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RESEARCH PAPER

Integrated nutrient management on quality and yield of strawberry fruits (*Fragaria* × *ananassa* Duch.) cv. Camarosa under shade net conditions

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Abstract : Studies on the influence of Integrated Nutrient Management were undertaken during *Rabi* season, 2018-19 at College of Horticulture, Venkataramannagudem, West Godavari District, Andhra Pradesh with an objective of examining their influence on quality and yield of Strawberry fruits (*Fragaria* × *ananassa*Duch.) cv. Camarosa grown under shade net conditions. The experiment was consisting of 9 treatments replicated thrice comprising of different combinations of inorganic fertilizers, organic manures like FYM, vermicompost and biofertilizers like Arka microbial consortium in randomized block design. Observations were recorded for fruit yield and quality parameters. Among different combinations 75 % RDN + 25% N through Vermicompost + Arka Microbial Consortium registered highest number of fruits plant^{-1} (24.00), fruit diameter (3.18 cm) , fruit weight (13.40 g), fruit volume(21.24 cm^3), fruit yield plant^{-1} (292.54 g), shelf life (44.10 h), juice recovery percentage (91.10 %) , TSS (11.05 °B), total sugars (7.71%), ascorbic acid (69.20 mg/100 g of pulp) and anthocyanin content (62.30 mg100g^{-1}).

Key Words : Strawberry, Organic manure, Biofertilizers, Quality, Arka microbial consortium

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INTRODUCTION

Strawberry crop (*Fragaria X ananassa* Duch.) (2n=8x=56) is a dicotyledonous, short day, perennial and low-growing herb mostly grown in arable regions of the world. It is a monoecious, octoploid hybrid developed from two dioecious octoploid species *i.e., Fragaria chiloensis* and *Fragaria virginiana,* which are regarded as progenitors of the present day cultivated strawberry varieties (Staudt, 1989).It is a good source of vitamin-A (60 IU) and vitamin-C (30-120 mg/100g of edible portion). Apart from various famous cultivars (like Chandler, Sweet Charlie, Selva, Tioga, Kalimpong Local, Pusa Early Dwarf) which are available in India, the cultivar Camarosa, developed in California is also becoming popular in India as it is highly productive, resistant to thermal stress and bears flowers even at high temperatures (32°C) (Fernandez *et al.,* 2001).

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The cultivation of Strawberry is very much limited under South Indian conditions. In this context, there is a strong need to increase the area, production and productivity of strawberry crop through adoption of better horticultural practices *viz*., Integrated Nutrient Management (INM) technique which helps in the maintenance of soil fertility and also helps in continuous nutrient supply to the plants at optimum level for sustaining the desired crop productivity through optimization of benefits from all possible sources of plant nutrients in an integrated manner and brings the economy and efficiency in use of fertilizers (Dolker *et al.,* 2017). Nutrition is one among the various factors which contributes for growth and yield of strawberry. It accounts for about one third of the total cost of the production (Bhat, 1999; Nazir, 2005).INM can increase the crop productivity through synergistic effects and also improves physical condition of the soil (Hazra and Som, 1999). Hence investigations were carried out to develop nutrient management for strawberry cultivar Camarosa subjected to various treatment combinations of organic, inorganic and bio-fertilizers.

MATERIAL AND METHODS

The present investigation was carried under shade net conditions at College of Horticulture, Venkataramannagudem, Dr.Y.S.R. Horticultural University, West Godavari District, Andhra Pradesh during the year 2018-19.

Strawberry runners of uniform size were transplanted 2-5 cm depth at a spacing of 40×30 cm. in the first week of November. FYM, Vermicompost and Biofertilizers were applied in the concerned plots as per the treatment. NPK were also applied as per the treatment.Arka microbial consortium (AMC) was mixed with FYM and vermicompost 10 days prior to field application to enable multiplication of microbes.

The following treatment combinations were replicated thrice and analysed statistically by subjecting to Simple Randomized Block Design (R.B.D).

RESULTS AND DISCUSSION

The present investigation was carried under shade net conditions at College of Horticulture, Venkataramannagudem, Dr. Y. S. R. Horticultural University, West Godavari District, Andhra Pradesh (A. P) during the year 2018-19. Among the plant characters the number of fruits per plant, fruit diameter, fruit weight, fruit volume and fruit yield per plant were recorded. Among the biochemical characters the shelf life, Juice recovery percentage, TSS, Total sugars, Ascorbic acid and Anthocyanin content were analysed. The results on each parameter are separately presented under respective headings.

