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Optimization of growing media consortia for carnation

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ABSTRACT : Carnation cultivation is being carried out under protected environmental conditions in the hilly regions of Tamil Nadu. Farmyard manure, vermicompost, cocopeat constituted the media components in the consortium. The components were added based on the ratio of carbon-nitrogen level, as two levels with 20 kg and 30 kg of consortia for 1 sq.m of area. The media consortia components were added as per the treatment schedules after bed preparation. The biofertilizers *Azospirillum*, phosphobacteria, VAM and biocontrol agents *Trichoderma viridae, Pseudomonas fluorescens* were added each @ 20 g/m^2 at bimonthly intervals except control. The beds added with consortia at the ratio of 10:1:1 (30 kg of consortia) with 25 kg of farmyard manure, 2.5 kg of vermicompost, 2.5 kg of cocopeat with biofertilizers *Azospirillum*, phosphobacteria, VAM and biocontrol agents *Trichoderma viridae, Pseudomonas fluorescens* @ 20 g/m^2 at bimonthly intervals proved best in terms of yield and quality when compared to control. Yield of carnation flowers increased with 249.48, 352.80, 201.60 flowers/m^2 over control with 180.00, 234.00, 180.00 flowers/m^2 during Ist, IInd and IIIrd flush of flowering and stalk length with 77.30 73.20, 71.50 cm over control with 60.00, 58.50, 54.00 cm during Ist, IInd and IIIrd flush of flowering. The media consortia helps in retaining the soil compactness with respect to soil moisture, aeration porosity and the plant growth promoting organisms helps in mobilizing the nutrients and crop stand till the cropping period.

KEY WORDS : Carnation, Growing media consortia, Biofertilizers, Biocontrol agents

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Carnation is one of the most important commercially cultivated crops in the scenario of present cut flower industry. Soil, as a growing media does not fulfil all requirements for achieving maximum growth, flowering, yield and quality. So the structure, texture, porosity, water holding capacity and element composition of the growing media are major factors which determine the availability of nutrients to plants (Anil *et al.*, 2009). In modern agriculture, use of chemical fertilizers is becoming essential for higher yield, but is not eco friendly. Bowe (1964) opined that growing media should have a property to drain excess water attained at field capacity which creates congenial root environment and results in healthy growth of plant. Padaganur *et al.* (2009) reported that organic manures in the growing media seem to act directly by supplying nitrogen and phosphorus in available form to plants through biological decomposition. These indirectly improve physical properties of soils such as aggregation, aeration, permeability and water holding capacity. The current trend is to explore the possibility of supplementing chemical fertilizers with organics especially micro organisms (Kumar *et al.*, 2007).

Hence, research on formulating ideal media consortia by incorporating farmyard manure, vermicompost and coco peat along with biofertilizers and

Table A : Treatment details

Sr. No.	Ratio of media consortia components FYM:VC:CP	Quantity of media consortia added/m^2 of soil (kg)	Quantity of media consortia components (kg/m^2) FYM : VC : CP		
T_1	1:0:0	20	20	0	0
T_2	0:1:5	20	0	3.3	16.7
T_3	10:1:1	20	16.7	1.65	1.65
T_4	5:1:0	20	16.7	3.3	0
T_5	5:0:1	20	16.7	0	3.3
T_6	1:0:0	30	30	0	0
T_7	0:1:5	30	0	5	25
T_8	10:1:1	30	25	2.5	2.5
T_9	5:1:0	30	25	5	0
T_{10}	5:0:1	30	25	0	5
T_{11}	Soil (existing) + biofertilizers and biocontrol agents				
T_{12} (Check)	Control (existing soil)				

FYM- Farm yard manure, VC- Vermicompost, CP- Cocopeat

biocontrol agents with the existing soil in appropriate ratios has been taken up in this study.

