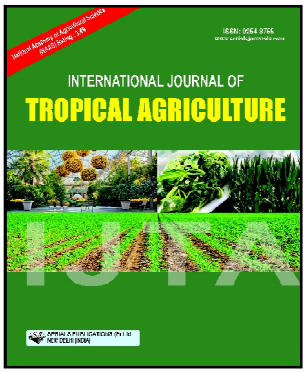

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Effect of bio-regulators on yield, Grades and quality of kiwifruit (*Actinidia deliciosa* Chev.) cv. Abbott

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Abstract: A field experiment was conducted on bearing vines of kiwifruit cv. Abbott to assess the effect of CPPU (Sitofex), promalin and Break Through on yield, grades of fruits, fruit size and quality. The results indicated that Ten (10) days after anthesis / two weeks after full bloom CPPU at 10ppm were applied to fruits by dipping them for about 10 seconds in aqueous solution of the compound. CPPU applied fruits increased fruit weight, size, yield, graded fruits, TSS, Total sugars, Dry matter content over the control. A higher proportion of the crop was in the large size grade and there was no loss of response as the crop load on the vine increased. CPPU produced a darker skin colour and some changes in appearance increased fruit size, advanced ripening by one week, reduced flesh firmness, increased soluble solids and decreased titrable acidity.

Keywords: Kiwifruit, Abbott, hormones, grades, yield

INTRODUCTION

Kiwifruit (*Actinidia deliciosa* Chev.), also known as Chinese Gooseberry has tremendous commercial potential in the Sub-Himalayan Regions and other Temperate Fruit growing Regions of India. Fruit size is one of the most important qualitative characteristics of kiwifruit. But growers in this region are not getting their prices mainly due to small size of the fruit. Several factors affect fruit size: Training and Pruning, pollination, anthesis period, bud and fruit load, fruit-leaf ratio, shoot type, photosynthetic efficiency and cultural practices. The situation calls for standardizing proper pruning and training operations and /or proper application of growth regulators. Influence of canopy structure on fruit size development will also have to be taken in order to tackle the problem with a holistic approach.

At present the percentage of A-Grade fruits is less than 10% severely affecting the marketability of the produce. Keeping this in view, the experiment was undertaken to increase the size and weight of the fruit to make maximum A-Grade fruit so that it can compete with imported Kiwi fruit and get maximum price of the produce.

The cultivar has a tendency to overbear, which leads to production of smaller and poor quality fruits. Profitable kiwifruit production depends upon the yield of good size fruits. The fruit size in kiwifruit can be manipulated either by thinning of fruits or directly by promoting fruit growth with the exogenous application of growth regulators. In fruit crops, various growth promoting auxin, gibberellins and Cytokinin have been found effective in improving fruit size and quality. Recently, a synthetic Cytokinin, i.e. CPPU (N-(2 chloro-4-pyridyl)-N phenyl urea (Sitofex), has been found very effective in stimulating fruit growth in kiwifruit (Antognozzi *et al.*, 1997). Therefore, an attempt was made to study the effectiveness of plant growth regulators CPPU, Promalin and Break Through on kiwifruit cv. Abbott.

MATERIALS AND METHODS

The experiments were conducted on 10–year-old kiwifruit vines of cv. Abbott planted at a spacing of 4 m x 4 m and trained on cross- bar trellis at the experiment orchard of ICAR-IARI, RS, Dhanda Farm, Shimla The vines were maintained under uniform cultural practices during the course of studies.

