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Effect of INM (Integrated nutrient management) on plant growth, yield and quality of strawberry (*Fragaria x ananassa Duch.*)

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Abstract

A study was conducted experimental site of Department of Horticulture Lovely professional university (phagwara) during 2020-2021 to study the impact of Integrated nutrients management on growth, yield and quality parameters of strawberry cv. Winter down. The runners of strawberry var. winter down was transplanted at first week of November with a spacing of 30 × 30 cm. The experiments was laid out in Randomised block design with 10 treatments replicated thrice. Result indicated that there was stabilized rise in plant height, plant spreading, number of leaves per plant and quite low at later stage of growth. The maximum plant height, higher number of leaves per plant, leaf area, chlorophyll content, plant spreading was recorded in T₇ (50% RDF + Vermicompost + Azotobacter) and minimum in control. On the other side the biochemical parameters like fruit weight, fruit length, fruit TSS, ascorbic acid /100 gm pulp, and acidity was also observed higher in T₇ along with higher yield per plant.

Keywords: Winter down, growth, yield, quality, vermicompost, azotobacter

1. Introduction

Strawberry is an important cash crop grown worldwide and liked by many in various forms such as fresh fruits, extracts etc. Botanically strawberry is known as *Fragaria ananassa Duch.* Belong to family Rosaceae with chromosome no. 56 (2n=8x) octaploid. It is delicious and nutritive soft fruit with wider adaptability. Besides having the dessert quality, It is a potent source of antioxidants which render beneficial contribution to the human health. Strawberry has been in cultivation since long time and during the course of understanding the plant physiology and cultivation, there has been many improvements with regard to the cultivation systems, nutritional requirements and other aspects of strawberry crop production (Bal, 2013). Strawberry fruit is rich source of vitamins and minerals. Vitamin C is present in higher amount rather than other vitamins. The flavour of fruit consists of three compounds i.e. sugar, acids and aromatic compounds. The major volatile compound which is responsible for the flavor of the fruit is Ethyl esters e.g. Ethyl butanoate and ethyl hexanoate. The leaf tissues and red achenes contains ellagic acid (antimutagenic and anticarcinogenic plant phenol) in strawberry fruit. Due to presence of more oleic acid and less linoleic acid ripe fruit contains more lipids than unripe fruits (Chattopadhyay, 2014). The first plant of strawberry is cultivated in France and America (diploids *F. chiloensis* and *F. virginiana*) which are considered as progenitors. The origin of modern cultivated strawberry is from Europe (1714-1759). FAOSTAT data (Food and Agriculture Organization of the United Nations) confirms China is by all means the absolute leader in fresh strawberry production with almost 3 million tons in 2014, followed by USA with 1.3 million tons (FAOSTAT, 2016). In India, strawberry is cultivated in Maharashtra, West Bengal, Himachal Pradesh, Uttarakhand, Uttar Pradesh, Delhi, Haryana, Punjab and Rajasthan (Bal, 2013). Total in world, it covers 9.2 lakh hectare area in 73 countries & annual production of strawberry is estimated 45.9 lakh T. In India, total area under strawberry cultivation is 1 lakh hectare. There annual production is nearly about 5000 million tonnes (NHB 2017). India is exporting strawberry fruit to different countries which are Austria, Bangladesh, Germany, Jordan.

It is perennial, stoloniferous herbs which spread by stolons & runners. Strawberry leaves have three leaflets which grow from the crown of the plants. Strawberry plant leaves are thick, blunt & toothed, flower colour is white & borne in small clusters. Fruit of strawberry is small in size & light to deep red in colour, fruit flesh is soft with pleasant aroma. Both hermaphrodite and unisexual plants are produced in case of strawberry. Strawberry is an

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Aggregate fruit. The seeds of strawberry are known as achenes. The achenes are the numerous, tiny, ellipsoid specks that cover the fruit surface. Thalamus is the edible portion of fruit (95% part of fruit is edible). Integrated nutrient management (INM) is a technique that is followed by safest way to dispose residues of crops & give better quality compost by a managed & integrated by using both sources of fertilizers like organic and inorganic for balancing fertility of soil & providing appropriate nutrient level to plants. Management of nutrients involving by using nutrient of crop as soon as possible to provide better productivity and protect environment. The major principle of integrated nutrient managements are managing inputs of soil nutrients along with requirement of crop. Lastly, Integrated nutrients management is a tool that can offer good options & economic choices to provide plant with a balancing level of nutrients that's require by crop & also minimize total cost, create suitable physiochemical conditions of soil & without effecting environment, protect the nutrients of soil, & find safety methods to get rid of agriculture wastes.