RESEARCH METHODS

The present study was conducted at M/s. Elkhill Agrotech Pvt. Ltd., Ooty who is one of the consortium partners in the National Agricultural Innovation Project with Tamil Nadu Agricultural University during 2009-2012. The media consortia components namely farm yard manure, vermicompost, cocopeat are applied based on the ratio worked out with the existing soil. The biofertilizers *viz.*, *Azospirillum*, Phosphobacteria, VAM and biocontrol agents *viz.*, *Trichoderma viridae*, *Pseudomonas fluorescens* were used for the study. The biofertilizers and biocontrol agents were applied @ 20 g/m^2 at bimonthly intervals in all the treatments except control (Table A).

Malaga, a bicolour variety was used for the experimental study. The plant vegetative parameters *viz.*, plant height (cm), number of leaves per plant, number of laterals per plant, internodal length (cm) and floral parameters *viz.*, days taken for flower bud appearance and opening, flower yield per m^2, duration of flowering (days), flower stalk length (cm) and flower bud circumference (cm), calyx splitting (%) were taken at monthly intervals for the total crop growth period of two years (three flush stages), available soil nutrient level of nitrogen, phosphorus, potassium at critical stages of crop growth were recorded.

Statistical analysis :

The obtained data was analyzed by statistical significant at $P<0.05$ level, S.E. and C.D. at 5 per cent level by the procedure given by (Gomez and Gomez, 1984).

RESEARCH FINDINGS AND DISCUSSION

Carnation cultivation under greenhouse requires sufficient amount of organic basal media to be added during every cropping period before taking up planting. Since the crop is cultivated continuously in a particular area, depletion of nutrients as well as soil structure and texture will have to be taken care of. Moreover, in the hilly regions, the soils are of acidic nature and organic amendments are required to be added. Carnation plants with their fibrous shallow root system are highly sensitive to water logging and attack of fungi, particularly *Fusarium oxysporum* f. sp. *dianthi*. The application of growing media consortia made up with various organic materials offer a valuable alternative over conventional use of soil, due to their good water holding capacity, proper aeration, nutrient absorption and lesser chances of exposure to soil borne pathogens.

Farm yard manure, vermicompost and cocopeat constituted the media components of the consortium in this experiment. FYM and vermicompost are additional sources of nutrients besides their ability to improve the physical, chemical and biological properties of soil. Cocopeat is a renewable peat substitute and improves the media texture.

The trend in recent days is to explore the possibility of supplementing chemical fertilizers with organics and biocontrols and this concept has been tried up in carnation in this experiment. The biofertilizers have emerged as a promising component of nutrient management since they play a significant role in facilitating availability and uptake of nutrients (Mishra *et al.*, 1999). The organic manures seem to act directly by supplying nitrogen and phosphorus in absorbable form to plants through biological decomposition. Indirectly they improve the physical properties of soil such as aggregation, aeration, permeability and water holding capacity.

Growth parameters :

The results showed significant differences among the media consortia. The treatment T_8 [with consortia at the ratio of 10:1:1 (30 kg of consortium) with 25 kg of farm yard manure, 2.5 kg of vermicompost, 2.5 kg of cocopeat with biofertilizers *Azospirillum*, phosphobacteria, VAM and biocontrol agents *Trichoderma viridae*, *Pseudomonas fluorescens* were added each @ 20 g/m^2 at bimonthly intervals] was found to be the best for growth characters *viz.*, plant height (79.43 cm, 77.77 cm and 72.40 cm), number of leaves (188.65, 160.50, 128.34), laterals (6.93, 9.80, 5.60) and internodal length (8.05, 7.70, 7.20) in first, second and third flush of flowering in T_8, respectively (Table 1).

The increased plant height could be due to improved nutrient uptake, photosynthesis, source-sink relationship besides excellent physiological activities due to the presence of *Azospirillum*, phosphobacteria and VAM. Similar results have been reported in marigold by Balasubramanian and Nambisan (1989) and in carnation by Bhatia *et al.* (2004). The superiority in plant height could be explained on the analogy of Rajadurai *et al.* (2000) who observed gradual increase in plant height of marigold when inoculated with VAM and *Azospirillum*.

