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Effect of plant growth regulators on fruit set, yield and fruit quality in pear cv. BAGGUGOSHA

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ABSTRACT

Treatments of growth regulators *viz*., T_1: 10 ppm GA_3, T_2 : 20 ppm GA_3, T_3: 5 ppm BA, T_4 10 ppm BA, T_5: 250 ppm promalin, T_6: 500 ppm, promalin, T_7: 10 ppm, GA_3 + 5 ppm BA, T_8: 20 ppm GA_3 + 500 ppm promalin, T_9 : 10 ppm GA_3 + 250 ppm promalin, T_{10} : 20 ppm GA_3 + 500 ppm promalin and T_{11}: control (no spray) were applied either once at full bloom or twice at full bloom and petal fall stage on Baggugosha pear trees. Combined treatment of 20 ppm, GA_3 +10ppm BA , 10 ppm GA_3 + 5 ppm BA and 10 ppm GA_3 + 250 ppm promalin when applied as single spray at full bloom increased fruit set, fruit retention, yield efficiency and fruit quality. GA_3 applied alone through increased fruit set but decreased fruit retention, yield efficiency and fruit size. However, there was no clear advantage of giving repeat application of growth regulator treatments at petal fa11.

Key words : Gibberrelic acid, Benzyl adenine, Promalin, Pear.

The pear (*Pyrus communis* L.) is an important pome fruit of considerable prominence by virtue of its melting texture, excellent taste and nutritional values. In Himachal Pradesh, soft pears are though mainly grown in the high hills, where number of high chilling cultivars are grown successfully but, there also exists a good scope for growing low chilling cultivars like Baggugosha in the mid-hills. However, during the last couple of decades, the problems of erratic flowering, low fruit set and lower productivity are often encountered mainly due to the changing climatic conditions. In order to make pear culture as a profitable and attractive entrepreneur in this zone, there is a need to have better control on fruit set, yield and fruit quality. Plant growth regulators have been reported to regulate or manipulate fruit set, yield and improve fruit quality. Plant growth regulators have been reported to regulate or manipulate fruit set, yield and improve fruit quality (Miller, 1988). Keeping in view this, the present investigation was therefore, carried out to evaluate the influence of plant growth regulators such as gibberrelic acid, benzyl adenine and promalin on fruit set, yield and fruit quality of pears.

MATERIALS AND METHODS

The study was conducted in the experimental orchard of the Department of Pomology, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan during the year 2002 and 2003, using twenty two uniform bearing trees of Baggugosha pear established on Kainth (*Pyrus pashia* Bush) seedling rootstock. On these trees, 66 uniform limbs were selected prior to bloom and divided into 22 lots, each comprising of three limbs for applying the treatment *viz*., T_1 : 10 ppm GA_3, T_2 : 20 ppm GA_3, T_3 : 5 ppm BA, T_4 : 10 ppm BA, T_5 : 250 ppm Promalin, T_6 : 500 ppm Promalin, T_7 : 10 ppm GA_3 + 5 ppm BA, T_8 : 20 ppm GA_3 + 10 ppm BA, T_9 : 10 ppm GA_3 + 250 ppm Promalin,. T_{10} : 20 ppm GA_3 + 500 ppm Promalin and T_{11} : Control (no spray). The solutions of different treatments were applied to run-off at full bloom in T_1 and T_2 with the help of a sprayer. In T_2, second applications of respective treatments were made at petal fall stage. The experiment was laid in a factorial randomized block design with three replications. The data of fruit set and fruit retained was taken as per standard method. Yield efficiency was worked out in kilogram of fruit per centimeter of limb circumference. Data on size, weight and shape index of ten fully mature fruits in each replication were recorded. Average number of seeds per fruits was worked out. Fruit flesh firmness was recoded with Effegi penetrometer (Model FT-327) and expressed in Newton (N=force in kg x 9.807). Total soluble solids, titratable acidity, sugars and ascorbic acid contents of fruits were estimated using A.O.A.C. (1980) methods. In this study, two years (2002 and 2003) data have been pooled analyzed.

