A COMPARATIVE STUDY ON GROWTH AND FRUITING OF SOME CLONES OF PECAN TREES GROWN UNDER BENI – SUEF GOVERNORATE CONDITIONS

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ABSTRACT: *The high variability in most characteristics among the different pecan genotypes leads to the importance of selecting the most promising pecan individual trees which give wide range of selecting for planting accordingly the region environmental conditions. Thus, the present study aimed to investigate the performance of twelve selected clones of pecan (Carya illinoensis (Wang) K. Koch) trees grown at the Horticulture Station Orchard of Seds, Beni-Suef Governorate, Egypt during 2009 and 2010 seasons. Generally, there is a positive relationship between tree performance and shoot growth characteristics, where, clone No. (1) was the superior in this concern. Moreover, the same clone (No. 1) recorded the highest No. of all bud development stages (dormant, vegetative and starting buds for staminate and pistillate flowers) as well as the highest fruit set (%) as it recorded (82.11 & 83.72 %) in both seasons. The period in which pollen shed coincides with stigma receptivity varied between pecan clones under study, where, some of them can be classified as protandrous (Type, 1) as 1, 7, 10 ,14 , 16 and 17 clones, while, others (3, 8, 12, 13 and 19 clones) as protogynous (Type, 2). Moreover, clones 5 and 8 can be good pollinators for most other studied clones. As for chuck cracking of fruits and harvesting dates, clones 5 and 16 were the earliest, besides, they had excellent kernel percentage, while, clone No. (3) was the least. Pecan clones with high nut weight had lower No. of nuts/kg. where, the maximum yield was obtained from clones 1 and 16 (12.04 and 9.45 kg./tree) as an average of both seasons. Kernel of clone No. 16 was the richest in oil content, while No. 19 was the poorest. Fatty acids composition of the oil extracted from the kernel of the studied clones showed that, the total unsaturated acids exceed the saturated ones. The main unsaturated fatty acid was Oleic acid; however, Palmetic acid was the most abundant saturated acid. The content of Linoleic acid is much lower than Oleic acid. In general, these properties in pecan oils were similar to extra-virgin oils. From the above mentioned results, we may recommend clones No. 1 and 16 for their high productivity and fruit quality and can be recommended to take their scions in vegetative propagation for further expansion at Middle Egypt region.*

Key words: *Pecan trees, Carya illinoensis, seedy trees, dormant, vegetative and flowering buds, production capacity, fruit set, fruit kernel , oleic acid, nuts and dichogamy phenomenon.*

INTRODUCTION

The pecan [*Carya illinoensis* (Wangenh.) K. Koch] is a deciduous tree native to the North America. It belongs to the *Juglandaceae* family as English walnut, black walnut and hickory. The climate of the native range of pecan is characterized by long, hot summers and moderately cool winters and accordingly has low chilling requirements (Pena, 1995). Regions having an arid/semi-arid growing season and will supplied with irrigation are optimum for commercial pecan production. Other organs of production has been extended to Australia, South Africa, Isreal, Argentina, Chile and Brazil (Do Prado *et al.*, 2009); therefore, it may be highly productive under Egypt environmental conditions compared to Persian walnuts and other nut trees (Wood, *et al.*, 1994). The pecan nut nutrient, micronutrient and phytochemical compound composition as well as the pecan nut color varies depending on growth conditions, water availability, location, weather, horticulture practices, cultivar and maturity level (Venkatachalam, 2004 and Shahidi & Naczk, 2004). Pecan nut contains high levels of lipids and significant quantities of proteins, carbohydrates in addition to many minerals and vitamins. Pecan nut is rich in monounsaturated, polyunsaturated fatty acids and contains few saturated fats and cholesterol free (Silva *et al.*, 1995 and Oro *et al.*, 2008). The pecan nut presents bioactive molecules, such as sterols, tocopherols and phenolic compounds in its composition. These compounds present antioxidant activity through the stabilization of free radicals molecules that contain an isolated electron which leading to rancidity and the development of unpleasant odors, flavors and loss of nutritional value (Kornsteiner *et al.*, 2006 and Do Prado *et al.*, 2009). The small acreage of this crop in Egypt is mostly due to scant knowledge of varieties cultivation and growth habit of pecan tree (Hamoda, 1982 and Andersen, 1995). Pecan clones for testing as potential cultivars can be selected from controlled crosses made by plant breeders; directly from native trees and from variety seedling trees found abundantly in orchards where these seedlings offspring from open – pollinated flowers of improved cultivars. There is high variability in most characteristics among the different pecan genotypes and must be selected for the most promising pecan individual trees to evaluate the criteria of these promising clones which give wide range of selecting for planting accordingly the region environmental conditions. Some factors that have to be taken into consideration when selecting a variety are regular production capacity, tree growth, branching properties, nut size and quality, kernel percentage, maturity and pollination characteristics (Herrera,1985; Yao *et al.*, 2004 and Thomposon, 2005). The flowering system in pecan trees must be understanding and it is necessary for choosing appropriate cultivars in the design of productive orchards and for monitoring bloom in orchards as an aid to diagnosing problems and routine management (Grauke & Thomposon, 2007). Pecan trees are monoecious where male and female flowers separate, but on the same tree

and bloom at different times (dichogamous flowering). Some of pecan cultivars are protandrous where pollen shedding before pistil receptivity (Type I). Another cultivars or clones are protogynous, pistil receptivity before pollen shedding (Type II) (Thompson & Romberg, 1985; Grauke&Thompson, 1996 and Sudheer *et al.*, 2005). Therefore, when planning an orchard, growers should study records of cultivar bloom patterns over several years (Worley *et al.*, 1992) and always recommended Type I to be planted with Type II for maximum pollination and subsequent productivity (Sibbett, *et al.*, 1987).

Emphasis in the current research has been placed on selection for the highest genotype in growth, yield and good quality. Therefore, the aim of this study was to evaluate growth, flowering, fruiting and kernel oil content of some seedy pecan clones grown under Beni-Suef Governorate environmental conditions. This evaluation may be essential with the purpose of selecting superior pecan genotypes based on the characteristics of cropping with best fruit quality. Hence, recommended the superior pecan clones and propagated vegetatively.

MATERIALS AND METHODS

The present study was carried out at the Horticultural Station Orchard of Seds, Beni-Suef Governorate during two successive seasons of 2009 and 2010 on seedy pecan trees grown in silty clay loamy soil. The selected trees were 13 years old at the beginning of the study (2009). Pecan seedlings were produced in the nursery of Horticultural Research Institute, Giza, Egypt and planted at January 1996 in one raw, 5 meters a part at seds orchard and received the same horticulture managements under flood irrigation system. A preliminary study was conducted in 2008 season on twenty individual seedy pecan trees in the experimental orchard and then twelve promising trees were selected for the present study. The clones were set in a Complete Randomized Block design and grown under the same environmental conditions. Some physical and chemical properties of the experimental soil are shown in Table (1) according to Wilde *et al* (1985).

Table (1): Chemical and mechanical analysis of the experimental soil.

pH	EC (mill mhos/cm)	SP	Anions (mill equivalent /Liter)				Cations (mill equivalent /Liter)			
			So_4^{2-}	Hco_3^-	Co_3^{2-}	Cl^-	K^+	Na^+	Mg^{2+}	Ca^{2+}
8.1	0.61	47	5.6	5.5	-	1.2	1.9	6.8	4.5	8.2

Particles size distribution				Texture
Coarse sand	Fine sand	Silt	Clay	
6.15 %	20.40 %	32.45 %	41 %	Silty clay loam

Environmental conditions of Beni-Suef Governorate during 2009 and 2010 seasons are presented in figures (1, 2 &3) as follows:

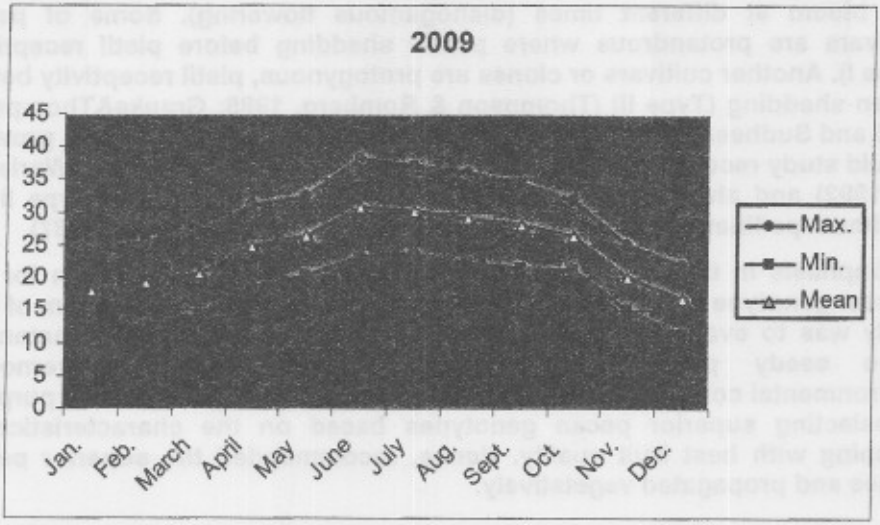

Figure (1): Average monthly temperature (C°) at Beni-Suef Governorate, Egypt during 2009 season.

