Kafrelsheikh University
Faculty of Agriculture
Department of Horticulture

PRODUCTIVITY OF "LE CONTE" PEAR TREES AS AFFECTED BY SOME AGRICULTURAL TREATMENTS

By

Abeer El-Saied Mohamed Moawad
B.Sc. Agric. Co-Operation Sciences (1997)
Completive study, Fac. of Agric. Kafr El-Sheikh, Tanta University (2000)

THESIS
Submitted in Partial Fulfillment of the Requirements
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Approval Sheet

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ABSTRACT

This investigation was carried out during 2003 and 2004 seasons on "Le Conte" pear trees grown in a commercial orchard located at El-Atwa El-Bharia village, Kotour district, El-Gharbia Governorate, Egypt. This study included two separate experiments, the first, amid to evaluated the effects of spraying Dormex with 2%, branch bending, soil mulching and K-spraying with 2% K_2SO_4 treatments as compared to the control on vegetative growth, flowering, fruit setting, yield and fruit quality as well as leaf mineral contents. The second, was designed to study the effect of branch age (A), bending angle (B) and their interaction (A x B) on flowering, fruit setting, yield and fruit quality.

With respect to the effect of some agricultural treatments the, data revealed that, foliar spraying with 2% K_2SO_4 is considered the best treatment for improving shoot and leaf growth parameters. Moreover, it increased initial fruit set and set after June drop percentages as well as leaf N and K contents. Besides, produced maximum yield with good fruit quality especially, weight, size and TSS value in both seasons of study.

Concerning, the effect of bending treatments, the data clarify significant differences among the three tested bending angles and between the two tested branch ages. However, the most important data were disclosed by the interaction. Bending 3-years old branches with 75° (widest angle) is considered the suitable combination treatment which increased floral spurs and fruit set percentages as well as C/N ratio, produced maximum yield as number of fruits and weight (kg/tree) and also improved fruit quality in both seasons.

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INTRODUCTION

INTRODUCTION

Pear is a deciduous tree belonged to Rosaceae family, grow well in a wide range of climalic condition. "Le Conte" pear is the commercial pear cultivar grown in Egypt, it needs about (600-680) effective chilling units below 7.2°C. The cultivated area reached about 8793 feddans produced 36388 tons fruits according to the last statistics of Ministry of Agriculture and Land Reclamation (2006).

The productivity of "Le Conte" pear trees is lower than the natural rate in some years as a result to a warm climate in winter due to the long rest period of their buds which resulted in a disorder in the opening of the flower and vegetative buds. So, flowering period elongated and fire blight disease occurs as a result especially, when air temperature and humidity increases during summer which causes death of large number of buds then decreased the final yield of the trees.

Dormex (Hydrogen cyanamide) has been widely identified as one of the most effective dormancy breaking agents for many deciduous fruit trees when chilling requirements is not be fulfilled under warm locations (**Stino, 1997**).

Pear trees are sensitive to poor light conditions with respect to flower bud formation (**Wagenmakers, 1988**). Horticultural use of branch reorientation away from the vertical position, referred to hereafter as bending is a long established practice for reducing vegetative growth and increasing fruiting of apple **(Luckwill, 1970)**.

Bending has been proposed as alternative to pruning for promoting early fruit production and controlling tree size (**Lespinasse, 1996**).

Soil mulching as one of agricultural practices may plays an important role by conserving soil moisture, improving soil structure, regulating soil temperature and controlling the weed population (**Rao and Pathak, 1988**). Also, mulching improving vegetative growth and increasing productivity and fruit quality as well as nutrients uptake of apple trees (**Verma *et al.*, 2005 and Mikhael and Mady, 2007**).

Potassium is the key element in plant nutrition for promoting root growth and tree vigour and improving yield and fruit quality as well enhancing resistance to pests and diseases (**Mengel and Kirkby, 1978**). In addition, "Le Conte" pear trees grown in North Nile delta region, where the soil is alkaline producing small fruits. In such types of soil depressing of potassium uptake is a nutritional problem, especially after building the High Dam. Thus, foliar and soil potassium application increased productivity and improved pear fruit quality.

Accordingly, this study was planned in two separated experiments on Le Conte" pear trees grown in El-Gharbia Governorate hoping to give some useful recommendations helping pear growers in this region.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Effect of some agricultural treatments:

I. Effect of Dormex application on:

1. Vegetative growth:

Stino and El-Fakharani (1995) tested the application of hydrogen cyanamide at 1.5 or 2.5% at 1/1, 20/1 first of January or 10/2 on Conadria fig trees. They found that, length of new shoots and average number of leaves borne on those shoots were significantly increased by application of hydrogen cyanamide. The best results were obtained when trees were sprayed by 2.5% at 20/1.

Gabr (1996) indicated that spraying "Le Conte" pear trees with Dormex at 1, 2, 3 and 4% significantly increased shoot diameter and leaf area of vegetative shoots. Moreover, 4% Dormex treatment gave the highest values as compared to the control and other concentrations. On the other hand, the control had significantly higher average shoot length than those of all different used Dormex treatments.

Stino (1997) studied the response of "Anna" apple trees to some treatments with hydrogen cyanamide, mineral oil and their combinations during the dormant season. He mentioned that, trees sprayed with H_2CN_2 at 0.75% + mineral oil at 2% developed shoots that were significantly longest with highest number of born leaves/shoot compared with the control and other treatments.

2. Bud break, flowering, fruit set and yield:

Reddy and Shikhamany (1989) studied the effect of hydrogen cyanamide and thiourea at 1.5, 3 or 4% on bud break of Thompson seedless grapevines, they found that 3% H_2CN_2 treatment resulted in higher percentage of bud break and lower mean number of days to bud break from pruning time compared with the control. Moreover, the number of days from pruning time to 50% flowering was reduced with 8 days at 3% H_2CN_2 treatment than the control.

Williams and Tax Tzco (1990) working on "Winter Banana" and "Wealthy" apple trees, found that spraying with 2 or 4% hydrogen cyanamide on 1 or 22 February, before dormancy had broken, significantly advanced bud break for both vegetative and floral buds, but no differences were found to be between dose rates and times of application.

Cheema *et al.* (1991) indicated that, spraying "Punjab" grapes with Dormex advanced bud break. The best results were obtained by spraying at 2% on 25 December, consequently flowering was 20 days earlier than those of untreated vines.

Stadler *et al.* (1991) studied artificial rest-breaking of apricot cv. Palsteyn and plum cvs Gaviota, Santa Rosa and Songold by using hydrogen cyanamide, found that concentrations of 5 or 1% applied 4 or 6 weeks before expected full bloom generally gave earlier and more uniform bud break in all cultivars. Moreover, all application of Dormex shortened flowering period.

Siller-Cepeda *et al.* (1992) studied the effect of hydrogen cyanamide with 0.125, 0.25, 0.5 or 1.0 M on bud break of "Red Haven" peach trees, they concluded that all concentrations promoted bud break and the most effective one was 0.125 M H_2CN_2 as compared to the control.

Finetto (1993) studied the influence of hydrogen cyanamide on breaking endo-dormancy of 14 mid-chilling apple cultivars grown in Yemen A.R., he found that treatment at 2% had a significant and positive influence on bud burst in all cultivars tested when applied 30 days before bud burst. In addition, the best results were obtained with Sturmer Pippin, Starkspur Gold and Gala apple cultivars.

Lioyd and Firth (1993) studied the effect of Dormex at 0.5% and promalin at 200 or 400 ppm either alone or in combination on "Florda Prince" peach trees grown in subtropical Australia, they indicated that H_2CN_2 stimulated floral bud break and advanced flowering led to an earlier harvesting with yield equivalent to those of control.

Cartabellotta *et al.* (1994) applied hydrogen cyanamide at 4 or 6% on different dates in January/February to dessert grape cvs. Matilde, Italia and Michele Palieri, they pointed out that bud break was advanced particularly at 4% when applied 40-50 days before normal bud break, while 6% concentration reduced bud fertility.

Gil and Lyon (1994) reported that hydrogen cyanamide was effective at 1% or 2% in stimulating bud break of pear cv. winter

Nelis which is used to pollinate the earlier flowering cultivar Packham's Triumph which is important in regions with insufficient cold winter weather.

Mann *et al.* (1994) studied the effect of Dormex at 1, 2, 3 and 4% on 5, 15 and 25 December as well as 5 January on bud burst flowering and fruit maturity of "Baggugosha" pear trees, they reported that spraying Dormex with 2, 3 and 4% on 5 January advanced bud burst by 2 weeks, flowering by 10 days and fruit maturity by 7 days. In addition, the highest concentrations of Dormex significantly reduced fruit yield.

Petri and Stuker (1995) studied the effect of sprayed "Gala" apple trees grown on Southern Brazil with either hydrogen cyanamide (H_2CN_2) alone at 0.5, 1.0, 1.5 or 2% or HCN at 0.25, 0.5, 0.75 or 1% and mineral oil at 2, 3 or 4% compared to the control, they reported that all treatments increased the percentage of lateral and terminal bud break and number of flower clysters/trees. Furthermore, the best treatment was 0.25% H_2CN_2 + 2% Mo which significantly produsedhigher yield than other treatments.

Stino and El-Fakharani (1995) stated that application of hydrogen cyanamide with 2.5% at 20/1 significantly increased the percentage of bud developed to vegetative growth and the number of fruits/tree in both breba and main crops of "Conadria" fig trees. Moreover, earlier application at 1/1 resulted in a more advanced bud burst.

Gabr (1996) studied the effect of spraying "LeConte" pear trees with Dormex at 1, 2, 3 and 4% in 20/1 and 8/2, he found that Dormex treatments enhanced bud break and advanced flowering as well as increased percentage of developing floral buds but, reduced the percentage of the developed vegetative buds. Moreover, spraying Dormex at all concentrations enhanced fruit set and generally, increased the percentages of fruit set and fruits remaining until harvest date and yield as compared to the control. The 3% Dormex treatment (recommended dose) produced the maximum yield (kg/tree).

Aly *et al.* (1997) studied the effect of some dormancy breaking treatments on "Anna" apple trees, they reported that spraying Dormex at 3% either alone or at 2%, 1.5% in combination with 3% mineral oil enhanced floral bud activity, accelerated full blooming and increased floral bud burst percentage, initial and final fruit set, and yield.

Stino (1997) reported that, spraying "Anna" apple trees with Dormex at 1.5% resulted in advancing with increasing bud burst percentage, enhancing floral bud burst activity and accelerated full blooming. However, fruit set percentage, number of retained fruits/tree and yield as kg/tree were not significantly affected.

Aly *et al.* (1998) studied the effect of some dormant breaking treatments on five plum cultivars; Methly, Golden Japanese, Santa Rosa, Holywood and Beauty grown in Giza and Qualubia Governorates. They mentioned that sprays of Dormex at 1.0, 1.5

and 2% either alone or mixed with 3% mineral oil increased floral and vegetative bud percentage, shortened blooming period, increasing the overlapping between cultivars except with "Hollywood" cultivar which was earlier than others and increased fruit set percentage.

Mansour *et al.* (1999) reported that, spraying Dormex 0.5% + folk oil 0.5% treatment advanced and increased percentages of flower and vegetative bud break, rate of flower bud development as well as fruit set and yield of "Flordaprince" peach trees.

Singh and Mann (2002) studied the effect of hydrogen cyanamide and thiourea on bud burst, flowering and fruit set of pear cv. Palhernkh, they found that bud burst was advanced by 11 days and time of flowering, full bloom and fruit set was advanced by 10-12 days by spraying Dormex with 1, 2, 3 and 4% on 5 January.

3. Fruit quality:

Williams and Tax Tzco (1990) sprayed "Winter Banana" and "Wealthy" apple trees with 2 or 4% hydrogen cyanamide on 1 or 22 February, they reported that, fruit diameter, average fruit weight and TSS values were significantly affected by application of hydrogen cyanamide.

Liaw (1991) treated *Pyrus serotina* cultivar Shinkou trees with 0.5% hydrogen cyanamide in August/September. He noticed that no significant differences were found in weight and TSS content of the fruits from treated trees and those of the control ones.

El-Shall *et al.* (1993) studied the effect of some Dormancy-breaking agents on "LeConte" pear buded on four rootstock, they concluded that Dormex application increased average fruit weight and volume.

Lotfy (1993) reported that application of hydrogen cyanamide on "Thompson seedless" grapevines increased the weight of 100-berry and TSS but reduced the juice acidity value.

Mokhtar *et al.* (1994) found that application of H_2CN_2 on Asian pears reduced both flesh firmness and acidity while increased the TSS value.

Stino and El-Fakharani (1995) studied the effect of type of pruning and hydrogen cyanamide application on "Conadria" fig trees, they mentioned that applied with hydrogen cyanamide at 1.5 or 2.5 at 1/1 or 20/1 led to increased average syconia weight, diameter and gave highest TSS value. However, juice acidity was markedly reduced.

Gabr (1996) reported that, spraying "LeConte" pear trees with Dormex at 3 and 4% on January, 20th or February, 8th significantly increased fruit weight, size, length and diameter but reduced fruit firmness as compared to the control. Moreover, 3 and 4% Dormex treatments gave the highest total soluble solids (TSS) and the lowest acidity percentage.

Aly *et al.* (1997) indicated that sprayed "Anna" apple trees with 3% Dormex and 2% Dormex + 3% mineral oil gave the highest

significant values of fruit weight and size and the least significantly fruit firmness compared to the control. On the other hand, Dormex treatments had no significant effect on juice TSS and acidity.

Stino (1997) found that Dormex application significantly increased average fruit weight, advanced fruit maturity and reduced flesh firmness and acidity. whereas, had no significant effect on juice TSS value.

Mansour *et al.* (1999) reported that, Dormex 0.5% + Folk oil 0.5% treatment significantly increased fruit weight and volume compared to the control. While, there were no significant differences in fruit diameter, height, firmness, TSS and acidity.

II. Effect of branch bending on:

1. Vegetative growth:

El-Sherbini (1978) reported that bending 1-year old shoots of "Birkher" apple trees, downward on 15, December resulted in reduction of the vegetative bud percentage than those on the control.

Myers and Ferree (1983) studied the influence of time of summer pruning and tree orientation on young apple trees, they found that orientation at 45° or 90° of trees declined of terminal shoot growth.

Banno *et al.* (1986) mentioned that shoot bending of Japanese pear trees (*Pyrus serotina* R.) cv. Shinsui on 10 June, decreased shoot growth than the control.

Baskin (1987) concluded that, stem bending of apple trees caused a slight growth of all cultivars after June.

Edwards and Notodimedjo (1987) studied the effect of defoliation, bending and tip pruning on apple trees under tropical condition, they pointed out that shoot bending reduced shoot growth which in turn, more nodes and leaves per shoot were formed.

Lawes *et al.* (1998) reported that bending of young "Doyenne Du Comice" pear trees horizontally increased the number of moderately weak side shoots and floral precocity.

Bahlool *et al.* (2000) studied the effect of some cultural practices on "LeConte" pear trees, they indicated that shoot bending nearly at horizontal position decreased shoot length. However, number of leaves/shoot and leaf area were increased.

Pierre-Eric (2001) evaluated genotype of apple trees affects growth and fruiting responses to shoot bending at various time of year, he reported that summer bending (June-July during flower premodia initiation) promotes lateral growth and reduces fruit number and weight. Meanwhile, winter bending reduces lateral growth, distributing it along the shoot to maintain good fruiting potential.

Abd El-Rahman (2002) tested the effect of winter bending of 1, 2 and 3 year old shoots with two angles 45° and 90° on "LeConte" pear trees, he indicated that winter shoot bending decreased shoot percentage but increased lateral shoot percentage. Bending also

significantly increased leaf area, leaf dry weight and specific leaf weight of current shoots and spurs compared to the control. Moreover, 90° angle gave better results for 2 and 3-year old shoots.

2. Flowering, fruit set and yield:

Pitushkan and Shtirbu (1985) reported that leaves on the upper part of the bent shoots of apple trained at Italian palmettes showed greater photosynthetic activity during the whole growing seasons than leaves on the other parts of the same shoots.

Banno *et al.* (1986) pointed out that shoot bending of "Shinsui" Japanese pear trees increased number of axillary buds and the final percentage of flower bud formation with approximately 60% while, in the control it only reached 15.2%. They also indicated that, bending led to decrease in IAA content in the shoot tips and increased it in axillary buds, while gibberellins content of both the shoot tips and axillary buds increased in the treated shoots.

Edwards and Notodimedjo (1987) working on apple trees, mentioned that shoot bending significantly increased flowered spurs and fruit set percentages as well as final yield compared to the control.

Wei (1987) studied the effect of bending on flower bud formation in young apple trees and bio-chemical changes in the treated shoots, he found that bending resulted in the highest percentage of flowered spurs and number of flowers.

Baart (1992) reported that stem bending of pear cvs. Doyenne Du Comice, Beurre Hardy and Beurre Alexander Lucas showed profused flowering in the first year. However, in the second year flower bud formation was poor in all cultivars.

Chen-Chung *et al.* (1997) found that, shoot bending increased floral bud formation and fruit set percentage of "Hasui" pear grown in Taiwan.

Lawes *et al.* (1998) mentioned that leader bending of "Doyenne Du Comice" pear trees resulted in superior trees with uniform lower development and greater flowering.

Ito *et al.* (1999) working on "Kosui", the most leading pear cultivar in Japan, has few flower buds per shoots, they indicted that shoot bending accelerated bud development and increased floral bud percentage without affecting shoot elongation.

Bahlool *et al.* (2000) studied the effect of some cultural practices on flower bud formation, fruit set and yield of "Le Conte" pear trees, they found that bending treatments caused an increase in flower spurs percentage, fruit set and yield. The best treatment was shoot bending + tip pruning + defoliation.

Pierre-Eric (2001) studied genotype of apple trees affects growth and fruiting responses to shoot bending at various time of the year, he reported that in Chantecler cultivar many flower bud were formed on 1-year old wood, bending during flower bud formation

(June-July) increased percent of lateral bud break and the number of flower buds as well as number of fruits/tree.