RESULTS AND DISCUSSION

All the treatments of growth regulators significantly increased the fruit set as compared to control (Table 1), however, the highest increase was achieved with the application of 20 ppm GA_3 + 10 ppm BA (21.3%), followed by the treatments of 10 ppm GA_3 + 250 ppm Promalin (20.8%) and 10 ppm BA (20.7%) in decreasing order. Repeat application of growth regulators at petal fall stage (T_2) however, did not exerted as additional

Table 1 : Effect of plant growth regulators on fruit, fruit retention and yield efficiency of pear

Treatment	Fruit set			Fruit retention			Yield efficiency (kg/cm) limbcircmference		
	t_1	t_2	Mean	t_1	t_2	Mean	t_1	t_2	Mean
T_1 : 10 ppm GA_3	18.8	20.1	19.4	60.0	60.3	60.2	0.13	0.14	0.14
T_2 : 20 ppm GA_3	19.4	19.6	19.5	59.3	59.6	59.5	0.14	0.14	0.14
T_3 : 5 ppm BA	19.7	20.8	20.2	62.8	63.4	63.1	0.15	0.16	0.16
T_4 : 10 ppm BA	20.6	20.7	20.7	60.8	60.9	60.8	0.16	0.16	0.16
T_5 : 250 ppm Promalin	18.9	19.9	19.4	61.2	62.0	61.6	0.14	0.15	0.14
T_6 : 500 ppm Promalin	19.7	20.2	19.9	60.8	62.1	61.4	0.15	0.15	0.15
T_7 : 10 ppm GA_3 + 5 ppm BA	20.1	20.6	20.3	64.3	65.5	64.9	0.16	0.17	0.17
T_8 : 20 ppm GA_3 + 10 ppm BA	21.4	21.3	21.3	66.5	67.4	66.9	0.17	0.18	0.18
T_9 : 10 ppm GA_3 + 250 ppm Promalin	21.4	20.2	20.8	64.4	65.3	64.9	0.16	0.17	0.17
T_{10} : 20 ppm GA_3 + 500 ppm Promalin	20.0	20.2	20.1	63.3	64.8	64.1	0.15	0.16	0.16
T_{11} : Control.	14.2	13.8	14.0	61.3	61.3	61.3	0.13	0.13	0.13
Mean	19.4	19.7		62.2	62.9		0.15	0.15	
C.D. (P=0.05) Treatment (T)			1.2			1.1			0.1
Time of application (t)			NS			0.5			NS

N.S. = Non-significant

influence on fruit set compared to single application given at full bloom. It has been earlier reported that fruit set in pear can be promoted with application of plant bioregulators like GA_3 (Herrero, 1984), BA (Mercelle, 1984) and Promalin (Deckers *et al.*, 1997). The experimental results revealed that application of GA_3 + BA in different combinations significantly improved fruit retention as compared to control (Table 1). In this study, these treatments when applied twice at FB and PF stages caused higher increase in fruit retention compared to the treatments given once at full bloom. The results are in conformity with those of Deckers *et al.* (1997) who observed that double application of growth regulators like GA_3 and Promalin had more consistent effect on fruit retention in pear when compared to single application.

Present results (Table 1) revealed that combined application of GA_3 + BA and GA_3 + Promalin considerably increased the yield efficiency as compared to control. The maximum yield efficiency (0.18 kg per centimeter limb circumference) was observed following

