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WINTER SHOOT BENDING EFFECTS ON LIGHT PENETRATION: IMPACT ON FLOWERING AND FRUITING OF LE CONTE PEAR TREES IN RELATION TO STARCH / AMMONIA

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ABSTRACT

This study was carried out during 1998-1999 and 1999-2000 seasons on nine-year-old Le Conte pear trees budded on *Pyrus communis* rootstock. Sunlight quantum penetration into tree canopy was positively correlated to shoot bending and bending angle. Bending increased lateral growth; spurs; flowering spurs, and fruit set; contrarily it decreased shoot formation. Ninty degree angle is recommended for all shoot ages for attaining the highest spurs and lateral growth. Moreover, for three year old shoots, 45° angle resulted in the highest fruit set.Conversely, for two year old ones 90 ° angle was the best.Fruit set increased with shoot age increment. Starch content in buds of one year old shoots decreased as bending angle increased , whereas a vice-versa trend took place with ammonia. Starch / ammonia decreased in these buds, 90° angle resulted in further reduction. Starch content of spur terminal buds of two and three year old shoots increased by bending and its bending angle, contrarily, ammonia decreased, consequently starch/ ammonia content increased by bending and bending angle. Yet recent work provides an evidence that the carbohydrate (starch) and nitrogen (NH3 – NH4) status of the tree influences flowering and fruit set of Le Conte pear trees.

Key words : ammonia , bending, pears, starch.

1. INTRODUCTION

The importance of maintaining an open canopy to intercept maximum sunlight has been demonstrated for pear trees (Forshey, *et al.*, 1992). Low light levels can reduce fruit growth and set, and increase shoot extension (Lakso and Corelli , 1994). Early observations indicated that nonbearing trees have higher starch reserves level than bearing trees during winter months (Hooker, 1982). Starch and soluble sugars are predominant reserve carbohydrates available for energy for growth and maintenance (Daie, 1985). Yet recent work provided an evidence that the carbohydrate (starch) and nitrogen (NH3– NH4) status of the tree do influence the number of floral shoots and total number of initiated flowers (Lovatt *et al.*, 1988). Starch is the most important storage carbohydrate in plant organs, especially in wood perennial (Chapin *et al.*, 1990). Regeneration of starch reserves occurs from fruit harvest to leaf abscission (Inglese and Desalvador, 1996). On the other hand, this complementary cycling between stem TSS and starch suggests that a conversion of starch to sugars occurs to support vegetative growth and flowering, while sugars produced from photosynthesis may be allocated directly to support flowering and fruit production (Xuan *et al.*, 1999).

There is a lack of information on the influence of training system on the seasonal and long term nonstructural carbohydrate partitioning between vegetative and fruit growth in apple trees (Stutte *et al.*, 1994). Other studies have indicated that high concentrations of carbohydrate reserves do not necessarily result in more flowering, fruit set, and higher yield, as reserve carbohydrates can be used preferentially for vegetative growth (Kaiser and Walestenholme, 1994). Bending accelerated bud development without affecting shoot elongation (Ito *et al.*, 1999). Alternatively, the correlation between flower bud density and vegetative growth may be an apical dominance phenomenon, thus substances other than carbohydrates (Maust and Darnell, 2000).

This research was conducted to assess the effect of shoot bending on sun light penetration into tree canopy, phenological and physiological traits of 1,2 and 3 year-old- shoots.

2. MATERIALS AND METHODS

This study was carried out during the two successive seasons 1998-1999 and 1999-2000 on Le Conte pear trees grown at the Horticulture Research Institute (HRI) in Giza .Nine-year-old trees budded on *Pyrus communis* rootstock were used in this investigation. Tree spacing was 5m apart. Orchard soil was clay loamy, fertile and of good drainage ,all trees received the normal horticultural practices. Two angles (45° and 90°) were tested beside the control .Each treatment consisted of three trees, three branches in each tree direction were tagged representing three replicates. Bending was done on November 1st and 5th in the two seasons of investigation successively. Bent shoots were inclined at an angle of 45° and 90° from the vertical and tied down with strings to the trellis at a height of 90 cm. whereas control shoots were left vertical.

2. 1. Field Studies

2. 1. 1. Amount of full sunlight received by trees

Light penetration into tree canopy was measured in the center of the canopy after bending treatments. Percentage of photosynthetic photon flux (PPF) was measured by using a Schenduler Plant Stress Monitor. All readings were taken between 11 am and 4 pm in summer and at 1 and 3 pm in winter (Habib *et al.*, 1993).

2. 1. 2. Lateral growth

Numbers of lateral growth and shoots to all number of buds on 1,2,3-year-old shoots were counted at the end of the growing seasons (October) as mentioned by (Myers and Ferree, 1983).

2. 1. 3. Spur number

Average numbers of spurs on labeled one, two and three year-old shoots were counted in October 25 th (1998) and in October 1st (1999) before bending treatments and recounted again in October 1st (1999& 2000) at the end of the two growing seasons, respectively.

