

Original Research Article

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Influence of Differential Combinations of Fertilizer and Manure Combinations on Vegetative Growth, Yield and Quality of Strawberry (*Fragaria x annanassa* Duch.) cv. Douglas

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ABSTRACT

Organic agricultural techniques are utilized globally to protect our environment and prevent health issues resulting from pesticides and hazardous chemicals. Traits such as plant growth characteristics (leaves/plant and plant spread), yield characteristics (flower buds, fruits per plant and fruit yield tons/ha) and quality characteristics (juice content, total sugar content, vitamin C and specific gravity) were observed. The runners of strawberry cv. Douglas were planted in the last week of October with a spacing of (30x60cm). The investigations was laid out in a randomized block design with five treatment combinations replicated thrice. The data regarding the different growth parameters observed at 30, 45, 60, 90, 105, 120 days after planting, yield parameters at 45, 60, 90, 120, 135, 150 days after planting and their quality parameters clearly indicate that the application of integrated sources of nutrients significantly affect the vegetative, reproductive and yield characteristics of the strawberry plant. However the manure fertilizer combination under treatment T4 (1/4 RD by Fertilizers and 3/4 RD by manures) was found to be the best treatment with regard to integrated and combined application of nutrient resources for strawberry cultivation in India. Considering overall performances, study suggested that vermicompost is a potential source of plant nutrients for sustainable strawberry production.

Keywords

Fertilizers, Manures, Combination, Strawberry, Douglas.

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Introduction

Cultivated strawberry (*Fragaria x annanassa* Duch) is octoploid specie belonging to the genus *Fragaria* of the family Rosaceae. It is an herbaceous crop with prostrate growth habit,

which behaves as an annual in sub-tropical region and perennial in temperate region. Modern agricultural practices are mostly directed toward high application of

commercial fertilizers to achieve high yield. It is widely recognized that application of fertilizer (especially nitrogen) can cause ground water pollution by nitrate leaching through the soil profile. A new approach to farming is often referred to as sustainable agriculture and it seeks to introduce friendlier agricultural practices to the environment and maintains the long term ecological balance of the soil ecosystem. The Strawberry (*Fragaria X annanassa* Duch.), a member of the rose family, is not really a berry but a false fruit and consists of many tiny individual fruits embedded in a fleshy scarlet receptacle. The brownish or whitish specks, commonly considered seeds, are the true fruits known as achenes. Strawberries are an excellent source of vitamin C, a good source of folate and potassium, and are relatively low in calories. Strawberry is one of the most widely appreciated fruits and it has attained a premier position in the fresh fruit market and processing industries of the world (Sharma and Sharma, 2003). Initially grown in temperate zones of India, its cultivation has now become possible in the sub-tropical zones as well with the introduction of day neutral cultivars (Asrey and Singh, 2004). Strawberry offers quicker returns on capital outlay than any other fruit crop since under special methods of cultivation a crop can be picked as early as the first summer after planting. The fruit is the first of the home-grown supplies to reach the market. Strawberry is one of the most important high value cash crops around the world. In India, it is cultivated commercially in Hamachal Pradesh, Utter Pradesh, Maharashtra, West Bengal, Nilgiri Hills, Delhi, Haryana, Punjab, Rajasthan and Jammu and Kashmir. Its cultivation can be extended successfully to other suitable areas of the world where irrigation and transportation facilities can be assured. Strawberry is an attractive, luscious, tasty and nutritious fruit with a distinct and pleasant aroma and flavor. It has a unique

place among cultivated berry fruits in world. Rich in vitamin C and iron, the principal demand for cultivated strawberry is from the processing and baking industries around the world. Among the various factors which contribute towards the growth, yield and quality of strawberry, nutrition is the most important and it has direct bearing on crop production (Umar *et al.*, 2008).