The vermicompost in the media consortium is a better source of nutrients and it might be the reason for increase in number of leaves and laterals. Incorporation of vermicompost might have helped to neutralize the pH of soil as a result of which the availability of nutrients is maximised. The findings are in accordance with results of Arora and John (1976); Mukhopadhyay and Sadhu (1988); Blake and Harris (1960) in carnation. The biofertilizers *Azospirillum*, phosphobacteria, VAM are potential alternatives to inorganic nutrient sources and ecofriendly products which contain growth promoting hormones like IAA, IBA, NAA, GA and vitamins which induce the better growth of plants. This is in conformity with the results of Bhatia *et al.* (2004) in carnation and Preethi *et al.* (1999) in Edward rose.

Flower yield and quality parameters :

The flower yield and quality parameters were also observed to be best in the media consortium T_8 with earliness in flower bud appearance in first, second and third flush of flowering, respectively and flower bud opening (190, 193 and 198 days) (Table 2). The vermicompost in growing media might have an indirect role which aids in better uptake of nutrients and biofertilizers making nutrients readily available to the

Table 1 : Effect of media consortia on plant height, number of leaves, laterals and internodal length

Treatments	Plant height (cm)			Number of leaves			Number of laterals			Internodal length (cm)		
	Flush I	Flush II	Flush III	Flush I	Flush II	Flush III	Flush I	Flush II	Flush III	Flush I	Flush II	Flush III
T_1	65.17	60.30	59.90	163.60	144.47	112.80	5.20	8.50	5.30	7.00	6.85	6.15
T_2	68.43	62.27	60.00	168.73	142.07	115.50	5.20	8.80	5.45	7.10	6.90	6.30
T_3	75.33	70.13	69.45	180.40	148.53	125.00	6.13	9.40	5.25	7.80	7.50	6.90
T_4	69.30	68.83	63.65	175.00	152.93	118.80	5.67	9.00	5.00	7.05	6.80	6.40
T_5	67.80	67.13	62.10	172.87	150.60	117.70	5.33	8.80	4.85	6.90	6.70	6.70
T_6	72.80	64.17	63.00	174.93	153.20	116.70	5.33	8.50	4.50	6.75	6.45	6.10
T_7	73.17	68.42	65.10	178.93	155.67	124.70	5.93	9.00	5.00	7.60	7.00	6.50
T_8	79.43	77.77	72.40	188.65	160.50	128.34	6.93	9.80	5.60	8.05	7.70	7.20
T_9	75.87	73.87	70.25	184.67	157.43	127.50	6.30	9.00	5.40	7.80	7.18	7.00
T_{10}	70.73	67.93	64.20	174.67	153.68	120.00	5.73	9.25	5.20	7.00	6.68	6.36
T_{11}	60.33	58.93	57.25	164.60	142.93	108.80	5.10	7.27	5.30	6.00	6.20	5.90
T_{12}(check)	57.77	54.17	52.00	160.80	138.93	104.20	5.00	6.50	5.00	5.60	5.50	5.15
Mean	69.68	66.16	63.28	173.99	150.08	118.34	5.65	8.65	5.15	7.05	6.79	6.39
S.E.±	0.042	0.043	0.038	0.056	0.045	0.049	0.003	0.005	0.003	0.005	0.004	0.003
C.D. (P=0.05)	0.088	0.090	0.080	0.116	0.094	0.102	0.006	0.011	0.007	0.011	0.008	0.007

plants thereby establishing a favourable source - sink relation with faster and more efficient mobilization of photosynthates. This is in congruence with the results of Somasundaram *et al.* (2004). The present findings also got support from the work of Haripriya and Sriramachandrasekharan (2002) who observed earliness in flowering in chrysanthemum when inoculated with VAM.

The yield of flowers per plant (6.93, 9.80, 5.60) and per m^2 (249.48, 352.80, 201.60) was evidently found better in the consortium T_8 (Table 3). This can be attributed to the basal application of farm yard manure, vermicompost and cocopeat along with the regular dose of water soluble fertilizers which presents the nutrients in available form to put forth luxuriant growth thereby helping the plants to produce more photosynthates in order to produce

Table 2 : Effect of media consortia on days taken for flower bud opening and duration of flowering (days)