Abd El-Rahman (2002) concluded that, winter shoot bending significantly increased the percentage of flowering spurs on 1, 2 and 3 year old shoots. Moreover 90° angle was the best treatment compared with 45° angle and the control. Furthermore, bending treatments also, significantly increased fruit set % and C/N ratio in leaves and wood of current shoots and spurs on 2 and 3 years old shoots of "LeConte" pear trees.

Kang *et al.* (2004) studied the effect of shoot bending on endogenous auxin and cytokinin levels in buds and its possible relationship to flower bud formation in "Kosui" pear trees, they reported that shoot bending (30-45°) accelerate flower development due changes of endogenous hormones. IAA concentration in the lateral buds on vertical shoots increased in mid-July but that in the bent shoots remained nearly constant. On the other hand, the concentration of cytokinins were higher in the bent shoots than in the vertical ones.

Colaric *et al.* (2007) studied the effect of bending on levels of carbohydrates and phenolic compounds in "Conference" pear leaves, they mentioned that carbohydrate levels showed no clear tendency among all treatments.

3. Fruit quality:

Banno *et al.* (1985) found that shoot bending significantly increased fruit weight and size of "Shinsi" Japanese pear.

Lespinasse and Delort (1986) reported that fruit size and quality of "Golden Delicious" apple was varied with branch angle. Equilibrium between vegetative vigor, yield and uniformly high fruit quality was produced from fruiting lateral branches oriented between 30^{o} and 45^{o}.

Dann *et al.* (1990) studied the influence of branch angle on growth and cropping of peach trees, they indicated that fruit under shade condition were smaller with lower quality than non shade conditions. Size and TSS were inversely related to shade levels, while, firmness proportionally affected by shade level.

Chen-Chung *et al.* (1997) concluded that "Hashi" pear fruit firmness was not significantly influenced by shoot bending treatments.

Bahlool *et al.* (2000) pointed out that, shoot bending treatments significantly increased fruit weight and volume of "LeConte" pear trees, while decreased its fruit firmness. TSS value, acidity and TSS/acidity ratio were insignificantly affected by all treatments.

Khattab *et al.* (2001) reported that, training "Anna" apple trees to central leader system produced fruit with the lowest length/diameter (L/D) ratio at maturity compared to the control.

Pierre-Eric (2001) studied the response of apple cvs. x 3318 and Chantecler to shoot bending at various time of year, they mentioned that bending increased the number as well as the weight of fruit.

Abd El-Rahman (2002) reported that winter bending significantly increased "LeConte" pear fruit weight, volume length, diameter, L/D ratio, TSS, TSS/acidity ratio and the branching at 90° angle was preferable than 45°, while this treatment significantly decreased acidity % and fruit firmness.

4. Leaf mineral contents:

Banno *et al.* (1985) suggested that, shoot bending improved nutrient components particularly NPK in leaves of Japanese pear trees (*Pyrus serotina* R.) compared to the control.

Dejong and Doyle (1985) decided that leaf nitrogen content is not uniformly distributed over peach tree canopy and this distribution is related to neutral light microenvironment.

Palliotti *et al.* (2000) noticed that grapevines leaves exposed to sun attained higher Pn and N-content than shaded leaves.

Abd El-Rahman (2002) reported that nitrogen content in leaves of current shoots of "LeConte" pear trees was significantly increased by winter bending without significant defference between 45°C and 90° bending angles.

III. Effect of soil mulching on:

1. Vegetative growth:

Stanek and Novota (1985) reported that mulching with black polyethylene increased "Golden Delicious" apple tree growth by 9.4%, whereas mulching with straw increased tree growth by 2.3%.

Jensen and Buszard (1988) indicated that soil mulching with P.E significantly increased shoot number from 0.7 to 3.1 and total growth from 12 to 93 cm of "McIntosh" apple seedling may due to modification of soil physical conditions and activities of soil microorganisms.

Gabr (1990) showed that shoot length and leaf area of "Thompson seedless" grapevines were significantly increased under all mulching treatments.

Pool *et al.* (1990) working on "Concord" grapevines pointed out that, soil mulching by oat straw increased the vine growth.

Zayan (1991) mentioned that, shoot growth of "Washington Navel" orange trees was increased under different mulching materials but the effect was more pronounced by organic mulching treatments (rice straw and cut grass) than black polyethylene.

Hifny *et al.* (1994) studied the response of growth and yield of "Banatu" grapevine to soil mulch for controlling weeds, he found that soil mulch with different materials to control weeds at vineyard, resulted in significant increase in shoot length, leaf area and fresh and dry weights of leaves. The best result was obtained with black

P.E. mulch followed by clear P.E mulch, while straw mulch was the least effective one.

Mikhael (1994) reported that shoot length and diameter as well as area per leaf of "Anna" apple trees were significantly increased by both rice straw and black polyethylene mulching treatments as compared to bare soil.

Zeerban (2004) found that all mulching materials significantly increased shoot length of "Thompson seedling" grapevines as compared to the control (bare soil) at different dates during the growing season. The highest shoot length came from black P.E, descendingly followed by rice and bean straw treatments.

Pande *et al.* (2005) studied the effect of various mulches on growth, yield and quality attributes of apple, they indicated that annual extension of growth (cm) was significantly increased by the various mulching treatments over the control. However, the dry cut grass and black P.E. mulches recorded the maximum extension growth followed by dry leaf and pine needless mulches.

Singh *et al.* (2005) studies the effect of mulches and antitranspirants on moisture conservation, yield and quality of "Red Delicious" apple trees, they mentioned that, black P.E. resulted in the maximum shoot growth compared to the control and other mulches treatments.

Verma *et al.* (2005) studied the effect of different mulching materials and methods of P and K fertilizers application in apple cv.

"Red Delicious", they also concluded that, plant growth parameters, terminal shoot growth, plant girth, height and spread were significantly affected by mulching and methods of P and K fertilizers application. The maximum terminal shoot growth was recorded under (grass mulches + band application of P and K fertilizers) treatments.

Mikhael (2007) reported that, both black P.E and dry cut grass treatments significantly increased shoot length, diameter and leaf area as well as leaf dry and specific weights of "Anna" apple trees compared to unmulched one. Moreover, dry cut grass increased the shoot and leaf growth parameters but to a less degree than black P.E. mulch.

2. Flowering, fruit set and yield:

Guiheneuf (1985) pointed out that, soil mulching with black polyethylene increased yield of "Granny Smith" apple trees from 40 to 70 t/ha as compared to bare soil (the control).

Niggle *et al.* (1985) indicated that, soil mulching treatments with fresh Oak, fire bark and rape haulm significantly increased the productivity of "Boskoop" and "Golden Delicious" apple trees.

Yuring (1987) reported that, yield of apple trees was significantly increased under soil mulching with peat.

Sanderson and Cutchiffe (1991) studied the effect of sow dust as mulch material with 0, 5 and 10 cm, depth on productivity of

"Lowbush" blue berry, they found that yield, fruit number and berry weight were significantly higher under the two mulching treatments.

Zayan (1991) mentioned that, fruit set percentage and yield of "Washington Navel" orange trees were higher under soil mulching with black P.E., rice straw and cut grass than those of unmulched one.

Zayan *et al.* (1991) reported that P.E. mulch did not show any significant differences in fruit set % of "Thompson seedless" grapeveines. While, cluster weight was significantly increased.

Hifny *et al.* (1994) found that yield of "Banaty" grapevine (kg/vine) was significantly increased under soil mulching treatments. However, the greater increase in grape yield was obtained from black P.E. treatment.

Mikhael (1994) working on "Anna" apple trees concluded that, initial fruit set and set after June drop percentages as well as yield as number of fruits and weight kg/tree were significantly increased by rice straw and black P.E. mulching treatments as compared with the control (bare soil).

Zeerban (2004) reported that, fruit set percentage and the yield of "Thompson seedless" grapevines as weight (kg) and number of mature cluster was significantly increased by all mulching treatments compared to the control. Rice straw treatment produced the highest yield/vine followed by bean straw and black P.E. treatments.

Pande *et al.* (2005) working on apple recorded maximum yield and highest final fruit retention % under dry grass mulch while, the minimum yield and maximum fruit drop were observed under clean cultivation. Moreover, the effect of mulching on bloom density and initial fruit set was not significant.

Sing *et al.* (2005) mentioned that, the highest fruit yield of "Red Delicious" apple trees was produced under organic mulch with dalweed followed by black polyethylene mulch treatments.

Tahir *et al.* (2005) studied the effect of ground cover materials, viz., aluminum, bark and black polypropylene on "Aroma" apple trees. They pointed out that, the highest yield was found for apples grown under bark and black polypropylene mulches.

Verma *et al.* (2005) concluded that, grass mulching with band application of P and K fertilizers was the most effective treatment for improving soil physical properties and produced maximum yield of "Red Delicious" apple trees.

Mikhael and Mady (2007) found that black polyethylene or dry cut grass mulching treatment gave higher fruit set % and produced maximum yield as number and weight (kg/tree) of "Anna" apple trees.

3. Fruit quality:

Tang *et al.* (1984) noticed that soil mulching with silver reflex film enhanced ripening and increased TSS and weight of

"Delicious": apple fruit. On the other hand, fruit acidity was affected by soil mulching.

Ayaad *et al.* (1987) reported that, soil mulching with polyethylene increased TSS, reduced acidity and advanced cluster ripening of "Thompson seedless" grapevines.

Zayan (1991) working on "Washington Navel" orange tree, found that, black P.E as mulching material significantly increased fruit weigh, while, had no effect on TSS and acidity.

Zayan *et al.* (1991) reported that, average cluster weight of "Thompson seedless" grapevines was increased under P.E mulching. Moreover, number of berries and TSS value were also increased. While fruit acidity was not significantly affected by all mulch treatments.

Hifny *et al.* (1994) concluded that, soil mulching with black or clear polyethylene film or straw significantly increased berry weight and volume, TSS % and TSS/acidity ratio while, reduced juice acidity of grapevines. Black P.E was the most effective treatment on fruit quality.

Zayan *et al.* (1994a) reported that, fruit weight length and diameter were significantly increased. Meanwhile, fruit firmness were significantly decreased under both black P.E and rice straw mulches as compared to the control. However, fruit shape index (L/D ratio) and the values of TSS and total acidity of "Anna" apple

fruit were not significantly affected by both soil mulching treatments.

Zeerban (2004) mentioned that soil mulching with rice straw produced cluster of "Thompson seedless" grapevine with the best physical properties, i.e., cluster volume and weight of 100 berries. On the other hand, chemical juice properties such as TSS, acidity and TSS/acidity ratio were not significantly affected by all mulching treatments.

Pande *et al.* (2005) reported that, the application of organic mulches viz., dry grass, pine needle and dry leaves gave relative low juice TSS and high acidity of "Red Delicious" apple fruit than black polyethylene mulch and clean cultivation (the control).

Tahir *et al.* (2005) indicated that aluminum mulching was more effectively controlled annual weed, increased fruit weight firmness, acid and sugar contents of "Aroma" apple trees, followed by bark and black P.E mulching treatments.

Verma *et al.* (2005) concluded that, grass mulching with band application of P and K fertilizers treatment was the most effective for improving apple fruit quality in terms of highest values of fruit weight, length breadth, firmness and acidity. Whereas, this treatment recorded the least values of TSS and total sugars compared to other mulching materials and methods of P and K fertilizer application treatments.

Mikhael and Mady (2007) showed that, both cut grass and black P.E mulching treatments significantly increased fruit weight and its dimensions (length and diameter) as well as TSS value, while reduced fruit firmness of "Anna" apple trees. However, total acidity was not significantly affected by all mulching treatments.

4. Leaf mineral contents:

Neilsen *et al.* (1986) reported that, N, P and K contents in leaves of "Red Delicious" apple trees were higher under black polyethylene mulching treatments.

Johanson and Samuleson (1990) indiceted that N content in leaves of "Bramley's seedling" apple trees was markedly increased by soil mulching with grass.

Zayan (1991) found that, soil mulching with black P.E., rice straw and cut grass increased leaf N, P and K contents of "Washington Navel" orange trees.

Thakur *et al.* (1997) studied the effect of clean cultivation, mulching and sod culture on mineral nutrition and root growth of apple cv. Red Delicious, they recorded the highest percent of leaf N and P contents with red clover. However, the highest percent of leaf K was observed with white clover compared to other mulching and clean cultivation treatments.

Mikhael (1994) reported that the percentages of N, P and K in leaves of "Anna" apple trees were increased significantly by both rice straw and black P.E mulching treatments as compared with the

control and the highest values belonged to rice straw followed by black P.E mulch treatment, then came the control (bare soil).

Zeerban (2004) working on "Thompson seedless" grapevines found that leaf N, P and K contents were increased by all mulching treatments. Highest values of leaf P and K contents belonged to rice straw while, the highest values of leaf N-content belonged to black P.E. mulch treatment.

Mikhael (2007) studied the effect of some drip irrigation and mulching treatments on vegetative growth and nutritional status of "Anna" apple trees, he found that, leaf N, P and K were increased by both black P.E and dry cut grass as compared to bare soil and the highest values of P and K were obtained by dry cut grass mulching. However, the highest value of N was recorded with black P.E. mulching.

IV. Effect of potassium foliar application on:

1. Vegetative growth:

Osman *et al.* (1990) studied the effect of potassium foliar application on guava trees, found that spraying potassium sulphate with 2% gave highest average of shoot length while, the shortest one was observed on the untreated trees (the control).

Kilany and Kilany (1991) indicated that potassium foliar application with 0.75% or 1.5% K_2SO_4 increased shoot length and diameter as well as leaf area of "Anna" apple trees growing in sand soil at El-Nubaria region.

Niederholzer *et al.* (1991) mentioned that shoot length of "French" prune trees was increased by raising the rate of soil application of potassium sulphate from 0 to 10 kg/tree.

Sharma and Sharma (1992) studied the effect of foliar application with NPK on guava tees, reported that longest terminal shoots and highest number of leaves per shoot were obtained with foliar spraying at 3% N, 1% P and 1% K treatment.

Mikhael (1994) studied the effect of foliar spraying with K_2SO_4 on vegetative growth and yield of "Anna" apple trees pointed out that the highest values of shoot length and diameter as well as individual leaf area were obtained from trees sprayed with 1% and 2% K_2SO_4 without significant difference between them.

El-Sherif *et al.* (2000) concluded that shoot length of "Montakhab El-Kanater guava trees was significantly increased by foliar application of potassium sulphate at 1% or 2%.

Shoeib (2004) studied the effect of potassium sulphate and vine load on the growth and yield of "Thompson seedless" grapevines, he found that soil addition of potassium sulphate at 100 to 300 kg/fed. significantly improved leaf area and shoot length compared to unfertilized trees.

Abo Ogiela (2006) reported that potassium foliar application with 2% K_2SO_4 increased number of new shoot, shoot length and diameter, total growth and area per leaf of guava trees compared to unsprayed ones.

Zayan *et al.* (2006) working on "Thompson seedless" grapevines, found that adding potassium at 48 g K_2O/vine/year to all NP treatments increased shoot length at different dates during the growing season from April tell the end of June.

2. Flowering, fruit set and yield:

Samra (1989) mentioned that foliar application with 4% K_2O increased fruit set percentage of guava trees.

Osman *et al.* (1990) concluded that fruit set percentage and yield as number or weight of fruits kg/tree were increased as a result of foliar spraying with 1.5 or 2% K_2SO_4.

Kilany and Kilany (1991) indicated that spraying "Anna" apple tree with 1.% K_2SO_4 significantly increased fruit set and yield **Sharma and Sharma (1992)** reported that foliar application of potassium as nitrate or potash at 1% alone or in combination improved flowering and fruit setting of Guava trees.

Zayan *et al.* (1994b) reported that K foliar spraying with 1% K_2SO_4 significantly increased yield as number and weight (kg) of "Anna" apple trees grown in calcareous soil compared to the control.

Singh *et al.* (1998) found that foliar spraying with 2, 4 and 6% KNO_3 increased yield of Allahabad Safeda guava trees.

El-Sherif *et al.* (2000) pointed out that foliar application of potassium sulphate at 1% or 2% significantly increased fruit set of "Montakhab El-Kanater" guava trees.

Bhatia *et al.* (2001) evaluated the effect of foliar K_2SO_4 at 0.5, 1 and 1.5% on guava cv. L-49, they indicated that all K_2SO_4 concentrations increased tree yield as compared to the control.

Shoeib (2004) mentioned that increasing potassium sulphate level from 0 to 300 kg/fed. resulted in a gradual increase in total and marketable yield (kg/vine) of "Thompson seedless" grapevines.

Abo-Ogiela (2006) found that K-foliar application at 2% of K_2SO_4 significantly increased fruit set %, number of fruit and yield of "Balady" guava trees.

Zayan *et al.* (2006) indicated that adding K with 48 g/tree/vine/year to all N and P fertilization treatments significantly increased yield of "Thompson seedless" grapevines as weight (kg) and number of cluster per vine.

3. **Fruit quality:**

Ferree and Cahoon (1987) found that spraying "Golden Delicious" apple trees with K_2SO_4 had no significant effect on TSS, acidity and fruit firmness.

Osman *et al.* (1990) indicated that average fruit weight and TSS value of "Montakhab El-Sabahia" guava trees were greatly affected by spraying with K_2SO_4, while fruit dimensions (diameter and length, cm) and total acidity were not significantly affected.

Kilany and Kilany (1991) pointed out that spraying "Anna" apple tees with 1.5% K_2SO_4 significantly increased average fruit

diameter, weight and firmness, while, TSS and acidity were not affected by foliar sprays with K_2SO_4.

Sharma *et al.* (1991) reported that spraying guava trees with potassium sulphate at 0.2, 0.4 and 0.6% resulted in high fruit weight and high total acidity in fruit juice.

Mikhael (1994) working on "Anna" apple trees, indicated that fruit length and diameter as well as TSS value were significantly increased by raising the concentration of K_2SO_4 from 0.25 up to 1%. Meanwhile, fruit shape (L/D ratio) and total acidity were not affected by K application.

