

Selection of Low Chilling Requirements of F1 Pear Hybrid Seedlings

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Abstract: Production of new low chilling requirements genotypes is one of the important objectives in pear breeding program at Department of Fruit Breeding Research to suit warm Egyptian climate conditions. Evaluation of chilling requirement of both pear cultivars parents and seedlings of F1 hybrids were estimated after 200, 300, 400 and 500 chilling hours at 7°C. Cultivars used as parents ('LeConte', 'Hood' and 'Ya Li') were varied in chilling requirement. 'Hood' had the lowest number of chilling hours below 200 chilling hours to bud break, 'LeConte' blew 500 chilling hours while, 'Ya Li' failed to break bud at 500 chilling hours. Seedlings of 26 F1 hybrids 'LeConte' x 'Hood' (LH) and 15 F1 hybrids 'LeConte' x 'Ya Li' (LY) were varied in chilling hours according to its male parent. Using 'Hood' parent reduced chilling hours of LH progenies while 'Ya Li' parent increased chilling hours of LY progenies. Seedlings of F1 hybrids 8LH, 9LH, 10LH, 14LH, 16LH, 17LH, 19LH, 20LH, 24LH, 33LH, 35LH and 44LH were found to be promising progenies as they are low chilling hours.

Key words: 'LeConte' • 'Ya Li' • 'Hood' • Pear • Chilling requirement • F1 hybrid • Bud break

INTRODUCTION

The genus *Pyrus* belongs to the subfamily Pomoideae in the Rosaceae family. It contains at least 22 widely recognized primary species. The most important species are *P. communis*, (European pear) *P. serotina*, (Japanese pear) *P. nivalis* and *P. Calleryana*. The majority of *Pyrus* which have been examined were diploid ($2n=34$, $x=17$), a few of them were species polyploidy [1]. In Egypt, pear is grown in warm, sub-tropical climatic conditions. The only main cv. 'LeConte' grower in Commercial orchards pears, a yield that varies from year to year. This variability has been attributed mainly to lack of adequate cross pollination, fire blight and climatic changes. Climatic changes have been affected the regularity of chilling hours during winter period and affects the dormancy process of temperate fruits compromising yield and quality of production.

The effectiveness of chilling temperatures and optimum temperatures for chilling accumulation and the termination of endodormancy varies among species as well as among cultivars of the same species [2]. In addition insufficient chilling is a common problem, when growing deciduous fruit crops in warm winter climates [3]. The chilling requirements of floral and

vegetative buds is seldom fully satisfied under these low chill conditions leading to a condition termed delayed foliation [4,5]. Typical symptoms include delayed vegetative and floral bud break, poor fruit set sparse bud break levels and bud break speared over an extended period resulting in fruit and flowers occurring on the same shoot. In severe cases, a total lack of bud break may be occur [6]. Differences in chilling requirements also exist among bud types, with flowers buds having a lower chilling requirement than vegetative buds [7-9]. Adaptation to low-chilling regions utilizing hybrids of the high chilling hour requiring *P. communis* and low chilling hour requiring *P. pyrifolia* has been a goal of the pear breeding program at the University of Florida in the USA; and has resulted in the release of 'Flordahom' pear [10]. Similar efforts have begun in Mexico and Brazil [11,12]. In India and Pakistan, (semi-soft) interspecific hybrids or hybrids with *P. pashia* are also being grown [13]. 'Hood' cv. has chilling requirements ranging from 160-260 hours below 7.2°C whereas, 'LeConte' cv. has chilling requirements ranging from 600-800 hours and 'Ya Li' cv. ranges from 1000-1200 chill units [14,8]. Moreover Abd El-Aziz [15] found that 250 hours at 5°C were adequate to break the rest period for 'Hood' cv. while, 450 hours were adequate for 'LeConte' cv. On the

other hand 'Ya Li' cv. buds failed to terminate then endodormancy up till 650 hours. Also, Helwah and El-Sheikh [16] reported that accumulated chill units to bud break of 'LeConte' were to 342-402 chill units under Egyptian condition.