2. 1. 4. Flowering spurs

Average numbers of spurs on labeled one, two and three year-old shoots were counted in the spring of 1999 & 2000.

2. 1. 5. Fruit set

On March 29^{th} 1999 and 2000 seasons, twenty (well distributed) spurs of 1,2,3 year-old shoots were selected around each and the number of flowers at full bloom was counted from March, 28th 1999 until March, 30^{th} 2000. Fruit number was recorded at the end of fruit drop period. Fruit set % was calculated on the basis of the initial number of flowers.

2. 1. 6. Chemical constituents of spur and current shoots

Samples (5gm) of spur terminal buds and current shoot buds were taken monthly from December up to March the following year for ammonia and starch determinations. Ammonia was determined according to (A.O.A.C, 1970). Starch was determined calorimetrically according to (Dubios *et al.,* 1956) as gm / 100 gm dry weight using spectrophotometer at 490 nm. S / A ratio was calculated by dividing Starch by Ammonia.

2. 2. Experimental layout and statistical design

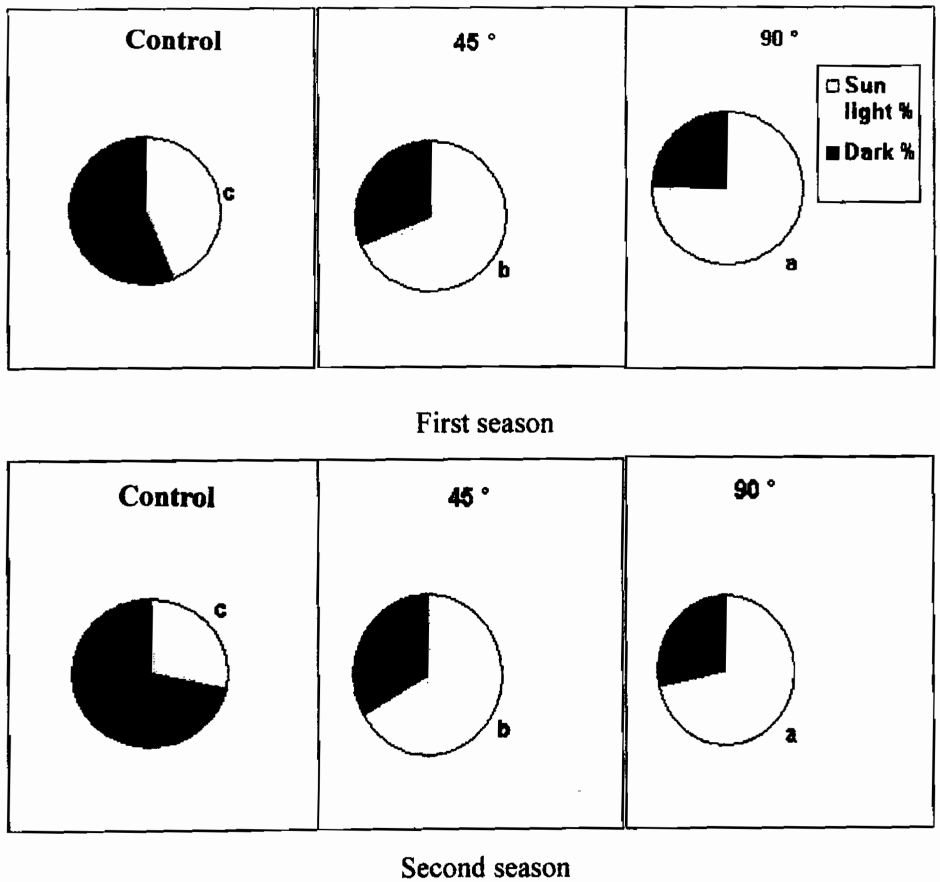
The randomized complete block design was adopted for assessing data of the present study and were tested for analysis of variance as indicated by (Snedecor and Cocharn; 1980). L.S.D at 5% level of significance was applied to compare between means.

3. RESULTS AND DISCUSSION

3. 1. Effect of winter shoot bending on

3. 1. 1. Sun light penetration (%) into the canopy of Le Conte pear tree

Fig.(1) shows that bending significantly increased sunlight penetration into tree canopy. 90°C angle resulted in the highest sunlight penetration followed by 45 °C while the control trees received the least. Such result is compatible to those of Warrington (1988), Warrington ,*et al.*, (1995) and Khattab *et al.*, (2001) who stated that the restructuring treatments resulted in improving light penetration to inner and lower canopy of apple trees.



Fig(1): Effect of winter shoot bending on sun light penetration (%) into the canopy of "Le Conte" pear trees.