Gobara (1998) studied the response of "Le Conte" pear trees to foliar applications of some nutrients, he found that foliar application with 0.1 potassium sulphate increased average fruit weight and dimensions as well as total soluble solids (TSS) while reduced fruit acidity.

El-Sherif *et al.* (2000) mentioned that K-foliar application with 1% and 3% K_2SO_4 at full bloom increased fruit weight and volume but, reduced total acidity of guava trees.

Shoeib (2004) studied the effect of potassium sulphate and vine load on "Thompson seedless" grapevines, he reported that increasing the level of potassium sulphate from 0 to 300 kg/fed. caused a progressive promotion in berry weight and TSS value with gradual reduction in total acidity.

Abo Ogeila (2006) sprayed "Balady" guava trees with 2% K_2SO_4 he obtained heavy and largest fruit with highest values of length and diameter as well as TSS%. However, fruit shape (L/D ratio) and total acidity were not significantly influenced by K foliar application.

Zayan *et al.* (2006) working on "Thompson seedless" grapevines, indicated that soil application with potassium sulphate at 48 g K_2O significantly increased weight and volume of 100 berries as well as TSS and TSS/acidity values while, Juice acidity were not significantly affected.

4. Leaf mineral content:

Spiers (1984) working on blue berries found that K-application decreased leaf N-content but, leaf P-content was not affected.

Mansour *et al.* (1986) mentioned that, potassium application did not record any significant differences in leaf N, P and K contents of "Mit-Ghamr" peach trees.

Ferree and Cahoon (1987) concluded that spraying apple trees with potassium spraying increased leaf N, P and K-contents.

Zayan *et al.* (1994b) pointed out that leaf K-content was significantly increased while, leaf N and P-contents were decreased with K_2SO_4 foliar application at the concentration of 1% and 2%.

Hassan (2000) found that N-content in leaves of "Chemlali" olive was higher with soil nitrogen + foliar K fertilization treatments

while, K-content was higher with foliar N + soil K application. However, P-content was higher when both N and K fertilizers were foliar sprayed on olive trees.

Abo Ogeila (2006) found that potassium foliar application with 2% K_2SO_4 significantly increased leaf N and K contents but, leaf P content was not affected.

Zayan *et al.* (2006) pointed out that application of potassium sulphate significantly increased leaf petioles K-content of "Thompson seedless grapevines".

MATERIALS AND METHODS

MATERIALS AND METHODS

The present study was carried out during two successive seasons of 2003 and 2004 on ten years old "Le Conte" pear trees grafted on *Pyrus communis* rootstock, spaced at 5 x 5 meters and grown in private orchard located at El-Atwa El-Bharia village, Kotour district, Gharbia Governorate where the soil is slightly alkaline, and classified as clay. The depth of water table was about 140-160 cm. Other chemical and physical properties of the experimental soil are presented in Table (1).

Table (1): Some chemical and physical properties of the experimental soil.

Soil depth (cm)	Soil pH	EC mmhos/cm	$CaCO_3$ %	Soluble cations meq/L				Soluble anions meq/L				Mechanical analysis %			Texture grade
				Na^+	K^+	Ca^{++}	Mg^{++}	CO^{--}_3	HCO^-_3	SO^{--}_4	Cl^-	Sand	Silt	Clay	
0-30	7.9	0.42	3.4	1.17	0.02	0.52	0.39	0.00	0.74	0.76	0.60	44	13	43	Clay
30-60	8.0	0.66	3.6	2.29	0.04	0.78	0.18	0.00	0.77	1.97	0.55	39	10	51	Clay

Also, data of air and soil temperature (°C), air relative humidity (RH%), rainfall (mm/day) and reference evapotranspiration (ETo) mm/day are presented in Table (2).

The present work was planed in two separated experiments as follows:

Table (2): The metrological parameters of Kotor weather station during 2003 and 2004 years.

Months	Air temperature (°C)		Relative humidity (%)		Rain mm/day	Soil temperature (°C)		ETo* mm/day
	Max.	Min.	Max.	Min.		Max.	Min.	
	2003 year							
Jan.	22.3	12.0	84.9	44.4	-	16.9	15.6	1.8
Feb.	19.7	11.0	82.3	41.5	-	17.4	14.7	2.3
Mar.	21.2	11.7	87.5	42.4	-	17.6	15.5	3.5
Apr.	27.8	15.1	85.2	34.5	-	22.4	20.3	4.5
May	33.6	19.8	84.5	24.2	-	26.6	23.9	6.3
Jun.	35.2	23.4	87.2	32.9	-	30.9	28.7	7.4
Jul.	35.2	24.9	87.8	45.7	-	32.7	30.9	7.7
Aug.	35.7	24.6	88.0	44.5	-	32.1	31.1	7.8
Sept.	33.3	22.2	88.8	41.2	-	31.9	30.2	7.0
Oct.	28.9	17.5	89.9	39.4	-	27.2	26.0	5.0
Nov.	24.41	16.6	89.6	47.1	-	22.6	21.5	3.5
Dec.	20.8	12.0	85.8	48.0	22	18.3	19.9	2.8
	2004 year							
Jan.	18.8	10.3	88.4	49.4	141	14.3	13.2	1.6
Feb.	20.1	10.4	90.2	48.6	81	15.4	14.4	2.3
Mar.	23.4	12.1	89.1	41.5	-	19.9	20.4	3.4
Apr.	26.4	15.5	90.0	34.0	-	24.4	22.4	4.9
May	41.3	22.2	40.0	11.9	-	34.2	30.4	9.9
Jun.	32.2	21.2	89.2	36.9	-	30.3	28.5	7.3
Jul.	33.8	21.3	90.5	44.5	-	32.4	30.6	7.7
Aug.	33.6	23.4	78.3	35.8	-	31.9	30.3	7.7
Sept.	32.4	21.2	75.6	26.3	-	31.8	29.9	6.0
Oct.	32.4	20.8	75.9	27.0	-	29.4	27.8	5.5
Nov.	27.7	19.1	73.8	30.7	40	25.1	23.9	3.1
Dec.	22.5	13.6	72.6	38.4	13	19.5	18.7	2.1

* reference evapotranspiration.

Experiment I:

This experiment aimed mainly to study the effect of Dormex spraying with 2% in winter, shoot bending, soil mulching with rice straw, and potassium foliar application with 2% K_2SO_4 as four agricultural treatments beside, the control on vegetative growth, flowering, fruit setting, yield and fruit quality as well as leaf mineral contents of "Le Conte" pear trees in 2003 and 2004 seasons.

Dormex is a commercial product contains 49% hydrogen cynamide (H_2CN_2) as end dormancy breaking agent was sprayed at concentration of 2% on December, 25th of previous winter seasons.

Bending was done on previous winter of the two seasons of investigation on November, 5th by tying three 3-years old branches in each tree direction to be nearly at horizontal position.

Soil mulching with rice straw in 10 cm depth were applied on both sides of the tree line from the trunk to a point under periphery of the tree at February, 24th of both season until the harvest time, the mulching area was about 40 m^2 for each replicate.

Potassium nutrient was sprayed in the form of potassium sulphate liquid (48% K_2O) as foliar application at concentration of 2% thee times at two weeks en tervals beginning at first of April. Each tree received 5 liters of the spraying solution.

Thus, 50 uniform in growth and vigour trees were selected and grouped under five treatments each treatment replicated 5 times with two tree plot (5 replicates x 2 trees) in a randomized complete block design.

The experimental trees including treated and control trees have been subjected to similar agricultural practices usually done in this area and the NPK fertilization program applied was 1.5 kg ammonium nitrate 33.5% N + 1.0 kg calcium super phosphate (16.0% P_2O_5) + 0.6 kg potassium sulphate (48% K_2O) per tree. Besides, adding 20 m^3 farm yard manure.

The obtained data were subjected to statistical analysis according to **Snedecor and Cochran (1990)** and LSD test at 0.05 and 0.01 probability levels was used for comparing between averages.

Experiment II:

The objective of this experiment was to evaluate and compare the effect of bending of 2 and 3-years old branch at 45, 60 and 75° angle on flowering, fruit setting and yield as well as fruit quality of "Le Conte" pear trees.

This experiment was conduced to assess of the effect of branch bending on sunlight penetration in tree canopy, phonological and physiological traits of 2 and 3 years old branches.

Three angles were tested on each bending treatments, three branches in each tree direction were tagged. Bending was done on November, 5th in the previous winter seasons. Bended shoots were inclined at angle of 45, 60 and 75° form the vertical (**Habib Khemira *et al.*, 1993 and Pierre-Eric, 2001**).

Eighteen uniform in vigour trees were selected and subjected to similar fertilization, irrigation, pruning and pest control practices usually done at this region.

In this regard 6 treatments represented all possible combinations between two branch ages (2 and 3 years old) and three tested angles (45, 60 and 75° were replicated 3 times with one tree plots (6 x 3 = 18 trees) in a randomized complete block design. The obtained data were subjected to analysis of variance as factorial experiment according to **Snedecor and Cochran (1990)** and the LSD-test was used to compare between the means representing the effect of bending related to branch age, angles, and their interaction.

Measurements and determinations:

I. Vegetative growth parameters:

Four branches of 3 years old on each tree in the four direction were labeled after dormant pruning. All new shoots which were developed on these branches in spring were counted and used for measuring shoot length and diameter (cm). Total growth was calculated (average shoot length x number of shoots/branch) and the number of leaf per shoot was counted. At the end of each growing seasons (August, 28th), thirty mature mid-shoot leaves were sampled for measuring area per leaf (cm^2), using Li-core 3100 Areameter according to **Singth and Snyder (1984)**. Shoots and leaves were dried and weighted to get average shoot dry weight (gm) and leaf dry weight (gm) then, leaf specific weight (LSW) was calculated as (mg/cm^2) according to **Hunt (1989).**

II. Flowering data:

Number of total floral spurs and number of floral spurs burst on labeled 3- years old branches were counted weekly in both seasons beginning from 5, Feb. until 19, March when the control reached full bloom (approximately, 70% of flower bud of spurs burst) in both season for estimating the percentage of floral spurs burst. Also, number of flowers at full bloom (March, 19th) and number of spurs at the end of the growing season in October, 15th were counted on the same labeled 3 years old branch.

III. Estimating fruit set percentage:

On April, 20th initial fruit set % was estimated by counting the total number of flowers and fruits which were developed on the selected branches in each tree. Fruit set % was estimated again after June drop (at June, 25th) according to the total number of flower recorded on Mar. 19th and total number of fruits after June drop.

IV. Yield values:

Yield as number and weight (kg) of fruits per tree as well as number of fruits/branch were recorded at harvest time of both seasons.

V. Physical and chemical fruit properties:

At the time of harvest (August, 3rd) in 2003 and 2004 seasons when "Le Conte" pear fruits attained maturity according to stands recorded by **El-Azouni *et al.* (1975)** samples of ten fruits were picked at random from each tree and prepared for determination of physical and chemical fruit quality.

a. Physical fruit quality:

Fruit weight (gm), length (cm) and diameter (cm) were measured and their fruit shapes (L/D ratio) were calculated.

A magenss-Taylor type pressure tester with plunger of 5/16 in^2 was used for determination fruit firmness (lb/in^2). Fruit volume in ml was determined by water displacement.

b. Chemical fruit quality:

- Total soluble solids (TSS) value determined by Gallilis hand refractormeter.
- Total acidity was estimated as malic acid according to A.O.A.C. (1990) using 5 ml from juice sample titrating with 0.1 sodium hydroxide (NaOH) using phenolphthaline as an indicator and applying the following equation.

$$\text{Malic acid \%} \frac{\text{ml. NaOH x N NaOH x 0.067}}{\text{ml juice used}} \times 100$$

- TSS/acidity ratio was estimated.

6. Leaf mineral contents:

In mid August of both seasons, fifty mature mid-shoot leaves per tree were sampled and washed three times with tap water, then washed again with distilled water. Samples were oven dried at 70°C to constant weight, ground and digested with H_2SO_4 and H_2O_2 for determination of NPK according to **Evanhuis and Deweared (1980)**.

- Nitrogen was determined by micro-kjeldahl gunning method (**AOAC, 1990**).
- Phosphorus was determined colorimetrically by the hydroquinone method (**Snell and Snell, 1967**).

- Potassium was calorimetrically determined by flame photometer E.E.L. Model (**Jackson, 1967**).

All NPK elements were expressed as percent of dry weight.

7. C/N ratio:

Total carbohydrates in shoots at July 1st (at the time of flower initiation) was determined colorimetrically by using spectrophotometer at 490 nm as gm/100 gm dry weight according to (**Dubios *et al.*, 1956**). Total nitrogen in shoots (N) was also determined according to **A.O.A.C. (1990)**, then, the C/N ratio was calculated.

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

Experiment I:

Effect of some agricultural treatments on vegetative growth, flowering, fruit set, yield, fruit quality and leaf mineral contents of "Le Conte" pear trees.

I. Vegetative growth parameters:

a. Shoot parameters:

Table (3) and Fig. (1) show the effect of Dormex, branch bending, soil mulching and potassium foliar spraying comparing to the control on number of new shoots/1-year old branch, average shoot length and diameter (cm), average shoot dry weight (gm) and total growth (cm) in 2003 and 2004 seasons.

1. Number of shoots/1-year old branch:

It is clear that, all treatments increased the number of shoots/1-year old branch compared to the control but the effect of Dormex 2% and soil mulching were only significant in both 2003 and 2004 seasons. The positive effect of Dormex (H_2CN_2) could be attributed to stimulate vegetative bud break of "Le Conte" pear. These results are in line with those reported by **Stino and Fakharani (1995)** on fig, they found that application of hydrogen cyanamide with 2.5% significantly increased the percentage of bud developed to vegetative growth. Moreover, **Jensen and Buszard (1988)** reported that soil mulching with P.E. significantly increased the number of new shoots of "McIntosh" apple trees.

Table (3): Effect of some agricultural treatments on shoot parameters of "Le Conte" pear trees in 2003 and 2004 seasons.

Treatments	No. of shoots/ branch*	Av. shoot length (cm)	Av. shoot diameter (cm)	Av. shoot d.wt. (gm)	Total growth (cm)
			2003		
Control	3.0	31.9	0.50	3.89	95.70
Dormex (2%)	4.2	35.8	0.52	4.42	150.36
Bending	3.2	27.9	0.72	6.29	89.28
Soil mulching	3.8	40.7	0.58	4.83	154.66
K-Spraying	3.4	46.6	0.63	5.97	158.44
LSD 0.05	0.8	3.9	0.07	0.72	7.89
0.01	1.1	5.4	0.10	0.99	10.86
			2004		
Control	3.2	33.7	0.56	4.22	107.84
Dormex (2%)	4.4	37.3	0.60	4.72	164.12
Bending	3.4	28.6	0.83	7.25	97.24
Soil mulching	4.2	43.9	0.67	5.26	184.38
K-Spraying	3.8	48.3	0.73	6.53	183.54
LSD 0.05	0.7	3.5	0.04	0.82	8.04
0.01	1.0	4.8	0.06	1.13	11.07

Dormex application with 2%
Previous winter bending on Nov., 5th
Soil mulching with rice straw in 10 cm, depth on Feb., 24th
Potassium foliar spraying with 2% K_2SO_4
* 1- year old branches

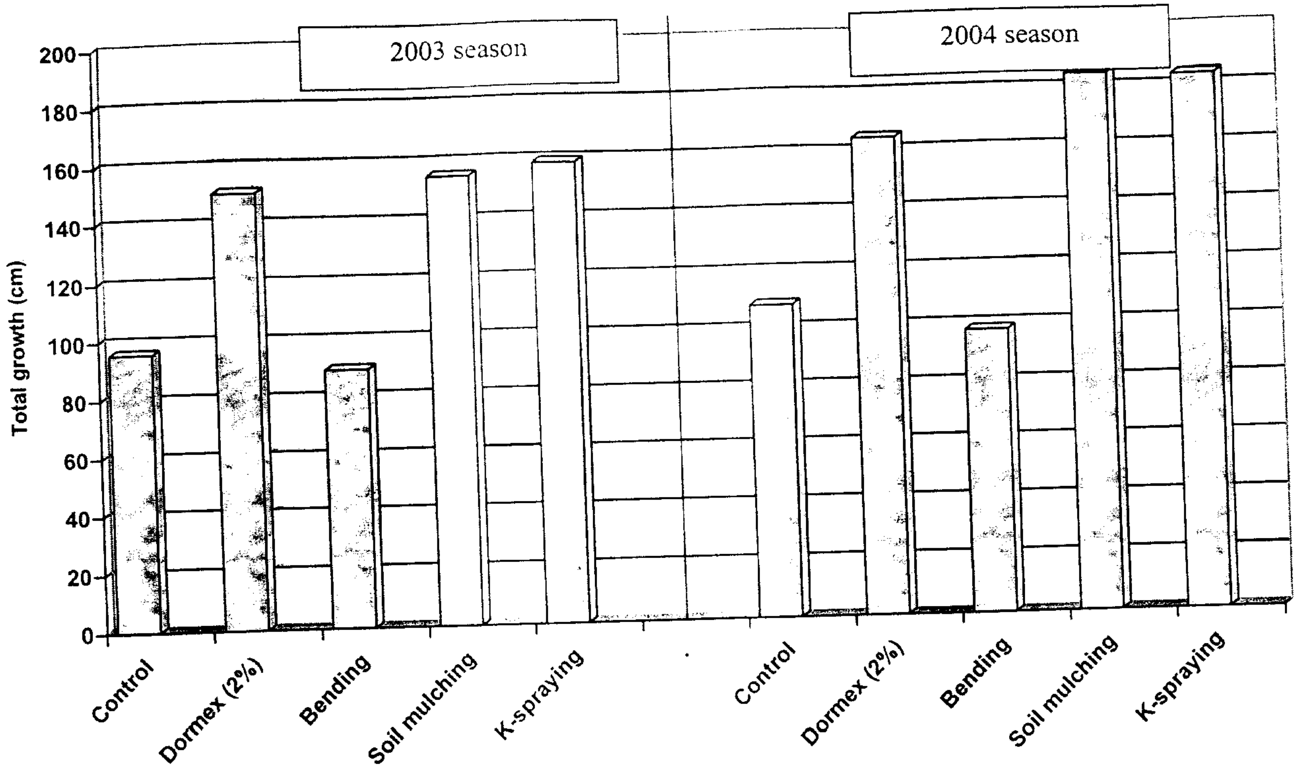

Fig. (1): Effect of some agricultural treatments on total growth of "Le Conte" trees in 2003 and 2004 seasons.

