Inducing precocity in European pear: First year effects on growth

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Summary

In a six month period of growth in 2008, there were some indications that CPPU, with delayed heading and deblading and with heading back at the 'grower's' timing, showed good increase in vegetative growth, as evidenced by percent increase in trunk cross-sectional area and in total growth of new shoots, expressed as shoot growth/number of new shoot breaks. These treatments were not significantly different than the 'grower's' control which was headed back at 'normal' timing, probably due to low replicate tree numbers and large spread in the data, but a trend appears to hold for improved vigor. Promalin with 'normal' timed heading showed some improvement in total growth of new shoots, expressed as shoot growth/number of new shoot breaks, compared to the 'grower's' control, however, this was the only difference seen. MaxCel, MaxCel + CPPU and cable ties (girdling) with delayed heading, showed greater %increase in TCSA than the 'grower's' control, but overall shoot vigor was not improved. Other treatments showed less vigor in TCSA growth and mostly less vigor in shoot growth (total length/number of breaks) than the control(s).

However, after two growing seasons, no treatment improved growth in circumference, height or total shoot production and length compared to the trees that received no chemical treatments, none was better than the trees that received only deblading and/or heading at the grower's timing, and both Promalin and MaxCel appeared to reduce the number of shoot breaks compared to the untreated, unheaded control. No improvement, therefore was seen from any of the tested treatments and an additional year of the trial is unwarranted.

Problem and its significance

Pear growers in California face many challenges in remaining viable. For those growers interested in planting new orchards, getting young trees into production faster would be a benefit. Precocity in young pear is not induced by cyclanilide or Promalin (mixture of 6-benzyl adenine and GA_{4+7}), as reported by Dr. Don Elfving (Washington State University); GAs induce vegetative shoot elongation but inhibit reproductive growth and can decrease return bloom in pome fruits, depending on type of gibberellin, timing of application and concentration; cytokinins like BA, however, may improve reproductive growth if used alone. CPPU, a synthetic cytokinin, is a candidate to test as well, as it is ~100 times stronger than 6-BA and is not metabolized by the plant. Ethephon is routinely used in many ornamental species for more rapid production of flower buds for the nursery trade. Use of these PGRs on non-bearing young trees may be a means of advancing flower production and cropping. Physical means are also

used in many applications for this purpose, including trellising or spreading laterals for a more horizontal branch angle, and scoring or girdling limbs or the trunk to increase the concentration of nutrients and growth factors for reproductive development, while decreasing vegetative vigor, in the scion. Reducing apical dominance by deblading terminal leaf clusters and removal of the most vigorous shoots can influence weaker laterals to produce higher numbers of spurs.

In 2008, we found some indications that CPPU, with delayed heading and deblading and with heading back at the 'grower's' timing, showed good increase in vegetative growth, as evidenced by percent increase in trunk cross-sectional area and in total growth of new shoots, expressed as shoot growth/number of new shoot breaks. These treatments were not significantly different than the 'grower's' control which was headed back at 'normal' timing, probably due to low replicate tree numbers and large spread in the data, but a trend appears to hold for improved vigor (Table 2). Promalin with 'normal' timed heading showed some improvement in total growth of new shoots, expressed as shoot growth/number of new shoot breaks, compared to the 'grower's' control, however, this was the only difference seen. MaxCel, MaxCel + CPPU and cable ties (girdling) with delayed heading, showed greater %increase in TCSA than the 'grower's' control, but overall shoot vigor was not improved. Other treatments showed less vigor in TCSA growth and mostly less vigor in shoot growth (total length/number of breaks) than the control(s).

Objectives

1. Reduce the developmental period of young European pear trees to fully cropped condition.

2. Compare rate of reproductive and vegetative development over a 3 year period, with treatments to include single year applications of PGRs, repeated annual applications, and physical means to reduce vegetative vigor.

Plans and Procedures

2008: The trial location is located at the Andy Scully ranch in Lake County as part of a new planting, spaced at 11.2' x 15'. On May 7 we obtained trees from the grower to plant two rows of 14 treatments with 7 single-tree replicates per treatment for a complete randomized block design. Of these replicates, approximately half received treatment in 2009, as in 2008. All treatments, with the exception of hydrogen cyanamide (Dormex) have been imposed; Dormex will be applied during early bud break (Table 1). Statistical Analysis Systems software (SAS Institute, Cary, NC) was used to perform means separations and the analyses of variance (PROC GLM) for experimental measurements.

All trees received some pruning, many 'remedial' in order to remove dead wood or improve structure. Several replants were required as a function of orchard predation by gophers and deer.

Data evaluated over the life of the trial (2 years)

1. Annual growth in length and diameter of a percentage of all laterals per trunk cross sectional area
2. Tree growth = trunk circumference at approximately 10 inches (25 cm) above the bud union, canopy height

Results and Conclusions

Despite some early indications of benefit found in 2008 (Table 2), no improvement in growth or inclination to precocity was observed in 2009 (Table 3). Although no flowers were produced as yet, there is no growth that appears to hasten fruitwood development. After two growing seasons, no treatment improved growth in circumference, height or total shoot production and length compared to the trees that received no chemical treatments, none was better than the trees that received only deblading and/or heading at the grower's timing, and both Promalin and MaxCel appeared to reduce the number of shoot breaks compared to the untreated, unheaded control. No improvement, therefore was seen from any of the tested treatments and an additional year of the trial is unwarranted.