The main aim of this investigation is selecting new genotypes with low chilling requirements to suit warm climate as Egypt.

MATERIALS AND METHODS

This experiment was carried out during the four consecutive seasons of 2011-2014 at El-Qatta, Giza Governorate; it is located at latitude 30°12' N longitude 30°58' E. The climate of which is characterized by hot, dry summers and mild, wet winters. Average summer high/low temperatures are 40°C/25°C, while average winter high/low temperatures 22°C/6°C. It is common to experience several summer days with high temperatures greater than 45°C and may be winter nights with low temperatures slightly to 4°C.

In a previous study of hybridization among a female parent 'LeConte', male parents 'Hood' and 'Ya Li', we get some F1 hybrid seedlings, which are under study. In March 2011, three scions of each 44 genotypes (total 132 trees) including parents ('LeConte', 'Hood' and 'YaLi'), 26-15 seedlings F1 hybrid of 'LeConte' x 'Hood' (LH) and 'LeConte' x 'YaLi' (LY) respectively, were grafted on *Pyrus betulifolia* rootstock. In March 2012, trees were planted at a distance of 2 x 2 m and trained as spindle trees according to local commercial practices.

Twenty adult shoots at one year old (25-30 cm long) from each tree (total 2640 shoots), have been chosen randomly and cut off wrapped in moistened sackcloth and placed in plastic bags to avoid desiccation and kept in refrigerator at 7°C according to Lombard [14]. Four treatments (200, 300, 400 and 500 hours) were applied, each treatment comprised of three replicates. Fifteen shoots of treatment were removed from the refrigerator after each period i.e. 200, 300, 400 and 500 hours of chilling for forcing. Shoots were placed in containers with enough water to maintain the water level approximately half inch above the cut surface. The basal cuts of these shoots were renewed. The containers were placed in greenhouse at a mean temperature of 22 ± 2 °C and the water level was checked daily and changed every other day. Percentages of bud break were calculated after 21 days of forcing period, respectively. Buds were considered out of dormancy when 50 % showed bud opening as described by Felker and Robitaille [17].

Experimental Design: The experiments followed the Completely Randomized Block Design (CRBD) on (44 genotype x 3 trees) as 4 treatments were applied, each treatment comprised of three trees and each tree was considered as a replicate. The obtained data were subjected to analysis of variance (ANOVA) according to Snedecor and Cochran [18]. Assisat program was used to compare between means of combinations according to Waller and Duncan [19], at probability of 5%.

RESULTS AND DISCUSSION

Table 1 shows that there were statistical significant differences of bud break percentage of excised shoots among 'LeConte', 'Hood' and F1 hybrid 'LeConte' x 'Hood' (LH) pear after 200, 300, 400 and 500 chilling hours at 7°C, during 2013 and 2014 seasons.

After 200 chilling hours, the progeny 20LH gave the highest percentage of bud break (61.80%) while, the lowest percentage was 29.14% for progeny 13LH in the first season. In the second season after same chilling hours the highest percentage was 68.66% for progeny 17LH while, the lowest percentage was 30.83% for progeny 15LH. After 300 chilling hours, two progenies 16LH and 9LH gave the highest percentage without any significant difference (68.38% and 68.65%) respectively. However, the lowest percentage were for progenies 11LH, 13LH, 15LH, 18LH and 21LH ranged among (38.61% to 41.06%), in the first season. In the second season, progeny 17LH gave highest value (75.31%), however, two progenies 13LH and 15LH gave the lowest value without significant different (37.34% and 39.65%) respectively.

After 400 hours of chilling, data show that one progeny 9LH gave the highest percentage (78.70%) while, the lowest values for progenies 11LH, 13LH, 15LH and 18LH ranged between (44.44% to 46.34%), in the first season. At the same hours of chilling, in the second season there was one progeny 10LH had the highest percentage of bud break (84.95%) while, the lowest value was 40.94% for only one progeny 13LH. After 500 hours of chilling in the first season the progeny 9LH gave the highest percentage (86.82%), while the lowest values were 51.39% and 53.75% for two progenies 13LH and 15LH. In the second season, parent "Hood" cv. and progeny 17LH gave the highest percentage (84.47 and 83.94%) respectively. While, the lowest value for progeny 13LH was 53.98%.