2. Average shoot length and diameter (cm):

The data presented in Table (3) indicated that, soil mulching with rice straw, K-spraying and Dormex (2%) treatments significantly increased average shoot length while, bending significantly reduced it as compared to the control in both seasons. Generally, all treatments increased average shoot diameter compared to the control and differences were significant except for the effect of Dormex in the first season. The highest values of shoot diameter always belonged to bending treatment. These results were true in both seasons.

The effect of Dormex in increasing shoot length and diameter might be due to advanced vegetative bud break. Such results are in harmony with those reported by **Stino and El-Fakharani (1995)** on "Condaria" fig and **Gabr (1996)** on "Le Conte" pear.

Also, the positive effect of soil mulching on improving shoot growth of "Le Conte" pear trees could be attributed to its effects on soil temperature and moisture content which enhance root growth leading to an increase in nutrients uptake via the roots. These findings are in full agreement with those obtained by **Pande *et al.* (2005), Verma *et al.* (2005) and Mikhael (2007)** on apple trees. In addition, **Mikhael (1994), El-Sherif *et al.* (2000) and Abo Ogiela (2006)** indicated that foliar application with 2% K_2SO_4 increased shoot length and diameter of many fruit species. The reduction in shoot length due to branch bending was also noticed by **Banno *et al.* (1986) and Bahlool (2000)** on pear trees.

3. Shoot dry weight (gm):

The data obtained in Table (3) revealed that, shoot dry weight of "Le Conte" pear trees was significantly increased by bending, soil mulching and spraying with 2% K_2SO_4 compared to the control, while the effect of Dormex with 2% was not significant in 2003 and 2004 seasons. The highest values always belonged to bending followed by K-spraying and soil mulching. This increment in shoot dry weight might be due to the effect of bending in reducing shade and increasing light penetration into tree canopy (**Honjo *et al.*, 1983 and Abd El-Rahman, 2002**). Beside, the role of potassium in carbohydrate synthesis and its translocation as effective in this respect. Similar results were also obtained by **Dejony (1990), El-Sherif *et al.* (2000) and Singh *et al.* (2005)**.

4. Total growth (cm):

Concerning total growth (number of new shoots x average shoot length) as shown in Table (3) and Fig. (1) it is clear that, application of Dormex with 2%, soil mulching with rice straw and foliar spraying with 2% K_2SO_4 treatments significantly increased total growth compared to the control. Whereas, branch bending significantly reduced it. The highest values were recorded for soil mulching and K-spraying treatments without significant differences between them and the differences between each of them and the control were significant in both 2003 and 2004 seasons. Meanwhile, the least values belonged to bending treatment. The positive effect of foliar sprays with K is in harmony with those of **Abo Ogiela (2006)** who reported that foliar application with 2% K_2SO_4 significantly

increased total growth of "Balady" guava trees. Moreover, **Pande *et al.* (2005)** found that annual extension growth of apple trees was increased under various mulching treatments. However, **Banno *et al.* (1986), Edwards and Notodimedjo (1987) Pierre-Eric (2001)** concluded that winter bending reduced pear shoot growth.

b. Leaf parameters:

Data of Table (4) and Figs. (2) show the number of leaves/shoot, leaf area (cm), individual leaf dry weight (gm) and leaf specific weight (mg/cm^2) as affected by Dormex, bending, mulching and K-foliar spraying treatments in 2003 and 2004 seasons.

1. Number of leaves/shoot:

Data presented in Table (4) exhibited that all treatments significantly increased the number of leaves/shoot except for soil mulching with rice straw as compared to the control. Untreated trees produced the minimum number of leaves per shoot. Meanwhile, the maximum number was recorded with K foliar spraying with 2% K_2SO_4 and the differences between this treatment and the control and other treatments were significant in both seasons. The superiority of K-foliar spraying was probably related to the role of potassium in improving photosynthesis and carbohydrate translocation. These findings are supported with those obtained by **Sharma and Sharma (1992)** who found that the highest number of leaves per guava shoots were obtained with foliar spraying with potassium. The present data also revealed that, winter shoot bending significantly increased number of leaves/shoot as shown in Table (4).

Table (4): Effect of some agricultural treatments on leaf parameters of "Le Conte" pear trees in 2003 and 2004 seasons.

Treatments	No. of leaves/shoot	Leaf area (cm^2)	Leaf D. wt. (gm)	L.S.W. * (mg/cm^2)
	2003			
Control	33.9	21.45	0.248	11.58
Dormex (2%)	36.4	26.24	0.299	11.42
Bending	39.6	27.86	0.353	12.68
Soil mulching	35.2	25.37	0.323	12.72
K-Spraying	48.7	28.03	0.371	13.22
LSD 0.05	2.8	3.78	0.061	N.S
0.01	3.9	5.21	0.085	N.S
	2004			
Control	34.8	23.37	0.264	11.28
Dormex (2%)	41.3	28.16	0.362	12.86
Bending	48.5	29.28	0.394	13.46
Soil mulching	40.2	27.67	0.386	13.94
K-Spraying	52.8	31.66	0.470	14.86
LSD 0.05	5.7	2.85	0.048	2.39
0.01	7.8	3.93	0.66	3.29

Dormex application with 2%
Previous winter bending on Nov., 5th
Soil mulching with rice straw in 10 cm, depth on Feb., 24th
Potassium foliar spraying with 2% K_2SO_4
* L.S.W. = Leaf specific weight.

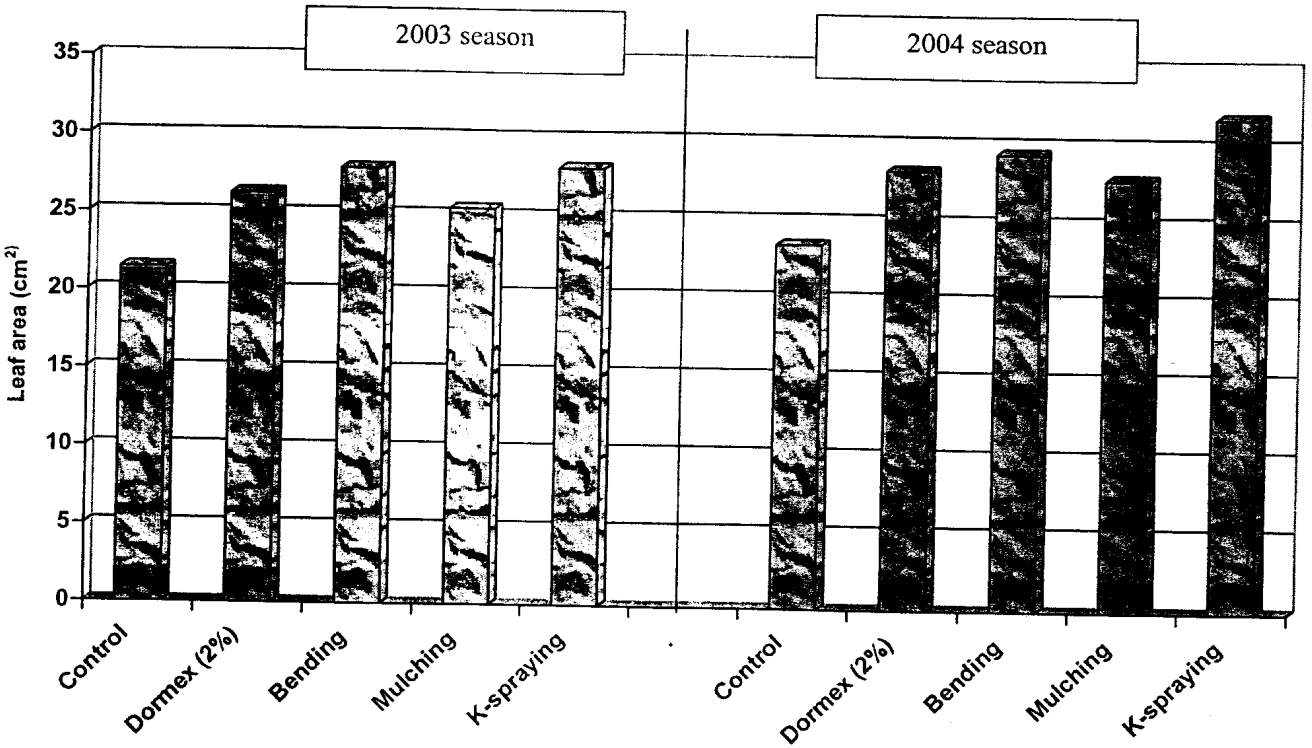

Fig. (2): Effect of some agricultural treatments on leaf area of "Le Conte" pear trees in 2003 and 2004 seasons.

Similar results were obtained by **Edwards and Notodimedjo (1987)** on apple and **Bahlool *et al.* (2000)** on pear, they found that, shoot bending reduced shoot growth which in turn, more nodes and leaves per shoot were formed. Moreover, application of Dormex at 2% significantly increased the number of borne leaves/shoot as compared with the control. These results are in conformity with the findings of **Stino and El-Fakharani (1995)** on "Condaria" fig. trees and **Stino (1997)** on "Anna' apple trees.

2. Leaf area (cm^2):

Regarding, the effect of Dormex, bending, mulching and K-spraying treatments on leaf area of "Le Conte" pear trees, the data of Table (4) and Fig. (2) showed that all treatments significantly increased leaf area (cm^2), compared to the control in 2003 and 2004 seasons. The effect of these agriculture treatments are arranged as follows:

K-spraying > Bending > Dormex > mulching > control

Largest leaf area of "Le Conte" pear due to potassium foliar application was also reported by **Kilany and Kilany (1991) and Mikhael (1994)** on "Anna" apple trees and **Abo Ogiela (2006)** on "Balady" guava trees.

The above mentioned results in concern to the effect of bending on leaf area was in accordance with those obtained by **Bahlool *et al.* (2000) and Abd El-Rahman (2002)** on "Le Conte" pear trees, they indicated that, leaf area of current shoots was significantly increased as influenced by winter shoot bending.

Moreover, **Gabr (1996)** mentioned that, spraying "Le Conte" pear tree with Dormex at 2% and 3% significantly increased individual leaf area. In addition, the improvement in leaf area under soil mulching with rice straw was also observed with previous investigators such as **Gaber (1990)**, **Hifny *et al.* (1994) and Zeerban (2004)** on grapevines and **Mikhael (2007)** on apple.

3. Leaf dry and specific weights:

It is evident from the data in Table (4) that, leaf dry weight (gm) was significantly higher under K-spraying, bending and soil mulching treatments compared to the control "Untreated trees". However there were no significant differece between Dormex and the control treatment in 2003 season. The same trend was obtained in the second season.

As for leaf specific weight (LSW), mg/cm^2, it is clear that , the differences among the tested treatments were only significant in the second season and the highest values were recorded for K-spraying and soil mulching treatments. The most effective result was obtained by K foliar application with 2% K_2SO_4 which superiors other treatments and the control in leaf dry and specific weights due to improving synthesis and translocation of carbohydrate substances. These results find support by those obtained by **Singh *et al.* (1998)**.

The data also cleared that, branch bending increased leaf dry and specific weights of "Le Conte" pear, these effect is mainly due to the role of bending in increasing the penetration of photosynthetic active radiation (PAR). Moreover, sunlight distribution have been

associated with leaf physiological attributes such as leaf specific weight (**Dann *et al.*, 1990**). Similar results were obtained by **Barden (1974)** who indicated that, leaf dry weight and leaf specific weight (LSW) of apple trees are reduced as light level decreased.

The positive effect of soil mulching with rice straw could be attributed to regulation soil temperature, increasing soil moisture and improving nutrients uptake (**Thakur *et al.*, 1997**). These results are in harmony with those of **Mikhael (2007)** who indicated that, black P.E and dry cut grass mulching treatments significantly increased leaf dry and specific weights of "Anna" apple trees.

Conclusively, application of Dormex with 2% produced the highest number of new shoots/1-year old branch. Moreover, potassium foliar spraying with 2% K_2SO_4 is considered to be the best treatment for improving shoot and leaf growth. While, bending treatment appear to reduce shoot length and total growth of "Le Conte" pear trees.

Generally, as for vegetative growth parameters data in both season revealed that, potassium foliar application with 2% K_2SO_4 followed by soil mulching with rice straw significantly increased number of new shoots/1-year old branch as well as all shoot and leaf growth parameters. These treatments recorded the highest values of vegetative growth parameters as compared with the control in both seasons. However, Dormex application with 2% significantly increased number of shoots/1-year old branch, shoot length, total growth, leaf area in both seasons beside, shoot diameter, number of leaves/shoot and leaf dry weight in the second season only. Dormex

treatment had no significant effect on shoot dry weight and leaf specific weight (LSW). In addition, branch bending significantly reduced shoot length and total growth and significantly increased shoot diameter and dry weight, number of leaves/shoot, leaf area and dry weight, while had no significant influence on number of shoot/1-year old branch and leaf specific weight of "Le Conte" pear trees in both seasons.

II. Flowering:

The data concerning the effect of hydrogen Cyanamide (Dormex) spraying, bending, soil mulching and K-spraying on the percentage of floral spurs burst, number of spurs/branch and number of flowers/branch of "Le Conte" pear trees are presented in Tables (5 and 6) and illustrated in Fig. (3).

1. Percentage of floral spur bud burst:

As shown in Table (5) and Fig. (3), it is clear that, the percentage of floral spur bud burst of "Le Conte" pear trees was gradually increased till 15/3 in both seasons. The data also revealed that using Dormex generally enhanced time of flowering and full blooming as compared to other treatments and the control. Trees sprayed with Dormex 2% reached full bloom (70% flowering) at 26/2 with 21 days earlier than the control. Meanwhile, both of bending and soil mulching treatments reached flowering at 12/3 after Dormex with 14 days with 7 days earlier than the control in both seasons. These results indicated that Dormex treatment was more effective than other treatments when applied on "Le Conte" pear trees in advancing flowering.

Table (5): Effect of some agricultural treatments on the percentage of floral spurs burst of "Le Conte" pear trees in 2003 and 2004 seasons.

Treatments	Feb. 5	Feb. 12	Feb. 19	Feb. 26	Mar. 5	Mar. 12	Mar. 19
	2003						
Control	0.0	0.0	0.0	10.4	19.7	45.3	69.5
Dormex (2%)	20.6	36.2	40.4	58.5	69.8	81.5	98.3
Bending	0.0	0.0	19.4	39.9	58.6	70.2	84.5
Soil mulching	0.0	0.0	15.9	37.6	53.4	62.0	75.2
K-Spraying	0.0	0.0	0.0	13.2	32.9	50.2	70.3
	2004						
Control	0.0	0.0	0.0	15.2	37.9	52.8	70.4
Dormex (2%)	23.3	42.5	50.2	66.9	74.3	83.6	99.5
Bending	0.0	0.0	20.3	40.3	61.3	75.2	89.8
Soil mulching	0.0	0.0	18.0	57.2	69.4	72.3	80.2
K-Spraying	0.0	0.0	0.0	16.8	38.6	57.9	72.6

Dormex application with 2%
Previous winter bending on Nov., 5th
Soil mulching with rice straw in 10 cm, depth on Feb., 24th
Potassium foliar spraying with 2% K_2SO_4
Full bloom at (Mar. 19th)

Table (6): Effect of some agricultural treatments on flowering and fruit set parentage of "Le Conte" pear trees in 2003 and 2004 seasons.