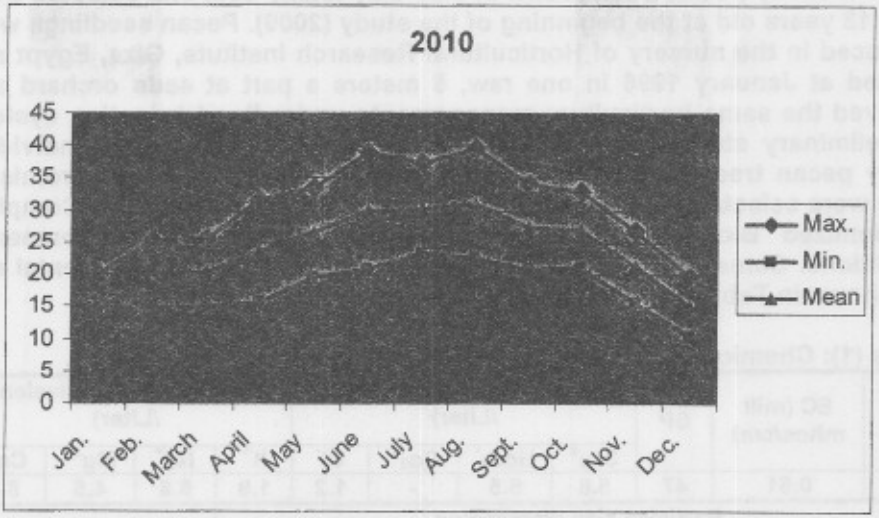

Figure (2): Average monthly temperature (C°) at Beni-Suef Governorate, Egypt during 2010 season.

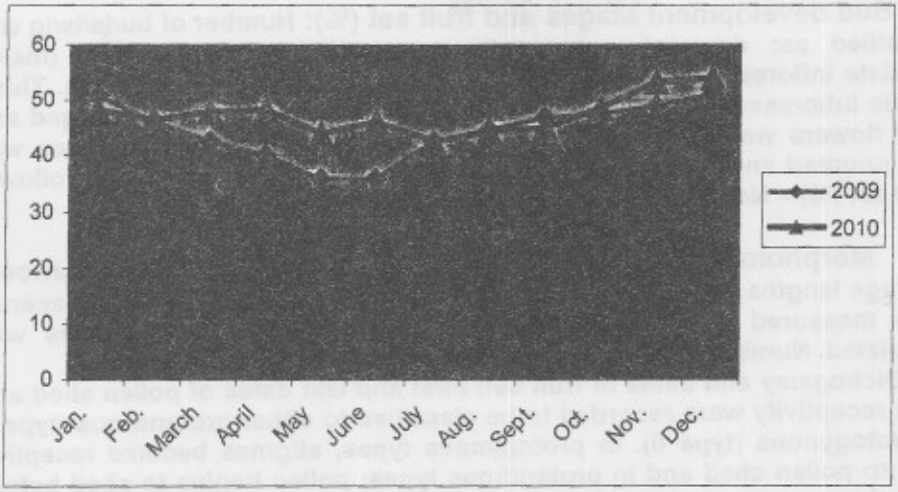

Figure (3): Average monthly relative humidity (%) at Beni-Suef Governorate, Egypt during 2009 and 2010 seasons.

Our study were based on the results of an investigation was previously carried out to evaluate some pecan varieties during 2008 and 2009 seasons under Giza Governorate environmental conditions by Abu-Taleb *et al.*, (2010).

The following characteristics were studied.

I. Vegetative growth characters

I.1. Tree dimensions and canopy shape: Tree trunk circumference (cm) was measured at uniform height 50 cm. from soil surface using calibrated tape, tree height and canopy circumference (cm) at the widest point were recorded at December of each season. Tree canopy shape was classified from rounded to pointed.

I.2. Shoot growth parameters: 40 twigs / experimental tree (10 each direction) were selected in both seasons at random and tagged for measuring twig length (cm.), No. of fully developed shoots/twig, shoot length & diameter (cm.), leaves/shoot, leaflets/ leave, No. of internodes /shoot, as well as leaflet area (cm^2) according to Ahmed and Morsy (1999) using the following equilibration = 0.53 (length X width) + 1.66. Leaf color: rates on 1-10 from dark green to brown, based on Munsell Color Chart for Plant Tissue.

II. Flowering characteristics

At the beginning of April of each season, the previously selected twigs were measured for the followings:

II.1. Bud development stages and fruit set (%): Number of buds/twig was classified as: dormant – vegetative – staminate inflorescence (male), pistillate inflorescence (female) and total No. of buds was calculated. Thirty female inflorescences distributed around the tree were selected, tagged and their flowers were counted. Number of fruitets on each inflorescence was also counted and recorded. Fruit set percentage was calculated as follows: Fruit set (%) = No. offsetting fruitlets / No. of female flowers × 100

II.2. Morphological characteristics of flowering inflorescences: Average lengths of middle & the two lateral panicles/staminate inflorescence were measured and average of total length of the three panicles was calculated. Number of flowers / pistillate inflorescence was counted.

II.3. Dichogamy and dates of fruit set: First and last dates of pollen shed and pistil receptivity were recorded to be classified to either protandrous (type I) or protogynous (type II). In protogynous types, stigmas become receptive prior to pollen shed and in protandrous types; pollen begins to shed before the stigmas are receptive. At the end of blooming period, the date of beginning of fruit set was determined.

III. Yield and fruit quality characteristics: Pecan fruits were harvested from Sept. - Oct. (depending on clones) as soon as the outer inedible hull (also called a shuck, husk or bur) has spilt and the shells are brown and once the hull can be removed easily from the nuts, the outer hull was removed promptly by hands so the nuts can dry properly, then fresh weight of fruit and hull (gm) was determined.

III.1. Dates of shuck dehiscence, harvesting and leaf abscission were recorded. After harvesting and hulling the nuts were dried properly to reduce kernel moisture, prevent molds developing and a disagreeable flavor (rancidity) and prolonged nut storage life. Nuts were dried under room temperature of about 20-30 C° for about 3-4 weeks by spreading in a single layer on a tray or screen to allow good air circulation and often stirred.

III.2. Yield: Average number of nuts/kg and weight of total yield/tree (kg.) were determined at harvest after hulling.

III.3. Fruit quality A random sample of 50 nuts/each replicate was tested for nut physical properties as:

-Nut characteristics: Nut dimensions; length and width as well as height were recorded.Nut shape based on nut length to height ratios as classified by Grauke & Thompson (2007). Apex & base shape (acute, acuminate or obtuse) and cross section form is described as laterally compressed, round or flattened. Dorsal grooves and kernel color was also described. Nut volume determined as described by Dodge (1944). Nut shell touch was classified as

rough or smooth. Nut shell hardness: A radial cut at tip, middle and base of nut, perpendicular to suture, and hardening is recorded as 0= no hardening, 1= hardening at apex, 2= hardened to middle, 3= hardened to base of nut (Kaniewski, 1965).Nut weight was determined by weighting 50 nuts/tree. Kernel weight was determined after the nuts were cracked using hand- held pecan cracker and then nut shell weight (gm.) was calculated by differences. Kernel percentage was calculated according to the following equation: Percentage of kernel = Average weight of kernel / Average weight of nut X 100.

-Kernel oil content and fatty acid composition: Samples were kept in sealed freezer bags at -18C° until analyzed. Before oil extracting pecan kernels were cracked using hand-held pecan cracker. Oil content was determined by extracting the oil from the dried samples by means of Soxhelt Fat Extraction using petroleum ether as a solvent at 60-80C° boiling points. Fatty acids composition were identified according to (A.O.A.C., 1990).

- **Statistical analysis:**

The obtained data during the study in both seasons were tabulated and statistically analyzed by ANOVA according to (Snedecor and Cochran, 1980).The differences between treatment means were compared using the least significant differences (L.S.D.) at 0.05 level.

RESULTS AND DISCUSSION

I. Vegetative growth characters

I.1. Tree dimensions and canopy shape:

Data presented in Table (2) showed the mean of the two seasons of 2009 & 2010 where each clone was presented by an individual tree. Clear differences among clones of pecan trees were noticed. The tallest clone was No. 8 (14.50 m.) followed by clone No.7 (13.25 m.). On the contrary clone No. 13 was the shortest one (6.00 m.) and the other clones were intermediate between them. Meantime, clone No. 1 surpassed the other clones in concern of trunk and canopy circumference followed by clone No. 5 while clone No.13 had the least trunk and canopy circumference. As for canopy shape, it can be observed that clones No. 7 & 8 have pointed shape while the others are rounded. Generally, the differences in growth vigour may be due to the differences in growth habit. Angles at which limps branch from the trunk or other limbs, affect confirmations and indirectly the strength of the frame work of the tree. This characterization can be coincide with the basis of identification of Hamoda, 1982; Sari El-Deen, 1993 ; Awad, 2002 and Abu-Taleb *et al.*, (2004) and (2010) on pecan varieties.

Table (2): Tree growth of the studied pecan clones grown under Beni Suef Governorate conditions (average of, 2009 and 2010 seasons).