Integrated nutrient management includes the use of inorganic and organic sources of nutrients to ensure balanced nutrient proportions by enhancing nutrient response efficiency and maximizing crop productivity of desired quality. It also helps to minimize the existing gap between nutrient removal through continuous use of chemical fertilizers and supply through slow release of fertilizers. It is widely reported that the extensive use of chemical fertilizers adversely affects soil health and results in decreased crop productivity and quality (Macit *et al.*, 2007). Even with the application of recommended doses, yield potential of strawberry cropping systems has reduced to a plateau because soil health has deteriorated drastically and especially its organic matter content has depleted significantly. As intensive agriculture is becoming more and more necessary to meet the needs of the population, the soil nutrient balance is becoming increasingly negative and thus requiring appropriate supplement through integrated nutrient management. The use of fertilizers and manures not only helps to increase crop yields but also helps to storehouse nutrients for successive crops in addition to improving the physical condition of the soil. Bio-organic nutrition also improves the yield and quality of product. Organically produced fruit fetches higher prices compared to products grown using inorganic fertilization. The practical approach will be organic farming to the most responsive fruit crops and to encourage integrated nutrient supply for tapping the

potential yield of crops. As reported by Hennion *et al.*, (1999), “strawberry cultivation is highly nutrition responsive” and therefore the present experiment was undertaken to manage the growth, yield and quality of strawberry through an integrated approach.

Materials and Methods

The present investigation was carried out at experimental fields of the horticulture department Allahabad Agriculture Institute (Deemed University) Allahabad during spring season 2008-09. The experimental field is located at an elevation of 78 m above sea level and latitude 81.15° E and longitude 28.87 ° N. The soil of the experimental field was sandy loam in texture, poor in nitrogen (0.24%), comparatively richer in potassium (0.57%) and phosphorus (0.62%) and slightly acidic (pH=6.60) in nature. The strawberry (Cv. Douglas) as procured from Wimco seedling Ltd, Baghwale Rudrapur (U.S.N) Uttar Pradesh, India. The experiment was comprised of the following five treatment combinations:

The manures used in this experiment was vermicompost the experiment was laid out in a Randomized Block Design with four replications as under the plant height was measured with the help of digital Vernier calipers. Data was recorded manually by counting leaves plant-1, plant spread (cm), flowers plant-1, and fruits plant-1. First flowering and fruit setting were recorded from the date of planting to first flower opening and first fruiting respectively. TSS was measured with the help of ERMA Hand refractometer. Titrable acidity (%), Vitamin C (mg/100g), total sugars (%) and juice content (%) were measured as per the methods suggested by Rangana. Stastical analysis was estimated by the analysis of variance as per the technique given by Gomez and Gomez.

Results and Discussion

All the treatments in the present investigation had significant impact for all observed traits. However, treatments differed significantly from one another at various time intervals (Tables 1 and 2; Figures 1-8). The highest Vegetative growth (16.25 mean leaves/plant and 22.50 cm mean plant spread) was recorded for treatment T4. Observations revealed that plant spread and leaves/plant coincided with peak flower buds/plant, which within one month produced the highest fruits/plant. Afterwards production declined drastically and fewer fruits/plant were produced towards the fag end of growth (i.e. mid April). The increase in vegetative growth characteristics under these treatments might be due to increase in nitrogen availability to the plants through vermicompost. Application of fertilizers along with vermicompost increased the available NPK status, organic carbon and microbial biomass and dehydrogenates activity and hence they help in increasing height and spread of the plants.

Overall, treatment T4 which contained a greater amount of organic manures and less inorganic fertilizers was judged superior to the other treatments. This treatment showed 45.61% superiority over treatments T5 and T1 (control) in average leaves/plant and 61.53% superiority over T1 in average plant spread/plant. Recently it was revealed that available NPK and micronutrients increased significantly with organic sources of nutrients either alone or in combination with inorganic fertilizers over inorganic fertilizers used alone, thus improving vegetative growth. Similar results were also reported by Rayees *et al.*, (2015), Hazarika (2011), Singh and Dwivedi (2011), Tripathi *et al.*, (2010), Arancon *et al.*, (2004), Gajbhiye *et al.*, (2003), Prasad *et al.*, (2002), Klaas (2000) and Funt and Blerman (2000). Hence, taking these findings as reference, strawberry cv.