Material and methods

The present investigation entitled "Effect of Integrated Nutrient Management on growth, yield and quality of strawberry (*Fragaria × ananassa Duchesne*) cv. 'Winter down' was laid out on the experimental site of Department of Horticulture Lovely professional university (phagwara) during 2020-2021. Experimental site of LPU (phagwara) is approximately 237 meters (768ft) above the mean sea level and is situated at 31.2232 °N latitude and 75.7670 °E longitudes in the Punjab state with an annual rainfall of 816 mm.

The strawberry runners of uniform size were transplanted on ridges at a spacing of 30×30 cm in first week of November during 2020-21. The treatments viz., T0 – 100% RDF Control (Untreated), T1 -50% RDF + FYM, T2 -50% RDF + FYM + Azotobacter, T3 - 50% RDF + FYM + PSB, T4 - 50% RDF + Vermicompost, T5 -50% RDF + Vermicompost + Azotobacter, T6 -50% RDF + Vermicompost + PSB, T7 - 50% RDF + FYM + Vermicompost + Azotobacter, T8 - 50% RDF + FYM + Vermicompost + PSB, T9 -50% RDF + FYM + Vermicompost + Azotobacter + PSB, were evaluated in randomized block design with three replications. The required quantity of organic manures as per treatments was applied at the time of land preparation. Urea was applied in two splits before planting and flowering stages while the full dose of phosphorus and potash was given before planting. *Azotobacter*, phosphorus solubilising bacteria solutions were made by dissolving 50 ml in 20 litres of water. Black

polythene of 200 gauges was used as mulch material. Other cultural practices like weeding, hoeing, irrigation, insect pest and disease management were done as and when required. Observations on vegetative growth parameters were recorded at 15 days interval whereas, Physiological parameters were recorded after final harvesting of the fruits. Yield per plant and per hectare were recorded at physiological maturity.

Results and Discussion

The data (Table 1) revealed that there was a steady rise in number of leaves per plant, plant height, spread of plants, with increase the age of crop. However rate of increase in these characters was slow at later stages of growth. The maximum number of leaves per plant (5.67, 7.67, 9.33, 15.00) were recorded in T7 and minimum number of leaves per plant (2.67, 5.00, 6.00, 9.33) was recorded in control T0 at 30, 60, 90, 110 DAP. The highest leaf area was observed 73.11 in T7 and minimum leaf area was observed in T0 68.61 as shown in table no. 1. As same tha higher chlorophyll content was recorded in T7 (55.46) and lowest chlorophyll content was observed in T0 control (46.03). The maximum height of plants (3.87, 5.40, 7.33, 12.24) were recorded in T7 and minimum height of plants (3.09, 4.55, 6.66, 9.88) at an interval of 30, 60, 90, 110 days after transplanting. Maximum spreading of plants (8.01, 11.02, 17.96, 22.09) were recorded in T7 and minimum spreading of plants occurred in T0 (7.50, 10.07, 15.88, 20.77). The reason for good growth (number of leaves, plant height, plant spreading) under treatment of 50% RDF + vermicompost + Azotobacter may be due to increased availability of nutrients of plants initially by 50% RDF and then by organic manure (vermicompost) and application of biofertilizer (*Azotobacter*). These organic manures supplying all the essential nutrients and improve physical condition of soil especially under light textured soil. The increase in growth parameters through integrated nutrient management were also reported by Nowsheen *et al.* (2006) and Tripathi *et al.* (2010) [31] in strawberry. Thus with the application of 50% RDF along with vermicompost and with the combination application of azotobacter the physical parameters was observed higher as compared to the other treatments in the strawberry crop cv. Winter down. Due to presence of good amount of vermicompost in T7 the results seems responding because Diverting waste from landfills is excellent, and vermicomposting also produces nutrient-rich castings for field. Vermicompost also benefits the environment by reducing the need for chemical fertilizers and decreasing the amount of waste going to landfills. Thus best results are shown in T7 after following the other treatments.