Treatments	Tree height (m)	Tree trunk circumference (cm)	Canopy circumference (m)	Head shape
Clone No.1	11.5	99.5	23.75	Rounded
Clone No.3	12.75	90.5	21.25	Rounded
Clone No.5	13.00	91.75	20.00	Rounded
Clone No.7	13.25	82.25	15.00	Pointed
Clone No.8	14.50	81.25	17.38	Pointed
Clone No.10	12.00	77.50	18.75	Rounded
Clone No.12	11.25	79.00	19.75	Rounded
Clone No.13	6.00	57.50	13.25	Rounded
Clone No.14	11.75	85.50	20.00	Rounded
Clone No.16	10.75	81.75	19.75	Rounded
Clone No.17	9.00	75.00	20.25	Rounded
Clone No.19	9.75	64.00	19.75	Rounded

I.2. Shoot growth parameters:

Data in Table (3) revealed that, significant differences were observed among clones in shoot growth parameters. Clones No.1 and No.3 were superior in twig length (38.61 & 40.21 and 38.20 & 40.23 cm.) and number of shoots/twig (3.53 & 4.36 and 3.02 & 3.78) in both seasons, respectively and the differences between the last two clones were not significant. On the contrary, clone No. 7 was the least in this respect (21.97 & 23.03 and 1.87 & 1.95) in 2009 and 2010 seasons, respectively. As regard to shoot length, clone No. 17 gave the tallest and widest shoots (19.84 & 18.37 and 0.65 and 0.75 cm.) in both seasons, respectively. On the other hand, clone No.7 produced the shortest shoot (8.14 and 6.08 cm.) while clone No. 3 gave the least values of shoot diameter (0.42 and 0.50 cm.) in both seasons, respectively. Number of internodes/shoot was the highest in clone No. 5 and lowest in clone No. 14 as compared with other genotypes in both seasons. The number of leaves/shoot was pronounced significantly in No.13 while clone No.3 had the least values during both seasons (Figure, 4). In addition, clone No.1 recorded the highest No. of leaflets /leave (17.33 & 18.43) and leaflet area (48.44 & 43.24 cm^2) while the lowest values were (12.14 & 13.72) for clone No.14 and (17.49 & 16.83) for clone No. 12, in both seasons, respectively. In addition, it can be identified the studied clones by leaf color characteristic which varied from dark green to yellow green. Morphological and biological characters are used to evaluate germplasm clones or cultivars which lead to wide variations in growth. This identification can be consistent with the results reported by Awad (2002) and Abu-Taleb *et al.*, (2010).

Table (3): Shoot growth parameters of the studied pecan clones grown under Beni Suef Governorate conditions during 2009 and 2010 seasons.

Treatments	Twig length (cm)		No. of shoots/ twig		Shoot length (cm)		Shoot diameter (cm)	
	2009	2010	2009	2010	2009	2010	2009	2010
Clone No.1	38.61	40.21	3.53	4.36	18.87	14.70	0.59	0.70
Clone No.3	38.20	40.23	3.02	3.78	13.09	9.38	0.42	0.50
Clone No.5	28.66	36.78	2.46	2.44	11.13	9.54	0.53	0.52
Clone No.7	21.97	23.03	1.87	1.95	8.14	6.08	0.50	0.58
Clone No.8	25.10	23.53	2.35	2.33	10.29	7.48	0.50	0.53
Clone No.10	23.27	27.80	2.30	2.42	8.59	6.40	0.61	0.60
Clone No.12	30.35	35.98	2.47	2.70	9.73	7.45	0.57	0.59
Clone No.13	29.15	31.11	2.55	3.17	14.30	12.35	0.56	0.70
Clone No.14	31.67	33.79	2.47	3.31	13.74	13.41	0.53	0.62
Clone No.16	26.58	30.18	2.69	2.73	15.65	14.79	0.57	0.62
Clone No.17	33.77	28.66	2.43	2.67	19.84	18.37	0.65	0.75
Clone No.19	34.07	33.07	2.86	2.89	17.68	16.31	0.60	0.70
*L.S.D. at 5% level	5.63	5.97	0.39	0.84	2.84	3.99	0.12	0.11

* L.S.D. Least Significant Difference at 5% level

Table (3): Cont.

Treatments	No. of internodes/ shoot		No. of leaves/ shoot		No. of leaflets/leave		Leaflet area $(cm)^2$		**Leaf color
	2009	2010	2009	2010	2009	2010	2009	2010	
Clone No.1	13.70	12.23	8.70	10.11	17.33	18.43	48.44	43.24	1
Clone No.3	13.98	10.84	6.70	8.33	15.17	14.04	35.20	40.52	2
Clone No.5	14.33	12.24	8.44	8.67	14.69	14.99	33.35	29.31	3
Clone No.7	7.86	5.70	7.26	9.55	15.64	16.40	26.93	28.61	3
Clone No.8	6.21	5.29	8.64	11.53	13.65	14.41	32.71	22.32	2
Clone No.10	6.61	5.58	8.15	13.00	16.29	16.13	19.41	19.91	3
Clone No.12	6.04	5.10	10.06	10.89	15.44	15.72	17.49	16.83	1
Clone No.13	6.11	5.15	12.30	13.22	16.14	16.35	35.67	30.24	2
Clone No.14	5.99	5.00	10.02	10.63	12.14	13.72	26.90	24.78	1
Clone No.16	10.85	10.34	9.52	9.26	15.81	16.12	28.52	25.62	2
Clone No.17	10.72	10.13	11.25	9.62	15.39	15.24	30.86	22.79	2
Clone No.19	10.57	8.84	10.36	11.64	15.22	15.49	29.21	27.84	1
* L.S.D. at 5% level	1.04	2.61	1.71	2.02	2.68	1.41	11.57	6.18	

* L.S.D. Least Significant Difference at 5% level

**Alternatively, use 1-3 scale where 1=dark green; 2=medium green ; 3=yellow green

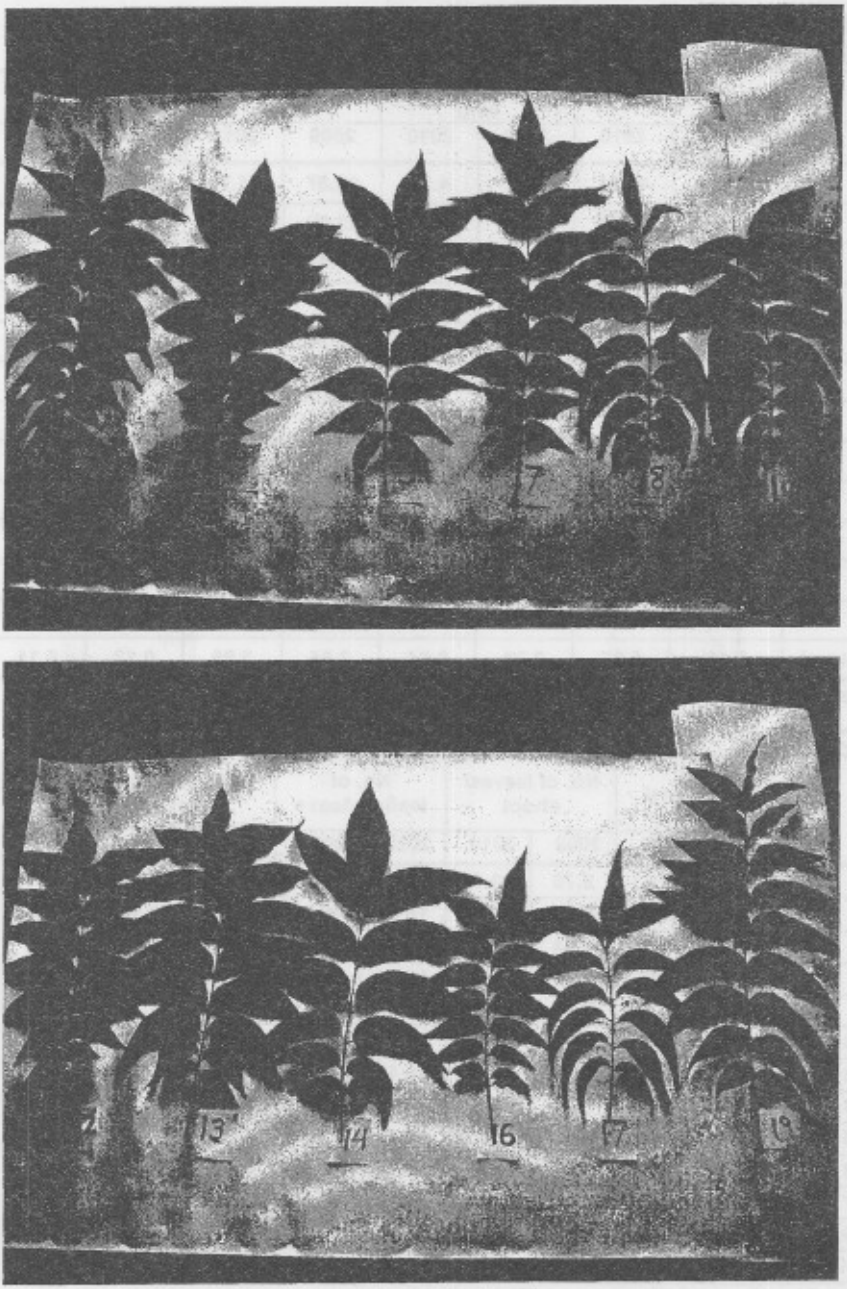

Figure (4): Leaf characteristics of the studied pecan clones.

II. Flowering characteristics

II.1. Bud development stages and fruit set (%):

Data in Table (4) illustrated significant differences among pecan clones regarding bud development stages during both seasons. Clone No.1 gave the highest number of vegetative buds and starting buds for staminate or pistillate inflorescences as well as the average total buds/twig followed by clone No.16 while the same clones had the lowest number of dormant buds. On the other hand, the opposite was true in clone No.14 as compared with the other clones or genotypes of pecan in both seasons except average total buds in 1 st season. The same trend was also observed in fruit set (%) whereas, clone No.1 had the highest values (82.11 and 83.72) followed by clone No.16 (80.09 and 81.19) while clone No.14 gave the lowest ones (57.22 and 61.75). Abu-Taleb *et al.*,(2010) reported that fruit set (%) ranged from 66.04 & 66.04% to reach 85.60 & 82.57% in the studied pecan varieties during both seasons. Pecans are monoecious and flowers develop from the compound buds. Male inflorescences are pendulous spikes commonly referred to as catkins. Catkins appear to be borne in groups of 2-3 laterally on 1- year wood, but are actually produced on extremely short, aborted shoots of current season's growth .The female flowers borne terminally on current season's growth (Grauke & Thompson 2007).