Table 1: Bud break percentage of excised shoots of 'LeConte', 'Hood' and F1 hybrid 'LeConte' x 'Hood' (LH) pear after 200, 300, 400 and 500 chilling hours at 7°C during 2013 and 2014 seasons

| Genotypes | 2013 | | | | | 2014 | | | | |
|-----------|-----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|-----------|----------|
| | 200 Hours | 300 Hours | 400 Hours | 500 Hours | Mean | 200 Hours | 300 Hours | 400 Hours | 500 Hours | Mean |
| LeConte | 30.83 lm* | 39.98 h | 47.42 fg | 55.18 gh | 43.35 jl | 32.68 lm | 36.99 i | 43.60 jl | 54.55 hi | 41.96 m |
| Hood | 57.39 ab | 66.78 ab | 74.20 ab | 83.80 ab | 70.54ab | 52.22 de | 61.80 bc | 79.08 ab | 84.47 a | 69.39 bc |
| 1 LH | 41.58 gh | 54.06 de | 64.28 bc | 70.29 cd | 57.55 fg | 39.50 ij | 48.71 fg | 60.48 fg | 70.26 bc | 54.74 gh |
| 4 LH | 44.93 ef | 54.78 cd | 63.44 bc | 73.48 bc | 59.16 f | 45.75 ef | 55.36 de | 62.85 ef | 67.25 cd | 57.80 fg |
| 8 LH | 49.22 cd | 59.77 bc | 72.298 ab | 80.10 ab | 65.35 bc | 53.18 cd | 68.57 ab | 76.8 ab | 79.75 ab | 69.59 bc |
| 9 LH | 60.85 ab | 68.65 a | 78.70 a | 86.82 a | 73.76 a | 61.91 ab | 65.27 ab | 73.30 bc | 77.61 ab | 69.53 bc |
| 10 LH | 55.66 ab | 63.00 ab | 73.35 ab | 77.09 ab | 67.27 bc | 65.93 ab | 72.95 ab | 84.95 a | 77.47 ab | 75.33 a |
| 11 LH | 30.60 lm | 40.35 h | 46.34 g | 55.92 gh | 43.30 jl | 40.91 hi | 46.92 gh | 54.80 gh | 60.84 ef | 50.87 ij |
| 13 LH | 29.14 m | 38.61 h | 45.60 g | 51.39 i | 41.19 l | 33.14 jl | 37.34 i | 40.94 l | 53.98 i | 41.35 m |
| 14 LH | 53.68 ab | 62.73 ab | 69.79 ab | 78.17 ab | 66.09 bc | 44.07 fg | 54.84 ef | 63.12 ef | 74.35 ab | 59.09 fg |
| 15 LH | 30.60 lm | 36.93 h | 44.49 g | 53.75 i | 41.44 l | 30.83 m | 39.65 i | 51.44 hi | 57.62 gh | 44.89lm |
| 16 LH | 60.46 ab | 68.38 a | 70.51 ab | 73.83 bc | 68.30 bc | 53.02 cd | 63.52 ab | 72.61 bc | 78.92 ab | 67.02 cd |
| 17 LH | 58.60 ab | 62.88 ab | 70.92 ab | 76.35 ab | 67.19 bc | 68.66 a | 75.31 a | 81.65 ab | 83.94 a | 77.39 a |