3. 1. 2. Lateral growth %

Data outlined in Figs.(2,3&6) illustrate the superiority of 90 °C angle in increasing lateral growth percentage. Three-year- old shoots recorded the highest percentage of lateral growth than one and two-year–old shoots. Bending at 90 °C angle proved promising to all shoot ages. This stimulating effect of bending on lateral growth as evidenced in this study is confirming those reported by Lawes *et al.*, (1998); Wilson (2000) and Wilson and Gartner (2001).

3. 1. 3. Shoots %

Data illustrated in Figs.(2,3&5) show that bending reduced shoot percentages significantly compared to the control. Bending angle of 90 °C resulted in the lowest shoot percentage. Shoot percentage increased significantly with shoot age advancement. Moreover, 90 °C angle resulted in further decrease for one and two -year-old shoots, while it was 45 °C angle for three-year-old ones. Our findings are in harmony with those mentioned by (Husabo, 1965) who mentioned that bending the branches of young apple trees decreased vegetative growth of the trees as the angle became wider.

3. 1. 4. Spurs %

Spur percentages as shown in Figs. (2,3&4) illustrate that shoot bending generally enhanced spur formation, which was positively correlated to the bending angle .The highest significant spur percentage was scored with the eldest age and 90° angle.

3. 1. 5. Flowering Spurs %

As shown in Fig.(7) regarding the efficacy of different bending angles on flowering spur percentage of different shoot age, it is interesting to indicate that almost all bending treatments under evaluation have induced significantly higher flowering spur percentages compared to the control. Higher tested bending angle 90 °C, attained higher percentage compared to the lower one and the control. Concerning shoot age as affected by bending practice, data revealed a significant increase in flowering spur percentage as shoot age increased. Significant difference was obvious among the two angles with both two and three year old shoots, with supremacy of bending

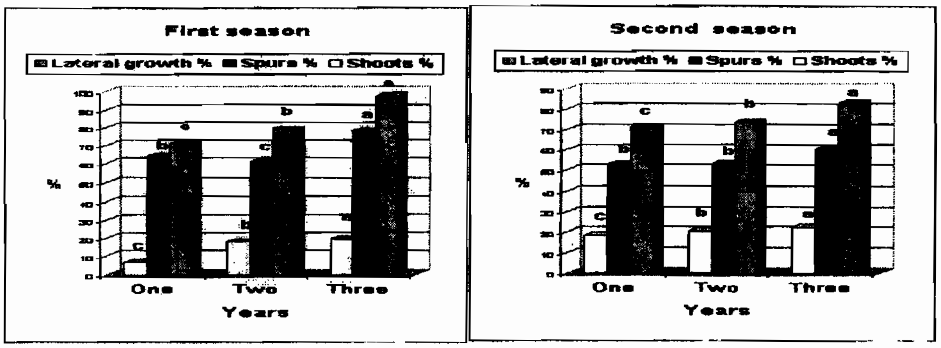


Fig.(2): Percentages of lateral growth, spurs and shoots as affected by shoot age of "Le Conte" pear trees.

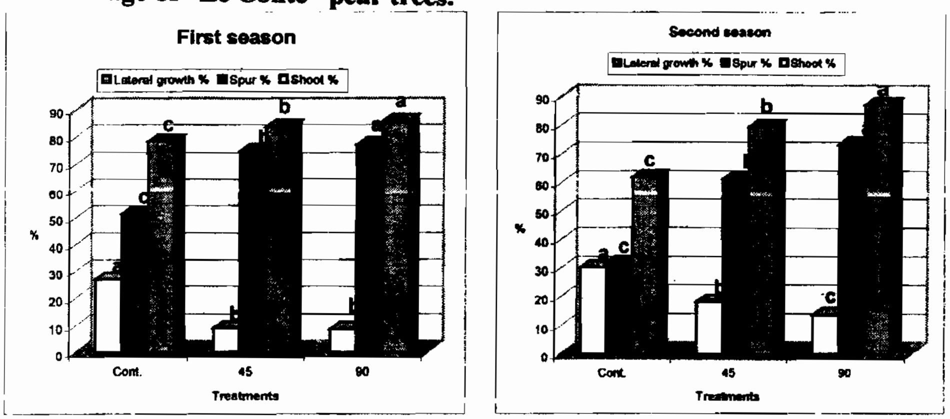


Fig. (3): Percentages of lateral growth, spurs and shoots as affected by bending angle of "Le Conte" pear trees.

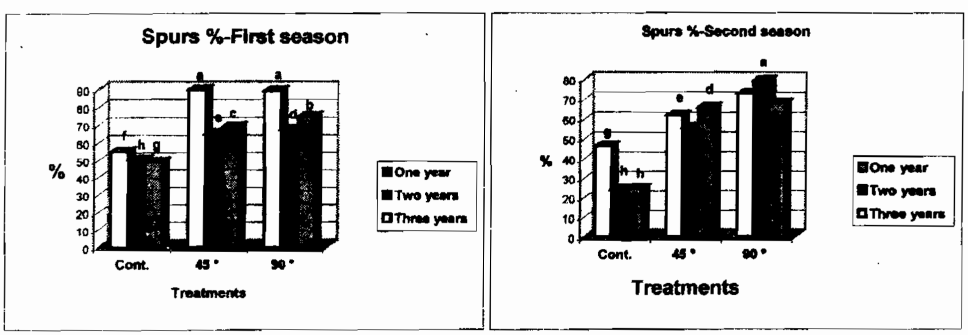


Fig. (4): Percentages of spurs as affected by bending angle and shoot age of "Le Conte" pear trees.