II.2. Morphological characteristics of flowering inflorescences:

It is clearly to observe from Table (5) and Figure (5) that, the staminate inflorescence in all studied clones contained three panicles (2 laterals & 1 middle). In addition, panicle length also varied significantly between different clones in the same inflorescence whereas, both lateral panicles were shorter in length than the middle ones. Furthmore, the lengths and average length of the three panicles were tallest in clone No. 8 as it recorded (36.22 and 38.88 cm.) for average length of three panicles. On the other hand, clone No.10 had the least records of average lengths (12.91 and 11.68) in 2009 & 2010 seasons. Moreover, the differences were clear regarding the number of flowers/pistilate inflorescence where the highest number was recorded for clone No.1 (5.40 and 5.97) followed by clone No.16 (4.95 and 5.14) while clone No.3 (3.01 and 3.24) had the lowest ones in both seasons. Grauke &Thompson (1996) reported that, the number of flowers produced on a single female inflorescence varies with shoot length, cultivar or clone and season. The obtained results are partially in the same line with those obtained by Sparks & Janoudi (2000); Awad, (2002) and Abu-Taleb *et al.*, (2004 and 2010) on some pecan varieties.

Table (4): Bud developmental stages characteristics of the studied pecan clones grown under Beni Suef Governorate conditions during 2009 and 2010 seasons.

Treatments	No. of dormant buds/twig		No. of vegetative buds/ twig		No. of staminate inflorescences / twig		No. of pistilate inflorescences / twig		Av. No. of total buds/twig		Fruit set (%)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Clone No.1	5.04	3.01	4.45	4.70	12.8	9.35	3.13	3.31	25.42	20.37	82.11	83.72
Clone No.3	7.19	6.00	4.19	2.35	3.36	2.97	2.97	2.04	17.71	13.36	62.59	66.31
Clone No.5	7.91	5.27	3.99	1.70	7.91	8.34	2.12	2.53	21.93	17.84	65.17	68.25
Clone No.7	6.41	4.26	3.17	1.86	6.34	3.56	2.24	3.25	18.16	12.93	62.50	64.21
Clone No.8	8.26	6.42	4.13	1.80	4.04	5.84	2.39	2.47	18.82	16.53	62.78	63.37
Clone No.10	6.61	6.60	3.20	2.44	5.13	5.56	2.75	3.09	17.69	17.69	73.28	72.15
Clone No.12	7.04	4.38	3.30	2.32	5.00	4.30	2.80	2.59	18.14	13.59	66.97	70.85
Clone No.13	6.42	5.55	3.47	2.03	4.34	3.58	2.76	2.76	16.99	13.92	66.65	70.34
Clone No.14	9.13	6.89	2.33	1.50	3.29	2.21	1.95	1.80	16.70	12.40	57.92	61.75
Clone No.16	5.08	3.65	4.22	2.45	11.5	8.86	3.02	3.26	23.82	18.22	80.09	81.19
Clone No.17	6.64	4.43	3.49	1.63	8.76	8.16	2.86	2.20	21.75	16.42	78.22	78.56
Clone No.19	5.34	4.37	2.66	2.36	5.74	4.37	2.05	2.11	15.79	13.21	62.79	64.85
*L.S.D. at 5% level	2.10	1.70	1.00	0.59	1.48	2.29	0.30	0.53	2.11	2.45	2.07	1.89

* L.S.D. Least Significant Difference at 5% level

Table (5): Morphological characteristics of flowering inflorescences of the studied pecan clones grown under Beni Suef Governorate conditions during 2009 and 2010 seasons.

Treatments	Staminate inflorescence								Pistilate inflorescence	
	Average panicle length (cm)								No. of flowers / pistilate inflorescence	
	1st lateral		Middle		2nd lateral		Av. Length of the three panicles (cm			
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Clone No.1	9.23	9.10	11.06	11.12	9.26	8.99	29.55	29.21	5.40	5.97
Clone No.3	6.49	7.47	8.48	8.90	6.49	7.47	21.46	23.84	3.01	3.24
Clone No.5	6.22	4.91	7.49	6.01	5.84	4.50	19.55	15.42	3.67	4.39
Clone No.7	5.86	4.99	7.36	6.64	5.70	4.38	18.92	16.01	3.45	3.52
Clone No.8	11.62	12.48	12.86	14.07	11.74	12.33	36.22	38.88	3.21	3.31
Clone No.10	3.88	3.79	5.07	4.35	3.96	3.54	12.91	11.68	4.01	4.34
Clone No.12	7.25	7.52	8.69	9.53	7.69	7.61	23.63	24.66	4.25	4.54
Clone No.13	7.32	12.00	8.53	14.13	6.76	11.84	22.61	37.97	3.64	4.98
Clone No.14	6.71	7.75	8.36	9.57	6.43	7.74	21.50	25.06	3.36	4.02
Clone No.16	5.60	7.68	6.74	8.73	5.68	7.71	18.02	24.12	4.95	5.14
Clone No.17	6.42	6.09	8.01	7.34	6.56	5.96	20.99	19.39	3.24	3.68
Clone No.19	9.32	7.71	11.21	9.54	9.16	8.38	29.69	25.63	3.86	3.67
*L.S.D. at 5% level	1.70	1.55	1.38	1.64	1.38	1.61	1.97	2.32	0.76	0.79

* L.S.D. Least Significant Difference at 5% level

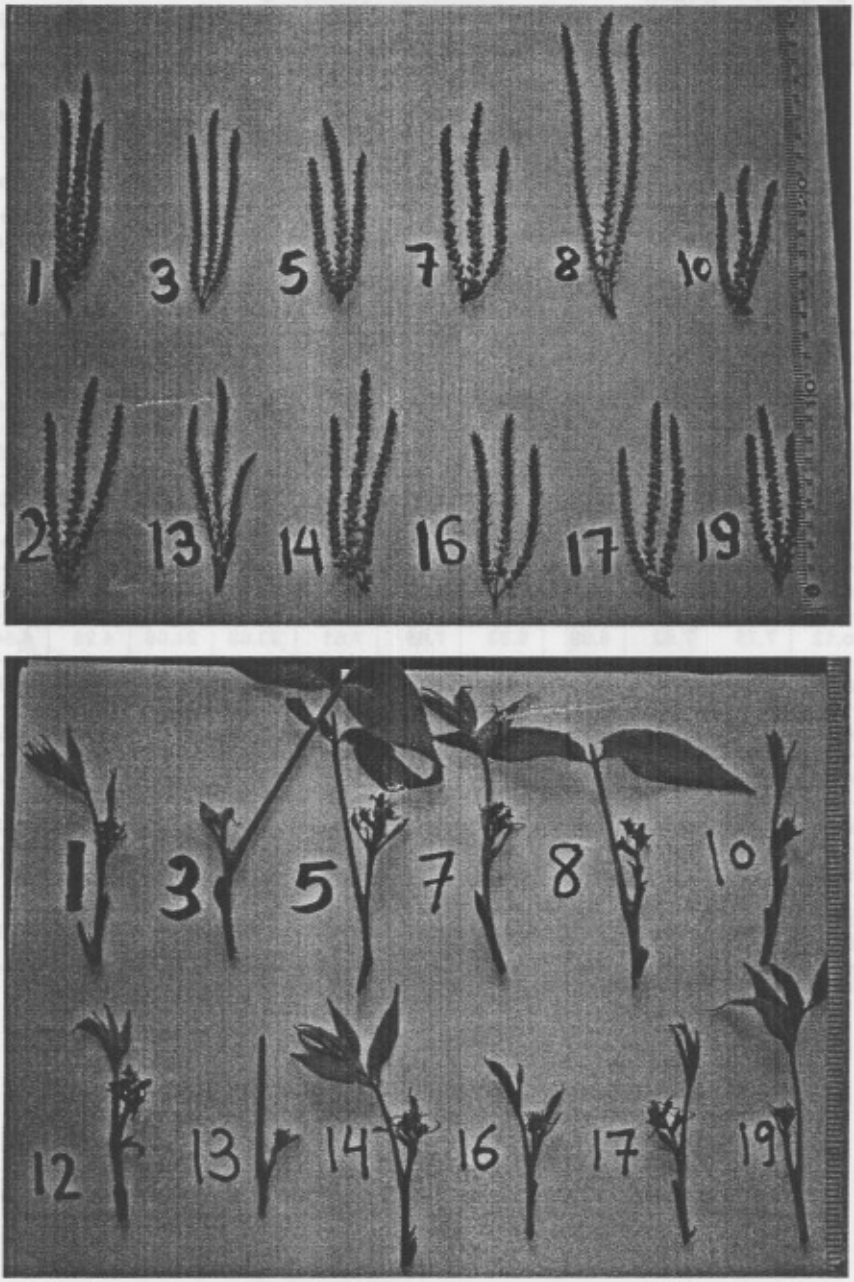

Figure (5): Staminate and pistilate inflorescences of the studied pecan clones.