Douglas responded positively to the manure and fertilizer combination applied in treatment T4. Eight pickings were carried out starting from 2 months after planting to 5 months after planting (i.e. from end of December to mid-April). Treatment T4 produced 2.5 mean flower buds/plant more than T1 whereas in the number of fruits/plant, treatment T4 produced 5.00 average numbers of fruits more than treatment T5 with greater length/diameter ratio of 1.45, compared to 1.25 for treatment T5.

Thus, treatment T4 showed 61.53%, 80.95% and 14.4% superiority over treatment T5 in average flower buds/plant, average number of fruits per plant and length/diameter ratio of fruits, respectively. Also fruit yield per plant was highest (27.81 tons/ha) with treatment T4 and lowest with treatment T5 (20.55 tons/ha); treatment T4 showed 37.14% superiority over treatment T5 in fruit yield tons/ha. The earliness may be due to an optimum supply of plant nutrients growth hormones in right amount during the entire crop period which induces the vegetative development of the plant and ultimately more photosynthesis. Similar findings also reported by Karma Beer *et al.*, (2017), Rayees *et al.*, (2015), Tripathi *et al.*, (2015), Yadav *et al.*, (2010), Umer *et al.*, (2010), Singh *et al.*, (2010), Singh and Singh (2009), Asrey and Singh (2004) and Gajbhiye *et al.*, (2003) all reported the superiority of organic manures compared to NPK inorganic fertilizers in producing higher yields. The superiority of treatment T4 in

producing a maximum number of fruits/plant may be due to a greater growth and reproductive capacity of plants as influenced by a mixture of manures and inorganic fertilizers.

The superiority of treatment T4 in producing a maximum number of fruits/plant may be due to a greater growth and reproductive capacity of plants as influenced by a mixture of manures and inorganic fertilizers applied in treatment. As far as fruit quality parameters are concerned, treatment T4 showed overall significant superiority to treatments T1 and T5. The juice content of fruits increased with increasing manure content and decreasing inorganic fertilizer content although reduced slightly when manures were used alone (Table 2; Figs. 1 and 5). The maximum juice content (93.2%) was recorded for treatment T4 and the minimum (82.00%) for treatment T1. The increase in juice content may be due to an interactional effect of mixture of manures and inorganic NPK applied through treatment T4 which might have improved cell elongation, cell thickening and fruit development, resulting in better ripening with more succulent fruits. Several reports have indicated that manure and fertilizer combinations in strawberry have led to the production of softer fruits Karma Beer *et al.*, (2017), Rayees *et al.*, (2015), Ayesha *et al.*, (2011), Herencia *et al.*, (2011), Singh *et al.*, (2010), Singh *et al.*, (2009), Mahadeen *et al.*, (2009), Ghaderi *et al.*, (2008); Odongo *et al.*, (2008) and Macit *et al.*, (2007).

The experiment was laid out in a Randomized Block Design with four replications

S No.	Treatments	Fertilizer and manure combination
1	T ₁	100% of Recommended dose by inorganic fertilizers
2	T ₂	75% Recommended dose by inorganic fertilizers + 25% by organic manures
3	T ₃	50% Recommended dose by inorganic fertilizers + 50% by organic manures
4	T ₄	25% Recommended dose by inorganic fertilizers + 75% by organic manures
5	T ₅	100% Recommended dose by organic manures

Table.1 Impact of different fertilizer and manure combinations on growth and development of strawberry cv. Douglas in India