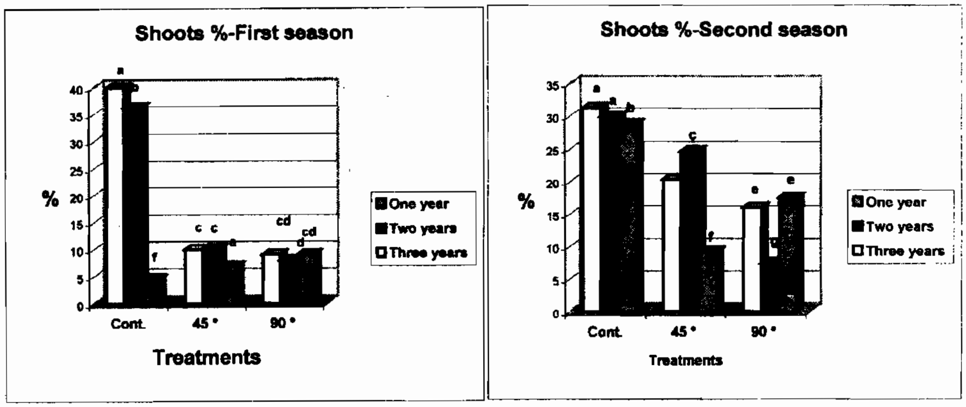


Fig. (5): Percentages of shoots as affected by bending angle and shoot age of "Le Conte" pear trees.

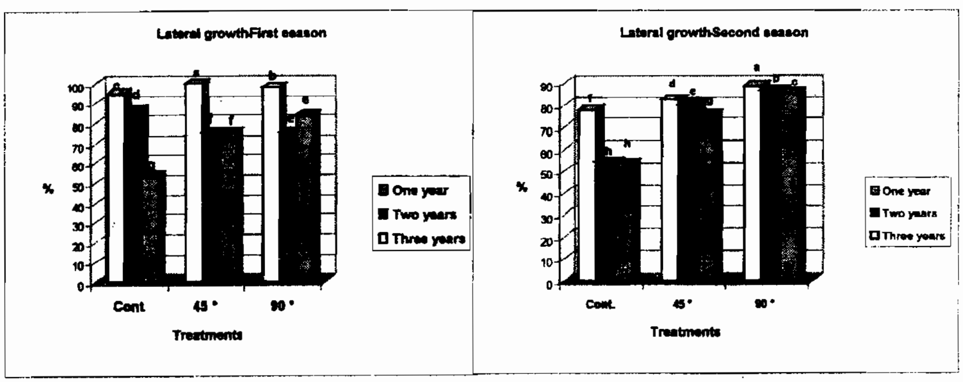


Fig. (6): Percentages of lateral growth, as affected bending angle and shoot age of "Le Conte" pear trees.

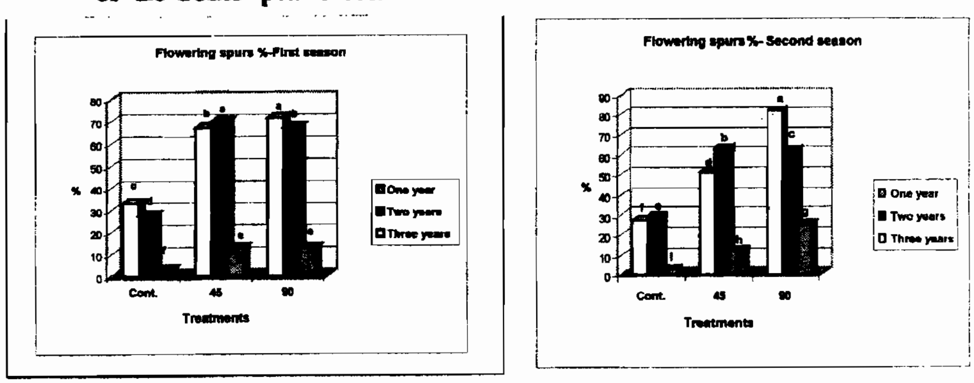


Fig.(7): Percentages of flowering spurs as affected bending angle and shoot age of "Le Conte" pear trees.

two-year-old shoots at 45 °C . Contrarily, the opposite was recorded for three old shoots as the supremacy of bending at 90° angle was detected. No significant difference was noted with one-year-old shoots among the two tested bending angles. Our findings go along with those of Lawes *et al.*, (1998) and with (Pierre , 2001) who reported that winter bending reduced lateral growth and redistributed the shoots to maintain good fruiting potential.