Treatments	No. of spur/branch	No. of flower/branch	Initial set %	Set after June drop %
	2003			
Control	18.2	91	20.0	7.6
Dormex (2%)	20.2	141	21.0	8.2
Bending	27.4	137	32.0	10.4
Soil mulching	20.4	102	27.0	9.4
K-Spraying	18.8	94	37.0	11.2
LSD 0.05	2.6	5.8	3.7	1.7
0.01	3.5	8.0	5.1	2.3
	2004			
Control	19.6	98	21.0	6.9
Dormex (2%)	20.6	153	23.0	7.4
Bending	29.8	149	34.0	9.0
Soil mulching	21.6	108	29.0	8.2
K-Spraying	19.6	98	38.0	10.8
LSD 0.05	2.7	6.1	4.1	1.3
0.01	3.6	8.4	5.7	1.8

Dormex application with 2%
Previous winter bending on Nov., 5th
Soil mulching with rice straw in 10 cm, depth on Feb., 24th
Potassium foliar spraying with 2% K_2SO_4

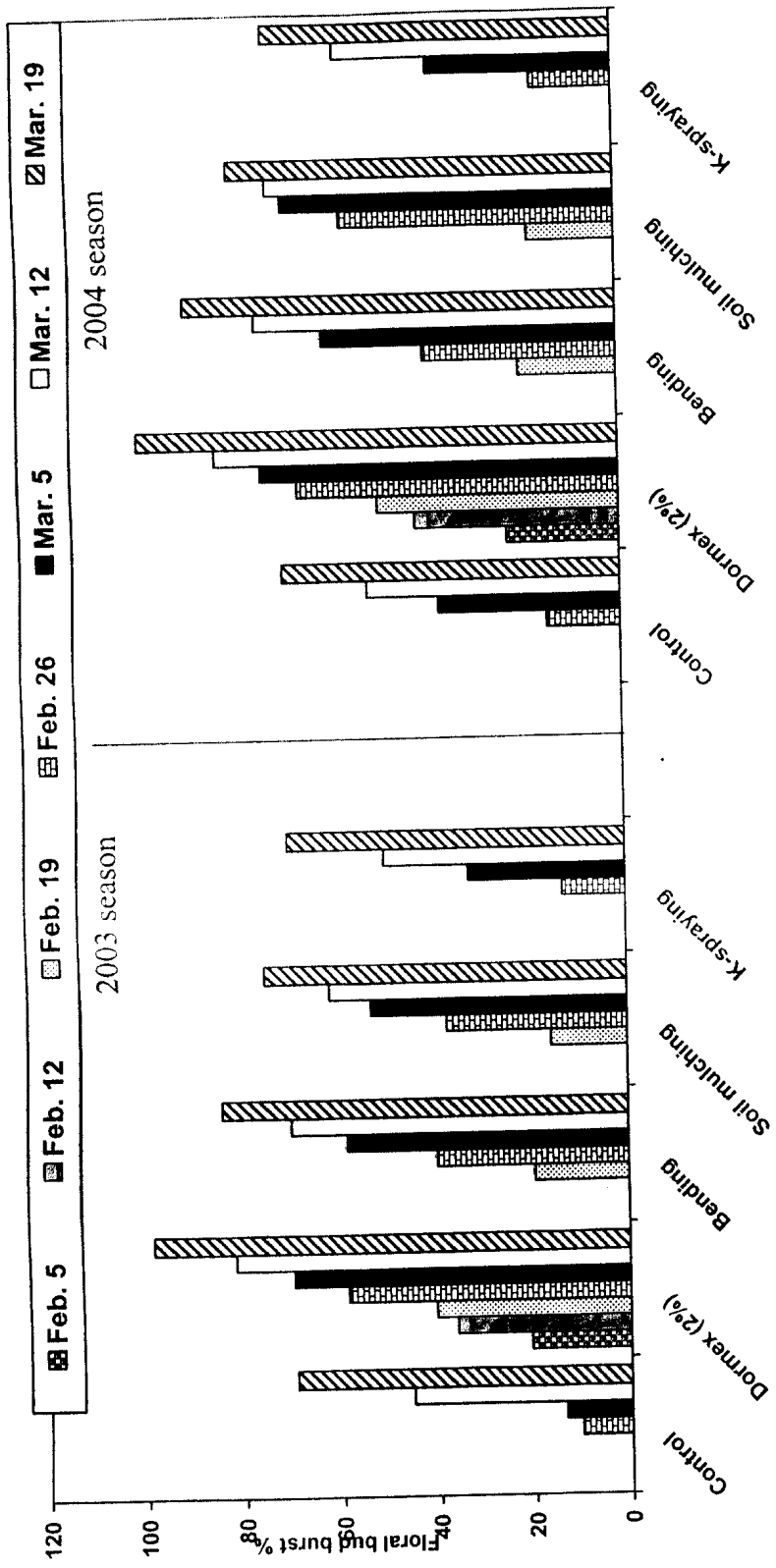

Fig. (3): Effect of some agricultural treatments on the percentage of floral bud burst% for of "Le Conte" pear trees in 2003 and 2004 seasons.

The above mentioned results are genorally in agreement with those previously reported by **Gabr (1996) and Singh and Mann (2002)** on pear trees and **Aly *et al.* (1997) and Stino (1997)** on apple trees they indicated that sprayed trees with Dormex resulted in enhancing floral bud burst activity and accelerated full blooming. Moreover, bending of shoots may weak competition between buds and other organs through altering growth regulator levels in lateral buds resulting in acceleration of flower development (**Ito *et al.*, 1999**). Similar results are obtained by **kang *et al.* (2004)**.

2. Number of spurs/branch:

Data of Table (6) clearly show that, winter branch bending significantly increased the number of spurs/branch at the end of growing season while, other treatments had no significant effect in this respect. Differences between bending and other treatments and the control were significant in 2003 and 2004 seasons. These results might be due to changes in endogenous hormones especially IAA and cytokinins (**kang *et al.*, 2004**) leading to improve light penetration into the tree canopy which in turn increased the accumulation of carbohydrates (**Mitchell *et al.*, 1989**). These findings are in line with those obtained by **Edwards and Notodimedjo (1987) and Wei (1987)** they indicated that bending of apple branches downward resulted in improving formation of flower spurs.

3. Number of flowers/branch:

According to the data in Table (6) it is clear that, the highest significant number of flowers/branch was recorded with Dormex spraying at 2% and branch bending treatments without significant

differences between them followed by soil mulching treatment Whereas, the control treatment gave the least values in both seasons. This increment in number of flowers/branch could be attributed to the role of Dormex in promoting flower bud break (**Siller-Cepeda *et al.*, 1992**). These results are in conformity with the findings of **Gil and Lyon (1994) and Mann *et al.* (1994)** on pear, **Aly *et al.* (1997)** on apple and **Manosur (1999)** on peach they mentioned that, Dormex application increased percentage of floral bud break and number of flowers/tree.

The impact of winter branch bending in increasing number of flowers/branch were also reported by **Lawes *et al.* (1998)** on pear and **Pierre-Eric (2001)** on apple they found that bending increased the percent of lateral bud break and the number of flowers as well as the number of fruits/tree.

Conclusively, spraying of Dormex at 2% may be considered the best treatment in enhancing floral bud burst and advancing time of full bloom with 21 days earlier than the control. However, winter bending produced the maximum number of spurs/branch at the end of growing season. Thus, both Dormex and bending treatments recorded the highest number of flowers/branch. Also, trees under treatment reached their full bloom on 12 March with 7 days earlier than control trees with one week

III. Fruit setting:

The data presented in Table (6) indicated that, K-foliar spraying, bending and mulching treatments significantly increased

the percentages of both initial set and set after June drop compared to the control in both seasons. However, Dormex treatment unsignificantly affected fruit set of "Le Conte" pear trees. The highest values of fruit set percentage belonged to potassium foliar application, descendingly followed by bending and mulching treatments, while, the least value belonged to the control and Dormex treatment without significant differences between them. The positive effect of potassium in increasing fruit set may be due to its effect in producing more leaves with largest area and stimulating carbohydrate synthesis and its translocation. The obtained results are in harmony with those reported by **Kilany and Kilany (1991) and Zayan *et al.* (1994b)** on apple and **El-Sherif *et al.* (2000) and Abo-Ogiela (2006)** on guava, they found that K-foliar spraying with K_2SO_4 significantly increased fruit set %.

The effect of bending in increasing fruit set percentages was supported with the findings of **Edwards and Notodimedjo (1987)**, on apple and **Chen-Chug *et al.* (1997) and Bahlool *et al.* (2000)** on pear. In addition, **Bande *et al.* (2005) and Mikhael and Mady (2007)** on apple, they obtained, maximum percent of fruit set under mulching treatments due to its effect on soil temperature and moisture content which influenced the absorption of nutrients especially Ca^{++} via roots.

Conclusively, K-spraying is considered to be the suitable treatment in increasing the percent of initial set and set after June

drop of "Le Conte" pear trees grown at Gharbia Governorate condition.

IV. Yield:

Table (7) and Fig. (4) show the effect of Dormex at 2%, bending, soil mulching and K-spraying on yield of "Le Conte" pear trees as number of fruits/branch, number of fruits/tree and weight kg/tree in 2003 and 2004 seasons.

1. Number of fruits/branch:

The data revealed that all tested treatments significantly increased the number of fruits/branch without significant differences among them and the difference between each of them and the control was significant in both seasons. This increment in number of fruits/branch could be attributed to the role of Dormex in enhancing floral bud break and increasing number of flowers, beside the effect of bending, mulching and K-spraying in improving fruit set. Similar results are reported by **Mikhael (1994) and Stino (1997)** on "Anna" apple trees.

2. Number of fruits/tree:

Data presented in Table (7) indicated that, all treatments significantly increased the number of fruits/tree as compared to the control and differences among them were unsignificant. This trend was true in both 2003 and 2004 seasons.

It appears that 2% Dormex spraying resulted in significantly higher number of fruits/tree when compared to the control due to the

enhanced floral bud activity leading to produce more flowers. These findings are in line with those reported by **Gabr (1996), Aly *et al.* (1997) and Mansour *et al.* (1999)** on various deciduous trees.

As for the effect of bending, data also exhibited significant increase in tree yield as number of fruits due to increasing fruit set %. These results are in harmony with those of **pierre-Eric (2001)**. With respect to the effect of soil mulching in increasing yield as number of fruits per tree. This might be due to keeping soil moisture and availability of nutrients associated with mulches which resulte in higher fruit retention and less fruit drop. Similar results are obtained by **Verma *et al.* (2005) and Mikhael and Mady (2007)**. In addition, the positive effect of potassium in producing more fruits was also reported by **Zayan *et al.* (1994b) and Abo-Ogiela (2006)**.

3. Yield (kg/tree):

From the mentioned data in Table (7) and Fig. (4) it is clear that, yield of "Le Conte" pear trees was significantly increased by all Dormex, bending, mulching and K-spraying treatments compared to the control. The maximum yield was produced with K-spraying and bending treatments with (37.26 & 38.37) and (36.33 & 36.82) kg/tree in 2003 and 2004 seasons, respectively without significant difference between them followed by Dormex and mulching treatments, while the minimum yield belonged to the control. These results could be attributed to the stimulating effect of these treatments in increasing number of fruit/tree and average fruit weight.

Table (7): Effect of some agricultural treatments on yield of "Le Conte" pear trees in 2003 and 2004 seasons.

Treatments	No. of fruit/branch	No. of fruit/tree	Yield kg/tree
	2003		
Control	3.5	210	20.69
Dormex (2%)	6.3	244	33.41
Bending	6.8	264	36.33
Soil mulching	5.4	245	32.48
K-Spraying	5.8	252	37.26
LSD 0.05	1.8	24.2	3.07
0.01	2.5	33.4	4.23
	2004		
Control	4.1	220	25.04
Dormex (2%)	6.7	257	35.49
Bending	7.1	258	36.82
Soil mulching	6.2	244	33.19
K-Spraying	6.9	254	38.37
LSD 0.05	1.6	17.5	3.39
0.01	2.3	24.1	4.67

Dormex application with 2%
Previous winter bending on Nov., 5th
Soil mulching with rice straw in 10 cm, depth on Feb., 24th
Potassium foliar spraying with 2% K_2SO_4

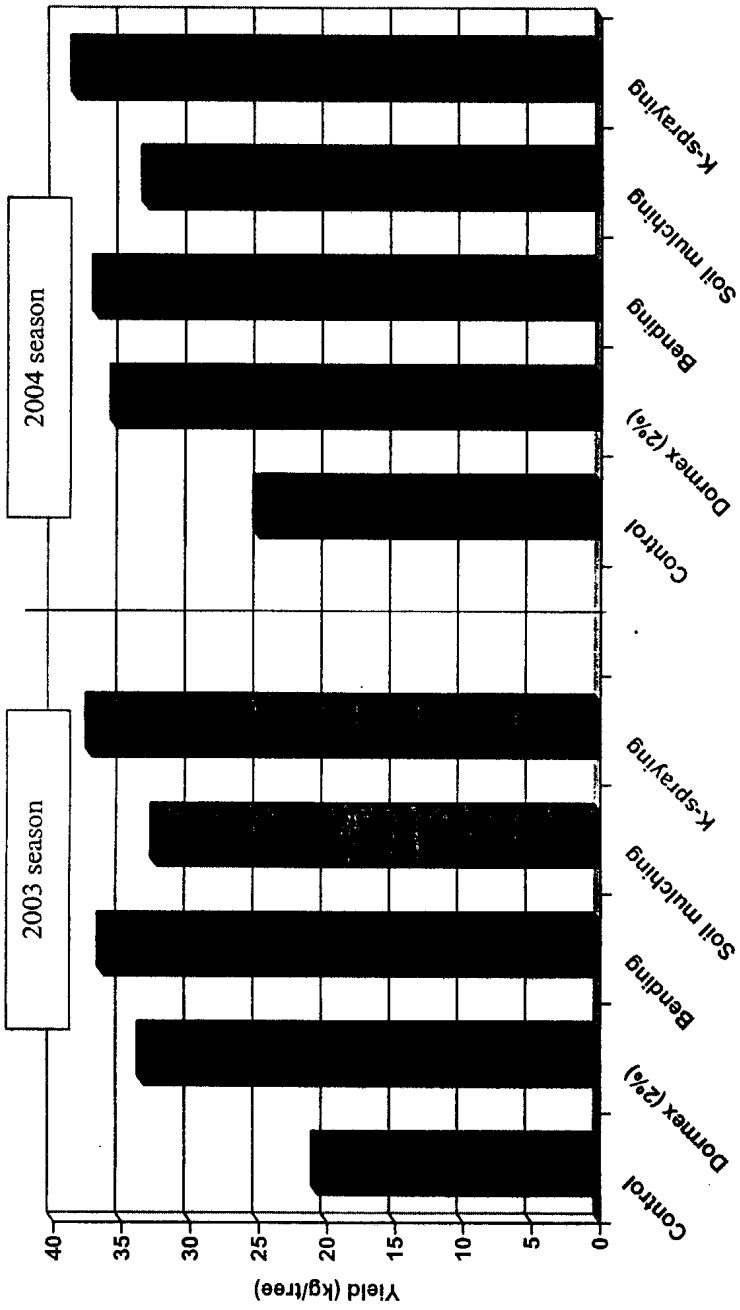

Fig. (4): Effect of some agricultural treatments on yield/tree "Le Cont" pear trees in 2003 and 2004 seasons.

These findings are in agreement with those reported by **Gabr (1996)** who found that spraying "Le Conte" pear trees with Dormex at 3% produced the maximum yield (kg/tree). Meanwhile, **Stino (1997)** indicated that sprayed "Anna" apple trees with Dormex 1.5% had no significant effect on yield (kg/tree). Moreover, **Edwards and Notodimedjo (1987) and Bahlool (2000)** suggested that, bending significantly increased tree yield. In addition. **Hifny *et al.* (1994) and Zeerban (2004)** on grapevines and **Singh *et al.* (2005) and Mikhael and Mady (2007)** on apple noticed that soil mulching produced the highest yield per tree compared with bare soil. Beside, **Kilany and Kilany (1991), Zayan *et al.* (1994b) and Abo-Ogeila (2006)** mentioned that K-foliar application significantly increased tree yield (kg).

Conclusively, K-spraying and bending may be considered the best treatments, both of them produced highest yield as number and weight of fruit per tree as well as number of fruits/branch and differences between them always unsignificant.

V. Physical and chemical fruit properties:

a. Physical fruit properties:

1. Average fruit weight (gm):

The data in Table (8) revealed that, all treatments significantly increased average fruit weight and the highest values always belonged to K-spraying with 2% K_2SO_4 in the two seasons followed by bending treatment.

Table (8): Effect of some agricultural treatments on some physical properties of "Le Conte" pear fruits in 2003 and 2004 seasons.

Treatments	Av. fruit weight (gm)	Av. fruit volume (cm^3)	Fruit length (cm)	Fruit diameter (cm)	L/D* ratio	Fruit firmness lb/in^2
	2003					
Control	98.53	94.18	6.55	5.46	1.20	19.43
Dormex (2%)	136.91	146.15	7.43	5.90	1.26	17.42
Bending	137.63	159.12	7.59	5.95	1.27	16.37
Soil mulching	132.58	142.22	7.32	5.83	1.25	18.25
K-Spraying	147.87	166.23	8.01	6.41	1.25	15.63
LSD 0.05	16.57	16.12	0.19	0.22	N.S	0.35
0.01	22.82	22.21	0.27	0.30	N.S	0.48
	2004					
Control	113.80	101.84	7.54	5.98	1.26	19.28
Dormex (2%)	138.09	151.22	8.16	6.32	1.29	17.33
Bending	142.72	162.13	8.28	6.59	1.26	16.92
Soil mulching	136.071	146.37	7.98	6.27	1.27	17.82
K-Spraying	151.07	174.26	8.45	6.76	1.25	15.76
LSD 0.05	13.66	26.56	0.34	0.22	N.S	N.S
0.01	18.82	36.59	0.33	0.31	N.S	N.S

Dormex application with 2%
Previous winter bending on Nov., 5th
Soil mulching with rice straw in 10 cm, depth on Feb., 24th
Potassium foliar spraying with 2% K_2SO_4
* Length/diameter ratio

However, the least values obtained from untreated trees (control). Meanwhile, soil mulching and Dormex 2% treatments gave an intermediate values. These results are in harmony with those of **Gabora (1998)** on "Le Conte" pear trees and **El-Sherif *et al.* (2000) and Abo Ogeila (2006)** on guava trees, they indicated that foliar application of K_2SO_4 significantly increased average fruit weight. Moreover, **Banno *et al.* (1985), Bahlool *et al.* (2000) and Abd El-Rahman (2002)** they found that shoot bending significantly increased pear fruit weight. Furthermore, **Tang *et al.* (19984), Zayan *et al.* (1994a), Mikhael and Mady (2007)** showed that application of organic mulches improved apple fruit weight. In addition, **El-Shall *et al.* (1993) and Gabr (1996)** reported that applying hydrogen cyanamide led to increase average fruit weight of "Le Conte" pear trees.

2. Fruit size and dimensions:

The data obtained in Table (8) show fruit volume, length and diameter as influenced by Dormex 2%, bending, mulching and K-spraying treatments in both seasons. It is clear that, these parameters take similar trend of average fruit weight. All tested treatments significantly increased fruit volume and dimensions (length and diameter). The largest "Le Conte" pear fruit was produced by foliar spraying with 2% K_2SO_4. This response was true in both seasons. Similar results are reported by **Mikhael (2004)** on apple, **Gabora (1998)** on pear and **Abo Ogelia (2006)** on guava. They suggested that largest fruit with the highest values of length and diameter was obtained when trees sprayed with K_2SO_4. The data also exhibited

that, bending Dormex and mulching treatments produced fruits with significantly higher volume, length and diameter than the control. Such findings are in general harmony with those reported by **Banno *et al.* (1985), Bahalool *et al.* (2000) and Abd El-Rahman (2002)** working on bending, **Williams and Tax Tzco (1990), El-shall *et al.* (1993) and Gabr (1996)** working on Dormex and **Verma *et al.* (2005) and Mikhael and Mady (2007)** working on soil mulching.