Treatments	Average leaf size/plant					Average plant spread (cm)					Average flower buds per plant					Average fruits per plant				
	Days after transplanting					Days after transplanting					Days after transplanting					Days after transplanting				
	30	45	60	90	120	30	45	60	90	105	45	60	90	120	135	60	90	120	135	150
T ₁	4.26	4.55	5.26	7.76	11.77	10.25	12.25	12.75	15.75	15.25	1.0	2.25	2.25	3.00	3.25	1.25	3.00	3.75	4.5	5.25
T ₂	4.77	5.29	5.52	8.28	12.23	10.5	12.25	13.00	16.25	16.00	0.75	2.25	2.25	4.00	4.25	1.00	3.50	4.50	5.25	5.75
T ₃	5.29	5.57	6.08	7.55	12.72	11.0	12.75	13.50	16.75	16.50	1.0	2.25	2.50	4.25	4.50	1.00	3.75	5.25	5.75	6.50
T ₄	6.78	7.09	8.71	12.22	16.25	12.0	14.0	17.25	22.50	21.75	1.50	3.00	3.75	5.50	5.25	1.75	4.00	8.00	9.0	9.50
T ₅	4.09	4.57	5.01	7.54	11.75	10.0	12.25	12.50	15.75	15.50	1.0	2.50	2.00	3.75	3.75	0.50	3.25	3.75	4.0	6.25
SE±	0.97	0.96	1.39	1.73	1.69	0.70	0.67	1.89	2.57	2.41	0.37	0.40	0.69	0.55	0.68	0.63	0.35	1.57	1.75	1.48
C.D at 5%	0.66	0.39	0.78	0.55	0.55	0.48	0.77	0.50	0.57	0.57	0.55	0.55	0.10	1.52	0.71	0.67	0.98	1.14	2.43	2.15

Table.2 Impact of different fertilizer and manure combinations on yield and quality characteristics of strawberry cv. Douglas in India

Treatment	Length/diameter ratio of fruits	Total fruits/plant	Fruit yield tones /ha	Juice content (%)	Acidity content (%)	TSS °B	Total sugar (%)	Ascorbic acid content (mg/100 g)	pH	Specific gravity
T ₁	1.30	24.50	22.13	82.00	0.16	9.00	13.75	54.60	3.01	0.80
T ₂	1.35	25.75	23.53	84.25	0.15	10.00	14.50	50.70	2.96	1.00
T ₃	1.40	27.75	25.93	89.10	0.14	11.00	14.75	42.75	2.91	1.10
T ₄	1.45	29.75	27.81	93.20	0.12	13.00	15.25	38.50	2.87	1.30
T ₅	1.25	24.50	20.55	91.40	0.11	14.00	15.50	35.50	2.81	0.90
SE±	0.06	2.14	2.60	4.16	0.019	1.85	0.63	6.75	0.06	0.17
C.D at 5%	1.17	5.55	9.08	19.54	0.48	7.40	4.09	7.32	1.01	0.84

Fig.1 and 2 Effect of different fertilizer and manure combinations on L/D ratio and Fruit yield of strawberry cv. Douglas

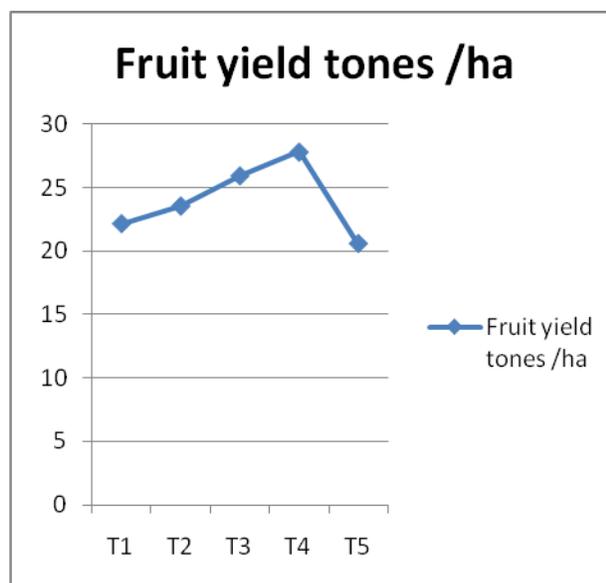
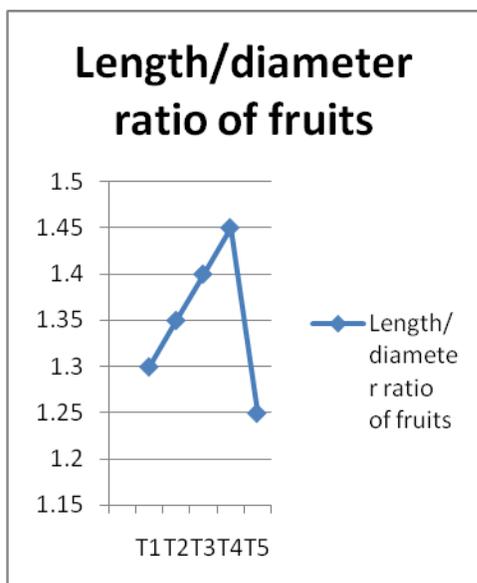