3. 1. 6. Fruit set %

Data of fruit set as shown in Fig.(8) reveal that the highest fruit set percentage was obtained by 45 °C bending angle treatment, followed significantly by 90 °C angle. Whereas the lowest significant fruit set percentage was attained with the control. As for shoot age, the three-year-old shoots scored the highest significant fruit set percentages followed significantly by two and one-year-old shoots. Fruit set percentages for one and three-year-old shoots have increased with bending angle 45 °C .Contrarily was the result with the two-year-old shoots. Our finding is closely related to the work featured by (Marini *et al.*, 1991) and (George *et al.*, 1996) who stated that sunlight distribution influences flower initiation and fruit set.

3. 2. Effect of winter bending on starch, ammonia and starch / ammonia ratio of buds of one -year-old shoots

Data shown in Tables (1&2) indicate that winter bending significantly decreased starch content in the buds compared to the control. The bending angle 90° resulted in the lowest percentage. Starch content in the buds increased significantly during dormancy period, then decreased at bud burst (March). Bending at 90° obviously decreased starch content in buds as it approached bursting.

A notable increase in ammonia content in the buds of one-year-old shoots due to bending in general was noted with the supremacy of 90° angle. Ammonia content in the buds decreased at dormancy, then increased at bud burst.

Regarding S/A content in the buds, the data indicate an announced decrease in this content due to bending with both angles. Also a notable increase in this content was detected in the buds from December and up to February followed by a sharp decrease which

Table (1): Effect of winter bending on starch, ammonia and starch/ammonia ratio of Le Conte pear tree buds on one-year-old shoots (1998-1999).

Bending angle	Starch				Mean	Ammonia				Mean	Starch / Ammonia S/A				Mean
	12	1	2	3		12	1	2	3		12	1	2	3	
Cont.	0.949	0.998	1.810	1.152	1.227	20.41	18.10	2.57	26.35	16.86	0.046	0.050	0.698	0.043	0.210
45o	0.092	0.105	0.655	0.410	0.315	19.36	20.41	10.07	48.86	24.69	0.005	0.005	0.065	0.008	0.020
900	0.140	0.240	0.536	0.176	0.273	52.48	30.01	10.07	14.51	26.77	0.003	0.008	0.053	0.012	0.019
Mean	0.393	0.447	1.00	0.579		30.75	22.84	7.58	29.91		0.018	0.022	0.272	0.021	
LSD 5%	Bending (B)		Period (P)		B&P	Bending (B)		Period (P)		B&p	Bending (B)		Period (P)		B&P
	0.008		0.009		0.016	0.075		0.087		0.150	0.008		0.009		0.016

Table (2): Effect of winter bending on starch, ammonia and starch/ammonia ratio of Le Conte pear tree buds on one-year-old shoots (1999-2000).

Bending angle	Starch				Mean	Ammonia				Mean	Starch / Ammonia S/A				Mean
	12	1	2	3		12	1	2	3		12	1	2	3	
Cont.	0.779	0.882	1.639	0.999	1.075	2.04	1.54	1.76	16.34	5.42	0.381	0.571	0.931	0.061	0.486
45o	0.418	0.619	1.139	0.380	0.639	39.64	20.11	11.93	7.58	19.81	0.010	0.030	0.095	0.050	0.046
900	0.189	0.460	0.692	0.656	0.499	28.81	30.81	23.57	49.15	33.08	0.006	0.014	0.029	0.013	0.015
Mean	0.462	0.653	1.157	0.678		23.50	17.49	12.42	24.36		0.132	0.205	0.351	0.091	
LSD 0.05	Bending (B)		Period (P)		B&P	Bending (B)		Period (P)		B&p	Bending (B)		Period (P)		B&P
	0.075		0.087		0.150	0.122		0.141		0.244	0.008		0.009		0.016

occurred in March. Interaction data in this regard as shown in Fig.(9) indicate the suppressive effect of bending in decreasing S/A ratio in the one-year-old shoots, which (in comparison to those of two and three year old shoots) was accompanied by the highest lateral growth %, the lowest spurs %; the lowest flowering spurs %; the lowest fruit set % which increased by bending with the supremacy of bending at 45 °C.

3. 3. Effect of winter bending on starch, ammonia and starch / ammonia ratio of spur buds of 2-year-old - shoots

According to starch data illustrated in Tables(3&4) bending led to an announced increase in starch content in the apical buds of the spurs of 2-year-old shoots. 90 °C angle resulted in further increase. Starch content in these buds decreased markedly at bud burst in March. A higher starch content in the control and those bent at 90 °C was detected in December and January, than at 45 °C angle; but in February this content increased by bending. This proved obviously in March, by breaking of bud dormancy, starch content decreased in the control trees, but increased obviously with bending, especially with 90 °C.