Table 1: Effect of INM on Number of leaves per plant, Chlorophyll Content, Plant height and spreading of plants of strawberry cv. Winter Down

Treatments	Number of leaves/plant				Leaf Area	Chlorophyll Content	Plant height (cm)				Plant Spreading
	30 DAP	60 DAP	90 DAP	110 DAP			30 DAP	60 DAP	90 DAP	110 DAP	
T ₀	2.66	5.00	6.00	9.33	68.61	46.03	3.09	4.55	6.66	9.87	7.49
T ₁	4.00	5.67	6.33	11.33	69.74	48.56	3.23	4.74	6.92	10.49	7.59
T ₂	3.00	5.33	6.33	11.67	69.89	51.26	3.27	4.76	6.96	10.96	7.63
T ₃	3.66	5.33	6.66	12.00	70.41	52.96	3.44	4.88	7.11	11.13	7.70
T ₄	4.33	6.33	8.00	13.00	71.36	53.90	3.52	4.95	7.13	11.50	7.74
T ₅	5.00	6.66	8.00	13.33	71.92	54.00	3.55	5.00	7.18	11.70	7.75
T ₆	4.33	5.66	6.67	12.00	69.99	51.13	3.31	4.80	6.94	10.53	7.57
T ₇	5.66	7.66	9.33	15.00	73.11	55.46	3.87	5.40	7.33	12.24	8.01
T ₈	5.33	6.66	8.00	11.00	69.94	51.76	3.28	4.56	6.56	10.02	7.60
T ₉	5.00	7.33	8.66	13.66	72.11	54.20	3.64	5.17	7.21	11.63	7.83

C.D	1.55	1.40	1.44	1.69	0.94	2.49	0.22	0.41	0.29	1.01	0.19
SE(m)	0.52	0.47	0.48	0.56	0.31	0.83	0.07	0.13	0.10	0.33	0.06

The quality parameters, Fruit weight was maximum recorded in T7 (R1-12.22, R2- 11.94, R3- 11.56 Mean-11.90 in gm) and minimum weight of fruits were recorded in T0 controlled (R1- 7.91g, R2- 8.12g, R3- 6.90 g Mean-7.64g) Fruit length were recorded maximum in T7 (4.54cm, 5.12cm, 4.72cm, mean-4.79 cm) while minimum fruit length were recorded in T0 (3.12cm, 3.03cm, 3.00cm, mean- 3.05) So as maximum fruit TSS was observed in T7 (6.97) after that higher TSS was observed in T9. Pooled data analysis revealed that physical

parameters like number of leaves per plant, leaf area, chlorophyll content in leaves, height of plant and spreading of plant was maximum observed in T7 on the other side physical parameters was recorded minimum in T0 with 100 % RDF. Thus along with the recommended dose of fertilizers with the application of organic manure and bio fertilizer the result shows good as compared to control (100% RDF) Because organic manures are rich in nutrient and bio fertilizers helps to maintain that fertility in the soil.

Table 2: Effect of INM on fruit weight, fruit length, fruit TSS, Ascorbic acid, Acidity and Number of fruits per plant of strawberry cv. Winter Down

Treatments	Fruit weight (gm)	Fruit Length (cm)	Fruit TSS degree brix	Ascorbic Acid (mg/100gm)	Acidity (%)	Number of fruits per plant
T ₀	7.64	3.05	5.51	49.08	0.55	6.66
T ₁	8.90	3.54	5.55	49.52	0.51	7.33
T ₂	9.80	3.89	5.69	49.68	0.62	7.66
T ₃	10.55	3.90	6.03	50.77	0.63	8.00
T ₄	10.66	4.13	6.19	51.12	0.67	8.00
T ₅	11.48	4.53	6.25	51.02	0.71	8.66
T ₆	11.36	3.92	5.73	49.81	0.63	7.33
T ₇	11.90	4.79	6.97	52.29	0.71	9.66
T ₈	9.02	3.79	5.57	50.55	0.65	7.00
T ₉	11.89	4.24	6.79	51.30	0.71	8.33
C.D	1.63	0.33	0.34	1.18	0.06	1.01
SE(m)	0.54	0.11	0.11	0.39	0.02	0.33

As shown in table no. 2 higher amount of ascorbic acid per 100gm pulp was recorded in T7 52.29 where as minimum amount of ascorbic acid was recorded in T0 (49.08), Acidity was recorded maximum (0.71) in both treatments T7 and T5 whereas minimum was observed in T0 (0.55). The yield parameter total number of fruits after 110 days of DAP was observed in (9.66) and minimum was recorded in T0 control (6.66). So it is concluded from the results that Growth parameters, quality parameters, yield parameters respond to T7 (50% RDF + Vermicompost + Azotobacter).

