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Response of different fertigation levels and cultivars of strawberry (*Fragaria × ananassa*) on yield and economic benefit

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Abstract

A field study was conducted to evaluate the "response of different fertigation levels and cultivars of strawberry (*Fragaria* × *ananassa* Duch.) on yield and economic benefit" at the Department of Horticulture, Dr. K.S.G.A. College of Agriculture, Eternal University, Baru Sahib (HP) during 2021-2022. The experiment was set up using a Factorial Randomized Complete Block Design with 12 treatment combinations, which included four levels of fertigation (0%, 50%, 75%, and 100%) and three cultivars (Camarosa, Chandler, and Winter Dawn) and replicated thrice. The maximum value of fruit setting (99.21 %), number of flowers/plant (20.36), yield/plant (425.27 g) and yield/plot (5.10 kg) were noted in fertigation level F_3 (100% recommended dose of NPK). The highest fruit setting (96.58 %), number of flowers/plant (19.14), yield/plant (381.31 g), yield/plot (4.57 kg) were recorded under "Chandler" cultivar whereas, maximum fruit setting (98.91 %), yield/plant (442.18 g) and yield/plot (5.30 kg) were obtained with treatment combination T_{12} (Camarosa+100% RDF dose of NPK through drip) as compared to other treatments. The maximum Cost: benefit ratio (3.31) was observed in treatment combination T_{12} (camarosa with 100% recommended dose of NPK through drip).

Key words: Chandler, Camarosa, Fertigation, Winter Dawn

Strawberry (*Fragaria* × *ananassa* Duch.), a member of the Rosaceae family, has a unique place among cultivated worldwide for its berry fruits (Kachwaya *et al.,* 2016). This is one of the few fruit crops that offer faster returns (Gaikwad *et al.,* 2018; Rathod *et al.,* 2021). The fruit's increasing market demand, ability to grow in different agro-climatic conditions, and short harvesting period make it attractive to farmers as reported by Brym *et al.* (2022). Adoption of drip irrigation and fertigation, enhance nutrient consumption, while using the least quantity of water and fertilizer, is crucial to lowering the cost of irrigation and fertilizers (Pervin *et al.,* 2014). The fertigation becomes prerogative for enhancing yield under drip irrigation as reported by Pervin *et al.* (2014). Therefore, a proper nutrition programme for strawberries that includes NPK is crucial in terms of productivity and fruit quality (Kachwaya *et al.,* 2015). Therefore, an experiment was conducted.

Materials and Methods

The experiment was conducted at Dr Khem Singh Gill, Akal College of Agriculture, Eternal University, Baru Sahib, located at geo-graphically situated at 30.73° latitude in the North and 77.31° longitudes in the East at an elevation of 898 m above mean sea-level. Three cultivars, viz, Camarosa, Chandler and Winter Dawn and four fertigation levels were used. The healthy sapling of uniform growth without any diseases and injuries were selected. All the plants were maintained under uniform cultural practices during the entire course of experimentation.

The Randomized Block Design (RBD) with three replications of each of the twelve treatment combinations were used. The treatments were randomized in each replication. Twelve plants were planted in each treatment of experimental plot. The runners of all cultivars were transplanted into a matted row at spacing of 90 cm ×30 cm row to row and plant to plant during first week of October 2021-22. Two different factors were used i.e. four fertigation levels (control, 50%, 75% and 100%) and three strawberry cultivars (Camarosa, Chandler and Winter Dawn). The different treatment combinations were used T_1 (Chandler + Control), T_2 (Chandler + 50% RDF dose of NPK through

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drip (75,50,60 kg/ha), T_3 (Chandler + 75% RDF dose of NPK through drip (112,75,90 kg/ha), T_4 (Chandler +100% RDF dose of NPK through drip (150,100,120 kg/ha), T_5 (Winter Dawn + Control), T_6 (Winter Dawn + 50% RDF dose of NPK through drip (75,50,60 kg/ha), T_7 (Winter Dawn+75% RDF dose of NPK through drip (112,75,90 kg/ha), T_8 (Winter Dawn+100% RDF dose of NPK through drip (150,100,120 kg/ha), T_9 (Camarosa + Control), T_{10} (Camarosa + 50% RDF dose of NPK through drip (75,50,60 kg/ha), T_{11} (Camarosa + 75% RDF dose of NPK through drip (112,75,90 kg/ha), T_{12} (Camarosa+100% RDF dose of NPK through drip (150, 100, 120 kg/ha). The number of flowers is counted from the beginning of the initial blossoming until the end of full bloom, were visually recorded and the average was computed. Fruit sets and the percentage of those set was then reported using the formula below:

$$\text{Fruit set}(\%) = \frac{\text{Total number of fruit set}}{\text{Total number of flower appered}} \times 100$$

The average yield per plant was derived by summing the total fruit yield of all the tagged plants with the use of a digital analytical balance. B: C ratio of each module in each replication was calculated by following method.

$$\text{Net return} = \frac{\text{Gross return} - \text{Cost of cultivation (₹)}}{\text{Cost of cultivation (₹)}}$$

The average of whole season price of produce was considered for this purpose.