Table 2 : Effect of plant growth regulators of physical characters of pear

Treatment	Fruit length (mm)			Fruit dia (mm)			Fruit shape index (lenth/diameter ratio)			Fruit weight (g)			Fruit volume (cc)			Number of seeds/fruit			Flesh firmness ($lb/inch^2$)		
	t_1	t_2	Mean	t_1	t_2	Mean	t_1	t_2	Mean	t_1	t_2	Mean	t_1	t_2	Mean	t_1	t_2	Mean	t_1	t_2	Mean
T_1 : 10 ppm GA_3	59.5	59.6	59.6	52.4	52.1	52.2	1.12	1.13	1.13	90.7	90.4	90.6	93.9	93.6	93.7	2.9	2.6	2.7	12.9	13.1	13.0
T_2 : 20 ppm GA_3	59.7	60.0	59.8	52.3	52.0	52.2	1.13	1.13	1.13	90.3	90.2	90.3	93.6	93.5	93.5	2.7	2.3	2.5	13.4	13.6	13.5
T_3 : 5 ppm BA	58.2	58.6	58.4	52.9	52.9	52.9	1.12	1.11	1.11	90.1	91.2	91.1	94.4	94.6	94.5	4.3	4.3	4.3	12.7	12.7	12.7
T_4 : 10 ppm BA	58.5	58.7	58.6	53.0	53.2	53.1	1.12	1.11	1.12	91.2	91.2	91.2	94.6	94.7	94.8	4.2	4.2	4.2	12.6	12.7	12.7
T_5 : 250 ppm Promalin	62.6	63.0	62.8	53.8	54.1	53.5	1.17	1.17	1.17	93.2	93.2	93.2	97.0	97.3	97.1	4.2	4.1	4.2	13.0	13.1	13.1
T_6 : 500 ppm Promalin	62.4	62.8	62.6	53.5	53.9	53.7	1.16	1.17	1.17	93.1	93.2	93.2	96.7	97.0	96.8	4.1	4.1	4.1	13.2	13.2	13.2
T_7 : 10 ppm GA_3 + 5 ppm BA	61.3	61.8	61.6	53.4	53.5	53.4	1.15	1.15	1.15	93.0	93.4	93.2	96.6	96.9	96.7	4.1	4.1	4.1	12.6	12.6	12.6
T_8 : 20 ppm GA_3 + 10 ppm BA	61.3	62.1	61.7	53.4	53.5	53.4	1.15	1.16	1.15	93.2	93.5	93.3	96.6	97.0	96.8	4.1	4.2	4.2	12.5	12.6	12.6
T_9 : 10 ppm GA_3 + 250 ppm Promalin	63.6	64.2	63.9	54.3	54.3	54.3	1.18	1.18	1.18	93.3	94.2	93.7	97.4	97.9	97.6	3.9	3.9	3.9	13.1	13.1	13.1
T_{10} : 20 ppm GA_3 + 500 ppm Promalin	63.1	63.7	63.4	54.2	54.1	54.2	1.17	1.18	1.18	92.9	93.9	93.4	97.3	97.5	97.4	3.9	3.9	3.9	13.1	13.3	13.2
T_{11} : Control.	57.2	57.3	57.2	53.5	53.6	53.5	1.11	1.11	1.11	91.6	91.6	91.6	95.2	95.1	95.1	4.4	4.4	4.4	12.6	12.6	12.6
Mean	60.2	60.9		53.4	53.4		1.13	1.15		92.0	92.3		95.4	95.8		3.8	3.8		12.8	12.9	
C.D. (P=0.05) Treatment (T)			2.2			1.1			0.05			1.0			0.8			0.2			0.3
Time of application (t)			NS			NS			NS			NS			NS			0.1			NS