Conclusion: Among various treatment studied, the treatment T₇ had reported maximum plant height, Number of leaves per plant, plant spreading, leaf area and total chlorophyll content, fruit set, fruit quality and fruit yield.

References

- Al-Hadethi ME, Ali SAD and BMK A. Influence of biofertilizers on growth and leaf mineral content in Peach transplants. IOSR Journal of Agriculture and Veterinary Science 2017;10(9):90-93.
- Barail, P, and Deb P. Influence of integrated nutrient management on yield and bio-chemical parameters of pineapple (cv. Kew). Journal of Pharmacognosy and Phytochemistry 2018;7(5):1339-1342.
- Chandra KK. Growth, fruit yield and disease index of carica papaya L. inoculated with pseudomonas straita and inorganic fertilizers. Journal of Biofertilizers & Biopesticides 2014;5(2):1.
- Dutta P, Kundu S and Chatterjee S. Effect of Bio-Fertilizers on homestead fruit production of papaya Cv. Ranchi. Acta Hort 2010;851:385-388. DOI: 10.17660/ActaHortic.2010.851.59.
- Ennab HA. Effect of Organic Manures, Biofertilizers and NPK on Vegetative Growth, Yield, Fruit Quality and Soil Fertility of Eureka Lemon Trees (Citrus limon (L.) Burm). J. Soil Sci. and Agric. Eng., Mansoura Univ 2016;7(10):767-774.
- Evans EA and Ballen FH. An overview of global papaya production, trade, and consumption. IFAS Extension, University of Florida 2012, 1-7.
- Fabi JP, Cordenunsi BR, Barreto GP, dM Mercadante AZ Lajolo FM and Do Nascimento JR O. Papaya fruit ripening: response to ethylene and 1-methylcyclopropene (1-MCP). J. Food Agric. Food Chem 2007;55:6118-6123. doi: 10.1021/jf070903c.
- Fabi JP, Peroni FH G and Gomez MLPA. Papaya, mango and guava fruit metabolism during ripening: postharvest changes affecting tropical fruit nutritional content and quality. Fresh Prod 2010;4:56-66.
- Fediala Abd El-Gleel Mosa W, Sas Paszt L, Fraç M, Trzciński P, Treder W, Klamkowski K. The role of biofertilizers in improving vegetative growth, yield and fruit quality of apple. Hort Sci (Prague) 2018;45:173-180.
- Food and Agriculture Organization of the United Nations (FAOSTAT). 2017. Food and agriculture organization of the United Nations. Crop downloads. Available at: <http://www.fao.org/faostat/en/#data/QC>
- Halder NK, Farid ATM, & amp Siddiky MA. Effect of Boron for correcting the deformed shape and size of jackfruit. Journal of Agriculture & Rural Development 2008;6(1):37-42.
- Hazarika BN, and Ansari S. Biofertilizers in fruit crops- A review. Agricultural Reviews 2007;28(1):69-74.
- Hazarika TK, Ralte Z, Nautiyal BP and Shukla AC. Influence of bio-fertilizers and bio-regulators on growth, yield and quality of strawberry (*Fragaria × ananassa*). Indian Journal of Agricultural Sciences 2015;85(9):1201-5.
- Jugnake MO. Effect of Bio-fertilizer and chemical