| 18 LH | 31.33 jl | 39.34 h | 45.23 g | 54.67 hi | 42.64 jl | 40.52 hi | 45.04 gh | 52.94 gh | 59.23 fg | 49.43 jl |
| 19 LH | 59.50 ab | 67.03 ab | 70.81 ab | 78.01 ab | 68.84ab | 64.15 ab | 74.38 ab | 77.69 ab | 79.78 ab | 74.00ab |
| 20 LH | 61.80 a | 67.33 ab | 73.80 ab | 78.22 ab | 70.29ab | 56.34 bc | 68.24 ab | 76.74 ab | 78.20 ab | 69.88 bc |
| 21 LH | 33.90 ij | 41.06 h | 52.62 ef | 60.19 ef | 46.94 ij | 32.42 lm | 41.67 hi | 49.94 ij | 56.84 gh | 45.22lm |
| 24 LH | 57.69 ab | 61.19 ab | 70.04 ab | 76.33 ab | 66.31 bc | 54.01 cd | 65.55 ab | 68.32 cd | 77.38 ab | 66.31 cd |
| 25 LH | 38.66 hi | 48.19 g | 56.86 de | 59.46 fg | 50.79 hi | 41.71 gh | 46.62 gh | 54.68 gh | 61.14 ef | 51.04 ij |
| 26 LH | 38.96 hi | 50.75 fg | 57.84 de | 66.76 de | 53.58gh | 40.83 hi | 54.70 ef | 60.46 fg | 69.72 bc | 56.43 fg |
| 27 LH | 49.08 cd | 57.33 cd | 63.70 bc | 73.23 bc | 60.84 ef | 47.11 ef | 55.69 de | 59.46 fg | 71.85 bc | 58.53 fg |
| 28 LH | 43.81 fg | 55.81 cd | 63.85 bc | 72.23 bc | 58.92 fg | 41.34 gh | 54.59 ef | 67.84 cd | 70.10 bc | 58.47 fg |
| 32 LH | 40.33 gh | 53.48 de | 64.81 bc | 75.58 ab | 58.55fg | 39.93 ij | 53.48 ef | 63.70 ef | 69.53 bc | 56.66 fg |
| 33 LH | 51.64 bc | 60.96 ab | 70.34 ab | 76.37 ab | 64.83 cd | 47.08 ef | 57.88 cd | 64.53 ef | 75.95 ab | 61.36 ef |
| 35 LH | 51.24 bc | 57.97 cd | 65.16 bc | 71.70 bc | 61.52de | 56.18 bc | 61.67 bc | 69.39 cd | 70.74 bc | 64.50 de |
| 36 LH | 46.66 de | 51.28 fg | 61.02 cd | 66.09 d | 56.26 fg | 41.36 gh | 48.71 fg | 57.89 fg | 65.78 de | 53.43 hi |
| 38 LH | 42.24 fg | 51.92 ef | 69.10ab | 71.18 bc | 58.61 fg | 44.77 ef | 55.55 de | 66.50 de | 71.20 bc | 59.50 fg |
| 44 LH | 56.91 ab | 67.17 ab | 74.69 ab | 79.99 ab | 69.69ab | 62.06 ab | 70.56 ab | 79.00 ab | 78.75 ab | 72.59ab |
| Mean | 46.69 d | 55.39 c | 64.00 b | 70.49 a | | 47.56 d | 56.48 c | 64.81 b | 70.61 a | |