3. Fruit shape index:

Fruit length and diameter were used for estimating the L/D ratio as indicator to fruit shape. It is clear that, this value was not significantly influenced by Dormex 2%, bending, mulching and K-spraying treatments in both 2003 and 2004 seasons as shown in Table (8). These results agree with those obtained by **Zayan *et al.* (1994a)** who found that fruit shape index (L/D ratio) of "Anna" apple was not significantly affected by both rice straw and black P.E mulching treatments. Moreover, **Mikhael (1994)** on "Anna" apple and **Abo Ogeila (2006)** on "Balady" guava concluded that L/D ratio was not significantly influenced by K foliar application. Otherwise, **Abd El-Rahman (2002)** noticed that winter bending increased L/D of "Le Conte" pear fruit.

4. Fruit firmness:

According to the data presented in Table (8) it is clear that all Dormex, bending, mulching and K-spraying treatments led to decrease fruit firmness compared to the control. The differences were only significant in the first season. This reduction in fruit firmness might be due the increase in fruit size and reduction of Ca^{++}

concentration. Similar results are reported by **Mokhtar *et al.* (1994) and Gabr (1996)** indicated that Dormex (H_2CN_2) application reduced flesh firmness of pear fruit. Furthermore, **Zayan *et al.* (1994a) and Mikhael and Mady (2007)** noticed that fruit firmness was significantly decreased under soil mulching. Moreover, **Abd El-Rahman (2002)** found that winter bending significantly decreased "Le Conte" pear fruit firmness. However, **Ferree and Cahoon (1987)** sprayed "Golden Delicious" apple trees with K_2SO_4 without significant effect on fruit firmness.

b. Chemical fruit properties:

1. Total soluble solids (TSS%):

Table (9) shows TSS value as affected by Dormex, bending mulching and K-spraying treatments, it is clear that, these values were significantly higher under all tested treatments compared to the control. These results are true in both 2003 and 2004 seasons. This effect could be attributed to the role of the tested treatments in advancing fruit maturity (**Ayaad *et al.*, 1987 and Stino, 1997**). These findings are in conformity with those obtained by **Lofty (1993), Stino and Fakharani (1995) and Gabr (1996)** they indicated that application of hydrogen cyanamide increased TSS value. Moreover, **Abd El-Rahman *et al.* (2002)** found that shoot bending increased light penetration and raised TSS value, also **Dann *et al.* (1990)** indicated that TSS value was inversely related to shade level. In addition, **Gabora (1998) and El-Sherif *et al.* (2000)** found that K_2SO_4 foliar application raising TSS%. Beside, **Michael and Mady (2007)** noticed that soil mulching with cut grass and black P.E. significantly increased TSS of "Anna" apple fruit.

Table (9): Effect of some agricultural treatments on some chemical properties of "Le Conte" pear fruits in 2003 and 2004 seasons.

Treatments	T.S.S. %	Acidity %	T.S.S/acidity ratio
	2003		
Control	11.43	0.31	36.87
Dormex (2%)	12.61	0.28	45.04
Bending	12.84	0.26	49.38
Soil mulching	12.72	0.27	47.11
K-Spraying	13.22	0.25	52.88
LSD 0.05	0.33	N.S	5.45
0.01	0.46	N.S	7.51
	2004		
Control	11.85	0.30	39.50
Dormex (2%)	12.77	0.27	47.29
Bending	12.93	0..25	51.72
Soil mulching	12.81	0.26	49.27
K-Spraying	13.43	0.24	55.96
LSD 0.05	0.34	N.S	5.75
0.01	0.47	N.S	7.93

Dormex application with 2%
Previous winter bending on Nov., 5th
Soil mulching with rice straw in 10 cm, depth on Feb., 24th
Potassium foliar spraying with 2% K_2SO_4

2. Total acidity:

It is evident from the data in Table (9) that, Dormex, bending, mulching and K-spraying treatments had no effect on the percentage of total acidity in both seasons. The highest values came from the control while, the least value came from K-spraying treatment. Moreover, all treatments slightly reduced malic acid percentage. These results mainly due to an advance ment in fruit maturity. Such results are in line with those obtained by **Mansour *et al.* (1999), Bahlool *et al.* (2000), Zayan *et al.* (2006) and Mikhael and Mady (2007).**

3. TSS/acidity ratio:

It is noticeable from data in Table (9) that, TSS/acidity ratio take the same trend of TSS value as influenced with Dormex, bending, mulching and K-spraying. All treatments significantly increased this ratio. The highest TSS/acidity ratio values belonged to K-spraying, followed by bending, soil mulching, Dormex 2% then came the control. This hold was true in both seasons. Generally, these results are in harmony with those of **Hifny *et al.* (1994), Abd El-Rahman (2002), Zeerban (2004) and Zayan *et al.* (2006).**

Conclusively, foliar application with K_2SO_4 2% is considerable the best treatment for improving fruit quality by this treatment desirable values were obtained for fruit weight, size, TSS and acidity. This treatment was not only improved vegetative growth behaviour and yield but also improved some fruit properties. Thus, this treatment is recommended for pear growers under similar conditions of this study.

VI. Leaf mineral contents:

1. Nitrogen:

Data in Table (10) indicated that all treatments significantly increased leaf N-content. The highest values belonged to soil mulching with (2.60 & 2.62%) in 1st and 2nd seasons, respectively followed by bending, K-spraying and Dormex while, the least value came from the control. This result might be due to mulching effect on modifyding soil temperature and moisture content which in turn improving root growth and increasing nutrients absorption via roots. Similar results are obtained by **Zayan (1991)** on "Washington Navel" orange, **Zeerban (2004)** on "Thompson seedless" grapevine and **Mikhael and Mady (2007)** on "Anna" apple they found that, soil mulching with black P.E., rice straw and cut grass increased leaf N-content. Moreover, the increment in leaf N-content with bending was also reported by **Palliotti *et al.* (2000) and Abd El-Rahman (2002)**.

Furthermore, leaf N-content was higher in the sprayed "Le Conte" pear leaves with 2% K_2SO_4 than the control. These results are in harmony with those reported by **Ferree and Cahoon (1987) and Abo Ogeila (2006)** they found that spraying with K_2SO_4 increased leaf N-content. On the contrary, **Spiers (1984)** found that K application decreased leaf N-content.

Table (10): Effect of some agricultural treatments on leaf mineral contents of "Le Conte" pear trees in 2003 and 2004 seasons.

Treatments	Macronutrients % on D.wt.		
	N	P	K
	2003		
Control	1.97	0.24	1.54
Dormex (2%)	2.17	0.24	1.60
Bending	2.39	0.25	1.72
Soil mulching	2.60	0.27	1.77
K-Spraying	2.36	0.25	1.87
LSD 0.05	0.17	N.S	0.17
0.01	0.24	N.S	0.23
	2004		
Control	1.98	0.23	1.56
Dormex (2%)	2.18	0.24	1.58
Bending	2.52	0.25	1.71
Soil mulching	2.62	0.26	1.80
K-Spraying	2.47	0.25	1.89
LSD 0.05	0.17	N.S	0.12
0.01	0.24	N.S	0.16

Dormex application with 2%
Previous winter bending on Nov., 5th
Soil mulching with rice straw in 10 cm, depth on Feb., 24th
Potassium foliar spraying with 2% K_2SO_4

2. Phosphorus:

According to leaf analysis presented in Table (10) it is clear that all treatments unsignificantly affected leaf P-content in both 2003 and 2004 seasons. The slight increase in P was absorbed with soil mulching by rice straw. These results find support in the findings of **Neilson *et al.* (1986), Zayan (1991), Zeerban (2004) and Mikhael (2007)** they mentioned that leaf N was increased by all mulching treatments compared to bare soil. However, **Spires (1984) and Abo Ogeila (2006)** indicated that leaf P-content was not affected by K-foliar application.

3. Potassium:

With respect to leaf K-content, data of Table (10) revealed that K-spraying, soil mulching and bending treatments significantly increased leaf K-content compared to the control while Dormex treatment had no significantly effect. The highest values belonged to K-spraying with 2% K_2SO_4 and soil mulching with rice straw without significant differences between them. These results are in agreement with those reported by **Kassam (1991) and Mikhael (1994)** on apple trees and **Abo Ogeila (2006)** on guava trees they found that leaf K-content was significantly increased by soil and foliar spraying with K_2SO_4. Moreover, **Neilson *et al.* (1986), Mikhael (1994) and (2007)** noticed that soil mulching increased K in leaves of apple trees. However, **Banno *et al.* (1985)** pointed out that, shoot bending increased K concentration in leaves of Japanese pear trees.

In summary, soil mulching with rice straw, K-foliar application with 2% K_2SO_4 and winter shoot bending significantly increased leaf N and K contents Moreover, Dormex at 2% only increased leaf N-content. However, leaf P-content was unsignificantly affected. The highest N and P contents belonged to mulching treatment while, the highest K-content came from K-spraying treatment. Whereas, the control recorded the least N, P and K contents in leaves of "Le Conte" pear trees.

Experiment II:

This experiment puts light on branch age, branching angle (bending treatments) which are considered among the factors affecting productivity and fruit quality of "LeConte" pear trees. The effects of these treatments were studied in details on:

I. Flowering:

Tables (11 and 12) show the effect of branch age (A), bending, angle (B) and their interaction (A x B) on vegetative and floral spurs percentages and C/N ratio in 2003 and 2004 seasons.

1. Vegetative and floral spurs percentages:

The data clarify significant differences between 2-years and 3-years old branches. It is quite evident that, branches of 3-years old significantly recorded higher floral spurs % and lower vegetative spurs % than those of 2-years old branches in 2003 and 2004 seasons. These results are in harmony with those of **Abd El-Rahman (2002)** who indicated that the higher vegetative spur and lower flowering spur percentages were scored with the youngest shoots in age of "Le Conte" pear trees.

As for the effect of bending angle, the data revealed that, vegetative spurs percentage was significantly decreased while floral spurs percentage increased as bending angle increased. The widest tested angle 75° attended lower vegetative spurs and higher

flowering spurs percentages compared to the narrowest one. Data of the second season declare the same trend.

Table (11): Effect of branch bending treatments on vegetative and floral spurs percentages, fruit set and yield of "Le Conte" pear trees in 2003 season.

Branch		Vegetative spurs %	Floral spurs %	C/N* ratio	Fruit set %		Yield	
Age (year)	Bending angle (0)				Initial set	Set after June drop	No. of fruits/tree	Kg/tree
2-years	45°	74.33	25.67	14.68	27.4	6.4	244	26.18
	60°	42.97	57.03	16.53	29.8	7.0	251	32.45
	75°	31.21	68.79	17.82	32.2	7.6	268	35.41
3-years	45°	73.22	26.78	19.32	30.4	6.8	262	31.77
	60°	36.19	63.81	20.23	32.4	8.2	264	35.94
	75°	27.41	72.59	22.45	35.6	8.4	274	39.67
LSD 0.05		3.55	3.38	2.95	3.40	2.40	21.5	3.06
0.01		5.05	4.81	4.19	4.83	3.56	30.6	4.35
Means of age	2- years	49.50	50.50	16.34	29.8	7.0	254	31.35
	3-years	45.61	54.39	20.67	32.8	7.8	267	35.79
LSD 0.05		2.40	1.95	1.70	1.96	1.45	12.4	1.77
0.01		3.41	2.78	2.42	2.79	2.06	17.6	2.52
Means of bending angle	45°	73.78	26.23	17.00	22.9	6.6	253	28.98
	60°	39.58	60.42	18.38	31.1	7.6	258	34.20
	75°	29.31	70.69	20.14	33.9	8.0	271	37.54
LSD 0.05		2.94	2.39	2.08	2.4	1.77	15.2	2.16
0.01		4.18	3.40	2.96	3.42	2.52	21.6	3.08

* C/N ratio of shoots in July, 1st

Table (12): Effect of branch bending treatments on vegetative and floral spurs percentages, fruit set and yield of "Le Conte" pear trees in 2004 season.

Branch		Vegetative spurs %	Flower spurs %	C/N* ratio	Fruit set %		Yield	
Age (year)	Bending angle (0)				Initial set	Set after June drop	No. of fruits/tree	Kg/tree
2-years	45°	70.35	39.65	14.53	30.2	6.2	268	32.72
	60°	33.52	66.48	16.48	31.6	7.2	274	34.63
	75°	29.02	70.98	18.59	34.8	7.6	288	40.05
3-years	45°	65.91	34.09	19.93	33.4	7.4	274	36.48
	60°	29.69	70.31	21.82	35.2	7.8	282	40.14
	75°	17.42	82.58	23.44	38.6	8.0	296	46.31
LSD 0.05		4.16	3.72	3.04	3.34	1.86	29.0	7.70
0.01		5.91	5.30	4.32	4.75	2.65	41.3	10.95
Means Of age	2- years	44.30	55.70	16.53	32.2	7.0	277	35.80
	3-years	37.67	62.33	21.73	35.7	7.7	284	40.98
LSD 0.05		2.05	2.15	1.75	1.93	1.08	16.8	4.45
0.01		2.92	3.06	2.49	2.74	1.53	23.8	6.32
Means of bending angle	45°	68.13	31.87	17.23	31.8	6.8	271	34.60
	60°	31.61	68.39	19.15	33.4	7.5	278	37.39
	75°	23.22	76.78	21.01	36.7	7.8	292	43.18
LSD 0.05		2.51	2.63	2.15	2.36	1.32	20.5	5.45
0.01		3.57	3.75	3.05	3.36	1.87	29.2	7.75

* C/N ratio of shoots in July, 1st

Similar results are mentioned by **El-Sherbini (1978)** on apple trees **and Lawes *et al.* (1998)** on pear trees they indicated that, bending shoots downward reduced vegetative buds percentage while, increased burst with highest percentage of flower. Moreover, **Bahlool *et al.* (2000) and Abd El-Rahman (2002)** found that bending treatments caused an increasing in flowering spurs percentage of "Le Conte" pear trees.

However, the interaction (A x B) was significant in both seasons. The highest floral buds and the least vegetative buds percentages came from bent 3-years old branch to angle 75° while, the least floral buds and highest vegetative buds percentages came from bent 2-years old branch to angle 45°. All other combinations came in between.

2. C/N ratio:

Regarding, carbohydrate to nitrogen ratio, the data of both seasons reflected that, C/N ratio in shoots of "Le Conte" pear trees at July, 1st (the time of flower induction for the following crop) was significantly increased with increasing of bent shoot age. The higher ratio was obtained with 3-years old compared to 2-years old as shown in Tables (11 and 12) and Fig. (5).

The data also clarify significant differences among the three tested angle. The highest values in both seasons were recorded for the widest angle (75°). These results mainly due to the effect of bending in increasing light penetration into the tree canopy which in turn may be increased the accumulation of carbohydrate.

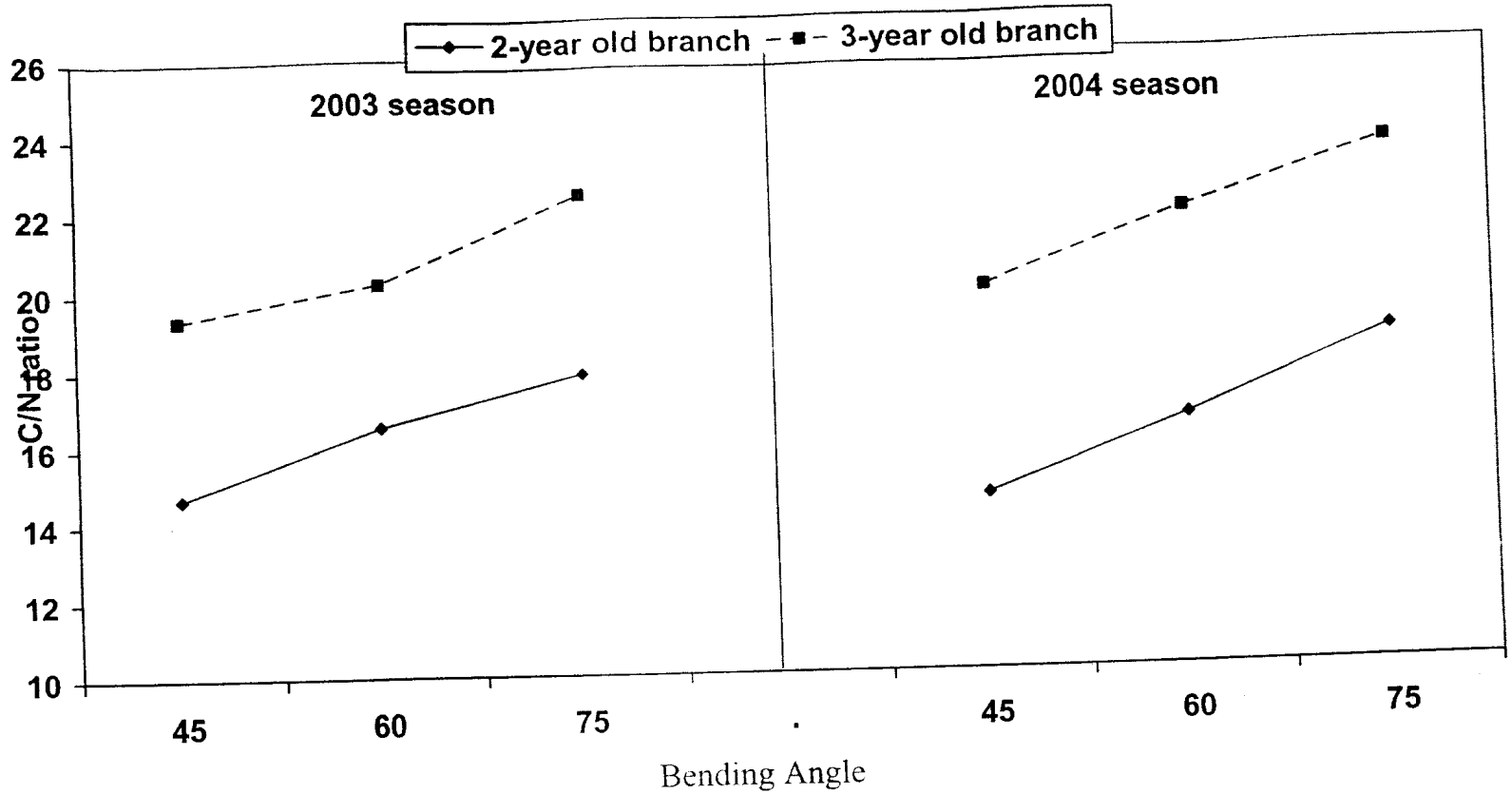

Fig. (5): Effect of branch bending treatments on C/N ratio in shoots of "Le Conte" pear trees shoots in 2003 and 2004 seasons.