Treatments	Flush I		Flush II		Flush III	
	Days for bud opening	Duration of flowering (days)	Days for bud opening	Duration of flowering (days)	Days for bud opening	Duration of flowering (days)
T_1	214.00	67.00	210.00	78.00	216.00	78.50
T_2	207.00	66.50	214.50	74.00	210.00	77.00
T_3	200.50	75.50	202.00	85.00	198.00	93.70
T_4	205.50	75.00	200.00	83.50	206.50	92.00
T_5	203.00	69.50	209.50	80.00	211.00	82.00
T_6	205.00	67.00	214.00	78.00	213.50	80.50
T_7	195.00	65.00	205.00	75.60	205.50	80.00
T_8	190.00	80.50	193.00	89.50	198.00	97.50
T_9	194.00	77.00	195.00	88.00	199.00	96.00
T_{10}	200.00	72.00	198.00	79.50	205.00	85.50
T_{11}	215.00	62.50	213.50	72.50	222.50	76.50
T_{12} (check)	218.00	61.00	216.00	70.00	225.00	74.00
Mean	203.92	69.88	205.88	79.47	209.17	84.43
S.E.±	0.058	0.040	0.054	0.040	0.059	0.054
C.D. (P=0.05)	0.121	0.083	0.112	0.084	0.123	0.113

Table 3 : Effect of media consortia on flower yield (number of flowers) per plant and per m^2

Treatments	Flush I		Flush II		Flush III	
	Yield /plant	Yield /m^2	Yield /plant	Yield /m^2	Yield /plant	Yield /m^2
T_1	5.20	187.20	8.50	306.00	5.30	190.80
T_2	5.20	187.20	8.80	316.80	5.45	196.20
T_3	6.13	220.68	9.40	338.40	5.25	189.00
T_4	5.67	204.12	9.00	324.00	5.00	180.00
T_5	5.33	191.88	8.80	316.80	4.85	174.60
T_6	5.33	191.88	8.50	306.00	4.50	162.00
T_7	5.93	213.48	9.00	324.00	5.00	180.00
T_8	6.93	249.48	9.80	352.80	5.60	201.60
T_9	6.30	226.80	9.00	324.00	5.40	194.40
T_{10}	5.73	206.28	9.25	333.00	5.20	187.20
T_{11}	5.10	183.60	7.27	261.72	5.30	190.80
T_{12} (check)	5.00	180.00	6.50	234.00	5.00	180.00
Mean	5.65	203.55	8.65	311.46	5.15	185.55
S.E.±	0.003	0.140	0.005	0.220	0.003	0.072
C.D. (P=0.05)	0.006	0.291	0.011	0.457	0.007	0.150

higher flower yields (Fig.1).

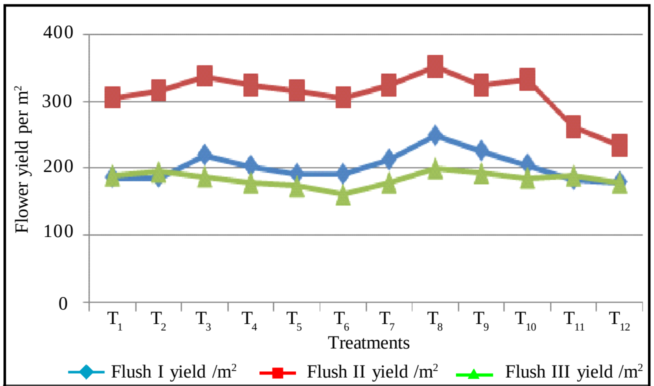

Fig. 1 : Effect of media consortia on flower yield per m²

Similar observations due to incorporation of vermicompost along with fertilizers have been reported by Kulkarni (1994) in China aster and Arora and Saini (1976) in carnation. The biofertilizers *Azospirillum* and VAM might have helped in better uptake of phosphorus and provided enhanced surface area for nutrient absorption as already reported by Tinker (1978) and Rai and Gaur (1982).

