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EFFECT OF GROWTH REGULATORS AND MICRONUTRIENTS ON GROWTH AND PRODUCTION OF STRAWBERRY (*FRAGARIA* × *ANANASSA* DUCH) CV. WINTER DAWN

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ABSTRACT

A field experiment was conducted during rabi season of 2014-15 to study the response of foliar application of different levels of growth regulators viz. (Control, NAA 5ppm, NAA 10ppm, NAA 15ppm, GA_3 25ppm, GA_3 50ppm, GA_3 75ppm, BA 5ppm, BA 10ppm, BA 15ppm, Morphactin 25ppm, Morphactin 50ppm, Morphactin 75ppm and micronutrients - Boric acid 0.2%, Boric acid 0.4%, Zinc sulphate 0.2% and Zinc sulphate 0.4% on growth and production of Strawberry (*Fragaria x ananassa* Duch) cv. Winter Dawn under open field condition.The result of the study showed that plant height (40.58cm), number of leaves (57.09), chlorophyll content of leaves (2.05mg g^{-1}), plant weight- Fresh weight (119.43g) as well as dry weight (49.28g), number of flowers per plant (58.60), number of fruits per plant (44.92) and fruit yield (503.48g) per plant increased with foliar spray of GA_3 75ppm over all other treatments. From the study it was concluded that treatment of foliar application of GA_3 75 ppm was found most effective to increase production of strawberry plants under Jhalawar condition.

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INTRODUCTION

The cultivated strawberry (*Fragaria x ananassa* Duch.) is a hybrid of two native American sp; *F. chiloensis* and *F. virginiana*. Strawberry is one of the most delicious, attractive, nutritious and refreshing soft fruits of the world. In India, it is mainly grown in Maharashtra and in hills of Himachal Pradesh, J&K and Uttarakhand. It is a short duration and short growth crop. In Rajasthan it is cultivated in Udaipur, Banswara, Jaipur and Sriganganagar district. Under Jhalawar condition it's cultivation is in recent five years. Since yield of strawberry is 5t/ha. It's cultivation is regulated by many factors and it can be influenced by PGR_S and micronutrients.

PGR_S and micronutrients are such type of input factors.PGR_Shave been applied to improve fruit yield and quality of various horticultural crops. (Moore *et al.*, 2004).

The application of gibberellic acid (GA_3) showed different result on fruit weight, for example 75 ppm GA_3 produce highest fruit set (Sharma and Singh, 2009).

Auxins are primary regulators of plant form. Application of NAA increases fruit size and delays ripening and increases anthocyanin accumulation in strawberry fruits. Antonio and Bettio (2003) showed that treating peaches cv. Diamante by the application of (NAA) at the rate of (30ppm) lead to increase fruit size and to delay the harvesting period of peaches.

BA, as a plant growth regulator enhances the size and shape of fruits, lateral bud break and lateral shoot growth, leading to improved branching in fruit trees. Probably benzyladenine as a cytokinin compound delayed the senescence stages of buds and increased the entrance of photosynthetic compounds, hormones and other metabolites to inflorescence buds which are so important for preventing bud abscission and increased the fruit set (Alireza *et al.*, 2006).

Morphactins are a group of substances which act on morphogenesis and modulate the expression of plants. Chemically they are methyl 2- chloro-9-hydroxyfluorene-9-carboxylate. In the presence of other natural hormones, morphactins exhibit both synergistic and antagonistic effects. However, the effect depends upon the relative concentrations.

Micronutrients forming constituent part of plant are considered essential for the plants. Zinc (Zn) is an essential micro element for plants. It is involved in many enzymatic reactions. It required in small amount, Zn is essential for carbon dioxide evolution and utilization of carbohydrate and phosphorus metabolism and synthesis of RNA (Sharma *et al.*, 2013).

Boron is a heavy non-metal micronutrient. It is absorbed by plant in the form of boric acid (H_3BO_3). For translocation of sugar; reproduction of plants and germination of pollen grains boron is necessary.

The above explanation clearly highlights the effectivity of PGR_S and micronutrients on growth and production of plants. Therefore, the present study was undertaken with the objects to find out and determine the effect of plant growth regulators and micronutrients on growth, yield attributes and yields from strawberry cv. Winter Dawn.

MATERIALS AND METHODS

The present studies were carried out at the Department of Fruit Science and the Protected Cultivation Unit, College of Horticulture and Forestry, Jhalrapatan city, Jhalawar (Rajasthan) during the year 2014-15.The experiment was laid out under RBD design comprising different growth regulators and micronutrients viz. Control (T_0), NAA 5ppm (T_1), NAA 10ppm (T_2), NAA 15ppm (T_3), GA_3 25ppm (T_4), GA_3 50ppm (T_5), GA_3 75ppm (T_6), BA 5ppm (T_7), BA 10ppm (T_8), BA 15ppm (T_9), Morphactin 25ppm (T_{10}), Morphactin 50ppm (T_{11}), Morphactin 75ppm (T_{12}), Boric acid 0.2% (T_{13}), Boric acid 0.4% (T_{14}), Zinc sulphate 0.2% (T_{15}) and Zinc sulphate 0.4% (T_{16}) with three replicates. The planting was done on 18th October 2014. The crop was grown on raised beds at 60 x 30 cm spacing on drip. The observations were recorded on characters namely plant height (cm), number of leaves per plant, total chlorophyll content of leaves (mg/g), plant weight-fresh weight as well as dry weight, number of flowers per plant, fruits per plant and fruit yield per plant (g).

