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EMPIRICAL STUDIES OF STRAWBERRY GROWTH, FLOWERING AND FRUITING BEHAVIOR USING INTEGRATED NUTRIENT MANAGEMENT

Fathema Zaman¹ and Govind Vishwakarma^{2*}

¹Department of Horticulture, SGRR University, Dehradun - 248 001 (UK), India.

²Department of Fruit Science, Rani Lakshmi Bai Central Agricultural University, Jhansi - 284 003 (UP), India.

*Corresponding author E-mail : govind0139@gmail.com

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ABSTRACT

Uttarakhand comes under subtropical and temperate zone favours the cultivation of strawberry. In light of this, an experiment titled “Empirical studies of strawberry growth, flowering, and fruiting behavior using integrated nutrient management” was carried out at the Main experiment station, Doon (PG) College of Agriculture Science and Technology, Dehradun, India in 2019-20 to assess the growth, flowering, and fruiting behavior of strawberries. Eight treatments with three replications each were statistically tested using a Completely Randomized Block Design (CRBD). According to various development and blooming characteristics, the response of various mixes of organic and inorganic nutrients was shown to be significantly improved. Among all the eight treatments, treatment T₆: FYM 10t + NPK (50%) + Vermicompost (50%) were found best to improve growth (Plant height, plant spread and number of leaves per plant), flowering (Days taken to first flowering and Number of Flowers per plant) and fruiting (Number of fruit per plant and Duration of harvesting) characteristics of strawberry. Treatment T₈: Control did not have any nutrient application and was noted lowest results for all the characters.

Key words : Nutrient, Organic manure, Inorganic fertilizer, Vermicompost.

Introduction

Strawberries are soft, extremely perishable, fragrant and according to botany, aggregation fruits with many seeds on their surface. It is the second most important soft fruit in the world after grapes, and people all over the world like it for its vibrant hues, delicious flavour, and pleasant perfume. The domestic strawberry (*Fragaria × ananasa* Duch.) is a synthetic product that began in France in the 17th century as a result of the hybridization of two American species, *Fragaria chilioensis* and *Fragaria virginiana*. The strawberry is an herbaceous, perennial, monoecious and octoploid hybrid having chromosome number $2n = 56$ and belongs to the family Rosaceae which can be successfully cultivated from tropical to temperate climate and up to 3000m above MSL with better irrigation facility. In India the strawberry is extensively cultivated under Haryana, Mizoram, Meghalaya, Kerala, Madhya Pradesh, Himachal Pradesh,

Tamil Nadu, Uttar Pradesh, Uttarakhand. During the year 2021-22 in India, an average production 14000 MT was noted from an area of 3000 hectare (1st Advance Estimate, NHB-2021-22). Strawberry is a fine source of Vitamin-C (30-120mg/ 100g edible portion), Vitamin-A (60 IU/100g edible portion), protein (0.67g) and different minerals viz. calcium, potassium, iron and phosphorus (Kanupriya, 2002). Regular use of strawberry will be helpful to inhibit the cancer disease and asthma in human due to presence of natural occurring plant phenol, ellagic acid (anti-mutagenic and anti-carcinogenic plant pherol) (Wange and Kzlogoz, 1998). There are several cultivars and hybrids viz. Chandler, Bangalore, Pusa early dwarf, majestic, sujata, sweet charlie, pajaroetc are commercially cultivated and preferred by different growers of India. Among these varieties Chandler is an exceptionally high dessert quality with outstanding colour, resistant to physical damage due to rain and tolerant to virus, fruit

large, flesh and skin firm and flavor excellent, suitable for fresh market and processing (Chadha, 2017). As suggested by Umar *et al.* (2009), nutrition is one of the most important factors, which maintains the plant growth and development and provides better returns. The increasing demands of foods the growers are willing to excessive use of chemical fertilizers. These chemicals fertilizers are killing the fertility of the soil by disturbing the soil structure which will be the cause of low and bad quality production also creating bad effect on human health. Hence, keeping such problems the practice of Integrated Nutrient Management is a better solution for economy, environment friendly and maintains of soil health. The concept of Integrated Nutrient Management includes the balanced supply of organic manure, inorganic fertilizer with the aid of bio-fertilizers to maintain the eco-friendly relationship among soil health, plant and human health in most efficient manner. Thus judicious application of different organic and inorganic nutrients with aid of bio-fertilizers may help in enhancing yield and quality of strawberry (Subraya *et al.*, 2017) as well as sustainable soil health (Meena *et al.*, 2019). In strawberry the practice of Integrated Nutrient Management is more essential to realize quality fruit and higher yield. Hence the present investigation is subjected to develop proper nutrient management for strawberry cultivation regarding different treatment combination of organic manure, inorganic fertilizer and bio-fertilizer.

