Indian J. Hort., **60** (1) : 34-39, 2003

Effect of plant bio-regulators and nutrients on fruit set, yield and quality of pear cv. Le Conte

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INTRODUCTION

There exists a great scope for extension of area under semi-soft pears in plains of northern India. Despite good eating quality and high returns, the growers are hesitant to plant semi-soft pears because of their shy bearing habit. This habit may be due to one or more factors like defective flowers, dichogamy, poor pollen germinability, impotence, ovule abortion etc. However, the most important reasons for low yield in Le Conte pear are self-incompatibility, excessive flower abscission and low fruit retention. Since there is no other commercial pear variety whose flowering time synchronizes exactly with Le Conte, hence, for improving the fruit set and reducing flower and pistal abscission with the use of plant bio-regulators (PBRs) and nutrients can provide a good alternative for successful semi-soft pear industry of northern plains. Apart from genic regulation, the PBRs play an important role in fruit growth and development. Some of the PBRs and biochemicals are synthesized endogenously, but occasionally, they are needed to be supplemented exogenously for additional stimulus and to counteract the effects of inhibitory factors for the intended purpose of increased fruit set, yield and quality (Goldwin, 3; Tromp and Wertheim, 11).

MATERIAL AND METHODS

Twenty five-year-old Le Conte pear trees on wild pear root suckers, planted 5 m x 5 m apart at Regional Fruit Research Station, Bahadurgarh (Patiala) PAU were selected for the study. The trees were sprayed at mid-bloom during 1997 and 1998 by 15 PBR treatments comprising gibberellic acid (GA_3) and Naphthalene acetic acid (NAA) @ 5 and 10 ppm each, chloramequat (CCC) and Alar (SADH) @ 500 and 1000 ppm each, boron @ 100 and 200 ppm, cobolt chloride ($CoCl_2$) @10

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and 20 ppm, sucrose @ 2.5 and 5.0 per cent and control (water spray). The experiment was laid out in Randomized Block Design and replicated thrice. Data were recorded on final fruit set and yield. Physico-chemical characteristics (AOAC, 1) of fruits were assessed after harvesting the ripe fruits. The data were statistically evaluated by using standard procedures as proposed by Gomez and Gomez (5).

RESULTS AND DISCUSSION

The data (1997 and 1998) related to fruit set, yield and physical fruit characteristics given in Table 1, indicate that during first year (1997) all the parameters were significantly influenced by various PBRs and nutrients except fruit diameter, whereas final fruit set, yield and firmness were also found to be significantly affected during second year (1998) of the experimentation. During 1997, GA_3 5 ppm tended to show the significantly highest final fruit set (63.3%) and yield (70.8 kg/tree), while in 1998, CCC 1000 ppm proved to be the most effective treatment to increase the final fruit set (38.7%) and yield (55.8 kg/tree) of Le Conte pear. The effect of CCC 500 ppm and SADH 500 and 1000 ppm were also found statistically at par with the best treatment (CCC 1000 ppm) in respect of final fruit set during the second year of fruiting. The higher fruit set and yield during first year (1997) might be due to GA_3 mediating process for faster translocation and mobilization of stored metabolites or photosynthates from source points. Sastry and Muir (9) also discussed the possibility that effect of GA on fruit set is partly due to a GA-mediating increase in auxin synthesis in the ovaries. In the second year (1998), comparatively low fruit set may be due to 'lean' crop year. The increase in fruit set and yield by CCC and SADH in the second year might be due to the reduction in vegetative growth followed by translocation of extra metabolites towards the reproductive growth or sink points (Grauslund, 6).

