J. Agric. Sci. Mansoura Univ., 28 (2): 1291 - 1299, 2003

EFFECT OF PLANTING ZONE ON PATTERN OF ANNA APPLE FLORAL BUD DORMANCY IN EGYPT

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ABSTRACT

Results of forcing lateral floral apple buds taken from three distinct zones of Egypt i.e. North Delta (N.D.), South Delta (S.D.), and West Delta (W.D.) at various dates of autumn and winter of both 1998 – 1999 & 1999 – 2000 seasons in a forcing chamber at 25 ± 2 were discussed. Accumulated chilling units (CU) and G.D.D. were computed till various dates of study. No deep end – dormancy that can be broken with accumulated chilling could be detected in the three zones. However, it was noticed in the three zones in the first season and (N.D.) in the second, that buds were dormant during this period and accumulated chilling was lower than the previously determined to break endo – dormancy. this case of dormancy might be related to incomplete formation of the essential organs in the flowers, which was completed afterwards in response to accumulated G.D.D. Buds weight and total carbohydrates increased during dormancy period. However ,buds dormancy in the field is mainly caused by other types as paradormancy or ecodormancy.

INTRODUCTION

Winter dormancy of buds involves progression from growth cessation and bud formation under influences of correlative inhibition (para-dormancy) through a period of rest (endo-dormancy),followed by a period of environmentally induced dormancy (eco-dormancy)(Vegis,1964, Williams et al. 1979 and Lang ,1987). Onset, intensity and dissipation of the physiological state of rest were determined in buds of several cultivars of pecans (Amling and Amling,1980). Bud dormancy in apple, which is generally induced naturally in late summer and fall, is broken by low temperatures that occur during fall, winter and spring (Samih and Lavee,1962). Chilling was effective in breaking rest after plants attained maximum rest. Development during rest (breaking rest) increased with decreasing temperature. No significant development occurred at 20°C. Rate of rest development at all temperatures varied during the breaking rest period and depended on developmental stage (Kobayashi and Fuchigami, 1983). How much winter chill is required for a variety or species is often decided by where that plant grew originally (Campbell, 1995). However, a bell shaped, rest-intensity curve as a function of time was obtained for (Elberta) peach and (Chinese) apricot leaf buds growing in the field. Rest was not closely associated with fluctuating environmental temperatures (Hatch and Walker, 1969) .It appears that chilling during dormancy preconditions the tree for metabolic response at temperatures that promote growth (Young, 1990). Most varieties of apples require a period of heat afterwards to complete the bud break (Young, 1992). Vegetative buds of apple trees grow steadily in weight from their inception in spring through rest period (Young *et al*, 1974). Significant correlation coefficients were found between bud weight and volume values vs. maximum temperatures and weighted chill hours during the rest (Del Real-Laborde,1987). Yehia, and Hagag (2000), described the histological development that takes place in the main parts of Anna buds throughout the various successive morphological stages of flower bud development. High amounts of polysaccharides in the buds at the time of deep dormancy phase reflected the high need for soluble sugars at the period of after dormancy .(Farag et al ,1981). The termination of dormancy is not the same either for particular genotypes nor for the same variety in different years. The purpose of this study was to evaluate winter dormancy and lateral bud break of Anna apple as affected by climatic conditions in fall, winter and spring in Egypt in relation to chilling and heat accumulation. Knowledge about dynamics of the deep dormancy termination is needed (Krska and Brno,1999).

MATERIAL AND METHODS

Bud dormancy status has been estimated by measurement of growth or development stage of terminal, lateral of isolated buds exposed to environmental conditions favourable for growth (Pavia and Robitaille, 1978 , Shaltout and Unrath , 1983). Dormancy is considered terminated when over 50% bud break occurs within 14 to 21 days using this protocol. The material used for this investigation was collected from three zones in Egypt : North Delta (N.D.), at Abou-Homos, South Delta(S.D.), at kanater, and West Delta (W.D.) at Berkash. Representative mature healthy Anna apple orchards on M.M.106. of the same age and vigour were selected in each zone .Same cultural, fertilization and irrigation practices are carried in the three orchards. One year old shoots were collected from those orchards at different dates, during the fall, winter and spring in the two successive seasons, 1998 - 1999 and 1999 - 2000. They were transferred directly to the laboratory in ice boxes . Stem cuttings each of three buds were prepared from the median portions of the shoots. Samples of fifteen representative cuttings were taken to represent each zone and divided into 3 replicates of five cuttings. They were placed directly with their bases immersed in a constant water hot bath (25 $\pm$ 2°C).The percentage of buds reaching silver tip stage to total examined buds was calculated for each sampling date at different zones (Westwood, 1978).Chilling units accumulated from the beginning of winter till considered dates were obtained from central laboratory for Agricultural climate, (A.R.C). Transformation table had been used when calculating chilling units (Richardson *et al*,1974).Accumulated heat units (growing degree days) (G.D.D) were calculated for specified periods in the two seasons . The following equation was used:

G.D.D = (Mx + Mn) / 2-BT

Mx = Max . temperature

Mn = Min . temperature

BT =Base temperature = 6.1, according to Shallenemberger *et al*,(1959)

-**Changes of bud weight** - Average weight of dry buds for each sample date was determined.

