1. INTRODUCTION

Pear can be considered the third in the importance among other deciduous fruits in the world and the fourth among all fruits together (Scheer & Juergensqn, 1976). In Egypt, pear acreage occupies about 15,063* feddans with total fruit production of about 49,363 metric tons.

Botanically pear belongs to the order Rosales (Roses) and family Rosaceae which includes 20 to 25 species of pear native to Europe, Asia and North Africa. There are thousands of varieties, but only few are of commercial importance in the world, derived from Pyrus communis L. in Europe. "Le conte" (Pyrus Lecontei Rehd), the most important pear cultivar in Egypt, is a hybrid between the Chinese sand pear (Pyrus serotina L.) and European pear (Pyrus communis L.). It is supposed to have originated near Philadelphia in 1850 (Hendrick, 1938). The "Le conte" pear tree is medium in size, slow growing and requires short chilling.

The cost of producing pear has been risen sharply in the last few years. The greatest increase has been in orchard overheads which now appear to represent over 50% of the total costs. Returns also have increased, but not as much as total costs. Thus, to meet rising costs, the production of premiumvalued fruit must be increased, especially on an annual basis. There have been several approaches to increase productivity. One method has been

* According to the statistics of the Ministry of Agriculture, Egypt; 1984 (under publication).
to design orchards for greater potential productivity by maximizing the volume of bearing mantle and increasing fruit density in this volume. For annual cropping, there is a need for a balance between fruiting buds and vegetative buds.

It is well known that regulation and control can be achieved by proper training and the use of suitable regulators (i.e. Alar "SADH" and Ethephon "CEPA").

Pear trees tend to give dense upright growth with limited secondary branching causing reduced light penetration into the tree canopy, that may result in a suppression of spur formation, spur longevity (Cain, 1971), bud initiation (Lasko, 1980), fruit set (Dood and Ferree, 1980), fruit colour (Jackson et al, 1977), as well as fruit size and fruit total soluble solids (Dood and Ferree, 1980). The quantity and distribution of light within a tree may be influenced by tree size, rows orientation and canopy shape. Training methods or the use of growth regulators, not only sets limits of tree form, but more importantly helps regulate the productivity of bearing wood, improves flowering, fruiting and fruit quality and reduces the costs of production.

Meanwhile, the natural growth habit of pear trees allows the growth of weeds, which compete with trees for nutrients and water. Weeds also harbour other pests such as insects, fungi, nematodes and bacteria. In addition, to direct competitive effects of weeds on the trees, weeds affects trees by the excretion of phytotoxic products,
stimulate the occurrence of nematodes on trees leading to root damage (Kosinova, 1972). Any soil management system could be practiced and recommended, if it gets rid of weed competition, inexpensive, provides an adequate level of soil moisture, maintains organic matter, favours the availability of nutrients and develops a soil with good aeration. Thus improves tree growth, yield, fruit quality and reduces the costs of production.

Young pear trees are known to be shy bearers and consequently any cultural practices that can increase fruit set and reduce the severity of fruitlet drop may contribute to higher yields. It is believed that the use of some growth regulators i.e. Gibberellin "GA3" and Alar "SADH" may be beneficial in this respect.

Therefore, this study was carried out to investigate the reflection of physiological responses of young "Le conte" pear trees to cultural practices i.e. training methods, soil management systems and growth regulators on tree growth, flowering and fruiting.
2.1. Tree growth

2.1.1. Effect of training methods

Lupescu (1969), studied the growth of young Cure, Beurre Hardy and Keiffer seedling pears trained on various systems viz. irregular palmette with oblique arms "shapeless, Heag, Tricroisillon, Drapel Marchand, Bouche, Thomas and lepage were compared. He found that trees trained on the "shapeless" hedge and palmette systems produced the greatest annual extension growth and total shoot length.

Tacyana (1970), trained 3-year-old apple trees grafted on Antonovka-seedlings rootstock as palmette had their 1 and 2-year-old shoots bent horizontally and vertically (through 180°), in March and June. He reported that shoot growth was reduced by both treatments more so by vertical bending.

Antudinov (1972), working on 4 to 8- year-old apple cvs. Grimes Golden and White Rosemary had their main and uppermost shoot bent down 45-50 and 80-90°, respectively, from the leader, which was removed at the start of full bearing, and compared it with conventionally pruned trees. Such treatment increased crown size by 30%, leaf area by 28.4% and increased crown illumination by 11.4%.

Bilets'ka (1972), showed that palmette and spindle bush training decreased shoot growth and improved the formation of bearing wood and leaves of 6-year-old apple trees.

Devyatov and Kozlov (1972), mentioned that in palmette trained trees, the oblique position of the main shoots is recommended for optimal branching of 8 apple cvs.
Golovanov (1975), reported that bending of 1-year-old shoots of 5-year-old apple trees to 40-45, 55-65 or 90° in early April, had little effect on shoot growth characteristics, whereas, bending of branches had a beneficial effect.

Vinovets (1975), carried out trials on 3 to 5-year-old trees whose crowns were trained and/or pruned in 5 different ways. The greatest leaf area per tree was obtained with all branches when shoots bent to the horizontal position.