- fertilizers on growth, yield and quality of Sweet Orange (*Citrus sinensis* L. Osbeck) (Doctoral dissertation, Vasantrya Naik Marathwada Krishi Vidyapeeth, Parbhani) 2017.
15. Khalil NH, and Agah RJ. Effect of Chemical, Organic and Bio Fertilization on Growth and Yield of Strawberry Plant. *Int. J. Adv. Chem. Eng. Biol. Sci* 2017;4(1):5.
 16. Korwar GR, Pratibha G, Ravi V and Palanikumar D. Influence of organics and inorganics on growth, yield of aonla (*Embllica officinalis*) and soil quality in semi-arid tropics. *Indian J. Agric. Sci* 2006;76:457-461.
 17. Kumar A, Sharma N, Sharma CL and Singh G. Studies on nutrient management in apple cv. Oregon Spur-II under the cold desert region of Himachal Pradesh in India. *Indian Journal of Agricultural Research* 2017, 51(2).
 18. Kumar M, Rai PN and Sah H. Effect of biofertilizers on growth, yield and fruit quality in low-chill pear cv Gola. *Agricultural Science Digest-A Research Journal* 2013;33(2):114-117.
 19. Kumar N, Singh HK and Mishra PK. Impact of organic manures and biofertilizers on growth and quality parameters of Strawberry cv Chandler. *Indian Journal of Science and Technology* 2015;8(15):1-6.
 20. Mamta DD, Gupta SB and Deole S. Effect of integrated nutrient management on growth and nutrient uptake in papaya (*Carica papaya* L.) At nursery level. *Journal of Pharmacognosy and Phytochemistry* 2017;6(5):522-527.
 21. Maskar SL. Studies on effect of bio-fertilizers and inorganic fertilizers on growth, yield and quality of sapota (*Manilkara Achras* (Mill.) Forseberg). Cv. Kalipatti (Doctoral dissertation, Vasantrya Naik Marathwada Krishi Vidyapeeth, Parbhani). 2015.
 22. Mosa WF, AEG, Paszt LS, and EL-Megeed NAA. The role of bio-fertilization in improving fruits productivity— A review. *Advances in Microbiology* 2014;4(15):1057.
 23. Olyaie Torshiz A, Goldansaz SH, Motesharezadeh B, Asgari Sarcheshmeh MA and Zarei A. Effect of organic and biological fertilizers on pomegranate trees: yield, cracking, sunburning and infestation to pomegranate fruit moth *Ectomyelois ceratoniae* (Lepidoptera: Pyralidae). *Journal of Crop Protection* 2017;6(3):327-340.
 24. Omotoso SO and Akinrinde EA. Effect of nitrogen fertilizer on some growth, yield and fruit quality parameters in pineapple (*Ananas comosus* L. Merr.) plant at Ado-Ekiti Southwestern, Nigeria. *Int. Res. J. Agric. Sci. Soil Sci* 2013;3(1):11-16.
 25. Prasad H, Sajwan P, Kumari M and Solanki SPS. Effect of organic manures and biofertilizer on plant growth, yield and quality of horticultural crop: A review. *International Journal of Chemical Studies, India* 2017;5(1):217-221.
 26. Raghavan M, Hazarika BN, Das S, Ramjan M and Langstieh LB. Integrated nutrient management in litchi (*Litchi chinensis* Sonn.) cv. Muzaffarpur for yield and fruit quality at foothills of Arunachal Pradesh. *IJCS* 2018;6(3):2809-2812.
 27. Santana EA, Cavalcante ÍHL, de Souza Brito D, do Carmo RN and de Souza Kdsm. Fruit production and quality of guava as a function of biofertilizer and nitrogen Fertigation in brazilian semiarid. *Emirates Journal of Food and Agriculture* 2017, 242-249.
 28. Santosh K, Pathak KA, Kishore K, Shukla R, Solankey S and Singh DK. Effect of bio-fertilizers on biological nitrogen fixation of banana cv. Giant Cavendish. *Asian Journal of Horticulture* 2013;8(2):436-439.
 29. Shaheen MA, Abd El ahab, SM El-Morsy FM and Ahmed ASS. Effect of organic and bio-fertilizers as a partial substitute for NPK mineral fertilizer on vegetative growth, leaf mineral content, yield and fruit quality of superior grapevine. *J. Hort. Sci. Ornamental Plants* 2013;5:151-159.
 30. Sourabh JRS, Baloda S, Kumar R, Sheoran V and Saini, VH. Response of organic amendments and biofertilizers on growth and yield of guava during rainy season. *Journal of Pharmacognosy and Phytochemistry* 2018;7(6):2692-2695.
 31. Tripathi VK, Kumar N, Shukla HS and Mishra AN. Influence of *Azotobacter*, *Azospirillum* and PSB on growth, yield and quality of strawberry cv. Chandler, Paper presented in National Symposium on Conservation Hort., during 2010;21:198-199.
 32. Vessey JK. Plant growth promoting rhizobacteria as biofertilizers. *Plant and soil* 2003;255(2):571-586.
 33. Vithu GN, Varu DK, Patel D and Aghera Sameer R. Efficacy of Biofertilizers to improve Flower Production: A review. *Bull. Env. Pharmacol. Life Sci* 2018;8:09-17.
 34. Wange SS, Patil MT and Singh BR. Cultivar biofertilizer interaction study in strawberry. *Recent Horticulture* 1998;4:43-49.
 35. Zhang Z, Feng H, Xiao X, Li H. Influence of bio-fertilizers on control of banana wilt disease and soil microbial diversity. *Journal of Fruit Science* 2010;27(4): 575-579.