N.S. = Non-significant

Table 3 : Effect of plant growth regulators on fruit quality of pear

Treatment	TSS (°Brix)			Titratable acidity (%)			Total sugar (%)			Ascorbic acid (mg/100g fruit plup)		
	t_1	t_2	Mean	t_1	t_2	Mean	t_1	t_2	Mean	t_1	t_2	Mean
T_1 : 10 ppm GA_3	10.6	10.5	10.6	0.61	0.62	0.61	7.54	7.50	7.52	1.35	1.39	1.37
T_2 : 20 ppm GA_3	10.5	10.4	10.4	0.63	0.70	0.66	7.34	7.43	7.39	1.40	1.43	1.42
T_3 : 5 ppm BA	11.1	11.1	11.1	0.43	0.45	0.44	8.67	8.79	8.73	1.21	1.19	1.21
T_4 : 10 ppm BA	11.3	11.3	11.3	0.46	0.49	0.47	9.02	9.25	9.14	1.19	1.13	1.16
T_5 : 250 ppm Promalin	10.9	10.9	10.9	0.60	0.63	0.62	8.29	8.09	8.19	1.38	1.42	1.41
T_6 : 500 ppm Promalin	10.8	10.9	10.9	0.61	0.64	0.62	8.17	8.02	8.09	1.34	1.47	1.41
T_7 : 10 ppm GA_3 + 5 ppm BA	11.0	11.1	11.1	0.57	0.60	0.58	8.56	8.60	8.58	1.45	1.56	1.50
T_8 : 20 ppm GA_3 + 10 ppm BA	11.2	11.2	11.2	0.54	0.57	0.55	8.67	8.78	8.72	1.46	1.47	1.46
T_9 : 10 ppm GA_3 + 250 ppm Promalin	10.8	10.8	10.8	0.63	0.60	0.61	8.02	8.18	8.10	1.47	1.48	1.47
T_{10} : 20 ppm GA_3 + 500 ppm Promalin	10.7	10.8	10.7	0.64	0.65	0.65	7.89	8.08	7.98	1.44	1.47	1.46
T_{11} : Control.	10.4	10.4	10.4	0.37	0.38	0.37	7.60	7.59	7.60	1.29	1.29	1.29
Mean	10.8	10.8		0.55	0.58		8.16	8.21		1.3	1.3	
C.D. (P=0.05) Treatment (T)			0.2			0.06			0.18			0.06
Time of application (t)			NS			NS			NS			0.03

N.S.=Non-significant

the application of 20 ppm GA_3 + 10 ppm BA treatment, followed by 10 ppm GA_3 + 5 ppm BA and 10 ppm GA_3 + 250 ppm promalin. Increased yield efficiency under these treatments may be attributing to increased fruit set, fruit retention (Table 1) and fruit size (Table 2).

During the course of present study, application of promalin either alone at 250 or 500 ppm or in combination with GA_3 at different concentrations significantly increased fruit length and L:D ratio (Table 2). The maximum increase in fruit length, fruit weight and volume was found following the treatment of 10 ppm GA_3 + 250 ppm promalin. Present findings are in agreement with earlier report (Mullinix *et al.,* 1995) that application of promalin produced elongated fruits. Negi and Sharma (2005) observed that bloom application of GA_3 alone or in combination with BA increased fruit length in pear. In this study, gibberellic acid applied alone at 10 or 20 ppm however, decreased fruit weight and volume. Yamada *et al.* (1991) and Negi and Sharma (2005) reported that gibberelic acid applied alone at 10 or 20 ppm decreased the number of well developed seeds in fruits significantly compared to control (Table 2). Other treatment except BA alone at 5 or 10 ppm though also decreased the seed count, but not as drastically as the treatments of GA_3 when applied alone. Growth regulator treatment given twice at full bloom and petal fall, however, caused more reduction in number of seeds irrespective of treatments compared to their single application at full bloom. Honeyborne (1996) reported that application of gibberellins at full bloom decreased the number of well developed seeds in pear. The maximum flesh firmness (Table 2) was found with 20 ppm GA_3.

Application of BA alone or in combination with GA_3 and GA_3 + Promalin increased total soluble solid content in fruits as compared to control (Table 3). The highest total soluble solid was found in fruits from limb treated with 10 ppm BA. GA_3 when applied alone at 10 or 20 ppm decreased TSS contents in fruits. It has been earlier reported (Negi, 2002). In the present investigation, GA_3 applied alone or in combination with promalin or BA or promalin applied alone increased titratable acidity in fruits. Sharma (1998) reported the combined application of gibberellins acid and cytokinins produced fruits with increased acid contents. The experimental results revealed that application of BA alone or in combination with GA_3 significantly increased total sugar, reducing sugar and non-reducing sugar in fruits (Table 3). The maximum sugars content found in the fruits treated with 10 ppm BA, while promalin application has less pronounced effect as compared to BA treatment. On the contray, GA_3 applied alone at 20 ppm decreased the sugar content in fruits. The present findings are in conformity with those of Negi (2002), who reported that application of BA increased the sugar content, while it was decreased with GA_3 application in pear. Gibberellic acid applied in combination with BA or promalin caused a marked increase in ascorbic acid content of fruits. These results are in agreement with the earlier findings of Negi (2002) in Flemish Beauty pear.

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