PERTINENT LITERATURE

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Acknowledgements

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Table 1. Treatments imposed on 'Bartlett' pear replants for precocity testing. Treatments included plant growth regulators and scaffold treatments (heading at planting, no heading, delayed heading, and /or deblading). Two treatments in addition to the 'untreated controls' (UTC) received no plant growth regulator but were girdled by cable ties. Seven single-tree replicates within two adjacent tree rows were established in a complete randomized block design.

Treatment		Scaffold present at start delayed heading, deblade	No Scaffold
1	MaxCel	X	
2	MaxCel		X
3	CPPU	X	
4	CPPU		X
5	MaxCel + CPPU		X
6	Cable ties	X	
7	Cable ties		X
8	Ethephon		X
9	Promalin	X	
10	Promalin		X
11	Dormex		X
12	UTC	X deblade , no heading	
13	UTC		X, head & deblade
14	UTC, no deblade		X

Table 2. First year results for growth in 'pear precocity' trial of 'Bartlett' pear, Lake County, 2008.

Treatments, Year 1		Scaffold present at start; delayed heading, deblade	No scaffold	Circumference (cm)	TCSA 19 Nov	%Increase in TCSA [y]	Total new shoot growth (cm)	#Shoot breaks	Growth (shoot cm/#new shoots)
1	MaxCel	X		22.5 ab [x]	40.3 ab	5.2	52.8	12.2	9.4 ab
2	MaxCel		X	20.7 ab	35.2 ab	11.0	102.4	12.2	8.8 ab
3	CPPU	X		21.7 ab	38.0 ab	11.2	134.2	15.8	14.2 a
4	CPPU		X	19.5 b	30.5 b	7.9	85.0	10.2	11.6 ab
5	MaxCel + CPPU		X	20.1 ab	32.4 ab	14.9	131.0	12.1	6.1 ab
6	Cable ties	X		21.3 ab	36.3 ab	13.9	91.6	15.0	5.1 b
7	Cable ties		X	20.2 ab	33.0 ab	5.4	61.4	12.2	5.7 b
8	Ethephon		X	20.8 ab	34.5 ab	9.9	92.6	10.6	5.3 b
9	Promalin	X		19.5 b	30.5 b	3.0	118.7	9.00	
10	Promalin		X	19.9 ab	31.7 ab	7.1	126.2	10.0	12.2 ab
11	Dormex (pending)		X						
12	UTC	X deblade , no heading		22.8 a	41.6 a	3.3	36.4	13.7	8.2 ab
13	UTC		X, head & deblade	19.6 b	31.0 ab	5.1	127.3	10.3	10.0 ab
14	UTC, no deblade		X	20.5 ab	33.4 ab	7.8NS	112.7NS	15.9NS	8.7 ab

[x] Mean separation by DMRT, $P = 0.05$; NS = nonsignificant.

[y] Change in TCSA (trunk cross-sectional area) from 21 May to 19 Nov, as a percentage derived from (change in TCSA May to Nov/TCSA Nov) x 100.

Table 3. Effect of treatments on tree gowth in pear precocity trial, Lakeport, California, 2009.

Treatment		Trunk diameter (mm)	Total tree height (cm)	Total length shoot growth (cm)	# Shoot breaks
1	MaxCel	24.3	113.9	127.5	8.4 c
2	MaxCel	23.4	109.3	124.7	9.2 bc
3	CPPU	26.4	132.6	279.3	15.9 ab
4	CPPU	24.4	140.2	276.2	11.5 abc
5	MaxCel + CPPU	23.9	148.6	338.8	16.6 a
6	Cable ties	25.1	122.4	212.5	13.2 abc
7	Cable ties	21.2	143.3	302.7	10.4 bc
8	Ethephon	22.5	133.3	181.6	9.7 bc
9	Promalin	17.2	117.2	142.5	9.4 bc
10	Promalin	22.3	123.8	86.8	10.1 bc
11	Dormex	23.9	129.3	184.9	12.9 abc
12	UTC, deblade, no heading	23.5	110.8	234.7	15.9 ab
13	UTC, head and deblade	23.9	123.0	283.9	13.0 abc
14	UTC, no deblade	24.0	151.1	276.6	16.7 a
ANOVA[1] (Insufficient data to determine block and treatment interactions)					
Treatment (p-value)		NS (0.17)	NS (0.85)	NS (0.53)	*
Block (p-value)		NS (0.77)	NS (0.61)	NS (0.13)	NS (0.26)

[1] Within columns treatment means significantly different (LSD multiple range test).

[2] * Indicates significance at P<0.1. NS indicates not significant P>0.1.