Fig.3 and 4 Effect of different fertilizer and manure combinations on T.S.S. (°B) & Total sugar (%) of strawberry cv. Douglas in India

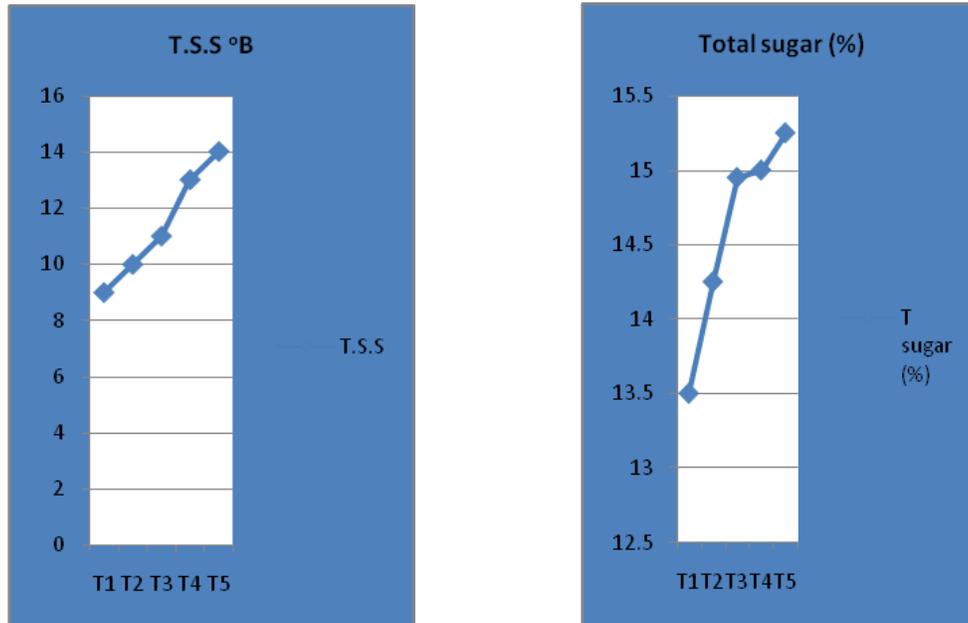


Fig.5 and 6 Effect of different fertilizer and manure combinations on vitamin C (mg/100 g) and juice content (%) of strawberry cv. Douglas