II.3. Dichogamy and dates of fruit set:

The period of time over which pollen is shed commonly dose not coincide with the period of female flower receptivity to pollen. Thus, pecans often require another cultivar or clone for pollination occur. The separation of male and female bloom periods for an individual tree may be complete, or the timing of pollen shed may overlap stigma receptivity (incomplete dichogamy). When a tree has complete separation of male and female bloom, it must be cross pollinated by another tree. The overlapping of pollen grain shedding and stigma receptivity is presented in (Table 6 and Figures, 6&7). It can clearly observe that varying degrees of dichogamy occur, depending on the clone physiology and environmental conditions (Brison, 1974). Adequate pollination is critical for maximum production of pecans. All clones in this evaluation exhibited relatively incomplete dichogamy in both seasons. The studied clones (1, 5, 7, 10, 14, 16, and 17) classified as protandrous (Type I) that pollens shed before the stigmas are receptive, meantime, clones (3, 8, 12, 13 and 19) as protogynous (Type, II) that stigmas become receptive prior to pollen shed. Generally, there were overlapping between Type I and Type II clones. Sibbett *et al.*, (1987) said that, self- pollination produces other problems in pecan production, such as smaller nut size and fewer nuts per cluster. With regard to beginning of fruit set, data showed that clone No.8 was the earliest one in both seasons while the latest ones were clone No. 17 in first season and clone No. 13 in second season. Such findings are supported by Sudheer *et al.*, 2005; Andersen, 2008 and Abu Taleb *et al.*, 2010 on pecan varieties.

Effect of environmental conditions on dichogamy phenomenon:

Figure (1, 2 and 3) shows the maximum, minimum and average of temperature and humidity of the investigation region. The periods of pollens shedding and stigma receptivity to pollens are shown in (Figure, 6 &7) which affected by temperature and relative humidity. The temperature degrees and humidity increased in the second season compared with the first one, consequently, these conditions affected clearly on the periods of polling shedding and stigma receptivity to pollens. In the first season, clone No.3 and clone No.16 which had the longest pollen shedding period. However, stigma receptivity to pollens was longest in clones No. 13, 14, 16, and 17 and 19. In the second season, the raising in temperature degrees and humidity leads to the shortest of periods of pollen shedding and stigma receptivity to pollens in most clones. The opening of the anther is caused by drying and contraction of the outer layer in relation to the inner layer. When moistened, the anther had the ability to re-close. The degree of dichogamy depends on the environment which influenced in cultivars with different degrees of overlapping (Grauke &Thompson (1996).

Table (6): Dates of pollen shed, pistil receptivity and fruit set of the studied pecan clones grown under Beni - Suef Governorate conditions during 2009 and 2010 seasons.

Treatments	Shedding of pollens				Stigma receptivity to pollens				Beginning of fruit set		Type
	2009		2010		2009		2010				
	Start	End	Start	End	Start	End	Start	End	2009	2010	
Clone No.1	25/4	1/5	18/4	24/4	28/4	7/5	19/4	26/4	2/5	22/4	I
Clone No.3	24/4	7/5	16/4	25/4	22/4	30/4	12/4	17/4	28/4	15/4	II
Clone No.5	19/4	26/4	7/4	15/4	24/4	28/4	12/4	18/4	27/4	14/4	I
Clone No.7	22/4	30/4	13/4	19/4	24/4	1/5	14/4	20/4	28/4	16/4	I
Clone No.8	23/4	4/5	13/4	23/4	21/4	27/4	11/4	17/4	25/4	13/4	II
Clone No.10	21/4	1/5	18/4	26/4	26/4	30/4	19/4	26/4	28/4	21/4	I
Clone No.12	24/4	30/4	12/4	18/4	22/4	28/4	11/4	16/4	26/4	14/4	II
Clone No.13	26/4	6/5	22/4	28/4	25/4	13/5	20/4	26/4	3/5	23/4	II
Clone No.14	21/4	29/4	15/4	21/4	25/4	11/5	19/4	23/4	3/5	20/4	I
Clone No.16	23/4	7/5	15/4	27/4	26/4	9/5	20/4	26/4	1/5	22/4	I
Clone No.17	21/4	29/4	14/4	20/4	26/4	11/5	20/4	26/4	4/5	22/4	I
Clone No.19	24/4	1/5	15/4	21/4	23/4	8/5	14/4	19/4	29/4	17/4	II

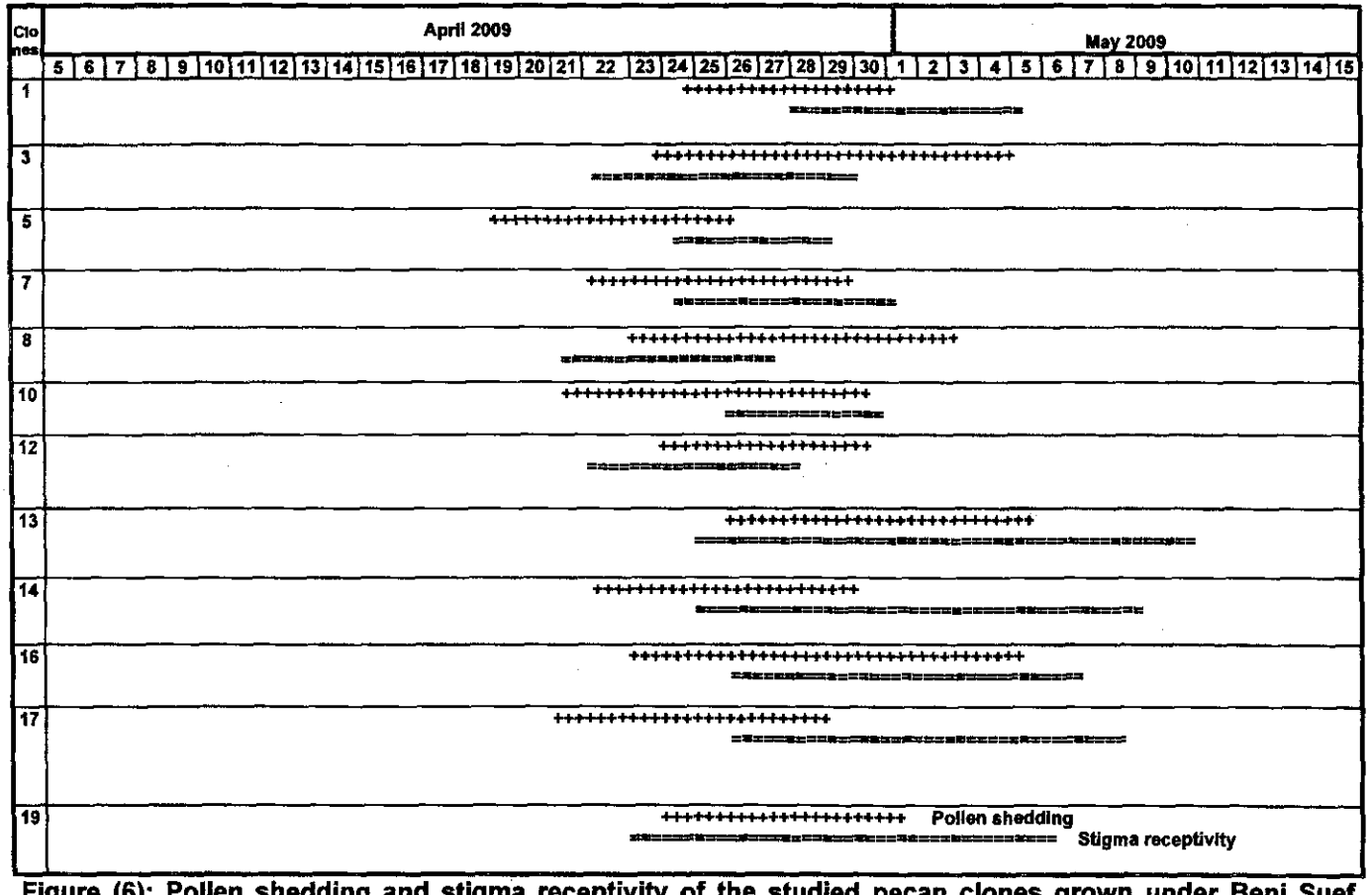

Figure (6): Pollen shedding and stigma receptivity of the studied pecan clones grown under Beni Suef Governorate conditions during 2009 season.