The quality parameters of carnation *viz.*, length of flower stalk (77.30, 73.20, 71.50 cm), stalk girth (1.95, 1.75, 1.56 cm) (Table 4), bud length (6.30, 6.00, 5.65 cm) and bud circumference (8.20, 7.25, 6.50 cm) (Table 5) are obviously correlated with the media consortium T_8. This might be due to cumulative effect of all the growth parameters observed throughout the growing period. The increase in growth parameters might have increased the size of flower due to mycorrhizal inoculation (VAM) in the growing media consortia which improves phosphorus and potassium uptake as reported earlier by Dufault *et al.* (1990) in gerbera. The addition of *Azospirillum* in the media consortia might have enhanced the levels of auxins which divert the photoassimilates to the developing flower buds resulting in increased bud length and circumference.

Significantly higher percentage of marketable flowers in the treatment T_8 is due to better uptake of nutrients by the biofertilizers leading to better quality of flowers. These results are supported by the earlier reports of Renukaradhya *et al.* (2011) in carnation.

It was interesting to note that there was a remarkable reduction in the percentage of calyx splitting (3.88 %) (Table 6) in the media consortium T_8. This might be due to the effect of vermicompost which contains micro and macro nutrients especially calcium and boron which are essential for carnation plants to evade calyx splitting.

The vase life of carnation flower (10.50, 9.67, 9.00 days) Table 4 was more in the media consortium T_8 which might be due to the growth promoting substances like cytokinins present in the vermicompost (Table 6). This is in accordance with the findings reported in marigold by Anuradha *et al.* (1990), China aster by Nethra (1996) and chrysanthemum by Hemavathi (1997).

Table 4 : Effect of media consortia on length and girth of flower stalk (cm)

Treatments	Stalk length (cm)			Stalk girth (cm)		
	Flush I	Flush II	Flush III	Flush I	Flush II	Flush III
T_1	65.00	63.50	59.50	1.40	1.38	1.10
T_2	65.30	62.60	60.00	1.42	1.38	1.12
T_3	73.10	72.40	67.00	1.80	1.68	1.45
T_4	68.70	64.50	62.10	1.75	1.59	1.36
T_5	66.00	65.30	62.00	1.66	1.58	1.32
T_6	66.00	62.00	61.40	1.62	1.50	1.25
T_7	72.00	70.50	66.00	1.50	1.44	1.18
T_8	77.30	73.20	71.50	1.95	1.75	1.56
T_9	76.00	72.00	69.40	1.88	1.72	1.52
T_{10}	70.40	68.00	67.50	1.70	1.54	1.31
T_{11}	63.50	60.50	58.00	1.18	1.05	0.90
T_{12} (check)	60.00	58.50	54.00	1.02	0.92	0.81
Mean	68.61	66.08	63.20	1.57	1.46	1.24
S.E.±	0.035	0.033	0.033	0.039	0.002	0.002
C.D. (P=0.05)	0.073	0.069	0.068	0.083	0.004	0.004

Incidence of disease *Fusarium oxysporum* f sp. *dianthi* was lesser in media consortium T_8. The biocontrol agents *Trichoderma viridae* and *Pseudomonas fluorescens* might have played their role in keeping the disease under control in synergy with the media consortium.

The increase in leaf area in treatment T_8 (18.20, 17.50, 16.30 cm^2) might have directly influenced the increase in chlorophyll contents and photosynthetic rates and corresponding increase in growth. Incorporation of biofertilizers and biocontrols agents especially *Trichoderma viridae* which solubilise insoluble and

Table 5 : Effect of media consortia on flower bud length and circumference (cm)

Treatments	Flush I		Flush II		Flush III	
	Flower bud length (cm)	Flower bud circumference (cm)	Flower bud length (cm)	Flower bud circumference (cm)	Flower bud length (cm)	Flower bud circumference (cm)
T_1	4.60	6.40	4.20	5.80	4.00	5.40
T_2	5.20	6.90	4.80	6.50	4.30	6.10
T_3	6.00	7.20	5.85	7.00	5.30	6.40
T_4	5.60	6.50	5.35	6.45	5.00	6.00
T_5	5.30	6.10	5.15	6.20	5.00	6.10
T_6	5.00	6.00	4.65	6.50	4.20	6.15
T_7	4.80	7.00	4.50	6.60	4.05	6.10
T_8	6.30	8.20	6.00	7.25	5.65	6.50
T_9	6.00	7.20	5.30	6.50	4.40	6.40
T_{10}	5.50	6.60	4.60	6.80	4.05	5.85
T_{11}	4.00	5.50	4.00	5.40	3.70	4.90
T_{12} (check)	3.90	5.20	3.85	5.10	3.00	4.65
Mean	5.18	6.57	4.85	6.34	4.39	5.88
S.E.±	0.004	0.005	0.004	0.004	0.004	0.004
C.D. (P=0.05)	0.009	0.010	0.009	0.008	0.009	0.010