Regarding ammonia content, bending significantly decreased ammonia content in the terminal buds; the lowest value was scored with 45° angle. Ammonia content in the apical buds of the spurs, decreased markedly during dormancy period (December and January), then showed a marked increase as buds started to swell for bursting in March. Interaction studies showed that during dormancy, control buds contained higher ammonia than those treated with bending. But as buds were approaching swelling and bursting in February and March, those bent at 45 °C contained higher ammonia than both control and 90° treatment. Also, those bent at 90° significantly decreased this content even than the control. As buds came to bursting; those bent at 90° gained the highest ammonia content followed by the control, whilst those bent at 45 °C contained the lowest ammonia content.

Regarding starch /ammonia ratio in the terminal buds of the spurs on 2-year-old shoots, data revealed an obvious increase with bending treatments and this increase was obvious as bending angle increased. A general increase in this ratio was detected during dormancy period (December and January), but an announced decrease occurred as buds started bursting in March. Regarding the interaction effect, bending generally increased this ratio all the time but during

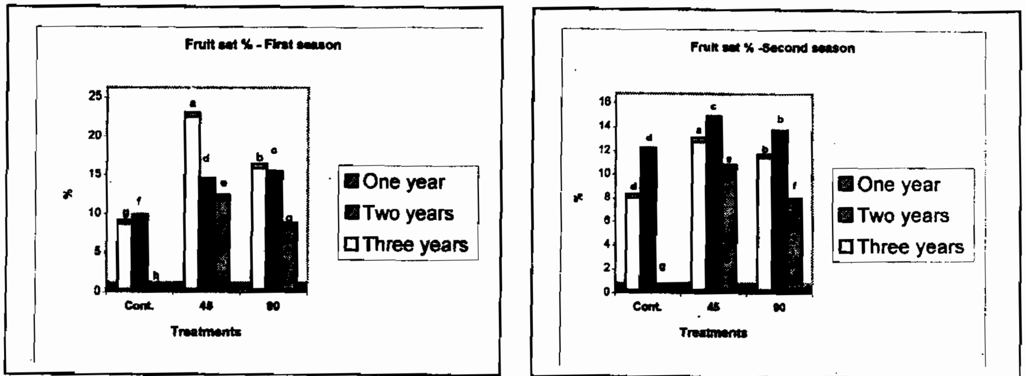


Fig. (8): Percentage of fruit set as affected by bending angle and shoot of “Le Conte” pear trees.

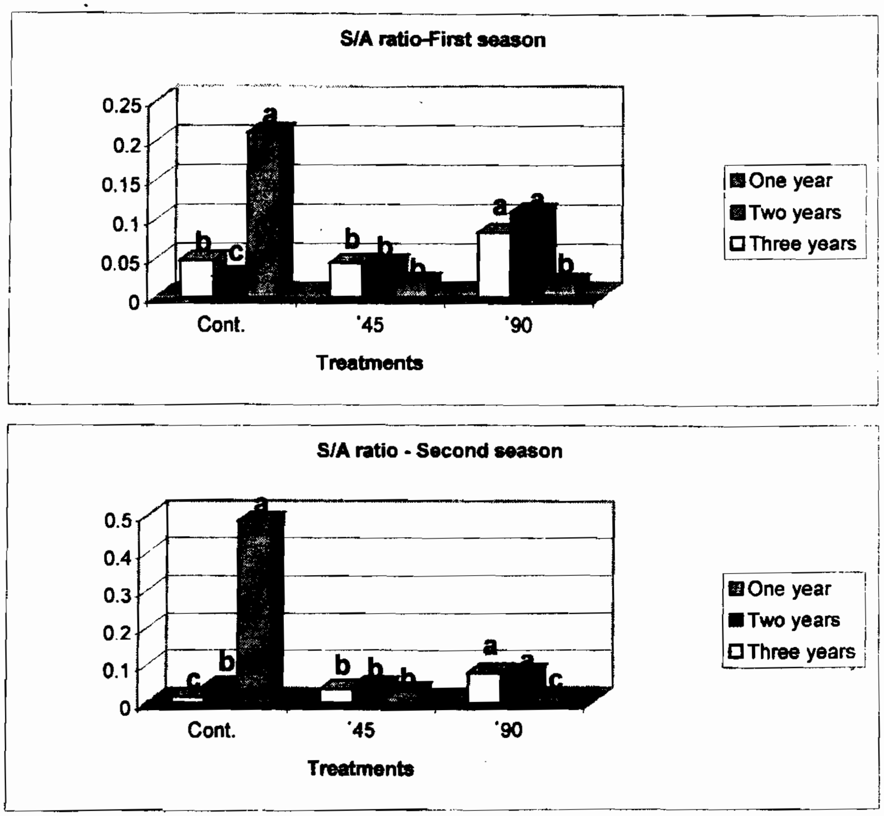


Fig. (9): Starch / Ammonia in the buds as affected by bending angle and shoot age of "Le Conte" pear trees.

