Indian J. Hort. 67(Special Issue), November 2010: 120-123

Effect of CPPU, promalin and hydrogen cyanamide on flowering, yield and fruit quality of kiwifruit

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ABSTRACT

A field experiment was conducted on bearing vines of kiwifruit cv. Allison to find out the effect of CPPU, promalin and hydrogen cyanamide on bud break, flowering, yield and fruit quality. The bud break and flowering was advanced by 6-7 days in vines sprayed with 4% hydrogen cyanamide. The results indicated that dipping of fruits in 10 ppm CPPU solution 14 days after full bloom gave highest fruit yield and registered 44 and 51 % increase in yield over control. The highest yield of 'A' grade fruits was obtained with 10 ppm CPPU treatment, which also produced better size and quality fruits, and also gave maximum net return per vine as compared to other treatments.

Key words: Kiwifruit, CPPU, hydrogen cyanamide, yield.

INTRODUCTION

Kiwifruit (*Actinidia deliciosa* Chev.) is the most recent introduction among the fruit crops in India and has emerged as a success story in temperate fruit production. This fruit holds a great promise for commercial cultivation in low and mid hills of entire Himalayan region. Among the different cultivars, Allison has been recommended for commercial cultivation in Himachal Pradesh because of precocity, regular bearing and high productivity. However, this 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 kiwifruit, growth promoting auxin and gibberellins were not were not found effective in improving fruit size (Kumar, 7). However, a synthetic cytokinin, i.e. CPPU (N-(2 chloro-4-pyridyl)-N phenylurea, has been found very effective in stimulating fruit growth in kiwifruit (Antognozzi *et al.*, 2). Therefore, an attempt was made to study the effectiveness of CPPU, promalin and hydrogen cyanamide on bud break, flowering, fruiting and quality of kiwifruit cv. Allison.

MATERIALS AND METHODS

The experiment was conducted on 14–year-old kiwifruit vines of cv. Allison planted at a spacing of 4 m x 6 m and trained on T- bar trellis at the experiment orchard of Dr Y.S. Parmar University of Horticulture and Forestry, Nauni. The experiment was laid out in a simple randomized block design with 13 treatments (Table 1.) Hydrogen cyanamide was applied as foliar spray 45 days before expected bud burst (28th January), while CPPU and promalin was applied 14 days after full bloom (6th May) as fruit dip method.. Each treatment was applied on separate vine and was replicated three times having one vine under each replication. Twenty 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 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 callipers and fruit weight was taken on a top pan balance. TSS, acidity in terms of maleic acid and sugars were recorded with the standard procedure of AOAC (1). Economic viability of various treatments was ascertained by comparing the net benefits of various treatments with control. For this purpose current grade-wise farm gate prices of kiwifruit viz.'A' grade(fruit weight > 70 g) Rs 40, B grade (50-70 g) Rs 30 and C grade (< 50 g) Rs 10 per Kg were used. The data recorded were statistical analysed in accordance with the method designed by Gomez and Gomez (6).

RESULTS AND DISCUSSION

Early (advanced) bud break and flowering was one of the striking effects of the hydrogen cyanamide at all

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the level of concentration. Data presented in Table 1 show that vines sprayed with different concentrations of hydrogen cyanamide advance bud break and flowering during both the year of study. The minimum time (80 and 79 days during 2004 and 2005, respectively) from leaf fall to bud break was taken by the vines sprayed with 4% hydrogen cyanamide, which showed 7 days advancement in bud break than the control vine. Similarly, the vines sprayed with 4% hydrogen cyanamide took 111 and 110 days during the two years, respectively from leaf fall to first flowering, indicating 7 days advancement in flowering than untreated vines. Hydrogen cyanamide application led to an abnormally high accumulation of proline in the buds prior to flower differentiation (Walton *et.al.*11). The appearance of proline was associated with a stimulation of pentose phosphate pathway, favoring continuous development and breaking of dormancy in the buds (Simmonds and Simpson, 10). The early flowering with the spray of hydrogen cyanamide might be due to the advanced bud break with 2 and 4% Hydrogen cyanamide (Table 1). These results are in consonance with that of Salinero and Lema (9), who observed advanced flowering by 7 days with 3 to 4% Hydrogen cyanamide in kiwifruit.

Significant variation in fruit yield and yield of different grades fruit was observed in vines subjected to different treatments of CPPU, promalin and hydrogen cyanamide, however more pronounced effect was noted with the application of CPPU. The highest yield was recorded with 10 ppm CPPU and registered 44 and 51% increase in yield over control during 2004 and 2005, respectively. Application of 5 ppm CPPU alone or in combination with 2% hydrogen cyanamide also significantly increased total yield as compared to other treatments of promalin and 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 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 2), which incurred due to direct effect of CPPU on cell division and enlargement (Antognozzi *et al*,. 3). Similarly, Costa *et.al*. (5) reported that CPPU enhanced yield in kiwifruit. The effect of promalin and hydrogen cyanamide 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. These results are inconformity with Salinero and Lema (9), who also recorded more yield of better size fruits with promalin and with hydrogen cyanamide application in kiwifruit.

Data presented in Table 2 showed significant increase in fruit size and weight with the application of CPPU. The maximum fruit size and weight was observed

Table 1. Effect of CPPU, promalin and hydrogen cyanamide on bud break, flowering and yield of kiwifruit cv. Allison.