Number of fruits per plant:

Among different treatments, T_4(75% RDN + 25% N through vermicompost + Arka Microbial Consortium) was recorded with highest number of fruits per plant (24.00) which was found on par with T_2 (21.83) (Table 1).

Fruit diameter:

Among different treatments, maximum fruit

Table 1: Effect of INM on yield parameters of strawberry cv. Camarosa

Treatments	Total number of fruits per plant	Fruit diameter (cm)	Fruit weight (g)	Fruit volume (cm^3)	Yield per plant (g)
T_1 100% RDF (80:40:40 NPK Kg ha^{-1})	18.67	2.75	9.06	18.45	161.18
T_2 75% RDN + 25% N through vermicompost	21.83	3.06	12.07	20.95	259.20
T_3 75% RDN + 25% N through FYM	18.10	2.66	10.51	18.32	185.64
T_4 75% RDN + 25% N through vermicompost + Arka Microbial Consortium	24.00	3.18	13.40	21.24	292.54
T_5 75% RDN + 25% N through FYM + Arka Microbial Consortium	20.50	2.98	10.44	19.59	209.34
T_6 50% RDN + 50% N through vermicompost	16.03	2.42	7.03	17.50	108.75
T_7 50% RDN + 50% N through FYM	13.90	2.25	5.65	15.21	78.33
T_8 50% RDN + 50% N through vermicompost + Arka Microbial Consortium	17.10	2.59	8.27	18.27	138.42
T_9 50% RDN + 50% N through FYM + Arka Microbial Consortium	14.42	2.34	6.59	16.95	95.49
SE(m)±	0.80	0.11	0.34	0.59	4.95
CD (P=0.05)	2.39	0.33	1.01	1.76	14.85

diameter (3.18 cm) was recorded in T_4(75% RDN + 25% N through vermicompost + Arka Microbial Consortium) which was significantly higher to that of other treatments but it was on par with T_2 (75% RDN along with 25% N through vermicompost) (3.06 cm). Least fruit diameter (2.25 cm) was obtained in T_7 (50% RDN + 50% N through FYM) (Table 1).

Fruit weight:

The treatment T_4(75% RDN + 25% N through vermicompost + Arka Microbial Consortium) recorded highest fruit weight (13.40 g) whereas minimum fruit weight (5.65 g) was noticed in plants supplied with 50% RDN along with 50% N through FYM (T_7) (Table 1).

Fruit volume:

Highest fruit volume of 21.24 cm^3 was noticed in the plants treated with T_4 75% RDN + 25% N through vermicompost + Arka Microbial Consortium while the lowest recorded fruit volume (15.21) was observed in T_7 50% RDN + 50% N through FYM (Table 1).

Fruit yield per plant:

Application of $T_4$75% RDN + 25% N through vermicompost + Arka Microbial Consortium gave significantly maximum total yield of fruit per plant(292.54g) followed by T_2 (75% RDN along with 25% N through vermicompost) (259.20 g). However, the minimum yield of fruits per plant (78.33 g) was observed in plant receiving T_7 50% RDN + 50% N through FYM (Table 1).

The total soluble solids, total sugars, ascorbic acid and anthocyanin content were also significantly influenced by integrated nutrient management.

Shelf life period:

The maximum shelf life (44.10 h) was recorded in treatment T_4 followed by T_2 with 43.21 h, while minimum shelf life was recorded in T_7 with 29.07 h (Table 2).

Total soluble solids (TSS):

The total soluble solids (11.05 °B) was recorded highest in treatment T_4 followed by T_2 with 10.02 °B, while minimum total soluble solids were recorded in T_9 with 7.70 °B (Table 2).

Total sugars:

The total sugar content was observed to be maximum in treatment T_4 with 7.71 % followed by T_2 with 7.21 %, while minimum total sugar content was recorded in treatment $T_7$with 5.43 % (Table 2).