-**Total carbohydrates** in dry buds were analysed by the method of Smith and Dubois (1956).

-**Statistical Analysis.** A randomized complete block design was used. Data were subjected to analysis of variance according to Snedecor and Cochran (1990) and averages were compared using L.S.D test.

RESULTS and DISCUSSION

Chilling units (CU)

Total chilling units (CU) in the dormancy period was generally higher in the second than in the first season in the three zones of study (N.D) ,(S.D) and (W.D) (Tables 1,2). No chilling units were accumalated in those zones at both September and October in the two seasons . However, in November, chilling was higher in the first than in the second season. This is highly apparent in (W.D) followed by (S.D) then (N.D).

The highest amount of chilling was accumulated during January in the first season in (W.D) and was 383 followed by (S.D) 275 and (N.D) 184. However, in the second the amount accumulated in this month was 232 (W.D) followed by (S.D) 158 and (N.D) 132.

G.D.D

G.D.D accumulated from 1st September till the end of next January was generally higher in the first than in the second season (Tables 1,2). It amounted to (1975,836.0), (1708,886), (2341,2068) in (N.D)(W.D) and (S.D) , respectively in the two seasons. It is clear that trend was nearly the same in (W.D) and (S.D) in September and October in the two seasons. However, accumulated G.D.D during January was (264,95) at (N.D), (239,136) at (S.D) and (171,68) at (W.D) in the two seasons.

Table(1): Accumulated CU and G.D.D. at various zones till specified dates during autum and winter in the first season (1998 - 1999)

North Delta (N.D)			South Delta (S.D)		West Delta (W.D)	
G.D.D	C.U		C.U	G.D.D	C.U	G.D.D
4th week of Sept.	-	566.0	-	943.0	-	586.6
3rd week of Oct.	-	948.4	-	1337.0	-	935.6
1st week of Nov.	10.5	1199.9	-	1601.2	2.0	1152.9
4th week of Nov.	18.5	150.1	24.5	1896.0	61.5	1391.6
3rd week of Dec.	38	1711.5	129.5	2101.4	263 0	1536.3
3rd week of Jan.	222	1975.2	404.5	2340.8	645.5	1707.7

Table(2): Accumulated CU and G.D.D. at various zones till specified dates during autum and winter in the second season (1999 - 2000)

Zones	North Delta (N.D)		South Delta (S.D)		West Delta (W.D)	
Dates of sampling	C.U	G.D.D	C.U	G.D.D	C.U	G.D.D
3rd week of Oct.	-	-	-	1009.0	-	238.9
1st week of Nov.	0.5	103.3	1	1272.0	-	438.1
3rd week of Nov.	2.5	287.8	16	1467	-	618
1st week of Dec.	21	477	37.5	1648.7	97 5	753.9
3rd week of Dec.	52	615.6	87	1782.0	210.0	720
1st week of Jan.	149.5	741.4	190	1932.0	361	818.3
3rd week of Jan.	281	836.0	348	2068.0	292.5	886.4
1st week of Feb.	454	999.8	518	2129	664.0	1023.7
3rd week of Feb.	539.5	1102.65	632 5	2231.0	666 0	1201.8

Effect of different zones and dates on percentage of bud burst:

Average results of the first season (Table 3) indicate that buds were dormant (≥ 50 %) bud burst through September and October only, this was also true with the interaction of period incubation X sampling dates after an incubation period of 15 days. Previous investigations consider the results of 15 days forcing as an indication of bud burst (Stino, 1991). Concerning various zones average results indicate higher burst at (N.D) than both (S.D) and (W.D), results taken after 15 days of incubation indicate that buds in the three zones were dormant at the 4th week of September, and also at the 3rd week of October in both (S.D) and (W.D) zones and active in the (N.D) zone, however at 1st week of November they were also dormant in (W.D) only. However, they were not dormant afterwards in the three zones.