Table 6 : Effect of media consortia on calyx splitting (%), vase life (days) and leaf area (cm^2)

Treatments	Calyx splitting (%)			Vase life (days)			Leaf area (cm^2)		
	Flush I	Flush II	Flush III	Flush I	Flush II	Flush III	Flush I	Flush II	Flush III
T_1	7.40 (15.70)	7.30 (15.67)	7.10 (15.45)	8.00	7.75	7.00	15.80	15.05	14.70
T_2	7.00 (15.27)	6.80 (15.11)	6.65 (14.94)	8.20	8.10	7.80	16.00	15.20	15.00
T_3	4.88 (12.70)	4.50 (12.24)	5.00 (12.92)	9.50	9.38	8.20	17.68	17.00	15.85
T_4	6.25 (14.40)	5.80 (13.93)	5.50 (13.56)	9.25	9.20	8.00	17.05	16.20	15.08
T_5	6.60 (14.81)	6.10 (14.29)	5.80 (13.93)	9.40	8.80	7.80	16.60	16.02	14.78
T_6	6.65 (14.87)	5.40 (13.43)	5.10 (13.05)	8.50	8.37	8.00	16.22	15.60	14.10
T_7	5.69 (13.73)	5.10 (13.05)	5.00 (12.92)	9.00	8.70	7.90	17.30	16.78	15.72
T_8	3.88 (11.31)	3.55 (10.86)	3.50 (10.78)	10.50	9.67	9.00	18.20	17.50	16.30
T_9	4.26 (11.85)	4.00 (11.53)	4.00 (11.53)	10.20	9.30	8.60	18.05	17.20	16.00
T_{10}	5.90 (13.99)	4.34 (12.02)	4.25 (11.90)	9.17	9.10	8.00	17.12	16.50	15.36
T_{11}	8.10 (16.46)	5.74 (13.86)	5.50 (13.56)	6.50	6.37	6.10	15.50	14.45	14.20
T_{12} (check)	8.90 (17.27)	5.43 (13.47)	5.30 (13.31)	6.00	5.80	5.37	14.72	12.38	12.10
Mean	6.29 (14.43)	5.34 (13.29)	5.23 (13.14)	9.40	8.75	8.16	16.68	15.82	14.93
S.E.±	0.007	0.005	0.005	0.011	0.009	0.009	0.007	0.009	0.007
C.D. (P=0.05)	0.015	0.012	0.011	0.023	0.020	0.019	0.016	0.019	0.016

sparingly soluble minerals to available form must have manifested in leaf area, resulting in more carbohydrate production through photosynthesis (Table 6). This is in agreement with the reports by Gomaa and Mohamed (2000) in dahlia and Altomare *et al.* (1999) in gladiolus. Moreover, the enhanced availability of phosphorus and nitrogen facilitated by *Pseudomonas fluorescens* must have led the enhanced the size of flowers. The growth promoting hormones and enzymes might have promoted the vegetative growth and increased the photosynthetic and metabolic activities causing more transport and utilization of photosynthetic products, as already reported by Khan *et al.* (2002) in wheat and chickpea.

The availability of nitrogen, phosphorus and potassium in the soil is high during the stages of peak vegetative and reproductive phase during the first and second flushes and further the availability of the nutrients to the plants gets comparatively reduced during the third flush of flowering. The peak productive yield is during the first and second flush of flowering stage whereas during the third flush of flowering, the yield and quality of the flowers gets reduced and this may be due to the lesser availability of the major nutrients to the plants.

