftikhar Ahmad *et al.*, (2011) in african marigold.

With regard to main plots, the treatment M_1 (black polythene mulch) registered higher flower yield of 6978, 9639 and 6150 (kg) ha^{-1} from January 2017 to March 2017, April 2017 to August 2017 and September 2017 to October 2017 respectively (Table 5 a, 5 b and 5 c). Among the sub plot treatments, I_2 (100 % WRc through drip irrigation) registered the higher flower yield of 6133, 8952 and 5325 kg from January 2017 to March 2017, April 2017 to August 2017 and September 2017 to October 2017 respectively.

Among the three sub plot fertigation treatments, F_3 (125 % RDF through fertigation) registered the higher flower yield of 6230, 8822 and 5071 kg from January 2017 to March 2017, April 2017 to August 2017 and September 2017 to October 2017 respectively.

Among the interaction effects the treatment combination M_1I_2 (Black polythene mulch + 100 % WRc through drip irrigation) had recorded higher flower yield of 8958, 12500 and 6850 kg from January 2017 to March 2017, April 2017 to August 2017 and September 2017 to October 2017 respectively.

The interaction effect between mulching and fertigation significantly influenced flower yield. The treatment, M_1F_3 (black polythene mulch + 125 % RDF through fertigation) recorded higher flower yield (9008, 12292 and 6750 kg) from January 2017 to March 2017, April 2017 to August 2017 and September 2017 to October 2017 respectively. The interaction effects between drip irrigation and fertigation indicated that the treatment, I_2F_3 (100 % WRc through drip irrigation + 125 % RDF through fertigation) recorded the highest flower yield (8350, 13091 and 5983 kg) from January 2017 to March 2017, April 2017 to August 2017 and September 2017 to October 2017.

The combined effect of application of black polythene mulch + 100 % WRc through drip irrigation + 125 % RDF through fertigation

($M_1I_2F_3$) registered higher flower yield from January 2017 to March 2017, April 2017 to August 2017 and September 2017 to October 2017 (13300, 18300 and 7625 kg) and this was on par with $M_2I_2F_3$ - coir waste + 100 % WRc through drip irrigation + 125 % RDF through fertigation (8375, 15850 and 7450 kg). The results obtained in this study demonstrate that the effects of quality of irrigation water and irrigation frequency are significantly important in order to obtain higher yield. This is in line with the findings by Koksal Aydinsakir *et al.*, (2011) in carnation, Bagali *et al.*, (2012) in onions; Lodhi *et al.*, (2014) in sweet pepper; ArifTuran *et al.*, (2015) in cut chrysanthemum; Ayyanna *et al.*, (2014) in marigold; Puneet Sharma and Arun Kaushal (2015); Ughade and Mahadkar (2015) in brinjal and Muthu Kumar and Ponnuswami (2013) in noni. Nutrients like N, P and K are being the constituent of proteins, amino acids, nucleic acid, various enzymes and coenzymes is associated with the increased shoot length and leaf area resulting in more photosynthesis and thus increased transformation of manufactured food material from source (leaf) to sink (flower bud) as reported by Vinoth (2012) in lilium hybrids; Khalid Elhindi *et al.*, (2015) in Zinnia and Jakadeeshkanth, (2014) in curry leaf. The present findings are in agreement with the findings of Rafat Saeed and Rafiq Ahmad, (2009) in tomato and Tomasz Spizewski *et al.*, (2010) in cucumber

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