Ascorbic acid:

The Ascorbic acid content was observed to be maximum in treatment T_4 with 69.20 mg / 100 g followed by T_2 with 66.28 mg / 100 g, while minimum ascorbic acid content was recorded in treatment T_7 with 40.20 mg / 100 g(Table 2).

Anthocyanin content:

The Anthocyanin content was observed to be maximum in treatment T_4 with 62.30 mg / 100 g followed by T_2 with 59.40 mg / 100 g, while minimum ascorbic acid content was recorded in treatment T_7 with 40.80

Table 2 : Effect of INM on quality parameters of strawberry cv. Camarosa

Treatments	Shelf life (h)	Juice recovery percentage (%)	TSS (°B)	Total sugars (%)	Ascorbic acid (mg $100g^{-1}$)	Anthocyanin content (mg $100g^{-1}$)
T_1 100% RDF (80:40:40 NPK Kg ha^{-1})	39.40	86.10	8.50	6.70	58.40	53.42
T_2 75% RDN + 25% N through vermicompost	43.21	90.20	10.02	7.21	66.28	59.40
T_3 75% RDN + 25% N through FYM	36.04	85.06	8.23	6.38	55.41	56.40
T_4 75% RDN + 25% N through vermicompost + Arka Microbial Consortium	44.10	91.10	11.05	7.71	69.20	62.30
T_5 75% RDN + 25% N through FYM + Arka Microbial Consortium	41.60	88.20	9.01	6.84	64.20	56.50
T_6 50% RDN + 50% N through vermicompost	32.08	82.09	7.95	5.73	44.13	44.10
T_7 50% RDN + 50% N through FYM	29.07	80.07	8.09	5.43	40.20	40.80
T_8 50% RDN + 50% N through vermicompost + Arka Microbial Consortium	33.51	85.71	7.85	5.95	49.25	47.50
T_9 50% RDN + 50% N through FYM + Arka Microbial Consortium	29.10	81.08	7.70	5.54	42.24	42.92
SE(m)±	0.27	1.37	0.20	0.19	0.76	0.99
CD (P=0.05)	0.80	4.12	0.60	0.58	2.28	2.96

mg / 100 g (Table 2).

The more number of fruits per plantcould be attributed to the higher percentage of fruit set in strawberry cv. Camarosa due to the cumulative effect of application of nitrogen in the form of urea and vermicompost along with Arka microbial consortium which contains Nitrogen fixing, Phosphate and Zn solubilising microbes. The significant increase in fruit diameter might have occurred due to the increased photosynthetic area. Application of 75% RDN along with 25% N through vermicompost and Arka Microbial Consortium might have resulted in increased photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin content in the plants which ultimate improved the fruit diameter.

The application of T_4 as an integrated nutrient management practice led to the efficient utilisation of N, P and K by the plants which resulted in producing maximum photosynthates in terms of high biomass and translocation of assimilates to the developing sink resulting in higher fruit weight (Patil and Shinde, 2013). Similar findings also reported by Hazarika *et al.,* (2015), Nazir *et al.,* (2015), Beer *et al.,* (2017) and Jain *et al.,* (2017) in strawberry.

Increased TSS and Ascorbic acid at higher levels of nitrogen might have resulted due to the fact that absorption of nitrogen may be exerted regulatory role as an important and during ripening of fruits the carbohydrate reserves of the roots and stem are drawn upon heavily by fruits which might have resulted into higher TSS, ascorbic acid and anthocyanin in fruits. Increased TSS, Ascorbic acid in fruits are in agreement with the findings of El-Hamid *et al.* (2006) who reported that application of biofertilizers in strawberry resulted increase in T.S.S., total sugar, ascorbic acid and juice percentage and Singh *et al.*(2008) who reported that the effect of vermicompost on strawberry cv. 'chandler' and reported that fruit harvested from plant receiving vermicompost were firmer, TSS and ascorbic acid increases, acidity decreased and colour more attractive.

Conclusion:

Among different combinations of treatments, T_4with75 % RDN + 25% N through Vermicompost + Arka Microbial Consortium was proved to be the superior in recordingnumber of fruits per plant, fruit diameter, fruit weight, fruit volume, fruit yield per plant. The biochemical characters *viz.,* the shelf life, Juice recovery percentage, TSS, Total sugars, Ascorbic acid and Anthocyanin content were also found to be more in treatment T_4.

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