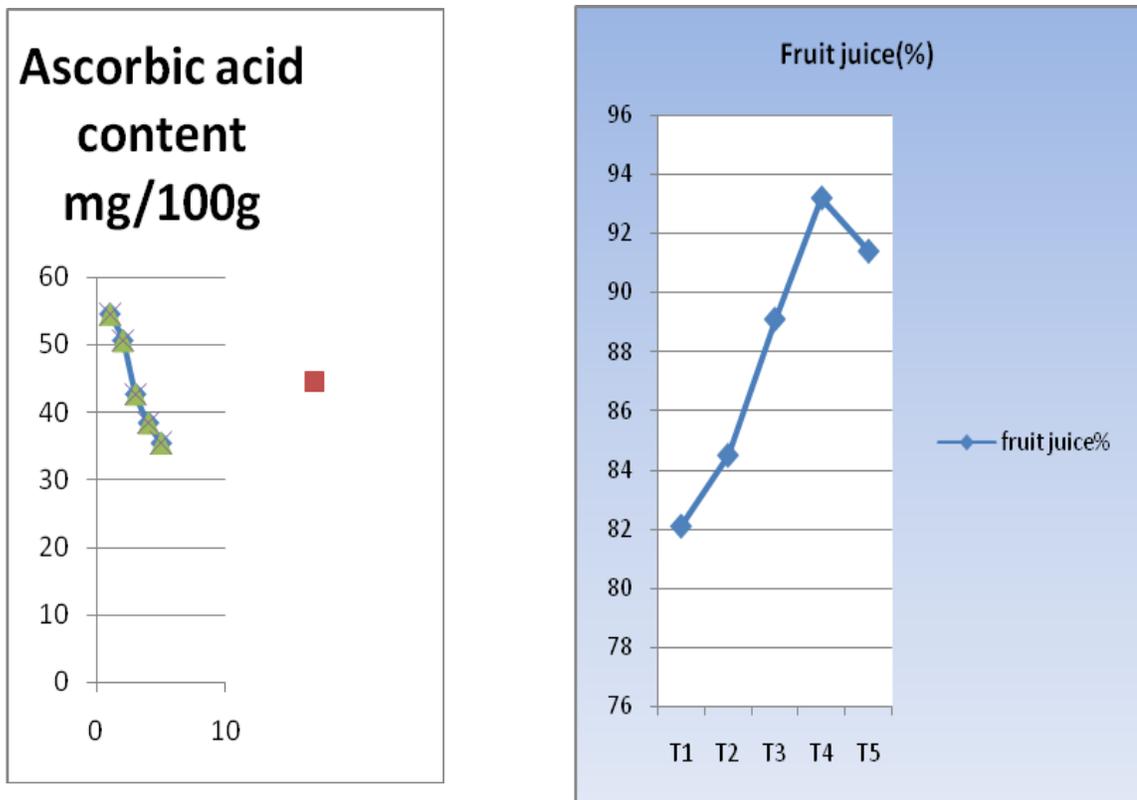


Fig.7 and 8 Effect of different fertilizer and manure combinations on acidity (%) and pH value of strawberry cv. Douglas

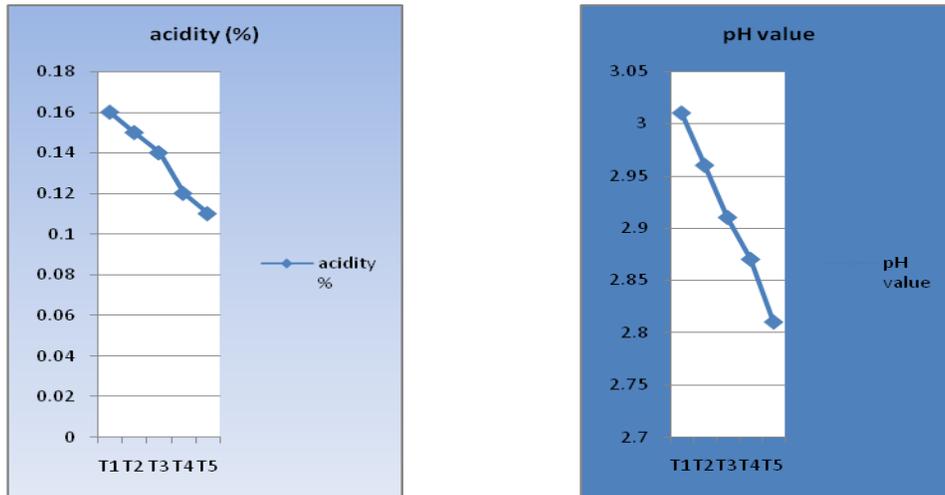
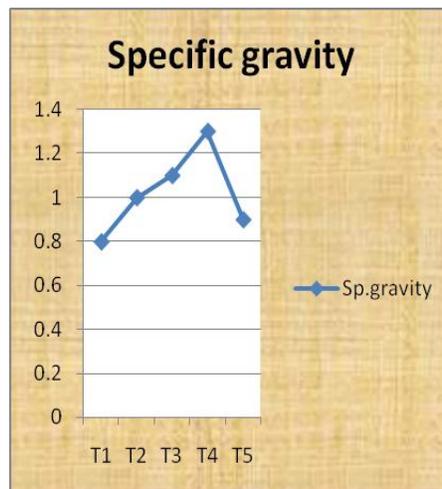


Fig.9 Effect of different fertilizer and manure combinations on specific gravity of strawberry cv. Douglas in India



The maximum TSS (14%) was found in treatment T5 and the minimum (9%) in treatment T1, likewise total sugar was highest in treatment T5 and lowest in treatment T1 (Table 2 and Figure 3 and 4). On the other hand, both acidity (%) and pH were highest in treatment T1 and lowest in treatment T5 while treatment T4 exhibited the highest specific gravity of fruits and treatment T1 the lowest, as shown in Table 2 and Figures 6, 7, 8 and 9. Thus strawberry cv. Douglas responded negatively to NPK inorganic fertilizers and

positively to higher manure levels under the experimental conditions of this study.