The effect of various PBRs and nutrients, varied significantly in respect of fruit weight and length during 1997, however, they failed to exert any significant influence on the above said parameters during 1998 and on fruit diameter during both the years of experimentation (Table 1). The application of 200 ppm boron excelled statistically in relation to fruit weight and fruit length over other treatments and their values were recorded as 101.7 g and 72.2 mm, respectively, during 1997 only. Almost similar effects were also observed by Golubinskii *et al.* (4). Blevins and Lakaszewski (2) suggested that adequate boron nutrition is critical not only for obtaining higher yields but also for fruit quality. Boron deficiency causes many anatomical, physiological and biochemical changes, most of which represent secondary effects. It is evident from the data in Table 1 that fruit softening measured in terms of flesh firmness was found to be accelerated significantly in GA_3 5 ppm (14.7 lb) and CCC 1000 ppm (15.1 lb) treated fruits during 1997 and 1998, respectively. Untreated control tended to remain firm (20.2 and 21.3 lb, respectively) on the commercial date of picking during respective seasons. The present finding is also in conformity with the results of Kondo (7).

Table 1. Effect of PBRs and nutrients on fruit set, yield and physical characters of fruits of Le Conte pear.

Treatment	Final fruit set (%)		Yield (kg/tree)		Fruit Physical characters							
					Weight (g)		Length (mm)		Diameter (mm)		Firmness (lb)	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
GA_3 5 ppm	63.3	23.9	70.8	31.3	85.4	114.4	69.3	69.0	54.9	55.7	14.7	16.3
GA_3 10 ppm	40.9	11.0	38.8	13.8	79.6	116.7	63.4	68.8	52.6	58.1	15.9	16.5
NAA 5 ppm	46.1	7.6	55.2	13.3	77.3	112.5	65.6	68.2	53.8	57.6	17.3	17.9
NAA 10 ppm	27.5	4.0	36.3	10.8	80.6	103.6	66.7	69.6	54.1	55.2	19.3	20.1
CCC 500 ppm	28.3	37.8	33.5	49.7	63.8	99.2	65.4	65.2	49.2	54.9	19.3	20.2
CCC 1000 ppm	29.3	38.7	38.5	55.8	77.9	100.0	67.3	64.8	55.4	54.1	14.9	15.1
SADH 500 ppm	27.0	33.1	29.0	47.8	81.3	99.4	65.6	65.9	55.3	53.8	16.2	17.2
SADH 1000 ppm	28.8	37.7	23.2	51.2	83.3	91.9	67.5	65.3	55.0	56.4	17.4	18.3
Boron 100 ppm	31.8	13.3	33.2	29.5	64.6	97.2	63.3	67.1	52.6	53.8	17.3	18.6
Boron 200 ppm	44.7	20.5	49.5	31.3	101.7	109.4	72.2	68.5	57.7	55.3	17.0	18.7
$CoCl_2$ 10 ppm	21.9	28.9	26.2	33.5	64.6	110.3	61.4	66.8	52.1	57.4	18.5	19.0
$CoCl_2$ 20 ppm	25.2	25.8	25.2	35.7	75.4	107.8	65.3	66.9	53.7	55.8	15.9	16.4
Sucrose 2.5%	39.9	22.9	46.3	32.2	81.5	117.8	65.5	67.2	53.1	57.7	17.3	18.5
Sucrose 5.0%	35.1	24.4	41.2	34.8	80.0	98.6	66.9	66.2	53.1	54.5	16.1	18.8
Control (water spray)	24.3	15.8	21.2	15.2	69.4	107.7	62.2	67.2	50.9	56.1	20.2	21.3
$CD_{0.05}$	8.4	7.3	2.6	4.2	6.8	NS	1.9	NS	NS	NS	0.4	1.3

*f.w. = frresh weight

Table 2. Effect of PBRs and nutrients on chemical characters of fruits of Le Conte pear.