The present results are in agreement with those obtained by **Abd El-Rahman(2000)** who indicated that, bending significantly increased **C/N** ratio in leaves and wood of currant shoots and spurs with supremacy of 45° angle. **C/N** ratio recorded the highest in march and the lowest in January. Moreover, **stutte and Martin(1986)** mentioned that, low light treatment resulted in lower concentration of carbohydrates than the high light. On the opposite, **Colaric et al.(2007)** indicated that carbohydrate levels in leaves of "Conference" pear trees showed no clear tendency among all bending treatments.

Accordingly, the interaction between branch age and bending angle (A x B) was significant, meaning the importance of the two factors in influencing C/N ratio in shoots of "Le Conte" pear tees.

II. Fruit setting:

Data presented in Tables (11 and 12) indicated that the highest percent of initial set and set after June drop came from bending 3-years old branch with 75° while, the least percentages came from bending 2-years old branch with 45° and the other combination values come inbetween. These results mean that, increasing branch age and bending angle degree caused significant increase in these values in both seasons. These results could be attributed to the effect of bending in improving sunlight penetration into tree canopy (**Robinson *et al.*, 1993**). However, **Wareing (1970)** reported that photosynthetic photon flux (PPF) penetration was lower to bendant lateral than to horizontal and vertical laterals. Similar results are

obtained by **Edwards and Notodimedjo (1987)** on apple trees and **Chen-Chug *et al.* (1997), Bahlool (2000) and Abd El-Rahman (2002)** on pear trees they mentioned that bending treatments significantly increased fruit set %.

Generally, data of both seasons indicated that, increasing bending angle from 45° to 75° degree significantly increased floral spurs % and C/N ratio as well as initial set and set after June drop percentages while, vegetative spurs % was reduced. Moreover, the older branch (3-years) recorded higher floral spurs %, C/N ratio and initial set and set after June drop percentages but, lower vegetative spurs % compared to the younger one (2-years).

Conclusively, bending three years old branch with 75° may be considered the best combination treatment for obtaining high flower spur percentage, increased C/N ratio and improved fruit setting of "Le Conte" pear trees.

III. Yield:

Tables (11 and 12) show yield of "Le Conte" pear trees as number and weight (kg) of fruits as influenced by branch age (A), bending angle (B) and their interaction in both seasons.

1. Number of fruits/tree:

From the mentioned data in Tables (11 and 12) it is clear that the interaction (A x B) was significant and the highest number of fruit per tree belonged to (3-years x 75°), (2-years x 75°) and (3-years x 60°) interactions without significant differences among them

in both seasons. Meanwhile, the least values belonged to (2-years x 45°) combination treatment. In this respect, the widest angle (75°) produced highest number of fruits/tree compared to narrowest one (45°). This result was true in both seasons. The data also clarify significant differences between the two tested branch ages. Briefly, 3-years old branch gave higher number of fruits per tree than that of 2-years old one. This effect might be attributed to the role of bending in improving flowering and fruit setting of "Le Conte" pear trees. These results also are in agreement with those presented in Tables (11 and 12). The obtained results herein are in line with those reported by **Pierre-Eric (2001)** who found that bending increased percent of lateral bud break and the number of flower buds as well as number of fruits/tree of "Chantecler" apple trees.

2. Yield kg/tree:

Regarding, the effect of branch age (A), bending angle (B) and their interaction (A x B) on yield kg/tree. It is clear from the data presented in Tables (11 and 12) and illustrated in Fig. (6), that raising bending angle significantly increased yield kg/tree. The maximum yield was obtained with the largest tested angle (75°) while, the narrowest angle produced the minimum yield kg/tree. Data of the second season declare similar trends.

Additionally, branch age exert a significant variation on fruit yield kg/tree whereas, the older branch of 3-years old recorded the highest yield than those of younger one of 2-years old.

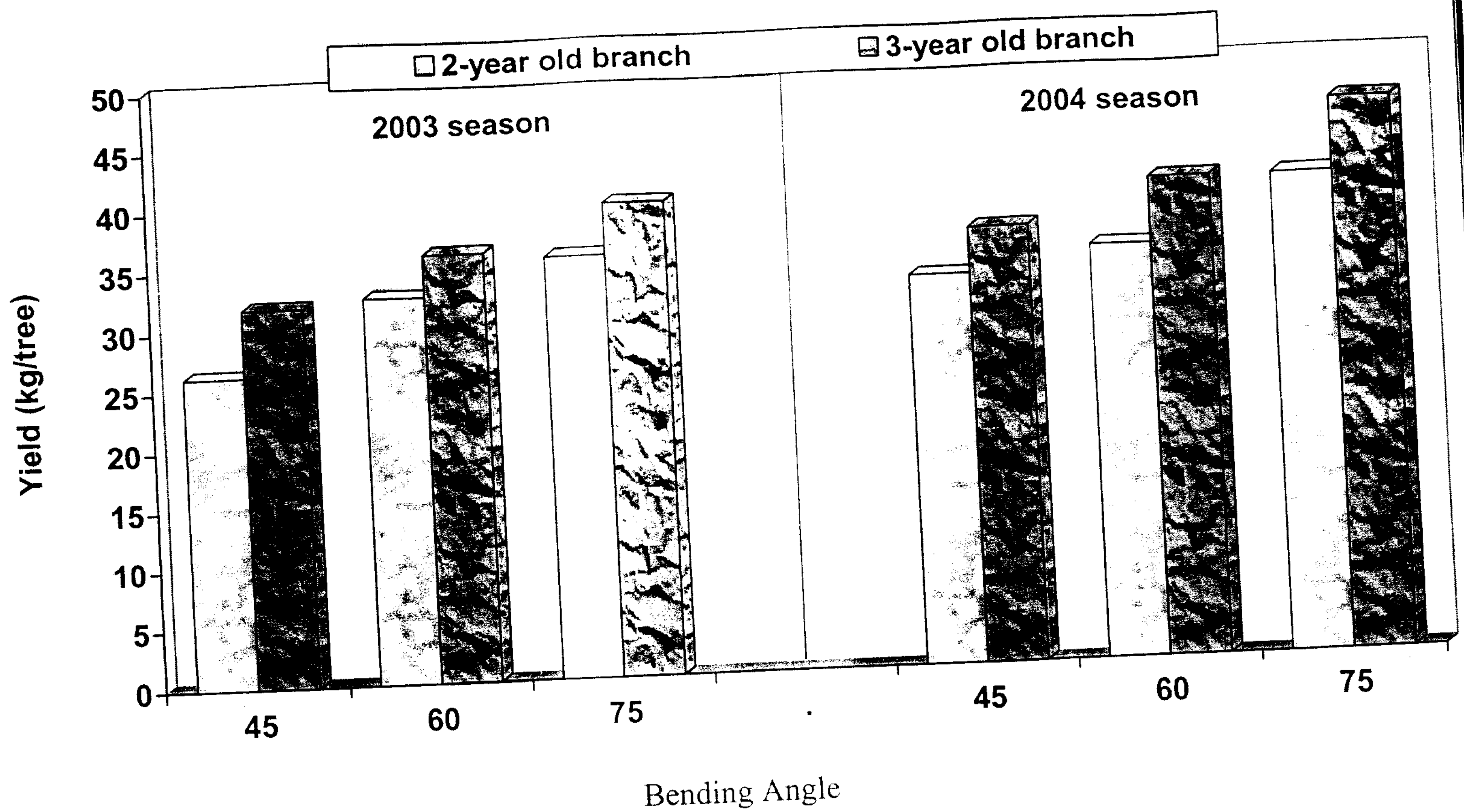

Fig. (6): Effect of branch bending treatments on yield of "Le Conte" pear trees in 2003 and 2004 seasons.

However, the interaction (A x B) was significant in both seasons. The highest fruit yield (kg/tree) belonged to (3-years x 75°) interaction with (39.67 & 46.31) kg/tree in 2003 and 2004 seasons, respectively. Meanwhile, (2-years x 45°) showed the least values.

These increasing in fruit yield kg/tree by bending treatments may be due to increasing both average fruit weight and number of fruits per tree. Such results are in line with those reported by **Edwards and Notodimedjo (1987)** on apple and **Bahlool *et al.* (2000)** on pear who found that bending caused an increase in final yield kg/tree compared to the control.

Generally, as for yield data of both seasons indicated that, increasing bending angle up to 75° significantly increased yield as number and weight (kg/tee). Moreover, 3-year old branch recorded higher yield as number and weight (kg/tree) than the younger (2-years old) one.

Conclusively, bending 3-years old branch with 75° degree is considered the best combination treatment for producing maximum yield as number and weight of fruits (kg/tree) of "Le Conte" pear trees at the condition of North Nile Delta.

IV. Physical and chemical fruit properties:

Data obtained in Tables (13 and 14) show some physical and chemical properties of "Le Conte" pear fruits as affected by branch age (A), bending angle (B) and their interaction in both seasons.

Table (13): Effect of branch bending treatments on some physical and chemical properties of "Le Conte" pear fruits in 2003 season

Branch		Av. fruit	Fruit	Fruit	Fruit	L/D*	Fruit	TSS	Acidity
Age (year)	Bending angle (0)	weight (gm)	volume (cm^3)	length (cm)	diameter (cm)	ratio	firm. lb/in^2	%	%
2-years	45°	107.28	105.94	7.21	5.43	1.33	18.28	12.69	0.27
	60°	129.27	111.68	7.42	5.62	1.32	17.62	12.71	0.26
	75°	132.14	117.37	7.59	5.97	1.27	16.86	13.00	0.25
3-years	45°	121.27	112.82	8.11	6.51	1.25	17.37	12.76	0.27
	60°	136.12	116.37	8.21	6.58	1.25	17.43	13.09	0.25
	75°	144.78	122.63	8.46	6.71	1.26	16.62	13.35	0.24
LSD 0.05		3.87	15.32	0.25	0.22	N.S	0.19	0.20	N.S
0.01		5.50	21.80	0.35	0.32	N.S	0.27	0.29	N.S
Means of age	2- years	122.90	111.66	7.41	5.67	1.31	17.59	12.80	0.26
	3-years	134.06	117.27	8.26	6.60	1.25	17.14	13.07	0.25
LSD 0.05		2.23	N.S	0.14	0.13	N.S	0.11	0.12	N.S
0.01		3.17	N.S	0.20	0.18	N.S	0.15	0.17	N.S
Means of bending angle	45°	114.28	109.38	7.66	5.97	1.29	17.83	12.73	0.27
	60°	132.70	114.03	7.82	6.10	1.29	17.53	12.90	0.26
	75°	138.46	120.00	8.03	6.34	1.27	16.74	13.18	0.25
LSD 0.05		2.73	10.08	0.17	0.16	N.S	0.13	0.14	N.S
0.01		3.89	13.42	0.25	0.22	N.S	0.19	0.20	N.S

At harvest time in August, 3rd
* Length/diameter ratio

Table (14): Effect of branch bending treatments on some physical and chemical properties of "Le Conte" pear fruits in 2004 season

Branch		Av. fruit	Fruit	Fruit	Fruit	L/D*	Fruit	TSS	Acidity
Age (year)	Bending angle (0)	weight (gm)	volume (cm^3)	length (cm)	diameter (cm)	ratio	firm. lb/in^2	%	%
2-years	45°	122.09	109.37	7.34	5.59	1.31	18.22	12.73	0.26
	60°	126.38	113.42	7.52	5.72	1.31	17.38	12.83	0.25
	75°	139.07	121.92	7.73	5.98	1.29	16.64	13.04	0.25
3-years	45°	133.15	123.36	8.22	6.53	1.26	16.64	13.02	0.26
	60°	142.34	129.39	8.25	6.66	1.25	16.96	13.27	0.24
	75°	156.45	138.12	8.63	6.73	1.28	16.42	13.55	0.23
LSD 0.05		6.93	7.57	0.20	0.21	N.S	0.17	0.19	N.S
0.01		9.85	10.76	0.28	0.29	N.S	0.24	0.28	N.S
Means of age	2- years	129.18	114.90	7.53	5.76	1.30	17.41	12.87	0.25
	3-years	143.98	130.29	8.37	6.64	1.26	16.67	13.28	0.24
LSD 0.05		4.00	4.37	0.13	0.12	N.S	0.10	0.12	N.S
0.01		5.69	6.21	0.16	0.17	N.S	0.14	0.16	N.S
Means of bending angle	45°	127.62	116.37	7.78	6.06	1.29	17.43	12.88	0.26
	60°	134.36	121.41	7.89	6.19	1.28	17.17	13.05	0.25
	75°	147.76	130.02	8.18	6.36	1.29	16.53	13.30	0.24
LSD 0.05		4.90	5.35	0.14	0.15	N.S	0.12	0.14	N.S
0.01		6.97	7.61	0.19	0.21	N.S	0.17	0.20	N.S

At harvest time in August, 3rd
* Length/diameter ratio

a. Physical fruit properties:

1. Average fruit weight (gm):

The data of 2003 and 2004 seasons revealed that, highest values of fruit weight always belonged to (3-years x 75°) combination treatment with (144.78 & 156.45) gm per fruit in 1st and 2nd seasons, respectively. While, the least values came from (2-years x 45°) treatment with 107.28 and 122.09 gm/fruit in first and second seasons, respectively, other combination treatments came in between.

Regarding, the effect of age of bent branches, it is clear that, older branches obtained significantly higher fruit weight than younger one in the two seasons. As for the effect of bending angle, the data exhibited that, largest angle (75°) was more effective than 60° or 45° one in increasing average fruit weight (gm). Data of the second season gave the same trend. These results could be attributed to the effect of bending treatments in increasing leaf area and stimulation of photosynthesis. These results are in conformity with the findings of **(Morgan *et al.*, 1984)** who indicated that fruit weight of "Gall" apple showed a highly positive correlation with photosynthetic Photon Flux density penetration. In addition, **Abd El-Rahman (2002)** mentioned that, shoot bending with 90° angle gave higher weight of "Le Conte" pear fruit than that of 45° angle.

2. Fruit size:

The data obtained in Tables (13 and 14) cleared that, bending treatments significantly increased fruit volume, length and diameter, also 75° angel was preferable than 45° or 60° angle in both seasons.

Moreover, bending of 3 years old branch produced large fruit than 2-years old one. However, the most important data were disclosed by the interaction (A x B) which was significant in both seasons. The highest values belonged to (3 years x 75°) treatment while, (2 years x 45°) interaction produced smallest fruit. As mentioned earlier that light level was correlated to fruit size (**Heinicke, 1963**). The present results find support in results obtained by **Banno *et al.* (1985), Chen-Chug *et al.* (1997), Bahlool *et al.* (2000) and Abd El-Rahman (2002)** on pear trees they reported that, shoot bending significantly increased fruit size. Additionally, **Lespinasse and Delort (1986)** indicated that fruit size of "Golden Delicious" apple was varied with branch angle and the largest fruit was produced from fruiting lateral oriented between 30° to 45°.

3. Fruit shape index:

It is noticeable from data in Tables (13 and 14) that, length/diameter (L/D) ratio was not significantly affected by age of the bent branch (A), bending angle (B) and their interaction in the two seasons. These results are in line with those obtained by **Eccher *et al.* (1993)** who suggested that, apples grown in different light condition showed slight differences in fruit shape. However, **Noe and Eccher (1996)** noticed that, shading increased L/D ratio while, natural light produced the lowest values. On the contrary **Abd El-Rahman (2002)** concluded that, the L/D ratio was significantly increased by bending, especially with 90° angle.

4. Fruit firmness:

It is evident from the data in Tables (13 and 14) that, branch bending significantly decreased fruit firmness. The highest values recorded with the control (2-years x 45°) while, the least values was realized with (3-years x 75°) combination treatment in both seasons. The reduction in fruit firmness with wide bending angle might be due to the increase in fruit size as reported by **Richardson (1986)** who mentioned that fruit firmness was decreased as fruit size increased. Moreover, **Klein (1961)** decided that light penetration led to increase in IAA which in turn increased cell wall plasticity due to the rupturing of Ca bonds then, fruit firmness was decreased. The data also revealed that, fruits from old bent branch (3-years) had lower firmness than those of the young one. This result was true in both seasons. The above mentioned results are also in accordance with those obtained by **Bahlool *et al.* (2000) and Abd El-Rahman (2002)** on "Le Conte" pear trees.

b. Chemical fruit properties:

1. Total soluble solids (TSS%):

Data presented in Tables (13 and 14) show TSS value as affected by branch age (A), bending angle (B) and their interaction (A x B) in both seasons It is clear that, bending 3-years old branch produced fruits with significantly higher TSS value as compared to fruits from 2-year old branch. Data of the second season showed the same trend.

Respecting, the effect of bending angle, the data clearly indicated that fruit total soluble solids TSS was significantly increased with increasing bending angle up to 75° degree. As regard

to the interaction (A x B), the data generally revealed that, the highest significantly TSS values came from (3-year x 75°), (2-year x 75°) and (3-year x 60°) treatments, respectively while, the least values belonged to (2-years x 45°) in both seasons. This effect may be due to the role of bending in increasing the penetration of sunlight into tree canopy and advancing fruit maturity. **Marini *et al.* (1991).** Moreover, **Dann *et al.* (1990)** reported that TSS in peach fruits inversely related to shad level. These results herein are in conformity with the findings of **Abd El-Rahman (2002)** who found that, winter shoot bending significantly increased TSS in fruits of "Le Conte" pear trees and the angle of 90° was preferable than 45° angle. However, **Bahlool *et al.* (2000)** mentioned that TSS value was not significantly affected by all tested bending treatments.