*Means with the same letters are insignificantly different at 5% of Duncan's multiple range tests.

Table 2: Bud break percentage of excised shoots of 'LeConte', 'Ya Li' and F1 hybrid 'LeConte' x 'Ya Li' (LH) pear after 200, 300, 400 and 500 chilling hours at 7°C during 2013 and 2014 seasons

| Genotypes | 2013 | | | | | 2014 | | | | |
|-----------|------------|-----------|-----------|-----------|----------|-----------|-----------|-----------|-----------|----------|
| | 200 Hours | 300 Hours | 400 Hours | 500 Hours | Mean | 200 Hours | 300 Hours | 400 Hours | 500 Hours | Mean |
| LeConte | 30.83 bc * | 39.98 ab | 47.42 ab | 55.18 ab | 46.04 a | 32.68 ab | 36.99 bc | 43.60 bc | 54.55 ab | 41.96 bc |
| Ya Li | 0.00 f | 7.15 f | 26.90 g | 37.42 e | 17.87 i | 0.00 h | 5.55 h | 24.31 fg | 35.51 c | 16.34 i |
| 1LY | 26.04 cd | 33.17 c | 36.60 ef | 42.90 de | 34.68 f | 25.77 bc | 28.60 ef | 34.58 ef | 50.00 ab | 34.74 fg |
| 2LY | 37.66 a | 41.35 ab | 52.65 a | 47.52 bc | 44.79 ab | 40.74 a | 47.63 a | 57.31 a | 59.31 a | 51.25 a |
| 3LY | 13.45 e | 19.33 e | 32.66 fg | 48.46 bc | 28.47 gh | 11.74 g | 15.12 g | 39.52 cd | 54.16 ab | 30.14 gh |
| 4LY | 16.70 e | 25.35 d | 37.10 de | 45.22 cd | 31.09 g | 15.02 ef | 22.52 fg | 34.28 ef | 43.86 bc | 28.92 h |
| 5LY | 14.85 e | 23.69 de | 30.17 fg | 37.59 e | 26.57 h | 12.21 fg | 18.24 g | 20.84 g | 33.99 c | 21.32 i |
| 6LY | 23.38 d | 33.09 c | 45.10 ab | 53.95 ab | 38.88 de | 26.45 bc | 35.72 bc | 54.01ab | 61.94 a | 44.53 bc |
| 7LY | 32.08 b | 40.11 ab | 38.02 cd | 55.01 ab | 41.30 bc | 30.90 ab | 35.06 bc | 43.57 bc | 55.14 ab | 41.17 cd |
| 8LY | 35.26 ab | 41.07 ab | 47.61 ab | 54.81 ab | 44.69 ab | 32.22 ab | 41.16 ab | 45.79 ab | 53.61 ab | 43.20 bc |
| 10LY | 33.05 ab | 45.59 a | 52.83 a | 59.53 a | 47.75 a | 36.34 ab | 43.35 ab | 48.40 ab | 54.01ab | 45.53 bc |
| 13LY | 30.49 bc | 38.37 bc | 42.94 bc | 53.68 ab | 41.37 bc | 37.37 ab | 35.50 bc | 43.47 bc | 52.44 ab | 42.19 bc |
| 14LY | 25.96 cd | 32.39 c | 41.12 bc | 52.18 ab | 37.91 de | 24.19 cd | 32.83 de | 49.23 ab | 49.50 ab | 38.94 de |
| 16LY | 37.21 a | 40.12 ab | 46.18 ab | 54.85 ab | 44.59 ab | 35.65 ab | 38.50 bc | 44.83 ab | 57.20 a | 44.05 bc |
| 17LY | 30.70 bc | 42.37 ab | 45.86 ab | 56.51 ab | 43.86 ab | 36.03 ab | 43.10 ab | 52.82 ab | 59.58 a | 47.89ab |
| 18LY | 26.65 cd | 37.39 bc | 45.53 ab | 51.66 ab | 40.31 cd | 27.02 bc | 34.72 cd | 39.13 de | 49.97 ab | 37.71 ef |
| 19LY | 22.91 d | 33.40 c | 42.36 bc | 48.68 bc | 36.83 ef | 21.06 de | 37.69 bc | 49.22 ab | 53.57 ab | 40.38 cd |
| Mean | 25.72 d | 33.76 c | 41.83 b | 50.30 a | | 26.20 d | 32.49 c | 42.64 b | 51.67 a | |

*Means with the same letters are insignificantly different at 5% of Duncan's multiple range tests.