Treatment	TSS (%)		Acidity (%)		TSS/ acidity ratio		Total sugars (%)		Ascorbic acid (mg/100g f.w.*)	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
GA_3 5 ppm	11.8	13.3	0.35	0.34	33.8	39.2	8.98	9.37	11.9	12.1
GA_3 10 ppm	11.9	13.0	0.38	0.32	31.3	40.6	8.61	9.12	17.0	17.4
NAA 5 ppm	11.2	12.7	0.40	0.29	27.9	43.7	9.01	9.13	13.0	13.6
NAA 10 ppm	13.2	12.1	0.46	0.38	28.6	32.0	8.68	7.96	14.1	14.4
CCC 500 ppm	13.2	12.5	0.45	0.43	29.3	29.1	8.59	9.41	17.1	17.4
CCC 1000 ppm	13.0	15.2	0.47	0.45	27.7	33.7	8.84	9.03	18.4	18.9
SADH 500 ppm	13.3	15.5	0.40	0.46	32.5	33.7	9.04	9.54	18.5	19.3
SADH 1000 ppm	12.8	14.0	0.49	0.47	26.2	29.8	9.21	9.45	16.5	16.9
Boron 100 ppm	13.8	14.0	0.46	0.34	29.7	41.2	9.41	9.38	13.2	12.3
Boron 200 ppm	12.7	12.8	0.45	0.32	28.2	40.1	8.85	9.13	11.4	12.3
$CoCl_2$ 10 ppm	13.7	12.2	0.47	0.32	29.1	38.0	9.84	10.43	12.5	13.1
$CoCl_2$ 20 ppm	13.2	14.4	0.48	0.40	27.4	36.1	9.14	10.31	14.4	15.1
Sucrose 2.5%	11.0	13.2	0.43	0.37	25.6	35.6	9.15	10.13	17.0	17.1
Sucrose 5.0%	12.3	13.5	0.41	0.32	30.1	42.2	8.34	8.37	15.3	15.9
Control (water spray)	13.0	13.8	0.45	0.33	28.9	41.9	9.61	9.97	14.5	15.1
$CD_{0.05}$	0.6	0.6	0.02	0.02	-	-	N S	0.23	0.7	0.6

*f.w. = frresh weight

The data on biochemical constituents as affected by PBRs and nutrients during both the years have been presented in Table 2. It is clear that significantly highest TSS content was registered with boron 100 ppm (13.8%) during 1997 and SADH 500 ppm (15.5%) during 1998. During first year (1997), the treatments did not affect the sugar contents of fruit statistically. However, significantly higher total sugars (10.43%) was observed with $CoCl_2$ 10 ppm. Lidster *et al.* (8) observed a positive correlation between boron and soluble solids. The possible reasons for increased TSS may be due to faster hydrolysis of starch into simple sugars and their mobilization into fruit by the use of boron, $CoCl_2$, growth retardants and the conversion of soluble sugars into ascorbic acid, which come to be a major component of TSS next to sugars in Le Conte pear.

The fruit acid content was recorded to be the significantly higher with those fruits which were treated with SADH 1000 ppm (0.49 and 0.47%) during both the years (1997 and 1998), however $CoCl_2$ 10 ppm, 20 ppm and CCC 1000 ppm during first year and SADH 500 ppm and CCC 1000 ppm during second year, were also found statistically similar to SADH 1000 ppm. The lowest fruit acid content during 1997 and 1998 was recorded in case of GA_3 5 ppm (0.35%) and NAA 5 ppm (0.29%), respectively. Srivastava and Agarwal (10) and Kondo (7) also noted the decrease in the fruit acid content by the application of gibberellic acid. The data presented in table 2 reveal that maximum TSS/acid ratio was observed with GA_3 5 ppm (33.8) and NAA 5 ppm (43.7) during 1997 and 1998, respectively. It is evident from the data (Table 2) that ascorbic acid content was affected with PBRs and nutrient treatments during both the years. The significantly higher ascorbic acid (18.5 and 19.3 mg per 100 g f.w.) was registered in case of SADH 500 ppm, which was closely followed by CCC 1000 ppm (18.4 and 18.9 mg per 100 g f.w.) in the respective years.

SUMMARY

Application of gibberellic acid (GA_3) 5 ppm in Le Conte improved the fruit set and yield during the first year, whereas CCC 1000 ppm was more effective in the following year. The physico-chemical characteristics of the fruits were not affected consistently by the application of PBRs and nutrients during both the years. The long-term effects of the PBRs and nutrients need to be studied further.

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