Similarly, leaf content and the uptake pattern of N, P and K is higher due to more availability of soil N, P and K in the added growing media consortia during the initial soil preparation and it plays a crucial role in holding and providing the available nutrients to the plants (Table 7).

Available nitrogen in the soil is higher in treatment T_8 and this greatly influences the leaf growth, leaf area and photosynthetic rate per unit area to control production of carbohydrate and other photosynthetic products (source activity) and influences numbers and size of vegetative and reproductive parts (sink capacity) as reported earlier by Enggels and Marschner (1995). Potassium efficiency is linked to the root growth and flowering, morphology, uptake efficiency, translocation and utilization efficiency (Fageria *et al.*, 2007) (Table 8).

There is no limiting effect on growth and performance on crop due to high range of nutrients made available in soil by fertigation practices. By fertigation, the sufficient level of nutrients in soil is always being ensured. Growing media consortium influences mainly the initial growth stages of the crop.

Table 7 : Effect of media consortia on leaf nitrogen, phosphorus and potassium (%)

Treatments	Flush I						Flush II						Flush III					
	Vegetative stage (90 DAP)			Reproductive stage (180 DAP)			Vegetative stage (330 DAP)			Reproductive stage (420 DAP)			Vegetative stage (570 DAP)			Reproductive stage (660 DAP)		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
T_1	1.12	0.42	2.01	0.33	0.34	1.00	1.14	0.28	1.49	0.66	0.41	1.30	1.17	0.35	2.40	0.50	0.32	2.18
T_2	1.19	0.58	2.76	0.11	0.30	2.02	0.89	0.31	2.49	0.58	0.35	2.26	1.20	0.42	2.74	0.25	0.46	2.40
T_3	1.44	0.56	2.71	0.47	0.31	2.68	1.03	0.32	2.30	0.66	0.42	2.20	1.26	0.50	2.52	0.17	0.48	2.21
T_4	1.40	0.55	2.11	0.22	0.32	2.28	1.28	0.28	2.44	0.42	0.21	2.15	1.40	0.32	2.41	0.18	0.30	2.10
T_5	1.20	0.41	2.72	0.33	0.37	2.43	1.20	0.31	1.37	0.44	0.30	1.03	1.42	0.28	2.55	0.19	0.25	2.00
T_6	1.28	0.53	2.39	0.16	0.31	1.50	1.34	0.32	2.30	0.50	0.32	1.20	1.45	0.54	3.10	0.42	0.46	2.28
T_7	1.14	0.46	3.03	0.47	0.31	1.73	1.45	0.38	1.75	0.70	0.22	1.55	1.48	0.61	2.62	0.44	0.55	2.00
T_8	1.56	0.75	3.09	0.89	0.48	2.68	1.66	0.98	2.62	0.89	0.70	2.26	1.51	0.78	3.30	0.78	0.55	3.15
T_9	1.45	0.68	1.88	0.56	0.36	1.23	1.03	0.36	1.72	0.78	0.32	1.42	1.54	0.72	3.00	0.67	0.68	2.90
T_{10}	1.31	0.55	2.00	0.44	0.33	1.68	0.56	0.34	1.78	0.84	0.40	1.40	1.56	0.36	2.74	0.58	0.32	2.68
T_{11}	1.00	0.39	1.45	0.29	0.25	1.31	0.76	0.21	1.41	0.68	0.20	1.22	0.42	0.28	1.98	0.75	0.25	1.82
T_{12} (check)	0.89	0.35	1.13	0.19	0.19	0.97	0.75	0.18	1.30	0.33	0.15	0.80	0.32	0.20	1.80	0.15	0.12	1.62
Mean	1.24	0.51	2.27	0.37	0.32	1.79	1.09	0.32	1.91	0.64	0.34	1.55	1.22	0.44	2.59	0.55	0.41	2.27
S.E.$\pm$	0.063	0.028	0.124	0.033	0.017	0.113	0.060	0.020	0.106	0.038	0.030	0.092	0.071	0.029	0.129	0.041	0.028	0.122
C.D.(P=0.05)	0.131	0.059	0.257	0.069	0.036	0.234	0.124	0.042	0.220	0.080	0.063	0.191	0.148	0.061	0.268	0.086	0.058	0.253