The mean, standard deviation and analysis of variance (ANOVA) of the data obtained from the experiment was subjected to Statistical Package and Social Science (SPSS) var. B. Mean were separated using least significant difference (LSD) at $p<0.05$.

Results and discussion

During the investigation period, data were collected on various yield parameters of strawberry, such as the number of flowers/plant, fruit setting (%), yield/plant (g) and the yield/plot (kg), which are presented in Table 1 and Table 2. The significant variation in yield characteristics among different cultivars of strawberry was attributed to the significant influence of varying fertigation levels. The maximum number of flower/plant (20.36), fruit setting (99.21%), yield/plant (425.27g), and yield/plot (5.10kg) were recorded under fertigation level F_3 (100% recommended dose of NPK) whereas minimum number of flower/plant (15.78), fruit setting (90.18%), yield/plant (264.94g), and yield/plot (3.10kg) were observed in fertigation level F_0 (0% recommended dose of NPK).

The application of NPK fertilizer at the recommended dosage of 100% through fertigation resulted in a significant enhancement of yield parameters. This improvement can be attributed to the increased vegetative growth of the plants and the optimized utilization of nutrients compared to soil fertilization. Furthermore, the fertilizer was applied in divided doses through fertigation, resulting in fragmented supplies that could meet the nutritional requirements of strawberries at various developmental stages. This approach resulted in improved fruit set, increased yield/plant and ultimately, higher overall yield, as reported by Kachwaya *et al.* (2016), Reddy *et al.* (2010) and Martinsson *et al.* (2012).

The increased absorption of nitrogen, phosphorus, and potassium by strawberry plants throughout the growing season, facilitated by the recommended dosage of NPK fertilizer applied through fertigation, may have significantly contributed to the improvement in yield parameters. This process, coupled with the synthesis of carbohydrates in the leaves, may have resulted in the formation of essential compounds such as amino acids, proteins, and chlorophyll. These biochemical changes are known to increase plant photosynthetic activity and carbohydrate synthesis, which helps new tissue grow and support various metabolic processes. Therefore, this fosters overall plant growth and enhances strawberry production characteristics. These findings are in line with previous research on strawberries conducted by Rathod *et al.* (2021), Kumar *et al.* (2009) and Jat & Kachha (2014).

Furthermore, among the various cultivars, the Camarosa cultivar (V_3) exhibited the highest yield parameters, including the number of flowers/plant (19.14), fruit setting (96.58%), yield/plant (381.31g) and yield/plot (4.57kg) while minimum number of flowers/plant (18.50), fruit setting (96.06%), yield/plant (359.49g) and yield/plot (4.31kg) were observed in Winter Dawn cultivar (V_2). The higher yield parameters observed could be due to the different genetic makeup of the genotypes. This study confirms the findings of Singh *et al.* (2020) and Neetu and Sharma (2018) in strawberry respectively. These results are further supported by the research of Ram and Yadav (2006), Singh *et al.* (2008) and Kumar *et al.* (2020).

Besides, among the various treatment combinations, the treatment T_{12} (Camarosa + 100% RDF of NPK) exhibited the highest yield parameters, such as number of flowers/plant (20.47), fruit setting (98.91%), yield/plant (442.18g) and yield/plot (5.30kg) while minimum

number of flowers/plant (16.07), fruit setting (90.36%), yield/plant (265.04g) and yield/plot (3.18kg) were obtained in treatment T_0 (Control). The combined effect of Camarosa cultivar + 100% recommended dose of NPK fertilizer indicates that proper amount of nitrogen, phosphorus and potassium within the plant system plays crucial role in the improvement of plant growth and genetic makeup of variety with appropriate climatic conditions which improves number of flower/ plant, fruit setting (%), and finally increased yield parameters of strawberry. These results are confirmed by the findings of Singh *et al.* (2020), Lakshmi *et al.* (2020), Choudhary *et al.* (2020) and Reddy *et al.* (2010).