Table 3: Bud break percentage of excised shoots of three parents 'LeConte', 'Hood' and 'Ya Li' pear after 200, 300, 400 and 500 chilling hours at 7°C during 2013 and 2014 seasons

| Genotypes | 2013 | | | | | 2014 | | | | |
|-----------|-----------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|---------|
| | 200 Hours | 300 Hours | 400 Hours | 500 Hours | Mean | 200 Hours | 300 Hours | 400 Hours | 500 Hours | Mean |
| LeConte | 30.83 b | 39.98 b | 47.42 b | 55.18 b | 46.04 b | 32.68 b | 36.99 b | 43.60 b | 54.55 b | 41.96 b |
| Hood | 57.39 a | 66.78 a | 74.20 a | 83.80 a | 70.54 a | 52.22 a | 61.80 a | 79.08 a | 84.47 a | 69.39 a |
| Ya Li | 0.00 c | 7.15 c | 26.90 c | 37.42 c | 17.87 c | 0.00 c | 5.55 c | 24.31 c | 35.51 c | 16.34 c |
| Mean | 29.40 d | 37.97 c | 49.51 b | 58.80 a | | 28.30 d | 34.78 c | 48.99 b | 58.17 a | |

Means with the same letters are insignificantly different at 5% of Duncan's multiple range tests.

The data represented in Table (1) show that mean four chilling treatments of bud break percentage of progenies LH and their parents, progeny 9LH gave the highest mean percentages (73.76%) comparing with other genotypes while, two progenies 13LH and 15LH gave the lowest mean percentages (41.19% and 41.44%) respectively, in the first season.

In the second season, the highest mean percentages for two progenies 10LH and 17LH were 75.33% and 77.39% respectively. progeny 13LH and parent 'LeConte' cv. gave the lowest mean percentages (41.35% and 41.96%) respectively.

The results based on the obtained data Table (1) show that, dormancy period (opening of 50% of buds) of "Hood" cv. and progenies 8LH, 9LH, 10LH, 14LH, 16LH, 17LH, 19LH, 20LH, 24LH, 33LH, 35LH and 44LH were broken at 200 hours in both two seasons except 8LH in first season and 14LH in second season. Moreover, dormancy of buds of progenies 1LH, 4LH, 26LH, 27LH, 28LH, 32LH 36LH and 38LH were broken at 300 hours of exposure in both two seasons. Whereas, progenies 11LH, 15LH 21LH and 25LH were broken at 400 hours in two seasons except 11LH in first season and 15LH in second season. However, buds of 'LeConte' cv., progenies 13LH and 18LH were broken at 500 hours in both seasons.

Data in Table (2) shows that there were statistical significant differences of bud break percentage of excised shoots of 'LeConte', 'Ya Li' and F1 hybrid 'LeConte' x 'Ya Li' (LY) pear after 200, 300, 400 and 500 chilling hours at 7°C during 2013 and 2014 seasons. After 200 hours progenies 16LY and 2LY gave the highest value (37.66% and 37.21%) respectively, in first season. Whereas, in second season one progeny 2LY gave the highest percentages (40.74%). While, the lowest values after the same chilling hours was parent 'Ya Li' (0.00%) in both seasons. After 300 chilling hours, progeny 10LY gave highest percentage (45.59%) in the first season; in the second season one progeny 2LY gave the highest value (40.74%). However, parent 'Ya Li' had the lowest value in the two seasons (7.15 % and 5.55%) respectively. After 400 chilling hours, bud break percentages two progenies 2LY and 10LY had the highest percentage of bud break

(52.65% and 52.83%) respectively, while, the lowest value was for parent 'Ya Li' (26.90%) only in the first season. In the second season the highest value was 57.31% for progeny 2LY while, the lowest value was 20.84% for progeny 5LY. After 500 chilling hours, showed progeny 10LY gave the highest value (59.53%) in first season; while, four progenies 2LY, 6LY, 16LY and 17LY gave the highest values ranging between (61.94% to 57.20%) in the second season. Parent 'Ya Li' and progeny 5LY gave the lowest percentages ranged between (33.99% to 37.59%) in both seasons.