Such an increase in total sugars, TSS and juice percentage have arisen due to synergistic effect of differential combination of inorganic fertilizer and vermicompost as reported by El-Hamid *et al.*, (2006). Present findings are in close conformity with the results presented by Rayees *et al.*, (2015), Tripathi *et al.*, (2015), Singh and Dwivedi (2011), Shehata *et al.*, (2011), Abu-Zahra *et*

al., (2011), Yadav *et al.*, (2010), Mahadeen *et al.*, (2009), Aracon *et al.*, (2004), Ali *et al.*, (2003), Prasad *et al.*, (2002), Singh *et al.*, (2001) and Woznaik *et al.*, (1997).

It can be concluded from the present study that a differential combination of inorganic and organic fertilizers applied as treatment T₄ One part of recommended dose as inorganic form and three parts of recommended dose in organic form (Vermicompost) is advisable for maximum returns from strawberry.

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References

- Abu-Zahra, T. R., and A. A. Tahboub.2009. Strawberry (*Fragaria ananassa* Duch.) fruit quality grown under different organic matter sources in a plastic house at Humrat Al-Sahen. *Acta Hort.*807: 353-358.
- Ali, Y. M., Iqbal, S. Z. A. Shah, and M.J. Ahmed. 2003. Effect of different combinations of nitrogen, Phosphorous and farm yard manure on yield and quality of strawberry. *Sarhad J. Agric.* 19:185-188.
- Arancon NQ, Edwards CA, Beriman P, Metzger JD, Lee S, Weich C 2003. Effect of vermicompost on growth and marketable fruit of field grown strawberry. *Pedbiologia*, 47(5-6):731-5.
- Arancon NQ, Edwards CA, Beriman P, Welch C, Metzger JD., 2004 - *Influences of vermicompost on field strawberries: I. Effects on growth and yields.* – *Bioresource Technology*, 93: 145-153.
- Ayesha, R. N., M. Fatima, K. Ruqayya, M. Qureshi, I. A. Hafiz, K. S. Khan, and A. Kamal. 2011. Influence of different growth media on the fruit quality and reproductive growth parameters of strawberry. *J. Med. Plant Res.*5(26): 6224-6232.
- El-Hamid, Aza AS, Abbou AA, Mansour SAA, El-Sayed AAA.2006. Effect of some biofertilizer on yield and fruit quality of strawberry. *Ann Agr Sci.* 2006; 44(10):251-64.
- Funt R.C., Blerman P., 2000 - *Composted yard waste improves strawberry soil quality and soil water relation.* – *Acta Horticulture*, 517: 37-39.
- Ghaderi N., Talaie A.R., 2008 - *Influence of manure and urea on yield and some other fruit characteristics in strawberry cv. Kurdistan.* - *Iranian J. Hortic. Sci.*, 39(1): 99-107.
- Gomez AA, Gomez KA 1984. *Statistical procedures for agricultural research.* New York: John Willey and Sons, Inc; 1984. p. 680.
- Hazarika, T.K, Nautiyal, B.P. and Bhattacharyya, R.K 2011. Effect of INM on productivity and soil characteristics of tissue cultured banana cv. Grand Naine in Mizoram, India. *Progressive Horticulture* 43: 30-35.
- Herencia, J. F., P. A. Garcia-Galavisa, J. A. R. Doradoa, and C. Maqueda. 2011. Comparison of nutritional quality of the crops grown in an organic and conventional fertilized soil. *Sci. Hort.* 129: 882-888.
- Karma Beer, Santosh Kumar, Alok K. Gupta and Syamal, M.M. 2017. Effect of Organic, Inorganic and Bio-Fertilizer on Growth, Flowering, Yield and Quality of Strawberry (*Fragaria × Ananassa* Duch.) cv. Chandler. *Int.J.Curr. Microbiol. App.Sci.*
- Klaas L., 2000 - *Effect of manure to the growth and forming runners in strawberry.* - *Proceedings of the International Conference on fruit Production and fruit breeding*, Tatur, Estonia, 12-13 September.
- Macit I., KOC A., Guler S., Deligoz I., 2007 - *Yield, quality and nutritional status of*