The benefit cost ratio for different treatment was computed and shown in table 3. Maximum cost of cultivation (12, 30,300) was calculated in treatment T_8 (Winter Dawn+100% RDF dose of NPK through drip). However, minimum (12, 20,000) cost of cultivation was calculated in treatment T_5 (Winter Dawn with control). Maximum gross return (53, 06,196) was calculated in the treatment T_{12} (Camarosa+100% RDF dose of NPK through drip), whereas minimum

Table 1: Effect of different fertigation levels and cultivars on number of flowers, fruit set percent, yield per plant and yield per plot of strawberry

Treatment	Number of flowers/plant	Fruit set (%)	Yield/plant (g)	Yield/plot (kg)
V_1	18.97	96.42	373.79	4.49
V_2	18.50	96.06	359.49	4.31
V_3	19.14	96.58	381.31	4.57
$CD_{0.05}$	0.19	1.21	7.06	0.08
SEm±	0.06	0.42	2.39	0.03
F_0	15.78	90.18	264.94	3.18
F_1	19.19	97.78	377.62	4.53
F_2	20.14	99.01	418.29	5.02
F_3	20.36	99.21	425.27	5.10
$CD_{0.05}$	0.22	1.42	8.15	0.10
SEm±	0.07	0.48	2.76	0.03

*V_1= Chandler, V_2= Winter Dawn, V_3= Camarosa, F_0= Control, F_1= 50% through fertigation, F_2=75 % through fertigation, F_3=100 % through fertigation

Table 2: Effect of different treatment combinations on number of flowers, fruit set percent, yield per plant and yield per plot of strawberry

Treatment combinations	Number of flowers/plant	Fruit set (%)	Yield/ plant (g)	Yield/plot (kg)
T_1	16.07	90.36	265.04	3.18
T_2	18.73	97.90	373.30	4.48
T_3	20.36	98.58	422.77	5.07
T_4	20.70	98.81	434.04	5.21
T_5	15.57	89.73	259.31	3.11
T_6	19.40	97.28	375.30	4.51
T_7	19.58	98.78	403.49	4.84
T_8	19.42	98.46	399.58	4.80
T_9	15.69	90.45	270.46	3.25
T_{10}	19.45	98.15	383.99	4.61
T_{11}	20.47	98.80	428.59	5.14
T_{12}	20.96	98.91	442.18	5.30
$CD_{0.05}$	0.38	1.83	14.12	0.17
SEm ±	0.12	0.83	4.79	0.06

Table 3: Effect of different fertigation levels and cultivars on benefit cost ratio of strawberry

Treatment Combination	Total Cost of Cultivation (₹)	Gross Return (₹)	Net Return (₹)	B:C Ratio
T_1	1220000	3180474.4	1960474.4	1.61
T_2	1225150	4479536.8	3254386.8	2.66
T_3	1227725	5073234.4	3845509.4	3.13
T_4	1230300	5208492	3978192	3.23
T_5	1220000	3111707.2	1891707.2	1.55
T_6	1225150	4506982.8	3281832.8	2.68
T_7	1227725	4841908	3614183	2.94
T_8	1230300	4794937.6	3564637.6	2.90
T_9	1220000	3245509.6	2025509.6	1.66
T_{10}	1225150	4607873.6	3382723.6	2.76
T_{11}	1227725	5143119.2	3915394.2	3.19
T_{12}	1230300	5306196	4075896	3.31

gross return (31, 11,707.2) was calculated in treatment T_5 (Winter Dawn with control). Maximum net return (40, 75,896) was calculated in the treatment T_{12} (Camarosa+100% RDF dose of NPK through drip). However, minimum net return (18, 91,707.2) was calculated in treatment T_5 (Winter Dawn with control). Maximum B: C ratio (3.31) was calculated in the treatment T_{12} (Camarosa+100% RDF dose of NPK through drip), whereas minimum B: C ratio (1.55) was calculated in treatment T_5 (Winter Dawn with control). These results are in agreement with the findings of Nedunchezhiyan *et al.* (2023), Parmar *et al.* (2020); Chauhan and Chandel (2008), Bhattacharya (2010), Patel *et al.* (2010) and Ramana *et al.* (2014) observed that fertigation significantly increased the economics as compare to application of fertilizers through soil.

Conclusion

The fertigation improved yield by encouraging proper fertilizer nutrient use, lower labour cost and increasing productivity. The saving of about 33 per cent irrigation water and 20 per cent fertilizer, along with a 30 per cent increase in fruit yield, could be achieved through fertigation compared to conventional practices. Hence application of treatment T_{12} (Camarosa cultivar + 100% recommended dose of NPK through drip) is highly recommended to improve in terms of vegetative growth, yield and quality fruits.

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