Materials and Methods

The present investigation entitled “Response of strawberry (*Fragaria × ananasa* Duch) to integrated nutrient management approaches in the view of yield and quality attributes” was carried out at the Main Experimental Farm and PG Laboratory, Doon (PG) College of Agriculture Science and Technology, Selaqui-Dehradun - 248 011, India during 2019-2020 at 30.3165° N, 78.0322° E and 447 MSL. It is sunny in the months during October to May, generally receiving an average of eight hours of sunshine per day. The temperature during hot weather commences by about end of February and ends by about the middle of June. Monsoon is warm and moderately humid. It commences in the middle of June and ends in the middle of September. In this region, monsoon is often erratic and uncertain, in respect of total rainfall and its distribution. The soil of Dehradun medium and the plant growth is bound to affect profoundly the rate of growth of plants and ultimately the final yield through its properties. Therefore, an attempt was made to assess the physical and chemical properties of soil of the experimental field. To evaluate the initial soil fertility status of soil, samples were collected from the

experimental field before sowing of crop taken randomly from different parts up to a depth of 0-30 cm and a composite sample was prepared, which was subjected to mechanical and chemical analysis as per the procedure. The sapling of strawberry cultivar Chandler was taken from a private nursery of Chandigarh, Haryana. This cultivar is most suited under Dehradun climatic condition and gives better response in view of quality fruit production.

There were eight treatment combinations of different organic manure and inorganic fertilizer. All the eight treatments as T₁: FYM 20t/hac, T₂: N: P: K (150:75:100) kg/hac, T₃: Poultry manure @ 5t/ha, T₄: Vermicompost @ 5t/ha, T₅: FYM 10t+NPK (50%) + PM (50%), T₆: FYM 10t+NPK (50%) + VC (50%), T₇: FYM 10t+VC (50%) + PM (50%) and T₈: Control were replicated three times with Completely Randomized Block Design suggested by Ranganna (1979). The experiment was conducted to ascertain the impact of different organic manure and inorganic fertilizer on plant height, plant spread, number of leaves per plant, days taken to first flowering, number of flowers per plant, number of fruit per plant and duration of harvesting.

Results and Discussion

Growth parameters

The data presented in the Table 1 and graphically presented in Fig. 1 showed significant results for plant height. All the treatments shows better result while treatment T₆: FYM 10t+NPK (50%) + Vermicompost (50%) have the highest (26.02cm) plant height in comparison to all other treatments. Treatment T₅ having FYM 10t+NPK (50%) + Poultry manure (50%) has the second maximum (24.01cm) results followed by treatment T₇: FYM 10t+ Vermicompost (50%) + Poultry manure (50%) while the treatment T₈, which do not have nutrients shows lowest (21.44cm) result for plant height. The average plant spread from East-West to North-South shows that the maximum (36.98cm) plant spread was recorded under the treatment T₆: FYM 10t+NPK (50%) + Vermicompost (50%) followed by (33.51cm) T₅: FYM 10t+NPK (50%) + Poultry manure (50%). The treatment T₈ having no use of fertilizers shows lowest (27.03cm) result among all others treatments. Data recorded on account of number of leaves per plant have been furnished in Table 1 and Fig. 1. The maximum (25.16) number of leaves per plant was recorded with combined application of T₆: FYM 10t+NPK (50%) + Vermicompost (50%) followed by application of T₅: FYM 10t+NPK (50%) + Poultry manure (50%), whereas lowest numbers of leaves per plant (17.20) was recorded under control.

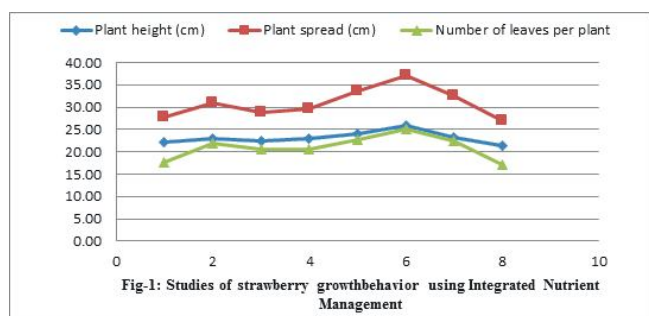


Fig. 1 : Studies of strawberry growth behavior using Integrated Nutrient Management.

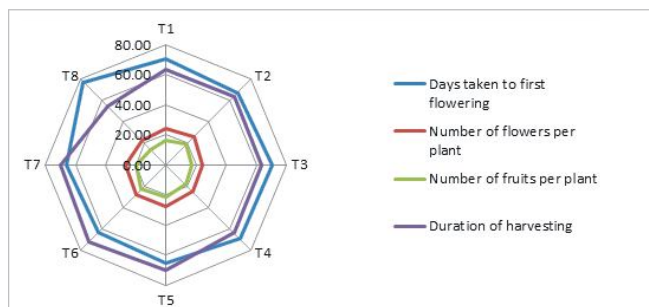


Fig. 2 : Studies of strawberry flowering and fruiting behavior using Integrated Nutrient Management.

Table 1 : Studies of strawberry growth, flowering and fruiting behavior using Integrated Nutrient Management.