The experiment consisting of 10 treatments of plant bio-regulators (Table 1) was laid out in a simple Randomized Block Design. Break Through was applied as foliar spray 10 days after full bloom, while CPPU was applied 10 days after petal fall as fruit dip method (Fig. 1) and promalin was applied at full bloom stage as spray method. Each treatment was applied on separate vine and was replicated three times having one vine under each replication. Twenty

Figure 1

shoots were randomly marked on the periphery of each vine for taking observations on time of bud break and first flowering. After harvest, total yield and yield of different grades fruit were determined on the basis of total weight of different grades (A grade > 70g, B grade 50-70 g, C grade < 50g) fruits harvested from the vine under each treatment. The size of fruit was measured in terms of length and diameter with the help of Vernier calipers and fruit weight was taken on electronic balance. TSS in terms of maleic acid and sugars were recorded with the standard procedures of AOAC (1990).Dry matter content was measured by oven drying with stable reading and Flesh firmness was measured by hand penetrometer. The data recorded were statistical analyzed in accordance with the method design by Gomez and Gomez (1984).

RESULTS

The data presented in Table 1 indicates that significant variation in fruit yield and yield of different grades fruit was observed in vines subjected to different treatments of CPPU, promalin and Break Through, however more pronounced effect was noted with the application of CPPU. The highest yield (49 kg/vine) was recorded with 10 ppm CPPU and registered more than 50% increase in yield over control. Application of CPPU , Promalin and Break

Table 1

Influence of CPPU, promalin and Break Through on yield, size, grades and fruit quality of kiwifruit cv. Abbott

Treatments	*Yield (Kg/ vine)*	*Yield of different grades fruits (Kg/ vine)*			*Fruit length (cm)*	*Fruit breadth (cm)*	*Fruit weight (g)*	*TSS (%)*	*Acidity (%)*	*Total sugars (%)*	*Flesh Firmness (Kgf)*	*Dry Matter per Fruit (g)*
		A	*B*	*C*								
2.5 ppm CPPU	40	7	24	9	6.37	4.70	81	15.2	0.86	9.5	8.2	14.7
5.0 ppm CPPU	44	14	25	5	6.51	4.80	84	15.4	0.80	9.6	8.2	14.9
10 ppm CPPU	49	17	27	5	6.68	4.95	90	15.6	0.74	9.8	8.0	15.3
10 ppm Promalin	36	6	17	13	6.27	4.13	66	14.2	0.84	8.9	9.4	13.4
20 ppm Promalin	38	6	24	8	6.30	4.20	68	14.4	0.82	9.1	9.2	13.6
40 ppm Promalin	40	7	24	9	6.51	4.31	70	14.6	0.80	9.0	9.0	13.7
1 % Break Through	36	5	17	14	6.26	4.25	66	14.5	0.86	8.9	9.0	13.9
2 % Break Through	37	6	18	13	6.31	4.32	68	14.8	0.84	9.0	9.1	14.0
4 % Break Through	38	7	20	11	6.49	4.32	70	15.0	0.82	9.2	9.2	14.1
Control	31	3	13	15	6.20	4.13	60	13.5	0.98	8.5	9.9	12.7
$CD_{(0.05)}$	3.3	2.5	2.8	5.1	0.09	0.30	4.8	0.8	0.17	0.7	0.4	0.6

Through also significantly increased total yield as compared to untreated control. Similarly, the highest yield of 'A' and 'B' grades fruit was obtained in 10 ppm CPPU treatment (Table 1), which gave lowest yield of 'C' grade fruits. The effect of promalin and Break Through on the yield of 'A' grade fruits was not found so pronounced as that of CPPU but it produced significantly more yield of 'A' and 'B' grades fruit as compared to untreated control.

Data presented in Table 1 showed significant increase in fruit size and weight with the application of CPPU. The maximum fruit length (6.68 cm) and breadth (4.95 cm) was observed in 10 ppm CPPU treatment, followed by 5 ppm CPPU treatment, which produced the fruits of 6.51 cm long with 4.80 cm breadth (Table 1). The minimum fruit length (6.20 cm) and breadth (4.13 cm) was found in untreated fruits. Similarly, fruit weight was significantly increased with the application of CPPU, promalin and Break Through as compared to control. The maximum fruit weight (90 g/fruit) was recorded in 10 ppm CPPU treated fruits and minimum (60 g/fruit) in control. Fruit size and weight was also recorded significantly higher in 40 ppm promalin and 4% Break Through treatments in comparison to control. The fruits dipped in 10 ppm CPPU registered highest TSS (15.6^{0}brix), total sugars(9.8%), dry matter content(15.3g) and lowest acid content(0.74%) and flesh firmness(8.0 Kgf) presented in Table 1. Likewise, fruits harvested from the vines sprayed with Break Through and promalin showed significantly more TSS and sugars content than control (Table 1).