* Figures in the parentheses are arcsine transformed values

Table 8 : Effect of media consortia on soil available nitrogen, phosphorus and potassium (kg ha^{-1})

Treatment s	Flush I						Flush II						Flush III					
	Vegetative stage (90 DAP)			Reproductive stage (180 DAP)			Vegetative stage (330 DAP)			Reproductive stage (420 DAP)			Vegetative stage (570 DAP)			Reproductive stage (660 DAP)		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
T_1	363.00	47.50	880.00	336.00	50.00	868.00	485.00	87.00	1187.00	471.00	81.00	1121.00	408.00	72.00	1132.00	382.00	51.40	1037.00
T_2	368.00	50.00	898.00	350.00	58.00	885.00	488.00	90.00	1214.00	473.00	82.00	1142.00	425.00	67.40	1145.00	388.00	44.30	1046.00
T_3	427.00	71.40	965.00	410.00	85.00	938.00	529.00	108.00	1302.00	514.00	98.00	1281.00	460.00	92.00	1236.00	414.00	62.60	1152.00
T_4	420.00	60.00	984.00	408.00	80.00	930.00	529.00	102.00	1296.00	510.00	90.00	1280.00	451.00	86.00	1218.00	418.00	79.30	1124.00
T_5	398.00	57.50	938.00	375.00	73.00	925.00	512.00	98.00	1245.00	511.00	91.00	1219.00	485.00	86.00	1202.00	410.00	79.00	1082.00
T_6	386.00	54.00	912.00	371.00	70.00	903.00	504.00	89.00	1238.00	492.00	84.00	1200.00	446.00	77.00	1190.00	398.00	86.00	1076.00
T_7	375.00	68.00	908.00	362.00	70.00	900.00	502.00	95.00	1213.00	490.00	90.00	1187.00	469.00	81.00	1183.00	395.00	59.50	1068.00
T_8	454.00	98.00	989.00	400.00	90.00	952.00	549.00	115.00	1314.00	536.00	108.00	1204.00	482.00	102.00	1265.00	431.00	98.00	1180.00
T_9	438.00	96.70	980.00	402.00	88.00	940.00	540.00	112.00	1308.00	523.00	102.00	1178.00	472.00	97.00	1254.00	422.00	89.00	1158.00
T_{10}	409.00	63.00	944.00	386.00	76.00	930.00	518.00	90.00	1287.00	504.00	84.00	1200.00	432.00	81.00	1204.00	404.00	78.00	1107.00
T_{11}	348.00	38.00	826.00	328.00	32.00	819.00	461.00	81.00	1028.00	449.00	70.00	988.00	381.00	72.00	988.00	346.00	68.40	972.00
T_{12} (check)	316.00	30.00	806.00	310.00	26.00	802.00	445.00	81.00	970.00	442.00	72.00	924.00	345.00	66.00	954.00	328.00	55.00	923.00
Mean	391.83	61.17	919.16	369.83	66.50	899.33	505.16	95.66	1216.83	429.91	87.66	1160.33	438.00	81.60	1164.25	394.66	70.80	1077.08
S.E.±	18.558	3.791	41.382	17.143	3.965	40.189	22.785	4.543	56.253	22.136	4.228	53.192	19.812	4.005	53.315	17.925	3.740	49.20
C.D.(P=0.05)	38.487	7.863	85.822	35.554	8.224	83.348	47.254	9.422	116.663	45.907	8.768	110.315	41.089	8.306	110.569	37.175	7.756	102.052

*Days after planting

Conclusion :

It is inferred that the treatment T_8 with growing media consortium at the ratio of 10:1:1 (30 kg of consortia) with 25 kg of farm yard manure, 2.5 kg of vermicompost, 2.5 kg of cocopeat with biofertilizers *viz.*, *Azospirillum*, phosphobacteria, VAM and biocontrol agents *viz.*, *Trichoderma viridae*, *Pseudomonas fluorescens* added each @ 20 g/m^2 at bimonthly intervals is the best growing medium to achieve favourable flower yield and quality in carnation when compared with treatment T_{12} (check) which consists of existing soil in the bed.

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