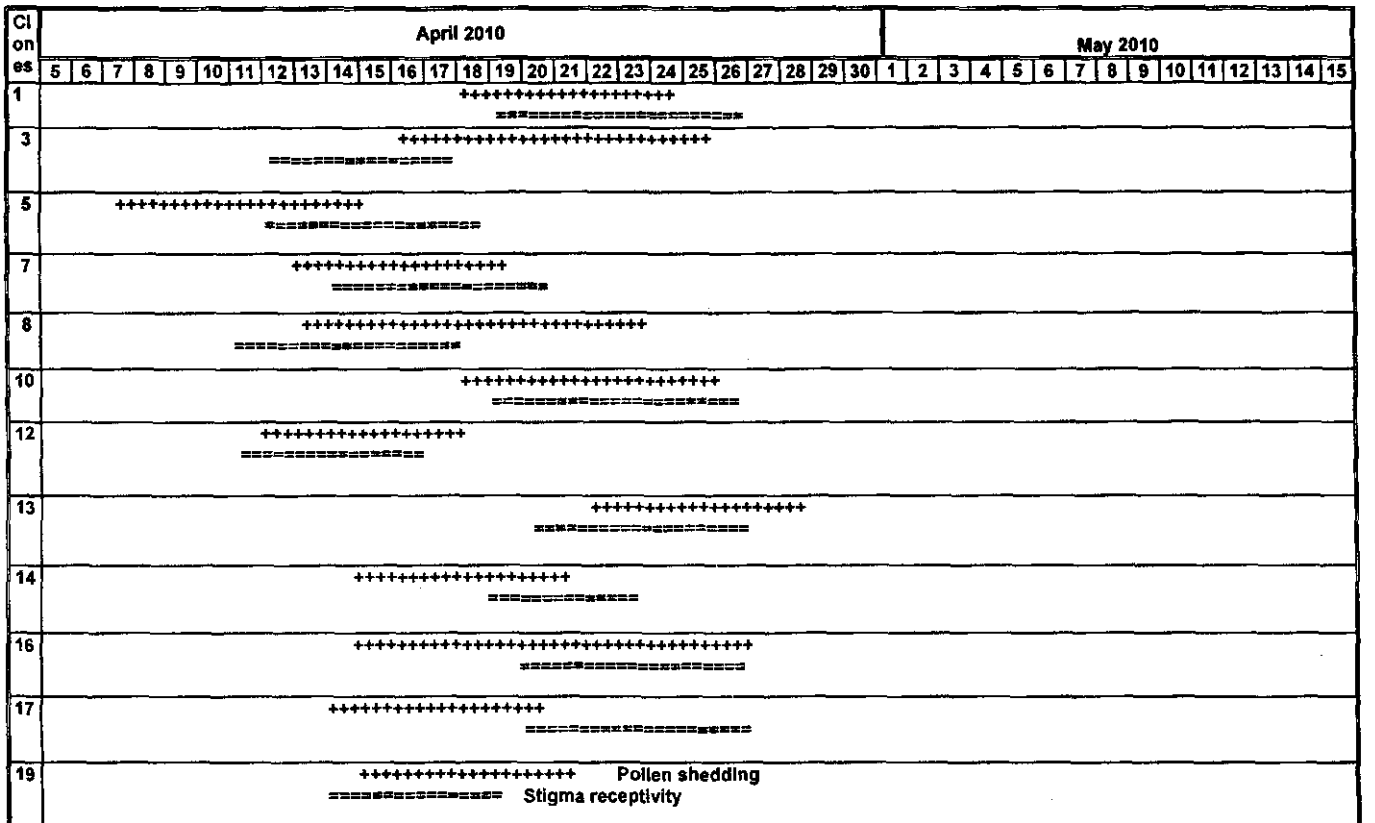

Figure (7): Pollen shedding and stigma receptivity of the studied pecan clones grown under Beni Suef Governorate conditions during 2010 season.

III. Yield and fruit quality characteristics

III.1. Dates of shuck dehiscence, harvesting and leaf abscission:

Data dealing with shuck dehiscence, harvesting and leaf abscission between clones and between the two studied seasons are presented in Table (7) and showed variation in that dates which may be due to clones or genotypes and the change in environmental conditions. In this respect, clone No.5 followed by clone No. 16 started and ended to crack shuck and harvesting earlier than other clones. On the other hand, clone No.14 was the latest in shuck dehiscence and harvesting dates. Moreover, clone No.13 was the earliest in leaf abscission while clone No. 17 was the latest in this respect. The duration between beginning and end of shuck dehiscence and harvesting was longer in clone No. 8, while the shortest duration was in clone No. 16 in the first season and clone No. 10 in the second one. Such a relationship between the end of leaf abscission and yield in the next year, which may be due to the increase in carbohydrate storage in the prolonged period before leaf abscission. The above results are comparable with those reported by Hamoda, (1982) and Abu Taleb *et al.*, (2004) and (2010). They stated that hull cracking related with harvesting time. Also, there is a relationship between date of the end of leaf abscission and kernel quality and yield in the next year which due to the increase in carbohydrate storage before leaf abscission. Time of nut maturity is dependent on heat accumulated. Temperature alters the time of bud break and subsequent rate of shoot elongation that, in turn affects the time of stigma receptivity. Consequently, the temperature effect on date of nut maturity is indirect (Sparks, 2009).

III.2. Fruit quality characteristics:

Significant differences were found between clones under study regarding fruit quality parameters (Table, 8). As regard to fruit and hull fresh weight, clone No.14 gave the highest values (39.00 & 38.37 and 27.57 & 24.37gm.) while the lowest ones (13.42 & 15.22 and 8.20 & 9.49gm.) for clone No.5.The values of dry nut weight ranged from (7.49 & 6.69 gm. in clone No.5 to 10.75 &10.82gm. in clone No.17) and shell weight (2.84 & 2.53 gm. in clone No.16 to 4.91 & 4.90 gm. in clone No.17) in both seasons, respectively. Our results were previously confirmed with those obtained by Abu Taleb *et al.*, (2010) on some pecan varieties, they found that Success cv. had higher weight of fresh fruits (49.22 gm) and hull (33.93 gm). Pawnee cv, gave higher weights of dry nut (17.40gm) and shell (10.03gm). One of the main components of pecan quality that determine the economic value of the crop that kernel percentage, data clear that the highest dry nut doesn't mean the highest kernel weight and percent whole nut. Where, clone No.16 was the superior (63.36 & 64.47%)

and the lowest kernel percentage (54.11 & 53.16) was obtained for clone No.13 in first & second seasons, respectively. Similarly results were obtained by (Herrera, 1985; Yao, *et al.*, 2004; Thompson, 2005; Maeda, *et al.*, 2006). Percentage of kernel is largely a genetic trait. Acceptable pecan clones are those having nuts with greater than 55 percent kernel. Clones with a lower percentage usually need other, overriding attributes, such as nut size and early harvest, to be profitable (Sibbet, *et al.*, 1987)

Table (7): Dates of fruit shuck dehiscence, harvesting and leaf abscission of the studied pecan clones grown under Beni Suef Governorate conditions during 2009 and 2010 seasons.

Treatments	Shuck dehiscence				Harvesting				Leaf abscission			
	2009		2010		2009		2010		2009		2010	
	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
Clone No.1	18/9	2/10	16/9	25/9	25/9	12/10	22/9	17/10	28/11	1/1	4/12	28/12
Clone No.3	22/9	7/10	15/9	24/9	28/9	20/10	20/9	10/10	28/11	21/12	1/12	19/12
Clone No.5	16/9	25/9	2/9	15/9	19/9	1/10	10/9	26/9	18/11	17/12	20/11	13/12
Clone No.7	18/9	7/10	16/9	2/10	22/9	18/10	22/9	9/10	18/11	7/12	17/11	3/12
Clone No.8	18/9	12/10	19/9	8/10	26/9	23/10	27/9	23/10	17/11	12/12	18/11	7/12
Clone No.10	22/9	2/10	12/9	20/9	25/9	10/10	19/9	1/10	20/11	17/12	29/11	25/12
Clone No.12	22/9	7/10	11/9	20/9	27/9	22/10	12/9	30/9	24/11	20/12	30/11	27/12
Clone No.13	25/9	12/10	11/9	24/9	2/10	27/10	22/9	8/10	11/11	5/12	15/11	2/12
Clone No.14	30/9	14/10	23/9	9/10	7/10	28/10	2/10	28/10	27/11	25/12	1/12	22/12
Clone No.16	17/9	25/9	8/9	20/9	20/9	2/10	15/9	5/10	27/11	28/12	29/11	19/12
Clone No.17	29/9	14/10	16/9	30/9	3/10	22/10	24/9	18/10	1/12	30/12	2/12	4/1
Clone No.19	20/9	5/10	16/9	28/9	1/10	20/10	27/9	22/10	21/11	10/12	27/11	23/12

Table (8): Yield and Fruit quality characteristics of the studied pecan clones grown under Beni Suef Governorate conditions during 2009 and 2010 seasons.

Treatments	Fruit weight (gm.)		Hull weight (gm.)		Dry nut weight (gm.)		No. nuts /kg.		Yield/ tree (kg.)			Shell weight (gm.)		% of Kernel		Kernel oil content (%)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	Av.	2009	2010	2010	2010	2010	2010
Clone No.1	29.54	30.90	20.07	17.80	9.57	9.05	108.10	105.51	10.17	13.91	12.04	3.72	3.36	61.13	62.87	66.66	68.12
Clone No.3	28.91	34.88	18.77	23.81	9.37	8.93	121.67	117.61	10.03	7.05	8.54	4.06	3.98	56.67	55.43	53.33	60.35
Clone No.5	13.42	15.22	8.20	9.49	7.49	6.69	151.70	147.23	6.70	8.88	7.79	2.98	2.54	60.21	62.03	56.70	62.34
Clone No.7	29.82	33.13	20.27	21.40	9.80	9.72	103.74	109.50	5.29	7.31	6.30	3.75	3.56	61.74	63.38	58.30	58.10
Clone No.8	18.85	19.07	9.10	9.92	9.19	9.38	110.53	109.10	8.58	6.38	7.48	4.38	4.37	52.34	53.41	66.62	67.63
Clone No.10	22.09	23.89	12.98	14.09	8.56	7.83	115.61	118.46	7.22	11.40	9.31	3.52	3.11	58.88	60.28	60.00	62.55
Clone No.12	17.95	19.33	10.50	11.80	8.03	7.30	125.53	134.95	9.11	6.49	7.80	2.96	2.72	63.14	62.74	63.37	65.30
Clone No.13	33.27	31.56	21.47	19.02	9.48	10.12	113.09	106.76	4.54	12.92	8.73	4.35	4.74	54.11	53.16	56.64	59.11
Clone No.14	39.00	38.37	27.57	24.37	9.97	10.80	91.53	91.00	5.37	10.55	7.96	4.15	4.24	58.38	60.74	70.00	68.78
Clone No.16	19.97	17.73	12.72	12.27	7.75	7.12	130.73	151.15	8.23	10.85	9.54	2.84	2.53	63.36	64.47	71.65	70.58
Clone No.17	27.93	29.47	17.13	17.73	10.75	10.82	95.15	94.79	6.17	10.45	8.31	4.91	4.90	54.33	54.71	69.00	70.11
Clone No.19	19.00	24.48	11.67	16.73	8.90	8.12	117.41	121.54	6.08	7.20	6.64	3.37	3.13	62.14	61.45	51.84	55.69
*L.S.D. at 5% level	2.67	2.55	2.11	2.61	1.35	0.79	2.70	4.60				0.62	0.38	3.25	2.46	4.64	3.86