Plant height and plant spread were measured by measuring scale. Chlorophyll content was measured as per method as suggested by Sadasivam and Manickam (1997). Plant weight-fresh weight as well as dry weight are taken before and after dried of plant in oven at 70°C. Number of leaves per plant, number of flowers per plant, fruits per plant and fruit yield per plant (g) are taken from tagged plant from initial to last harvesting and average was drawn to record the data. Analysis of variance for individual character was done on the basis of mean values as suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Plant Growth parameters

Data presented in Table 1 revealed that the plant growth parameters were significantly influenced by different growth regulators and micronutrients. The maximum plant height (40.58cm), number of leaves (57.09), chlorophyll content of leaves (2.05mg g^{-1}), plant weight- fresh weight (119.43g) as well as dry weight (49.28g) was obtained in treatment T_6- $GA_3$75ppm.

Increase in growth parameters like plant height, number of leaves per plant following use of GA_3 may be due to its effect in cell division and cell enlargement (Neil and Ross, 2002) and these results are in conformity with those of Eshghi *et al*. (2012) in strawberry and Ramteke *et al*. (2015) in papaya. Similarly, Qureshi *et al*. (2013) reported increase in number of leaves in strawberry following use of GA_3.

GA_3 increases chlorophyll content of leaves as it has been proved that GA_3 increases activity of oxigenase carboxylase non phosphate ribolose (Rabisco) enzyme that is a main photosynthesis enzyme in plants. These results adapted with results of Mynett *et al*. (2001) in Freesia and Yaghoubi *et al*. (2013) in Bellis perennis about effect of GA_3 on increase of greenness index.

The application of GA_3 resulted in increased fresh and dry weight of seedlings was mainly due to trans- location of applied GA_3 to the expanding internodes and young leaves (Hazrat *et al.,* 2006). Singh and Tripathi (2010) reported increase in growth parameters with $GA_3$100ppm in strawberry cv. Chandler.

Production parameters

Data presented in Table 1 revealed that the various production parameters were significantly influenced by different growth regulators and micronutrients. Treatment- $GA_3$75ppm resulted in maximum number of flowers per plant (58.60), number of fruits per plant (44.92) and fruit yield (503.48g) per plant.

Increase in number of flowers per plant with GA might be due to the action of GA, stimulating the conversion of storage polymers (polysaccharides, proteins and fats) into sucrose or mobile amino acids to facilitate their translocation via phloem into and throughout the young root and shoot system and

Table 1: Effect of growth regulators and micronutrients on growth and production of strawberry (*Fragaria* × *ananassa* Duch.) cv. Winter Dawn

Treatments	Plant height (cm)	No. of leaves/ plant	Chlorophyll content of leaves (mg/g)	Plant weight (g)		Number of flowers / plant	Number of fruits/ plant	Fruit yield/ plant (g)
				Fresh	Dry			
T_0- Control	16.12	40.42	1.83	92.14	30.56	35.72	22.11	249.49
T_1- NAA 5ppm	16.59	41.08	1.81	100.28	36.09	41.55	25.08	348.94
T_2- NAA 10ppm	17.15	41.63	1.80	99.59	35.64	45.65	26.67	352.65
T_3- NAA 15ppm	21.66	43.18	1.83	103.46	37.66	48.76	29.40	362.27
T_4- GA_3 25ppm	28.67	45.03	1.86	102.00	43.55	52.79	26.69	425.50
T_5- GA_3 50ppm	30.24	51.71	1.88	111.31	46.50	54.39	30.56	434.73
T_6- GA_3 75ppm	40.58	57.09	2.05	119.43	49.28	58.60	44.92	503.48
T_7- BA 5ppm	16.17	35.67	1.82	93.51	35.36	49.91	23.60	350.16
T_8- BA 10ppm	17.80	41.23	1.81	95.85	35.86	51.44	25.33	354.71
T_9- BA 15ppm	20.06	41.16	1.83	97.61	37.07	53.20	27.62	400.09
T_{10}-Morphactin 25ppm	13.94	38.35	1.78	54.19	17.77	33.20	21.31	201.07
T_{11}-Morphactin 50ppm	11.47	33.96	1.77	53.68	17.28	32.68	17.58	167.19
T_{12}-Morphactin 75ppm	10.48	31.94	1.75	51.32	16.03	31.59	13.92	128.56
T_{13}- Boric acid 0.2%	22.11	44.14	1.82	97.00	39.57	45.73	28.18	435.37
T_{14}- Boric acid 0.4%	23.82	46.04	1.83	99.11	42.26	47.63	31.04	470.25
T_{15}- Zinc sulphate0.2%	23.55	43.46	1.81	97.14	39.70	50.29	32.49	482.53
T_{16}- Zinc sulphate 0.4%	24.69	44.25	1.84	101.52	40.18	51.49	34.17	499.91
CD at 5%	1.53	1.27	0.05	7.00	0.37	3.84	4.53	6.76
SEm ±	0.75	0.62	0.02	3.12	0.13	1.86	2.22	3.32

thus influencing flower production. Similar effects have also been reported in Day lily (Das *et al.,* 1992). Paroussi *et al.* (2002) reported promotory effect of GA_3 on number of flowers per plant in strawberry.

Increase in fruit/plant and fruit yield with the use of GA_3 might be due to fact that gibberellic acid causes the production of large number of flowers with rapid elongation of peduncle, leading to full development of flower buds having all reproductive parts functional which increases the fruit set and number of berries per plant. It could also be due to the fact that GA application accelerates the development of differentiated inflorescence. Similar results have been reported by Kranthi and Sharma (2016) in grape. Singh and Tripathi (2010) observed increase in yield parameters following use of treatment $GA_3$100ppm in strawberry cv. Chandler

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