Treatment	Days taken from leaf fall to bud break		Days taken from leaf fall to first flowering		Yield (kg/vine)		Yield of different grades fruits (kg/vine)					
							A >70g		B 50-70 g		C <50g	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
2.5 ppm CPPU	87	85	117	116	76	80	13	16	48	46	15	18
5.0 ppm CPPU	86	85	118	116	89	92	31	32	51	50	7	10
10 ppm CPPU	87	85	117	115	92	95	32	33	54	52	6	10
10 ppm promalin	87	86	118	118	72	71	12	11	34	36	26	24
20 ppm Promalin	88	85	118	116	77	79	11	12	48	45	18	21
40 ppm Promalin	87	86	117	116	81	80	14	14	49	46	18	20
1% HCN	83	82	115	113	72	66	10	9	34	35	28	22
2% HCN	80	80	112	112	74	69	12	10	36	36	26	23
4% HCN	80	79	111	110	76	68	14	12	40	37	22	18
2% HCN and 5ppm CPPU	82	81	112	112	90	93	30	32	52	51	8	10
2% HCN and 20 ppm Promalin	81	82	113	112	76	76	12	10	40	39	24	27
2.5 ppm CPPU and 10 ppm Promalin	88	86	118	117	84	80	18	16	48	50	18	14
Control	87	86	118	117	64	64	7	6	28	31	29	27
$CD_{(0.05)}$	2.3	2.8	3.8	4.1	3.20	1.46	2.6	2.1	2.8	3.3	5.9	6.6

Table 2. Effect of CPPU, promalin and hydrogen cynamide on fruit size, weight, quality of kiwifruit cv Allison

Treatment	Fruit length (cm)		Fruit breadth (cm)		Fruit wt. (g)		TSS (%)		Acidity (%)		Total sugar (%)		Reducing sugar (%)		Non-reducing sugar (%)		Net benefits (Rs/vine)		Per cent increase in net benefit over control	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
2.5 ppm CPPU	6.58	6.54	4.75	4.74	80	80	15.2	15.11	0.86	0.91	9.50	9.45	7.89	7.79	1.52	1.58	1860	1952	50	54
5.0 ppm CPPU	6.61	6.63	4.91	4.83	85	86	15.3	15.14	0.80	0.78	9.60	9.57	8.36	8.44	1.17	1.09	2605	2631	112	108
10ppm CPPU	6.69	6.65	4.98	4.94	89	88	15.5	15.23	0.74	0.71	9.81	9.84	8.60	8.51	1.14	1.26	2720	2711	120	114
10 ppm Promalin	6.28	6.29	4.20	4.14	65	64	14.2	14.51	0.84	0.85	8.9	8.77	7.12	6.95	1.69	1.61	1560	1565	27	24
20ppm Promalin	6.34	6.32	4.30	4.21	66	65	14.6	14.88	0.82	0.87	9.2	9.43	7.84	7.78	1.29	1.57	1840	1814	48	43
40ppm Promalin	6.51	6.54	4.36	4.31	73	75	14.7	14.54	0.80	0.89	9.1	8.79	7.15	7.04	1.85	1.66	1975	1882	59	49
1% HCN	6.25	6.23	4.26	4.24	66	65	14.8	13.52	0.86	0.94	8.9	8.62	7.13	6.93	1.68	1.65	1460	1378	18	9
2% HCN	6.30	6.29	4.29	4.31	67	66	15.0	13.74	0.84	0.99	9.1	8.76	8.25	6.96	0.80	1.73	1600	1386	29	9
4% HCN	6.48	6.44	4.37	4.31	70	69	15.4	13.50	0.81	0.99	9.4	8.65	8.29	6.94	1.05	1.74	1730	1307	40	3
2% HCN and 5ppm CPPU	6.68	6.63	4.80	4.75	87	86	15.3	15.13	0.80	0.84	9.5	9.72	8.36	8.47	1.08	1.49	2590	2513	109	98
2% HCN and 20 ppm Promalin	6.26	6.28	4.36	4.33	66	65	14.5	14.81	0.86	0.89	8.9	8.82	7.16	7.05	1.65	1.69	1740	1419	40	18
2.5ppm CPPU and 10ppm Promalin	6.48	6.54	4.65	4.59	80	82	15.1	14.79	0.81	0.76	8.8	8.78	7.76	7.02	1.14	1.65	2050	2022	65	60
Control	6.21	6.20	4.20	4.14	64	63	13.6	13.46	0.91	0.99	8.5	8.42	6.94	6.86	1.48	1.48	1240	1267	-	-
$CD_{(0.05)}$	0.09	0.10	0.32	0.30	4.8	4.63	0.8	0.67	0.16	0.17	0.7	0.35	0.28	0.25	0.12	NS	-	-	-	-

in 10 ppm CPPU treatment, which was statistically at par with 5 ppm CPPU treatment (Table 2). 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*., 2). However, Patrick (8) 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. Fruit size and weight was also recorded significantly higher in 40 ppm promalin and 4% hydrogen cyanamide treatments in comparison to control. Similar increase in fruit size and weight was recorded with with 4% hydrogen cyanamide in kiwifruit (Salinero and Lema, 13)

A significant increase in total soluble solids and sugar content was found in CPPU, promalin and hydrogen cyanamide treated fruits. The fruits dipped in 10 ppm CPPU registered highest TSS, reducing and total sugars, and lowest acid content (Table 2). 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*., 5) The observation of Biasi and Costa (4) also corroborate these findings, who reported that CPPU treatment increased TSS and sugar content and reduced acidity in kiwifruit. Like wise fruits harvested from the vines sprayed with hydrogen cyanamide and promalin showed significantly more TSS and sugars content than control. Kumar (7) also found significantly higher total and non-reducing sugars in kiwifruit with promalin application.

Results of economic analysis have projected 10 ppm CPPU as the most beneficial treatment, followed by 5 ppm CPPU. These treatments resulted in maximum production of A grade fruits with better size quality and accounted for the higher increase in net benefits over control.

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Received: November, 2006; Revised: January, 2010
Accepted: August, 2010