* L.S.D. Least Significant Difference at 5% level

III.3. Yield and kernel oil content:

Results in Table (8) indicated that clones with high nut weight had lower No. nuts/kg. In this respect, clone No.17 and clone No.14 had the heaviest nuts (10.75&10.82 and 9.97&10.80 gm.) and the lowest No. of nuts/kg (95.15&94.79 and 91.53& 91.00).On the contrary, clone No.5 and clone No.16 gave the least nut weight (7.49&6.69 and 7.75&7.12 gm.) and the highest No. of nuts/kg. (151.70 & 147.23 and 130.73 & 151.15) in both seasons, respectively. Abu Taleb *et al.*, (2010) recorded the highest number of nuts/kg. for Burkett cv. (136.0 nuts/kg.). As for nut yield, the values were differed according to different clones and seasons. Clone No.1 produced the heaviest nut yield (10.17 and 13.91 kg.) followed by clone No.16 (8.23 and 10.85 kg.). On the other hand, clone No.7 produced the least nut yield (5.29 and 7.31 kg.) in both seasons, respectively. Abu Taleb *et al.*, (2010) reported that Desirable cv. had the highest yield (12.50 and 10.20 kg.) in both seasons. In addition, nut yield was differed from season to another; it was higher in 2010 season compared to 2009 season in most clones. In this respect, Worely *et al.*, (1972) found that pecan yield was negatively correlated with yield of the previous year, but was positively correlated with accumulated yield over several years.

Concerning kernel oil content, clone No.16 followed in a descending order by clones 14, 17 and 1 gave the highest values of kernel oil content (%). On the other hand, clone No.19 had the lowest percentage of kernel oil. Abu Taleb *et al.*, (2010) found that the least kernel oil content in their studied varieties was (67.31%). Similarly results were recorded by Awad, (2002) and Abu Taleb *et al.*, (2004), they reported that, oil content vary in pecan according to tree load, variety, region and geographic area.

Fruit dimensions:

Data in Table (9) and Figure (8) shows the variation between clones regarding to nut dimensions and shape. It is clear that clone No.14 gave the highest values of nut length and height. On the other hand, clone No.5 had the shortest nut length. Clone No.12 was the superior in nut shape index and gave the lowest values of nut height. Clone No.1 gave the highest values of nut width and volume. On the contrary, clone No.16 gave the lowest nut width and clone No.5 gave the lowest nut volume in both seasons. Similarly results were recorded with those obtained by Abu Taleb *et al.*, (2010).

Nut physical characteristics:

The data in Table (10) & Figure (8) indicated that, fruit length is longer than height and width in all clones under study. Whereas, clone No.5 has ovate shape as their shape index (previously recorded in Table, 9) ranged between (1.40 to 1.59 cm.) widest at base, clone No. 13 has oval elliptic (1.40 to 1.59 cm.) widest in middle and clone No.12 &16 have oblong elliptic (1.80 to 1.99 cm.). The other clones have elliptic nut shape (1.60 to 1.79 cm.).With respect

Table (9): Nut dimensions of the studied pecan clones grown under Beni Suef Governorate conditions during 2009 and 2010 seasons.

Treatments	Nut length (cm.)		Nut height (cm.)		Nut shape index		Nut width (cm.)		Nut volume (cm.)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Clone No.1	3.73	3.68	2.20	2.12	1.70	1.74	2.68	2.66	11.34	10.80
Clone No.3	3.83	3.78	2.24	2.09	1.72	1.81	2.27	2.22	6.120	5.48
Clone No.5	3.27	3.28	2.17	2.10	1.51	1.56	2.18	2.14	5.75	4.92
Clone No.7	3.99	3.96	2.32	2.27	1.72	1.74	2.37	2.32	6.64	6.54
Clone No.8	3.82	3.77	2.19	2.23	1.75	1.70	2.29	2.28	5.88	5.17
Clone No.10	3.74	3.60	2.17	2.14	1.72	1.68	2.25	2.18	9.10	8.63
Clone No.12	3.82	3.75	1.91	1.94	2.01	1.94	2.06	2.02	7.56	7.25
Clone No.13	3.76	3.75	2.37	2.38	1.58	1.53	2.52	2.49	9.12	9.92
Clone No.14	4.07	4.09	2.47	2.48	1.65	1.65	2.58	2.54	10.31	10.79
Clone No.16	3.80	3.78	1.98	1.95	1.92	1.94	2.04	1.99	7.87	6.01
Clone No.17	3.85	3.82	2.30	2.30	1.67	1.68	2.43	2.37	7.51	6.33
Clone No.19	3.79	3.72	2.19	2.15	1.73	1.72	2.25	2.27	6.89	6.16
*L.S.D. at 5% level	0.16	0.09	0.09	0.06	0.11	0.07	0.09	0.06	1.38	1.25

- L.S.D. Least Significant Difference at 5% level

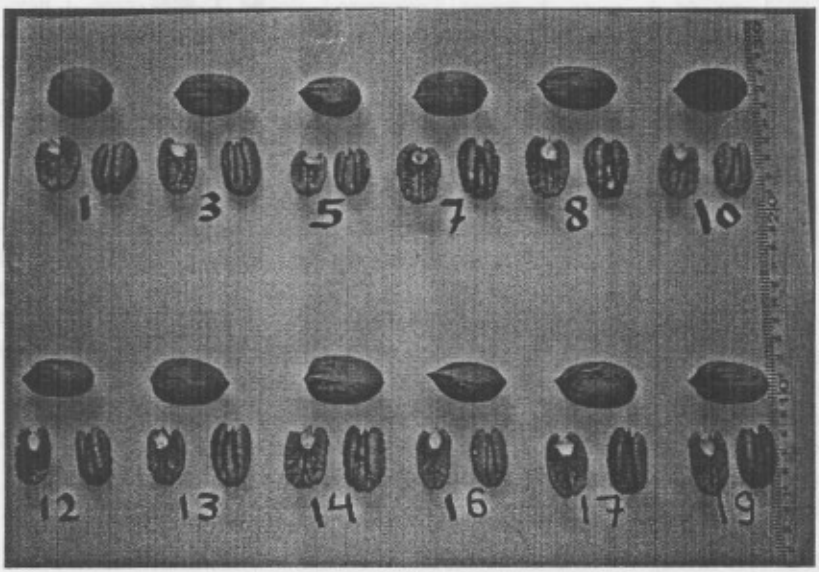

Figure (8): Nut shape of the studied pecan clones.

Table (10): Some nut physical characteristics of the studied pecan clones grown under Beni Suef Governorate conditions .

Treatments	Nut shape	Apex shape	Base shape	Cross section form	Kernel color	Dorsal grooves	Shell surface	Shell hardness
Clone No.1	Elliptic	Obtuse	Round	Laterally compressed	Golden	Deep - wide	Rough	0*
Clone No.3	Elliptic	Acute to acuminate	Obtuse	Round	Golden	Deep - tight	Smooth	1
Clone No.5	Ovate	Acute to acuminate	Obtuse - round	Round	Golden	Narrow	Smooth	1
Clone No.7	Elliptic	Obtuse	Obtuse	Round	Golden to light brown	Prominent dark brown speckles	Smooth	1
Clone No.8	Elliptic	Obtuse	Obtuse - round	Laterally compressed	Golden to light brown	Narrow - tight	Smooth	0
Clone No.10	Elliptic	Obtuse	Round	Laterally compressed	Golden	wide	Rough	3
Clone No.12	Oblong elliptic	Acute to acuminate	Round	Laterally compressed	Golden	Deep - tight	Rough	1
Clone No.13	Oval elliptic	Obtuse	Obtuse - round	Round	Golden	Wide - shallow	Rough	1
Clone No.14	Elliptic	Obtuse	Obtuse - round	Round	Golden	wide	Rough	2
Clone No.16	Oblong elliptic	Acuminate	Obtuse	Round	Golden	Narrow - deep	Rough	0
Clone No.17	Elliptic	Acute	Round	Laterally compressed	Golden	Wide - deep	Rough	3
Clone No.19	Elliptic	Obtuse	Obtuse	Round	Golden - light brown	Deep - tight	Smooth	1

* 0 = no hardening, 1= hardening at apex, 2= hardened to middle, 3= hardened to base of nut

to nut apex and base shape were differed according clones which varied between acute, acuminate, obtuse and round. As for cross section form, clones No.1, 8, 10, 12 and 17 have laterally compressed form while the others have round form. Kernel color was golden in all clones except clones No.7, 8 and 19; that they were golden to light brown. Shell surface was smooth in clones No.3, 5, 7, 8 and 19 while; it was rough in the other studied clones. Moreover, the hardness didn't appear in clone No.1, 8 and 16 and the hardness was at nut apex in clones No. 3,5,7,12,13 and 19 while it was at base in clones No.10 and 17. Our data are partially supported by findings of Hamoda, (1982); Grauke & Thompson (2007); Attia & Wafaa (2007) and Abu Taleb *et al.*, (2010).