- organically and conventionally grown strawberry cultivars.* - Asian Journal of Plant Sciences, 6(7): 1131-1136.
- Mahadeen, A. Y. 2009. Influence of organic and chemical fertilization on fruit yield and quality of plastic-house grown strawberry. *J. Agric. Sci.* 5: 167-177.
- Odongo, T., D. K. Isutsa, and J. N. Aguyoh. 2008. Effects of integrated nutrient sources on growth and yield of strawberry grown under tropical high altitude conditions. *Afr. J. Hort. Sci.* 1: 53-69.
- Ranganna S.1997. Handbook of analysis and quality control of fruit and vegetable products. 2nd ed. Culcutta: Tata Mc. Graw Hill Publishing Co; 1997. p. 279–309.
- Rayees A. Wani, S A Hakeem, Sabiya Bashir, Seerat Geelani, Mohammad Najeeb Mughal, V.M. Prasad 2015 Impact of Integrated nutrient management on growth, yield and quality of strawberry (*Fragaria ananassa Duch*) cultivation in India. *Nature and science United States of America*, 2015, 13(1): 39-44.
- Sahu SK, Singh DB 2005. Effect of different levels of biofertilizer of growth yield and quality of Strawberry (*Fragaria x ananassa Duch.*) cv. *Sweet Charley*. *Orissa J Hort.* 2005; 33(2):82–5.
- Shehata, S. A., A. A. Gharib, M. E. Mohamed, K. F. A. Gawad, and E. A. Shalably. 2011. Influence of compost, amino and humic acids on the growth, yields and chemical parameters of strawberries. *J. Med. Plants Res.* 5(11): 2304-2308.
- Singh A., Singh J.N., 2009 - *Effect of biofertilizer and Bioregulators on growth, yield and nutrient status of strawberry cv. Sweet Charlie.* - Indian Journal of Horticulture, 66(2):220-224.
- Singh R., Sharma R R., Kumar S, Gupta R K, Patil R T.2008.Vermicompost substitution influences the physiological disorders, fruit yield and quality of strawberry (*Fragaria ananassa Duch*). *Bioresource Technol.* 2008; 99:8507–11.
- Singh S.R., Zargar M.Y., Singh U., Ishaq M., 2010 -*Influence of bio-inoculants and inorganic fertilizers of yield, nutrient balance, microbial dynamics and quality of strawberry (Fragaria x annanassa) under rain fed conditions of Kashmir valley.* - Indian Journal of Agricultural Sciences, 80(4): 275-281.
- Tripathi, V.K. Sanjeev Kumar and Gupta, A.K 2015. Influence of *Azotobacter* and Vermicompost on Growth, Yield and Quality of Strawberry Cv. Chandler. *Indian J. Horticulture*, 72(2): 201-205
- Umar, I., Wali, V.K., Rehman, M.U., Mir, M.M., Banday, S.A. and Bisati, I.A.2010. Effect of Subabul (*Leucaena Leucocephala*), Urea and biofertilizer application on growth, yield and quality of strawberry cv. chandler. *Applied Biological Res.*, 12: 50-54
- Wozniak, W., B. Radajewska, A. Reszelska-Siecicchowicz, and I. Dejwor. 1997. Sugars and acid content influence organoleptic evaluation of fruits of six strawberry cultivars from controlled cultivation. *Acta Hort.* 439: 333-336.
- Yadav S.K., Khokher U.U., Yadav R.P., 2010 – *Integrated nutrient management for strawberry cultivation.* – Indian Journal of Horticulture, 67(4): 445-449.

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