2. Total acidity:

It is evident from the data in Tables (13 and 14) that, all tested branch ages (A), bending angle (B) and their interaction had no significant effect on the percentage of total acidity in both seasons The obtained results herein are in similar with those obtained by **Bahlool *et al.* (2000)** on "Le Conte" pear fruits. Contrarily, **Abd El-Rahman (2002)** revealed that, winter bending significantly decreased fruit acidity compared to the control.

Generally, the data exhibited that, winter bending of 3-years old branches had significantly higher average fruit weight, volume, length and diameter as well as TSS% but, lower firmness than those of 2-years old one. In addition, fruit weight, size and TSS value was increased while, flesh firmness was decreased as bending angle

increased. Moreover, bending up to 75° was more effective than 60° or 45°. So, it was preferable than others. On the other hand, fruit shape and total acidity were not affected with all tested branch ages, bending angles and their interaction.

Conclusively, bending 3 years old branches at 75° angle is considered the best combination treatment for improving physical and chemical properties of "Le Conte" pear fruits particularly fruit weight, size and total soluble solids (TSS). Wherefore, this treatment is not only increased fruit set and produced maximum yield but also improved fruit quality.

SUMMARY

SUMMARY

The present study was carried out during 2003 and 2004 seasons on ten years old "Le Conte" pear trees grafted on *Pyrus comunis* rootstock and grown in Kotour region, El-Gharbia Governorate where the soil is slightly alkaline The purpose of this work was to study the productivity of "Le Conte" pear trees as affected by some agricultural treatments. So, this study was planned in two separated experiments.

In experiment I, evaluated the effect of Dormex at 2%, branches bending, soil mulching with rice straw and K-foliar spraying with 2% K_2SO_4 as four agricultural treatments compared to the control on vegetative growth, flowering, fruit setting, yield, fruit quality and leaf mineral contents.

In experiment II, bending of two and three old years branches at 45°, 60° and 75° angle in six combination treatments including the control were tested in a randomized complete block design as a factorial experiment and their effects were studied on flowering, fruit setting, yield and fruit quality.

The obtained results are summarized as follows:

Exp. I. Effect of some agricultural treatments:

1. Foliar spraying with 2% K_2SO_4 and soil mulching with rice straw is considered the best treatments for improving shoot and leaf growth parameters especially, shoot length and diameter, shoot dry weight and leaf area as well as leaf dry

and specific weights in both seasons. However, application of Dormex with 2% produced the highest number of new shoot/1-year old branch.

2. The application of Dormex with 2% may be considered the best treatment in increasing the percent of floral bud burst and advanced time of full bloom with 21 days earlier than the control. Meanwhile, branch bending treatment produced the maximum number of spurs/branch at the end of growing season. Beside, both Dormex and bending treatments obtained the highest number of flowers/branch in both 2003 and 2004 seasons.
3. Potassium foliar spraying with 2% K_2SO_4, branches bending and soil mulching treatments significantly increased both of initial set and set after June drop percentages compared to the control. Whereas, Dormex with 2% treatment had no significant effect in both seasons.
4. Foliar spraying with 2% K_2SO_4 and branch bending may be considere the best treatments, both of them produced maximum yield as number and weight (kg) of fruits per tree without significant differences between them in both 2003 and 2004 seasons. While, the minimum yield belonged to the control.
5. Foliar application with 2% K_2SO_4 is preferable than other treatments for improving fruit quality, by this treatment desirable values were obtained for fruit weight, size, TSS and acidity.

6. **Soil mulching with rice straw, foliar application with 2% K_2SO_4** and branch bending treatments significantly increased leaf N and K contents. Moreover, Dormex at 2% only increased leaf N-content. However, leaf P-content unsignificantly affected. Additionally, the highest N and P contents belonged to mulching treatment while, the highest K-content came from K-spraying treatment. On the other hand, the control recorded the least N, P and K-contents in leaves of "Le Conte" pear trees in both seasons.

Exp. II: Effect of branch age and bending angle treatments:

1. Increasing bending angel up to 75° signficantly increased floral spurs and fruit set percentages as well as C/N ratio in shoots at the time of floral induction for the following crop. While, reduced vegetative spurs percentage. In addition, the older 3-years old branch recorded higher floral spurs and fruit set percentages and C/N ratio with lower vegetative spurs percentage compared to younger one in both seasons.
2. Bending 3-years old branch at 75° is considered the best combination treatment for producing maximum yield as number and weight of fruit (kg/tree) of "Le Conte" pear trees.
3. Widest angle (75°) recorded the highest fruit yield as number and weight (kg/tree). Moreover, bending of 3-years old branch produced higher yield than those of 2-years old one in the two seasons.

4. Bending 3 years old branch at 75° seemed to be superior than other combination treatments for improving quality of "Le Conte" pear fruits particularly weight, size and TSS value.
5. 75° angle was more effective than 60° or 45° for improving fruit quality. It recorded highest values of fruit weight, volume, and fruit length and diameter and TSS value. On the other hand, fruit shape (L/D) ratio and acidity were not affected.

Thus, this study recommends pear growers to spray their trees with 2% K_2SO_4. This treatment not only increased vegetative growth parameters and yield as fruit number and weight (kg/tree) but also, improved fruit quality of "Le Conte" pear trees especially weight, size and TSS values. Beside, bending 3-years old branches at 75° angle is considered the suitable combination treatment which reduced vegetative spurs percentage. Meanwhile, increased floral spurs and fruit set percentages as well as C/N ratio, produced maximum yield as number and weight (kg/tree) and also improved fruit quality.

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ARABIC SUMMAY

جامعة كفرالشيخ
كلية الزراعة
قسم البساتين

انتاجية أشجار الكمثرى (الليكونت) وتاثرها ببعض المعاملات الزراعية

رسالة مقدمة من

عبير السعيد محمد معوض
بكالوريوس فى العلوم التعاونية الزراعية (١٩٩٧)
دراسة تكميلية بكلية الزراعة بكفرالشيخ ــ جامعة طنطا (٢٠٠٠)

للحصول على درجة الماجستير فى العلوم الزراعية (الفاكهة)

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التاريخ / /٢٠٠٨

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للحصول على درجة الماجستير فى العلوم الزراعية
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٢٠٠٨

بسم الله الرحمن الرحيم

﴿ أَوَلَيْسَ ٱلَّذِى خَلَقَ ٱلسَّمَٰوَٰتِ وَٱلْأَرْضَ بِقَٰدِرٍ عَلَىٰٓ أَن يَخْلُقَ مِثْلَهُم ۚ بَلَىٰ وَهُوَ ٱلْخَلَّٰقُ ٱلْعَلِيمُ ﴿٨١﴾ إِنَّمَآ أَمْرُهُۥٓ إِذَآ أَرَادَ شَيْـًٔا أَن يَقُولَ لَهُۥ كُن فَيَكُونُ ﴿٨٢﴾ فَسُبْحَٰنَ ٱلَّذِى بِيَدِهِۦ مَلَكُوتُ كُلِّ شَىْءٍ وَإِلَيْهِ تُرْجَعُونَ ﴿٨٣﴾ ﴾

صدق الله العظيم

(يس ٠٨١-٠٨٣)

إنتاجية أشجار الكمثرى "الليكونت" وتأثرها ببعض المعاملات الزراعية

عبير السعيد محمد معوض

الملخص العربى

أجريت هذه الدراسة خلال موسمى ٢٠٠٣ ، ٢٠٠٤م على أشجار الكمثرى "الليكونت" عمر ١٠ سنوات والمطعومة على أصل الكميونس والمنزرعة فى منطقة قطور ــ محافظة الغربية ذات التربة القلوية الخفيفة والغرض من هذا البحث هو دراسة إنتاجية أشجار الكمثرى "الليكونت" وتأثرها ببعض المعاملات الزراعية وقد تم تنفيذ هذه الدراسة فى تجربتين منفصلتين كما يلى:

التجربة الأولى:

تم تقييم تأثير أربعة معاملات وهى الرش بالدورمكس بتركيز ٢% وثنى الأفرع وتغطيه سطح التربة بقش الأرز والرش الورقى بسلفات البوتاسيوم بتركيز ٢% مقارنة بالكنترول على النمو الخضرى والتزهير وعقد الثمار والمحصول وصفات الجودة والمحتوى المعدنى للأوراق.

التجربة الثانية:

تهدف لدراسة تأثير ثنى الأفرع عمر سنتين وثلاث سنوات عند زوايا ٤٥° ، ٦٠° ، ٧٥° فى ٦ معاملات مركبة شاملة الكنترول وذلك كتجربة عاملية باستخدام تصميم القطاعات الكاملة العشوائية وقد تم دراسة تأثير المعاملات على التزهير وعقد الثمار والمحصول وصفات الجودة.

وأمكن تلخيص النتائج المتحصل عليها فى النقاط الآتية:

التجربة الأولى: تأثير بعض المعاملات الزراعية:

١- أظهرت النتائج أن الرش الورقى بسلفات البوتاسيوم بتركيز ٢% وتغطيه سطح التربة بقش الأرز تعتبر أفضل معاملتين فى تحسين النمو الخضرى خاصة طول وقطر النموات والوزن الجاف للنمو والمساحة الورقية والوزن الجاف والوزن النوعى للورقة فى كلا الموسمين بينما أعطت المعاملة بالدورمكس بتركيز ٢% أكبر عدد من النموات الحديثة/فرع عمر سنة.

٢- أوضحت النتائج أن المعاملة بالدورمكس بتركيز ٢% تعتبر أفضل معاملة فى زيادة النسبة المئوية لتفتح البراعم الزهرية وتبكير وقت التزهير الكامل بـــ ٢١ يوم عن الكنترول بينما معاملة ثنى الأفرع قد أعطت أكبر عدد من الدوابر/فرع فى نهاية موسم النمو. بالإضافة لذلك فإن كلا من معاملتى الدورمكس وثنى الأفرع أعطت أكبر عدد من الأزهار/فرع فى كل من موسمى الدراسة.

٣- أوضحت النتائج أن معاملات الرش الورقى للبوتاسيوم فى صورة سلفات بوتاسيوم بتركيز ٢% وثنى الأفرع وتغطية سطح التربة أدت إلى زيادة معنوية فى كلا من النسبة المئوية للعقد الأولى والعقد بعد تساقط يونيو مقارنة بالكنترول بينما معاملة الدورمكس لم تظهر تأثيرا معنويا فى كلا الموسمين.

٤- أظهرت النتائج أن الرش الورقى بسلفات البوتاسيوم بتركيز ٢%وثنى الأفرع تعتبر أفضل معاملتين حيث أعطت كل منهما أعلى محصول كعدد ثمار وكوزن بالكجم/شجرة بدون فروق معنوية بينهما فى كل من موسمى ٢٠٠٣ ، ٢٠٠٤م بينما أعطت اشجار الكنترول أقل محصول.

٥- بينت نتائج كلا الموسمين أن الرش الورقى بسلفات البوتاسيوم بتركيز ٢% كانت أفضل المعاملات فى تحسين صفات الجودة حيث تحصل على القيم المرغوبة بالنسبه لوزن وحجم الثمار ومحتواها من المواد الصلبة الذائبة الكلية (TSS) والحموضة.

٦- أوضحت النتائج أن معاملات تغطية سطح التربة بقش الأرز والرش الورقى بسلفات البوتاسيوم بتركيز ٢% وثنى الأفرع أدت إلى زيادة معنوية فى محتوى الأوراق من النيتروجين والبوتاسيوم بينما لم يتأثر معنويا محتوى الأوراق من الفوسفور. بالإضافة لذلك فإن معاملة تغطية سطح التربة أعطت أعلى محتوى من النيتروجين والفوسفور فى الأوراق بينما معاملة الرش الورقى بسلفات البوتاسيوم قد أعطت أعلى محتوى من البوتاسيوم فى الأوراق ، ومن جهة أخرى فإن اشجار الكنترول أعطت أقل قيم لمحتوى الأوراق من النيتروجين والفوسفور والبوتاسيوم.

التجربة الثانية: تأثير معاملات ثنى الأفرع:

١- أدى زيادة زاوية التفريع حتى ٧٥° إلى زيادة معنوية فى النسبة المئوية للدوابر الزهرية و لعقد الثمار ونسبة الكربوهيدرات إلى النيتروجين (C/N ratio) فى الأفرع وقت الدفع الزهرى للمحصول القادم بينما أدت إلى خفض النسبة المئوية للدوابر الخضرية.

كما أظهرت النتائج أن ثنى الأفرع الأكبر (عمر ٣ سنوات) أعطت أعلى نسبة مئوية للدوابر الزهرية وعقد الثمار وأعلى نسبة الكربوهيدرات إلى النيتروجين بينما أعطت أقل نسبة مئوية للبراعم الخضرية مقارنة بالأفرع الأصغر فى كل من موسمى ٢٠٠٣ ، ٢٠٠٤م.

٢- أعطت زاوية الثنى الواسعة ٧٥° أعلى محصول ثمار كعدد وكوزن بالكجم/شجرة بالإضافة لذلك فإن ثنى الأفرع عمر ٣ سنوات أنتج أعلى محصول مقارنة بالأفرع عمر سنتين فى كلا من سنتى الدراسة.

٣- أوضحت النتائج أن معاملة ثنى الأفرع عمر ٣ سنوات عند زاوية ٧٥° قد تفوقت على المعاملات المركبة الأخرى فى تحسين صفات جودة ثمار الكمثرى "الليكونت" خاصة وزن وحجم الثمار وقيمة الـ TSS (المواد الصلبة الذائبة الكلية)

٤- بينت النتائج أن الزاوية ٧٥° كانت أكثر تأثيرا من الزاوية ٦٠° والزاوية ٤٠° فى تحسين صفات جودة الثمار حيث أعطت أعلى القيم بالنسبه لوزن وحجم الثمار وأبعاد الثمرة (الطول والقطر) وقيمة TSS بينما كانت أقل صلابة. ومن جهة أخرى فإن شكل الثمار (نسبة الطول/القطر) والحموضة لم تتأثر.

لذلك توصى هذه الدراسة مزارعى الكمثرى بالرش الورقى بسلفات البوتاسيوم بتركيز ٢% حيث تعتبر أفضل معاملة حيث أنها لم تؤدى فقط إلى زيادة مقاييس النمو الخضرى والمحصول كعدد ثمار وكوزن بالكجم/شجرة بل أيضا حسنت من جودة ثمار الكمثرى "الليكونت" خاصة وزن وحجم الثمار ومحتواها من المواد الصلبة الذائبة الكلية (TSS) بالإضافة إلى ذلك فإن ثنى الأفرع عمر ٣ سنوات عند زاوية ٧٥° والتى تعتبر أفضل معاملة مركبة حيث خفضت النسبة المئوية للدوابر الخضرية بينما زادت النسبة المئوية للدوابر الزهرية وعقد الثمار ونسبة الكربوهيدرات إلى النيتروجين (C/N ratio) كما أعطت أعلى محصول كعدد وكوزن ثمار بالكجم/شجرة وكذلك حسنت من صفات جودة الثمار.

إنتاجية أشجار الكمثرى (الليكونت) وتأثرها ببعض المعاملات الزراعية

عبير السعيد محمد معوض

المستلخص العربى

أجريت هذه الدراسة خلال موسمى ٢٠٠٣ ، ٢٠٠٤م على أشجار الكمثرى "الليكونت" النامية فى بستان تجارى بقرية العتوة البحرية ــ مركز قطور ــ محافظة الغربية ــ مصر واشتملت هذه الدراسة على تجربتين منفصلتين ، فى التجربة الأولى تم تقييم تأثير معاملات الرش بالدورمكس بتركيز ٢% وثنى الأفرع وتغطية سطح التربة بقش الأرز والرش الورقى بسلفات البوتاسيوم بتركيز ٢% مقارنة بالكنترول على النمو الخضرى والتزهير وعقد الثمار والمحصول وصفات جودة الثمار والمحتوى المعدنى للأوراق ، أما التجربة الثانية فقد صممت لدراسة تأثير عمر الفرع (أ) وزاوية الثنى (ب) والتفاعل بينهما (أ × ب) على التزهير وعقد الثمار والمحصول وصفات جودة الثمار.

فيما يتعلق بتأثر بعض المعاملات الزراعية أوضحت النتائج أن الرش الورقى بسلفات البوتاسيوم بتركيز ٢% يعتبر أفضل معاملة لتحسين مقاييس نمو النمو والورقة. علاوة على زيادة النسبة المئوية للعقد الأولى والعقد بعد تساقط يونيو ومحتوى الأوراق من النيتروجين والبوتاسيوم فضلا عن إنتاج أعلى محصول بأفضل صفات جودة خاصة وزن وحجم الثمار وقيمة TSS فى كلا من موسمى الدراسة.

وفيما يختص بتأثير معاملات ثنى الأفرع فقد أظهرت البيانات وجود فروق معنوية بين الثلاث زوايا تفريع وعمرى الأفرع المختبرة وكانت أكثر البيانات أهمية هى تلك المرتبطة بالتفاعل. كما أفادت النتائج أن ثنى الأفرع عمر ثلاث سنوات عند زاوية ٧٥° (الزاوية الأوسع) تعتبر أنسب معاملة مركبة والتى رفعت النسبة المئوية للدوابر الزهرية وعقد الثمار وزادت نسبة الكربوهيدرات الى النيتروجين (C/N ratio) كما أنتجت أعلى محصول كعدد ثمار وكوزن بالكجم/شجرة وحسنت من صفات جودة الثمار فى كلا الموسمين.

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انتاجية أشجار الكمثرى (الليكونت) وتاثرها ببعض المعاملات الزراعية

رسالة مقدمة من

عبير السعيد محمد معوض

بكالوريوس فى العلوم التعاونية الزراعية (١٩٩٧)
دراسة تكميلية بكلية الزراعة بكفرالشيخ ــ جامعة طنطا (٢٠٠٠)

للحصول على درجة الماجستير

فى

العلوم الزراعية

(الفاكهة)

٢٠٠٨