DISCUSSION

Significant variation in fruit yield and yield of different grades fruit was observed in vines subjected to different treatments of CPPU, promalin and Break Through, however more pronounced effect was noted with the application of CPPU. The highest yield and yield of 'A' and 'B' grades fruit was obtained in 10 ppm CPPU treatment at early stage, which gave lowest yield of 'C' grade fruits. The increase in total yield of 'A' and 'B' grades fruit with the application at 5 and 10 ppm CPPU was mainly attributed to the increase in fruit size (Table 1), which incurred due to direct effect of CPPU on cell division and enlargement (Mok et al.,1987; Antognozzi *et al*, 1993). Similarly, Costa *et.al.* (1990,1997) and Biasi et al.,1991 reported that CPPU promoted fruit growth in kiwifruit. The effect of promalin and Break Through on the yield of 'A' and 'B' grade fruits was not found so pronounced as that of CPPU but it produced significantly more yield of 'A' and 'B' grades fruit as compared to untreated control. The increase in fruit size and weight with CPPU might be attributed to the stimulation of cell division and elongation by CPPU, which increased the number and size of small cells in the outer and inner pericarp and increased cell number in core (Antognozzi *et al.*, 1997). However, Patrick (1988) was of the opinion that increase in fruit size of kiwifruit was mainly due to the direct effect of CPPU on sink strength of fruit, which further causes increase rate of assimilate transfer towards the fruits and it act as a sink. Cytokinins are used to affect fruit morphogenesis was reported by Costa *et al.,*2011. The influence of seeds and exogenous plant bioregulators on the growth of Actinidia deliciosa (A. Chev), J.G.Cruz-castillo et al. (2003) supported the view that unknown factors from the seed interact with known bioregulators to promote fruit growth. The cytokinin-active compound, N_1-(2-chloro-4-pyridyl)-N_3-phenylurea (CPPU), applied at different flowering dates, affected final 'Hayward' kiwifruit size. Ovaries from early opening flowers had significantly greater (*P*d"0.05) length, diameter, and fresh and dry weight than late ovaries was reported by Cruz-castillo,J.G et al. (2002) . A significant increase in total soluble solids and sugar content was found in CPPU, promalin and Break Through treated fruits. The fruits dipped in 10 ppm CPPU registered highest TSS, total sugars, and lowest acid content (Table 1). This

increase in TSS and sugar content with CPPU application may be attributed to early ripening induced by CPPU due to more ethylene evolution (Costa *et al*., 1997). The observation of Biasi and Costa (1991) also corroborate these findings, who reported that CPPU treatment increased TSS and sugar content and reduced acidity in kiwifruit. Likewise, fruits harvested from the vines sprayed with Break Through and promalin showed significantly more TSS and sugars content than control. CPPU application at petal fall induced abnormally protruding fruit tip reported by Kim,J.G. *et al*, 2006.

CONCLUSION

There is a great demand of Kiwi fruit to combat Dengue disease also instead of its nutritional quality. Although kiwifruit cultivar Abbott occupies an important position in the mid hills, but due to the problem of overbearing, fruit size and quality are adversely affected which are the important determinants of financial returns. Based on the results obtained, dipping of fruits 10 days after petal fall in 10 ppm CPPU for 10 seconds improved fruit size, yield and quality and give higher returns. Further study is needed to determine the CPPU residual toxic effect in fruits and its influence on vegetative and productive activity.

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