Data in Table (2), show significant differences were observed among mean four chilling treatments of bud break percentages of progenies LY and their parents under study. In first season the parent 'LeConte' cv. and progeny 10LY gave the highest values (46.04% and 47.75%) respectively, the other parent 'Ya Li' cv. had the lowest value (17.87%). In the second season, progeny 2LY had the highest mean percentage (51.25%) while, the lowest mean for 'Ya Li' cv. and progeny 5LY (16.34% and 21.32%) respectively without any significant differences. Treatments 200 and 300 chilling hours in Table (2) failed to break bud dormancy (opening of 50% of buds) of any genotypes in both seasons. While, bud dormancy period of progenies 2LY and 10LY were broken at 400 hours in first season and progenies 2LY, 6LY and 17LY were broken at 400 hours in second season. Bud dormancy of 'LeConte' cv. and progenies 6LY, 7LY, 8LY, 10LY, 13LY, 14LY, 16LY, 17LY and 18LY were broken at 500 hours in first season. While, parent 'LeConte' and progenies 1LY, 2LY, 3LY, 6LY, 7LY, 8LY, 10LY, 13LY, 16LY, 17LY, 18LY and 19LY broke their bud dormancy at 500 hours in the second season. Table (3): shows that there were statistical significant differences in bud break percentage of excised shoots of three parents "LeConte", 'Hood' and 'Ya Li' pear after 200, 300, 400 and 500 chilling hours at 7°C during 2013 and 2014 seasons. 'Hood' cv. gave the highest bud break percentages were ranged (52.22% to 84.47%), followed 'LeConte' cv. with significant differences ranged (32.68% to 55.18%). While 'Ya Li' cv. gave the lowest percentages were ranged (0.00% to 37.42%) at all chilling hours treatments in both seasons.

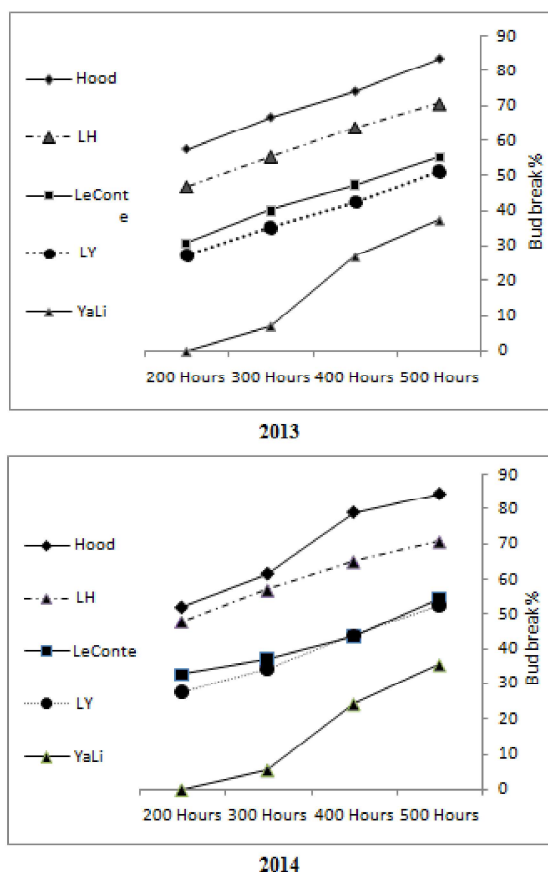


Fig. 1: Bud break percentage of excised shoots of 'LeConte', 'Hood', 'Ya Li', mean F1 hybrids 'LeConte' x 'Hood' (LH) and mean F1 hybrids 'LeConte' x 'Ya Li' (LY) pear after 200, 300, 400 and 500 chilling hours at 7°C during 2013 and 2014 seasons.

These results indicated that a positive relationship occurred between chilling requirements and depth of endo-dormancy. 'Ya Li' had the longest period and needed higher number of chilling hours to break buds dormancy compared with 'LeConte' cv. however, 'Hood' cv. requires the lowest chilling hours for dormancy break. In addition, the results proved that there was a gradual increase in bud break percentage for studies genotypes as chilling hours increased. Also, 500 hours gave the highest significant values of bud break percentage for all genotypes followed by 400, 300 and 200 hours respectively. Clearly, the difference in the chilling requirements due to the genotype differences among the parents and progenies. These results agree with Abd El-Aziz [15] who reported that, 'Hood' and Flordahome cvs. required less chilling (fewer 250 hours) requirements to terminate its endo-dormancy of buds followed by 'Tsu LI' (fewer 350 hours) and 'LeConte' (450 hours). However, 'Ya