Zhukova (1977), showed that vigorously growing apple trees were pruned hard during the 1st. year after planting and moderately during the subsequent years; some primary and secondary branches were also bent down. This treatment resulted in the production of shoot of medium length and increased leaf surface area.

Modoran (1977), realized that growth of Jonathan, Starkrimson and Golden Delicious was better when the branches were trained obliquely than when they were horizontal.

Tertecel (1978), mentioned that the least shoot growth of pear trees cvs. Williams and Cur [Vicar of Winkfield], was produced by bending of medium-length shoots at 90° in late June.

Shemetun (1978), indicated that crown size and trunk girth of apple trees cvs. Snew Calville and Jonathan were decreased with increased shortening of 1-year-old shoots. For these 2 cvs. crown thinning is recommended only as a mean of tree training.
Myers and Ferree (1980), reported that potted, actively growing MM 106 apple trees were pruned or left unpruned and oriented to 0° (vertical), 45°, 90° (horizontal), and 90° rotated (irpm). Total shoot growth after 3 weeks of 90° rotated trees was 7% greater than 0° unpruned trees, and 18% greater than both 45 and 90° unpruned trees. Regrowth 3 weeks after pruning of 90° rotated trees was 32%, 63% and 43% greater than 0, 45 and 90° orientation, respectively. Pruning increased total shoot regrowth more than 240% in all orientation treatments. Orientation did not influence the number of shoots, except for the 90° rotated, unpruned treatment which exhibited an increase in shoot number.

Mihaescu (1982), noticed a very slight effect on trunk and shoot girth when long lateral shoots of 3-year-old apple trees were bent down, compared with intact shoots (controls).

Miller (1984), trained trees of "Golden Delicious", "Triple Red Delicious", Red Yorking, and Styman-201 apple to the following forms, as free-standing trees, 1) central leader, 2) modified central leader, 3) modified leader, 4) open center, 5) double-T, and 6) free form (no training). He found that moderate pruning as employed in systems 3 and 6 resulted in significantly more shoots and total shoot growth.
2.1.2 Effect of soil management systems.

Baxter (1970), reported that peach trees growing in straw mulched strips 3 m. wide grew at a faster rate than the controls under permanent pasture. Apple trees growing in mulched strips 1.5 m. wide made more growth than control trees grown under cultivation.

Monstra et al (1972), declared that pear trees cvs. Coccia precoce and Butirra precoce morettini, trained as palmette were given 4 soil management treatments., mulching with straw, mulching with 0.1 mm. thick polyethylene, chemical weed control and traditional soil cultivation. There was no clear differences between treatments for Coccia precoce, trunk increment was observed with mulching.

Amirdzhanyan (1972), mentioned that pear trees cv. Abass Begi were planted in the semi-arid, stony ground of the Ararat basin which was kept under clean cultivation, green manure (clover), and permanent sward, all with irrigation. The best tree growth and most economic use of water were obtained from green manure treatment.

Kramer et al (1972), mentioned that under both soil management regimes (vegetation-free soil with subsequent green manuring and under clover-grass sward in the interrows), leaf analysis showed no dependence of tree N and P on soil management practices, but leaf K was increased in partial mulching treatment.

Fideghelli et al (1973), mentioned that peach trees cvs. Red haven trained as palmettes were managed as follows: 1) cultivation, 2) chemical weed control overall, 3) straw
mulching in the tree row and cultivation of the interrow and, 4) straw mulching in the row and chemical weed control in the interrow. Treatment (4), gave the largest increase in trunk diameter. Leaf analysis showed better mineral nutrition especially as regards phosphorus and potash in treatment (2), and (4).

Bacon (1974), indicated that a black polyethylene mulch placed around trickle irrigated apple and peach trees at planting, enhanced tree size.

Teskey and Wilson (1975), showed that the fabric portion of used tyres was evaluated and compared with hay as a mulching material for apple and peach trees. Fabric and old hay produced similar effects on soil moisture, soil temperature, soil density and penetration and weed and tree growth. Tyre fabric does not contribute significant amounts of plant nutrients to the soil, nor does, it contain any toxic elements.

Husabo (1975), declared that three rows of apple cvs close on M.111 and Red Gravenstein on M.4 and M.111 were grassed down, clean cultivated, treated with herbicides, or covered by black plastic sheeting 1.4 m. wide and 0.04 mm. thick. The best results in terms of top and root growth were obtained with black plastic sheeting treatment.

Vardaniya and Vardaniyal (1976), found that the best tree growth and development of tea was observed in mulched plots compared with clean cultivated plots.

Atkinson and Holloway (1976), found that apple trees cv. Cox on M26 rootstock were grown for 7 years in clean
herbicides strips with grasses and then subjected to competition from either a good cover of annual weeds. Neither weed treatment significantly reduced total shoot growth, although mean length was reduced by the annual weed treatment in the light crop and fruit size in both and full crops years.

Rahovic and Petrovic (1977), indicated that three pear and two peach cvs were planted at 4 X 1 m. and the interrows were mulched with, black polyethylene or were clean cultivated (control). Mulching increased trunk circumference, shoot length, and number of bearing branches compared with the control.