Table (3): Effect of winter bending on starch, ammonia and starch/ammonia ratio of spurs buds born on 2-year-old shoots (1998-1999) of Le Conte pear tree.

Bending angle	Starch				Mean	Ammonia				Mean	Starch / Ammonia S/A				Mean
	12	1	2	3		12	1	2	3		12	1	2	3	
Cont.	0.320	0.220	0.250	0.080	0.217	7.59	5.46	8.83	16.91	9.69	0.042	0.040	0.028	0.005	0.028
45o	0.289	0.110	0.313	0.317	0.257	6.58	3.84	10.12	4.61	6.29	0.044	0.029	0.030	0.068	0.043
900	b0.46 4	0.573	0.324	0.460	0.455	5.76	2.11	4.82	22.79	8.87	0.080	0.271	0.067	0.020	0.109
Mean	0.357	0.301	0.296	0.285		6.64	3.80	7.92	14.77		0.055	0.113	0.041	0.031	

LSD 0.05	Bending (B)	Period (P)	B&P	Bending (B)	Period (P)	B&p	Bending (B)	Period (P)	B&P
	0.008	0.009	0.016	0.046	0.053	0.092	0.008	0.009	0.016

Table (4): Effect of winter bending on starch, ammonia and starch/ammonia ratio of spurs buds born on 2-year-old shoots (1999-2000) of Le Conte pear tree.

Bending angle	Starch				Mean	Ammonia				Mean	Starch / Ammonia S/A				Mean
	12	1	2	3		12	1	2	3		12	1	2	3	
Cont.	0.127	0.102	0.580	0.029	0.209	22.70	17.70	3.31	37.79	20.38	0.006	0.006	0.175	0.001	0.047
45o	0.554	0.011	0.348	0.180	0.273	4.94	1.10	10.09	4.66	5.19	0.111	0.010	0.034	0.038	0.048
900	0.549	0.649	0.548	0.175	0.480	6.81	4.68	6.23	11.26	7.24	0.080	0.141	0.087	0.015	0.080
Mean	0.410	0.254	0.492	0.128		11.48	7.82	6.54	17.91		0.066	0.052	0.098	0.018	

LSD 0.05	Bending (B)	Period (P)	B&P	Bending (B)	Period (P)	B&p	Bending (B)	Period (P)	B&P
	0.008	0.009	0.016	0.046	0.053	0.092	0.008	0.009	0.016

winter (December) no difference was detected between bending at 45 °C and control; this ratio increased significantly at 90 °C; this trend continued up to January and February but in March it is lowered significantly than 45 °C. At bud burst, the highest S/A ratio was detected with those bent at 45 °C followed by 90 °C and those untreated they attained the lowest S/A ratio. As in Fig. (9) S/A ratio in terminal buds of two-year-old shoots increased by bending with the supremacy of 90 °C angle, which resulted in the formation of the highest spurs and fruit set percentages.

3. 4. Effect of winter bending on starch, ammonia and starch/ ammonia ratio of spur buds on 3-year-old shoots

Data presented in Tables (5&6) show that, bending significantly increased starch percentage with 90 °C angle, while significantly decreased it at 45 °C only at the first season· These criteria changed during the period of dormancy as the highest percentage was scored in January then decreased in February and March. An announced decrease in starch content was detected in March by both bending angles.

Regarding ammonia content, it was significantly decreased by bending especially at 90 °C angle.Concerning Starch / Ammonia, it was increased by bending at 90 °C, but a slight decrease was detected only in the first season by 45°· S/A ratio was higher in December compared to those scored in March. The interaction indicated that bending significantly decreased S/A ratio in December in the first season.Contrarily, second season data recorded sharp increase. In March bending was of no effect as S/A ratio was significantly equal to control. Interaction between shoot age and bending angle as shown in Fig. (9) reveals that bending in general and 90 °C angle in particular increased S/A ratio in the terminal buds of three year old shoots which was accompanied clearly by the formation of the highest flowering spurs and fruit set percentages.

Our findings concerning starch content in buds are closely related to work featured by (Correa and Marlongeon, 1969) who found that at the beginning of flowering, the soluble sugars and starch tended to decrease from the flower buds of peach trees. Focusing on the beneficial role of starch, (Arbeloa and Herrero, 1991) mentioned that, starch decreased because starch within the ovule is involved in the

Table (5): Effect of winter bending on starch, ammonia and atarch/ammonia ratio of buds spur born on 3-year-old shoots (1998-1999) of Le Conte pear tree.