Li' required high chilling hours (650 hours) failed to bud break dormancy. Also, Helwah and El-Sheikh [16] reported accumulated chill units at bud break of 'LeConte' were to 342-402 chill units under Egyptian condition. Moreover, Lombard [14] found that both Flordahome and 'Hood' had chilling requirements ranging from (160 to 250 hours) below 7°C while, 'LeConte' cv. had chilling requirements ranging from (600 to 800 hours). In addition, Arzani and Mousavi [20] working on some Asian pear cultivars showed that all the studied cultivars needed different chilling requirements. The range of chilling requirements were 400 hours for KS6 and KS13, 600 hours for KS8, KS9, KS11 and KS14, 700 hours for KS10 and 800 hours for KS7 and KS12 at 4±1°C. Differences of chilling hours among cultivars used as parents and progenies, are due to the difference in genotypes according Gebauer *et al.* [21] and Atkinson *et al.* [22].

Fig. (1) show that bud break percentage of excised shoots of parents ('LeConte', 'Hood' and 'Ya Li'), mean of individuals F1 hybrids of 'LeConte' x 'Hood' (LH) and 'LeConte' x 'Ya Li' (LY) pear after 200, 300, 400 and 500 chilling hours at 7°C during 2013 and 2014 seasons. Data in Fig. (1) show that mean of individuals progeny LH at 200 chilling hours was (46.93% and 47.96%) located between parent 'Hood' which low chilling hours (57.39% and 52.22%) and other parent 'LeConte' (30.83% and 32.68%) in both seasons respectively. Also, at 300 hours mean of individuals progeny LH was 55.47% and 57.06% this value located between parents 'Hood' (66.78% and 61.80%) and 'LeConte' (39.98% and 36.99%) in two seasons respectively. after 400 chilling hour mean of individuals progeny LH was 63.88% and 65.11% this value located between parents 'Hood' (74.20% and 79.08%) and 'LeConte' (47.42% and 43.60%) in both seasons respectively. mean of individuals progeny LH at 500 chilling hours was 70.70% and 70.74% located between parent 'Hood' (83.80% and 84.47%) and other parent 'LeConte' (55.18% and 54.55%) in both seasons respectively. Fig (1), show that mean of individuals progeny LY at 200 chilling hours was (27.30% and 27.68%) located between parent 'Ya Li' which low chilling (0.0%) and other parent 'LeConte' (30.83% and 32.68%) in both seasons respectively. Also, at 300 hours mean of individuals progeny LY was 35.20% and 34.22% this value is located between parents 'Ya Li' (7.15% and 5.55%) and 'LeConte' (39.98% and 36.99%) in two seasons respectively. After 400 chilling hour mean of individuals progeny LY was 42.52% and 43.98% this is value located between parents 'Ya Li' (26.90% and 24.31%) and 'LeConte' (47.42% and 43.60%) in both seasons respectively. Means of individuals progeny LY at 500 chilling hours was 51.19% and 52.70% which are located between

parents 'Ya Li' (37.42% and 35.51%) and other parent 'LeConte' (55.18% and 54.55%) in both seasons respectively. This shows that most of F1 progenies varied in chill hours according male parent where, 'Hood' parent reduced chill hours of (LH) progenies while, 'Ya Li' parent increased chill hours of (LY) progenies. In addition Sato *et al.* [23] showed that the variation in the family mean of plant height in 1-year-old seedlings in Japanese pear could be largely explained by the degrees of inbreeding,

CONCLUSION

'Hood' required lower number of chilling hours to break buds than dormancy 'LeConte' which required hours however; 'Ya Li' needed higher chilling hours to break bud dormancy. Progenies 8LH, 9LH, 10LH, 14LH, 16LH, 17LH, 19LH, 20LH, 24LH, 33LH, 35LH and 44LH whose, lower chill hours at 200 hours can be select suit for warm Egyptian climate.

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