Jazbec (1977), reported that when 4 soil management systems were compared, covering the soil with black plastic film, gave the best apple tree growth. Mulching (with organic material) was next followed by clean cultivation.

Mullins et al (1978), compared 12 herbicides applied annually with black plastic mulch and mowed control under 1-year-old grapevine cv. Concord. They found that, plant vigour was highest when plastic mulch was used.

Kawecki (1979), compared 4 soil management systems were applied under 7 red currants cvs. (a) Gesatop 50 [simazine], at 3 Kg/ha, (b), Gesatop 50 at 6 Kg/ha, (c), mulching with bitumenous paper, (d) clean cultivation, or (e), were permanent sward. Manual weeding in (d), and mowing in (e) were carried out every 3 weeks. He found that the treatments had little effect on the beginning and termination of plant growth.
Bootsma (1979), pointed out that planting young apple trees in potting soil + mulching with mushroom compost + irrigation gave the best results, and increased growth of the second year by over 300%.

Oladokun (1980), indicated that when 4 cover crops and two types of organic mulch were used in comparison with clean weeding as control in establishing Quillou Coffee (Coffea canephora), cover crop and mulch treatments significantly affected leaf P and K only, while interactions between these treatments were insignificant for any of these nutrients.

Helal (1981), compared 4 soil management systems: clean cultivation, rice straw mulching, and herbicides (dalapon + paraquat, bromacil + diuron, and dalapon + bromacil) for navel orange orchard. He found that rice straw mulch caused the largest increase in non furiting shoot length, increase in leaf number percentage, leaf dry weight and leaf area as compared to all other treatments. Moreover, rice straw mulch system increased leaf N,P,K,Mg,Fe,Mn and Zn, while leaf Ca content was not affected.

Stanek (1983), showed that the growth of 4 apple cvs. (James Grieve, Belle de Boskoop, "Golden Delicious" and Starkrimson), was most vigorous with straw mulch, whereas the least growth was obtained with mowing or herbicide treatments.

Xu et al (1983), pointed out that film mulching of young apple trees in the first ten days of May followed by grass mulching in the second half of the month, increased
shoot length and width of the shoot tip by 121.6% and 103.4%, respectively.

Proctor and Crowe (1983), stated that apple cvs. summerland (normal bearing), and M2ecpur (spur bearing), on Malling (M26) rootstock were grown in pots under 100, 88, 50 or 12% full sunlight with grass, bare soil or white plastic ground covers. Macspur grew and flowered more than Summerland. Both varieties responded similarly to shade, but not to ground covers. The greatest increase in fresh weight, number of shoots and blossom clusters for Macspur resulted with white plastic (i.e. reflected light), while the least response occurred with grass; the reverse held for Summerland.

Frimanslund (1984), revealed that young pear trees grown in black plastic covered soil were vigorous in vegetative growth. Leaf N and chlorophyll a and b were also higher.

2.1.3. Effect of growth regulators

2.1.3.1. Effect of Gibberellin "GA3"

Webster and Crowe (1959), mentioned that the application of GA3 at full bloom markedly increased shoot length of apple trees. Also, Marcelle and Sirnoval (1963), reported that GA3 at 100 and 300 ppm enhanced shoot length of "Golden Delicious" apple trees. In accordance, Dennis and Edgerton (1966), pointed out that "GA3", KGA3 and "GA3+7" at concentrations ranged from 100 to 1,000 ppm. greatly stimulated shoot growth of five apple varieties. In this respect, Greenhalgh and Edgerton (1967), treated individual
limbs of McIntosh apple trees with potassium gibberellate at 0, 100, 200 and 400 ppm. at two different times of application, namely 2 days and 25 days after full bloom. He found that gibberellin treatments extended the period of apical meristem activity and increased shoot growth. Moreover, Grochowska (1970), indicated that repeating applications of "GA₃" at 2 to 500 ppm. increased the number of lateral shoots and leaf area of young apple trees. Also, llornete et al (1972), showed that spraying the young shoots of Williams pear trees with "GA₃" at 50 ppm, stimulated the internode elongation and increased the leaf surface area. In accordance, Pajput and Teskey (1978), applied "GA₃" at 10 or 100 ppm., BA at 10 or 100 ppm. or Alar at 500 or 1,000 ppm. to 2-year-old Red Delicious apple trees as soon as growth started. The indicated that trees treated with 100 ppm. "GA₃" produced the longest shoots with most leaves, whereas trees treated with Alar at 1,000 ppm. produced shoots with the greatest girth. In this concept, Kilany (1982), sprayed 29-year-old "Le conte" pear trees with "GA₃" at 50 and 100 ppm. on May, 1st., June, 15th. and July, 15th. He stated that, "GA₃" at 50 ppm. followed by 100 ppm. not only increased shoot elongation and internode length but also enhanced the formation of leaves on both bearing and non-bearing spurs (5 - 7 leaves in average). "GA₃" intensified the bearing of side branching of shoots and increased shoot diameter and leaf area compared with the control. Moreover, Curry and Williams (1983), showed that the application of "GA₃" at 25 ppm. at full bloom