Treatments	Plant height (cm)	Plant spread (cm)	Number of leaves per plant	Days taken to first flowering	Number of flowers per plant	Number of fruits per plant	Duration of harvesting
T ₁ : FYM 20t/hac	22.18	27.73	17.53	70.32	23.74	16.01	63.20
T ₂ : N: P: K (150:75:100) kg/hac	23.01	30.83	21.86	67.42	26.07	19.07	64.23
T ₃ : Poultry manure@5t/ha	22.34	28.83	20.53	70.05	24.34	16.87	63.40
T ₄ : Vermicompost@5t/ha	22.98	29.73	20.60	69.25	24.87	18.01	64.00
T ₅ : FYM 10t+NPK (50%) + Poultry manure (50%)	24.01	33.51	22.70	65.19	27.87	21.90	70.40
T ₆ : FYM 10t+NPK (50%) + Vermicompost (50%)	26.02	36.98	25.16	63.45	28.30	23.12	72.10
T ₇ : FYM 10t+ Vermicompost (50%) + Poultry manure (50%)	23.18	32.43	22.50	66.09	26.70	20.07	70.30
T ₈ : Control	21.44	27.03	17.20	77.52	22.30	14.40	55.06
S.Em.±	0.658	0.669	0.684	0.569	0.765	0.885	0.618
C.D.	1.995	2.029	2.074	1.726	2.319	2.685	1.875

The vegetative growth parameters viz. maximum plant height and plant spread and number of leaves in strawberry cv. Chandler were recorded due to the application of Farm Yard Manure, NPK, Vermicompost and Poultry Manure along with inorganic fertilizers. From the observation made during experimental year it was interesting to note that neither FYM nor inorganic fertilizers alone were able to grow the tallest plants but in combination with inorganic fertilizers and FYM the tallest

plants were measured. This increase in various vegetative developments may be related to the nitrogen from the vermicompost, which are the primary component of the plant's protoplasm and the building block of protein. Promotes the production of amino acids, which may have contributed to the strawberry plant's indirect growth in height. The results regarding different vegetative growth were confirmed with the finding of Arancon *et al.* (2004). Hassan (2015) and Saha *et al.* (2019) were reported the better vegetative growth of plants and number of leaves in strawberry with the use organic and in-organic fertilizers. Rajbhar *et al.*, 2015 was also reported same while working on strawberry.

Flowering attributes

It is clear from the data that all the treatment significantly ensured earlier flowering in comparison to control. The minimum (63.45 days) number of days taken for first flowering were recorded with the combined application of T₆: FYM 10t+NPK (50%) + Vermicompost (50%) closely followed by application T₅: FYM 10t+NPK (50%) + Poultry manure (50%) and T₇: FYM 10t+

Vermicompost (50%) + Poultry manure (50%). The maximum (77.52 days) days were taken for first flowering under control. It is clear from the data presented in the Table 1 and Fig. 2 that all the treatments were found significantly superior in respect to number of flowers per plant as compared with control. The maximum number of flowers per plant (28.30) was recorded with combined application of T₆: FYM 10t+NPK (50%) + Vermicompost (50%), whereas the treatment T₅, T₇ and T₂ were found

at par with the treatment T₆, whereas the minimum (22.30) number of flowers per plant was recorded under the treatment T₈ control. The minimum number of days required for the first flower to appear shows that a balanced application of both organic and inorganic fertilizers provides all the necessary components for plants to bear early flowers in strawberry crops. This could be explained by the plant's ability to absorb nutrients easily and the concurrent movement of substances that promote growth, such as cytokinins, to the axillary buds. This broke the apical dominance, which in turn produced a better sink for the faster mobilization of photosynthates and the early transition of plant parts from the vegetative to the reproductive phase. Sood *et al.* (2018) noted the minimum days taken for flowering and maximum number of flower with the use of bio fertilizer in strawberry. The similar results were also noted by Singhalge *et al.* (2019) and Subraya *et al.* (2017). Better flowering was noted in strawberry with the application of organic and inorganic fertilizer by Hassan (2015).

Fruiting attributes

Data recorded on account of number of fruits per plant is presented in Table 1 and Fig. 2. The maximum (23.12) number of fruits per plant was recorded with combined application of T₆: FYM 10t+NPK (50%) + Vermicompost (50%), whereas the T₅: FYM 10t+NPK (50%) + Poultry manure (50%) was found at par with the treatment T₆. Treatment T₈ which do not any nutrient application keeps minimum fruits per plant. In respect of duration of harvesting was observed longer (72.10 days) under T₆: FYM 10t+ NPK (50%) + Vermicompost (50%). Treatment T₅: FYM 10t + NPK (50%) + Poultry manure (50%) and T₇: FYM 10t + Vermicompost (50%) + Poultry manure (50%) were closely related and found at par with the treatment T₆. Minimum (55.06 days) duration of harvesting was recorded under treatment T₈: control. The early harvesting may have resulted from an optimal supply of nutrients in the proper amounts for the duration of the crop, which encouraged the vegetative growth of the plants and eventually increased photosynthesis. Maximum duration of fruiting in strawberry was noted Rueda *et al.* (2016), Todeschini *et al.* (2018) and Meena *et al.* (2019). Rajesh *et al.* (2012) and Einizadeh and Shokouhian (2018) were found the same results.

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