Kernel oil fatty acids content:

Data presented in Table (11) show the fatty acids composition of the oil extracted from kernel of the studied pecan clones during 2009 and 2010

seasons. The total unsaturated fatty acids surpassed the saturated ones. Whereas, clone No. 1 gave the highest values of the total unsaturated fatty acids (91.79 and 91.15 % w/w) while clone No. 19 had the lowest ones (89.66 and 89.23% w/w). The saturated fatty acids were higher in clone No. 19 (10.16 and10.52 % w/w) while they were lower in clone No.1 (8.21 and 8.51 % w/w) during both seasons, respectively. The main unsaturated fatty acid of the kernel was oleic acid that varied between (60.70 to 73.56 & 61.10 to 74.10 % w/w in the studied clones in both seasons). Plametic acid was the most abundant saturated fatty acid in kernel oil. One feature of pecan oil was its very low content of Linolinec acid compared with many other oils such as cottonseed, sunflower and maize oil (Attia and Wafaa, 2007).Linoleic acid is responsible for oxidation and rancidity in pecan kernels. Linoleic acid varies widely in different varieties and from year to year in the same variety (Herrera, 2005). The unsaturated fats in pecan are protected against oxidation by the high concentration of y- tocophenol and polymeric flavones (Haddad

Table (11): Fatty acids composition (weight %) of pecan kernel of the studied pecan clones grown under Beni Suef Governorate conditions during 2009 and 2010 seasons.

Treatments	Saturated fatty acids						Total saturated		Unsaturated fatty acids			
	Plametic C 16 : 0		Stearic C 18 : 0		Arthodonic C 20 : 0				Palmelonolei c C16:1		Oleic C18 : 1	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Clone No.1	5.78	5.99	2.33	2.40	0.10	0.12	8.21	8.51	0.09	0.10	73.56	74.10
Clone No.3	6.66	6.71	2.40	2.45	0.13	0.15	9.19	9.31	0.04	0.04	63.44	64.12
Clone No.5	6.99	6.93	2.95	2.90	0.10	0.10	10.04	9.93	0.08	0.09	70.12	71.02
Clone No.7	6.93	6.97	2.57	2.73	0.09	0.09	9.59	9.79	0.08	0.07	65.78	65.64
Clone No.8	6.68	6.73	2.89	2.82	0.10	0.08	9.67	9.63	0.08	0.08	69.25	69.27
Clone No.10	6.78	6.90	2.60	2.66	0.11	0.12	9.49	9.68	0.07	0.08	67.65	66.81
Clone No.12	7.57	7.63	2.46	2.25	0.09	0.10	10.12	9.98	0.08	0.10	60.70	61.10
Clone No.13	5.45	5.88	2.48	2.73	0.13	0.14	8.24	8.75	0.09	0.09	67.82	65.71
Clone No.14	6.35	6.61	2.31	2.34	0.08	0.08	8.74	9.03	0.07	0.08	65.84	66.23
Clone No.16	6.27	6.35	2.45	2.53	0.08	0.09	8.80	8.97	0.09	0.08	71.23	71.12
Clone No.17	6.35	6.48	2.31	2.40	0.07	0.08	8.73	8.96	0.07	0.07	65.84	66.10
Clone No.19	7.40	7.12	2.67	2.60	0.09	0.08	10.16	10.52	0.07	0.09	63.36	65.10
* L.S.D. at 5% level	0.79	0.94	0.54	0.38	0.02	0.02	1.21	1.04	0.02	0.02	2.70	2.93

* L.S.D. Least Significant Difference at 5% level

Table (11): Cont.

Treatments	Unsaturated fatty acids (cont.)						Total Un-Saturared		U / S ratio	
	Linoleic C 18 : 2		Linolinec C 18 : 3		Gadoleic C 20 : 1					
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Clone No.1	17.17	15.96	0.71	0.68	0.26	0.31	91.79	91.15	11.18	10.71
Clone No.3	26.21	25.05	0.90	0.91	0.22	0.25	90.81	90.37	9.88	9.71
Clone No.5	18.69	17.85	0.73	0.77	0.34	0.29	89.96	90.02	8.96	9.07
Clone No.7	23.15	23.11	1.12	1.13	0.27	0.25	90.40	90.20	9.43	9.21
Clone No.8	19.89	19.91	0.85	0.84	0.25	0.26	90.32	90.36	9.34	9.38
Clone No.10	21.60	22.00	0.87	0.85	0.30	0.28	90.49	90.02	9.54	9.30
Clone No.12	27.59	26.93	1.13	1.10	0.27	0.30	89.77	89.53	8.87	9.97
Clone No.13	22.85	24.37	0.60	0.64	0.31	0.29	91.67	91.10	11.13	10.41
Clone No.14	24.19	23.21	0.84	0.90	0.26	0.28	91.20	90.70	10.43	10.04
Clone No.16	18.56	18.41	1.04	0.95	0.26	0.30	91.18	90.86	10.36	10.13
Clone No.17	24.19	23.11	0.89	0.81	0.26	0.23	91.25	90.32	10.45	10.08
Clone No.19	24.92	22.85	1.06	0.96	0.25	0.23	89.66	89.23	8.82	8.48
*L.S.D. at 5% level	2.45	2.33	0.05	0.13	0.02	0.05	1.19	0.96	1.33	1.14

* L.S.D. Least Significant Difference at 5% level

et al., 2006).The ratio between unsaturated and saturated fatty acids, its higher values were for clone No.1 (11.18 and10.71 %) and its lower values were for clone No.19 (8.82 and 8.48 % w/w), in both seasons, respectively. The proportion of oleic, linoleic and linolenic fatty acids determined the oxidative stability, viscosity and melting/ crystallization behavior of pecan oil. In general, these properties in pecan oils were similar or superior to extra- virgin olive oil and unrefined sesame oil (Toro- Vazquez *et al.*, 1999).

From the above mentioned results, we may recommend clones No. 1 and 16 for their high productivity and fruit quality and can be recommended to take their scions in vegetative propagation for further expansion at Middle Egypt region.

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دراسة مقارنة على نمو و اثمار بعض سلالات أشجار البذرية النامية تحت ظروف محافظة بنى سويف

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الملخص العربى:

تأتى أهمية الانتخاب لأفضل الأشجار الفردية للبيكان نتيجة الاختلاف الكبير فيما بينها والتى تعطى مدى واسع عند الاختيار للزراعة و طبقا للظروف البيئية لمنطقة الزراعة. لذلك يهدف هذا البحث إلى دراسة سلوك اثنى عشر سلالة من البيكان والنامية فى بستان محطة بحوث البساتين بسدس – محافظه بنى سويف- مصر خلال موسمى الدراسة ٢٠٠٩ & ٢٠١٠ . وعموما هناك علاقة ايجابية بين سلوك الشجرة وخصائص نمو الأفرع حيث وجد أن السلالة (١) كانت متفوقة فى هذا الخصوص كما سجلت هذه السلالة أيضا أعلى عدد للبراعم (الساكنة – الخضرية –البراعم التى تعطى النورات المزكرة والمؤنثة) كما سجلت أيضا أعلى نسبة للعقد (٨٢,١١ &٨٣,٧٢ %) خلال موسمى الدراسة. كما اختلفت السلالات فيما بينها فى التوافق بين فترات انتشار حبوب اللقاح واستعداد المياسم للتلقيح ويمكن تصنيف السلالات رقم ١و٥و٧و١٠و١٤و١٦و١٧ بأنها مبكرة الطلع (نموذج ١) أما السلالات رقم ٣ و ٨ و ١٢ و١٣ و ١٩ بأنها مبكرة المتاع (نموذج ٢). كذلك يمكن اعتبار السلالة رقم ٣ و ١٦ كملقح جيد لمعظم السلالات تحت الدراسة.بالنسبة لموعد انفصال الغلاف الخارجى عن الثمرة والحصاد فكانت السلالات ٥ و ١٦ الأبكر من حيث ذلك كما أعطوا أعلى نسبة من اللب فى حين أن السلالة رقم ١٣ كانت الأقل. وأوضحت النتائج أن السلالة التى لها أعلى وزن للثمار كان لها أقل عدد من الثمار فى الكيلوجرام و تفوق محصول السلالات أرقام ١ و١٦ (١٢,٠٤ & ٩,٤٥ كجم /شجرة) كمتوسط للموسمين.وكانت أعلى السلالة رقم ١٦ هى الأغنى فى محتوى للزيت فى لب الثمار بينما السلالة رقم ١٩ كانت الأفقر فى ذلك.كما أوضحت النتائج الخاصة بتركيب الأحماض الدهنية بالزيت المستخلص من اللب أن الأحماض الدهنية الغير

مشبعة الكلية تجاوزت الأحماض الدهنية المشبعة وكان الحمض الدهنى الغير مشبع والأساسى هو حمض الأولييك بينما الحمض الدهنى المشبع والوافر هو حمض البالمتيك كما أن محتـــوى حمض اللينولينيك كان أقل كثيرا عن حمض الأولييك وعموما فان تلك الخصائص لزيت البيكان تجعله من الزيت البكر الممتاز .

ومن النتائج المذكورة سابقا يمكن التوصية بالسلالات أرقام ١ و ١٦ لإنتاجيتهـــا الأعلـــى وجودة ثمارها وكذلك بأخذ طعوم من هذه الأشجار للتكاثر الخضرى وزراعـــة هـــذه الـــسلالات للتوسع فى بساتين البيكان بمنطقة مصر الوسطى.