Bending angle	Starch				Mean	Ammonia				Mean	Starch / Ammonia S/A				Mean
	12	1	2	3		12	1	2	3		12	1	2	3	
Cont.	0.469	0.311	0.199	0.342	0.330	3.26	15.22	10.78	30.27	14.88	0.143	0.020	0.018	0.011	0.048
45o	0.348	0.444	0.240	0.086	0.279	10.71	3.95	9.99	9.15	8.45	0.034	0.112	0.024	0.009	0.044
900	0.243	0.728	0.360	0.097	0.357	17.22	2.65	10.11	14.18	11.04	0.014	0.275	0.036	0.007	0.083
Mean	0.353	0.494	0.266	0.175		10.39	7.27	10.29	17.86		0.064	0.135	0.026	0.009	
LSD 0.05	Bending (B)		Period (P)		B&P	Bending (B)		Period (P)		B&p	Bending (B)		Period (P)		B&P
	0.008		0.009		0.016	0.026		0.030		0.053	0.008		0.009		0.016

Table (6): Effect of winter bending on starch, ammonia and starch/ammonia ratio of buds spur born on 3-year-old shoots (1999-2000) of Le Conte pear tree.

Bending angle	Starch				Mean	Ammonia				Mean	Starch / Ammonia S/A				Mean
	12	1	2	3		12	1	2	3		12	1	2	3	
Cont.	0.294	0.453	0.161	0.199	0.277	20.17	25.01	5.65	17.39	17.06	0.014	0.018	0.028	0.011	0.018
45o	0.398	0.490	0.543	0.369	0.450	9.45	6.67	31.61	20.01	16.94	0.042	0.073	0.017	0.018	0.038
900	0.782	0.880	0.811	0.212	0.671	10.12	15.02	4.54	20.60	12.57	0.077	0.059	0.178	0.010	0.081
Mean	0.491	0.607	0.505	0.260		13.25	15.56	13.94	19.33		0.044	0.050	0.074	0.013	
LSD 0.05	Bending (B)		Period (P)		B&P	Bending (B)		Period (P)		B&p	Bending (B)		Period (P)		B&P
	0.008		0.009		0.016	0.046		0.053		0.092	0.008		0.009		0.016

development of both ovular structures and the embryo. Such view was approached later by (Stutte *et al* ., 1994) and (Inglese and Sottile, 1999). They indicated that at dormancy period, starch content increased in non-pruned and central leader-trained trees.

Concerning ammonia content, bending significantly increased it. 90 °C angle gave higher content of ammonia in spur buds of 2 and 3-year-old shoots. Such findings go along with those of (Thomas, 1978) who mentioned that low light intensities or darkness reduced expression of light dependent genes and disappearance of photosynthetic proteins.

Regarding starch / ammonia ratio, our findings are parallel in this respect with (Lovatt *et al.*, 1988) who provided that, the carbohydrate (starch) and nitrogen (NH_3 – NH_4) status of the tree, influence the number of floral shoots and total number of initiated flowers.

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ثنى أفرع الكمثرى الليكونت شتاء و تأثيره على اختراق الضوء والعلاقة بين التزهير و الإثمار والنسبة بين النشا إلى الامونيا

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ملخص

أجريت هذه الدراسة على أشجار الكمثرى الليكونت عمر تسعة سنوات المطعمة على اصل الكميونس و ذلك بمزرعة بحوث البساتين بالجيزة . شملت الدراسة ثنى الأفرع عمر سنة و سنتين و ثلاثة سنوات في الشتاء خلال موسمي ١٩٩٨–٢٠٠٠.بهدف دراسة تأثير الثني على الإزهار و الاثمار و النسبة بين النشا إلى الامونيا.

تتلخص النتائج المتحصل عليها فيما يلي:

أدى الثني إلى زيادة نسبة الضوء الساقط في قلب الشجرة والتي كانت مرتبطة بثني الأفرع و زاوية الثني .أدى الثني إلى زيادة نسبة النموات الجانبية والدوابر و الدوابر الزهرية و نسبة العقد. على العكس قللت من تكوين الأفرع أعطى ثني الأفرع عمر ثلاثة سنوات بزاوية ٤٥ درجة أفضل النتائج للصفات المدروسة. بينما كان ثني الأفرع عمر سنتين عند ٩٠ درجة الأنسب. كانت أعلى نسبة عقد تحصل عليها من ثني الأفرع لكل الأعمار المدروسة عند ٤٥ درجة. تزداد نسبة العقد بزيادة عمر الأفرع. قل محتوى براعم الأفرع عمر سنة من النشا بثني الأفرع و بزيادة زاوية الثني بينما كان العكس صحيحا بالنسبة للأمونيا وبالتالي قلت نسبة النشا إلى الأمونيا في هذه البراعم وخاصة بالزاوية ٩٠ درجة. إزداد محتوى البراعم الطرفية للدوابر على الأفرع أعمار سنتين و ثلاثة سنوات من النشا بثني الأفرع وكذلك بزيادة زاوية الثني .و العكس حيث قل محتوى الأمونيا في هذه البراعم و بالتالي ازدادت نسبة النشا إلى الأمونيا في هذه البراعم بثني الأفرع وبزيادة زاوية الثني . وهذا يوضح أن مستوى الكربوهيدرات (النشا) و النيتروجين (الأمونيا) فى الشجرة يؤثر فى التزهير و العقد .

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