Table (3): Effect of different zones and dates of sampling on percentage of bud burst in the first season (1998 - 1999)

Zones (A)	Dates (B) week / month	Incubation period at 25°C (C) (5 days)	(10 days)	(15 days)	(20 days)	Means
North Delta (N.D)	4 / Sept.	0	26.67	40.00	60.00	31.67 fg
	3 / Oct.	13.33	33.33	60.00	73.33	45.00 de
	1 / Nov.	13.33	40	73.33	86.67	53.33 bcd
	4 / Nov.	6.67	33.33	73.33	100.00	53.33 bcd
	3 / Dec.	26.67	46.67	80.00	100.00	63.33 a
	3 / Jan.	20.00	46.67	80.00	100.00	61.67 ab
Means (A x C)		13.33 g	37.78 e	67.78 b	86.67 a	51.39 a
South Delta (S.D)	4 / Sept.	0.00	13.33	26.67	33.33	18.33 h
	3 / Oct.	6.67	20.00	46.47	86.67	40.00 ef
	1 / Nov.	20.00	53.33	66.67	86.67	56.67 abc
	4 / Nov.	13.33	53.33	66.67	86.67	55.00 abc
	3 / Dec.	20.00	40	80.00	86.67	56.67 abc
	3 / Jan.	26.67	46.67	66.67	100.00	60.00 ab
Means (A x C)		14.44 g	37.78 e	58.89 c	80.00 a	47.78 b
West Delta (W.D)	4 / Sept.	0.00	0.00	13.33	13.33	6.67 I
	3 / Oct.	0.00	13.33	33.33	53.33	25.00 gh
	1 / Nov.	13.33	33.33	40.00	73.33	40.00 ef
	4 / Nov.	20.00	40.00	60.00	80.00	50.00 cd
	3 / Dec.	26.67	46.67	73.33	86.67	58.33 abc
	3 / Jan.	13.33	33.33	73.33	93.33	53.33 bcd
Means (A x C)		12.22 d	27.78 f	48.89 d	66.67 b	38.89 c
Means (C)		13.33 d	34.44 c	58.52 b	77.78 a	
Dates of sample		**Means (B x C)**				**Means (B)**
4 / Sept.		0.00 n	13.33 lm	26.67 ij	35.56 hi	18.89 d
3 / Oct.		6.67 mn	22.22 jkl	46.67 g	71.11 de	36.67 c
1 / Nov.		15.56 klm	42.22 gh	60.00 f	82.22 bc	50.00 b
4 / Nov.		13.33 lm	42.22 gh	66.67 ef	88.89 ab	52.78 b
3 / Dec.		24.44 jk	44.44 gh	77.78 cd	91.11 ab	59.44 a
3 / Jan.		20.00 jkl	42.22 gh	73.33 cde	97.78 a	58.33 a

Separation between means by L.S.D (0.05)

Concerning the results in the second season (Table 4), averages indicate that after 15 days of incubation , buds taken at all dates were not dormant as bud burst ≥ 50 % . If we consider the interaction between planting zones and sampling dates ,it can be noticed that results of (N.D) were irregular throughout the study period However, those of the other two zones were more regular and exceeded 50 % of burst in the majority of the dates .

Table (4): Effect of different zones and dates of sampling on percentage of bud burst in the second season (1999 - 2000)

Zones (A)	Dates (B)	Incubation period at 25°C (C)				Means
	week/ month	(5 days)	(10 days)	(15 days)	(20 days)	
North Delta (N.D)	3 / Oct.	0.00	26.67	53.33	46.67	31.67 hijk
	1 / Nov.	0.00	13.33	26.67	40.00	20.00 jk
	3 / Nov.	40.00	46.67	46.67	46.67	45.00 efgh
	1 / Dec.	0.00	53.33	53.33	60.00	41.67 fghi
	3 / Dec.	0.00	6.67	40.00	40.00	21.67 jk
	1/ Jan.	0.00	33.33	53.33	60.00	36.67 ghij
	3 / Jan.	0.00	20.00	20.00	20.00	15.00 k
	1 / Feb.	0.00	26.67	40.00	33.33	25.00 ljk
	3 / Feb.	20.00	60.00	60.00	66.67	51.67 cdefg
Means (A x C)		6.67 g	31.85 de	43.70 cd	45.93 c	32.04 b
South Delta (S.D)	3 / Oct.	0.00	53.33	93.33	100.00	61.67 abcde
	1 / Nov.	0.00	53.33	73.33	93.33	55.00 bcdefg
	3 / Nov.	0.00	20.00	60.00	93.33	43.33 efghi
	1 / Dec.	0.00	20.00	60.00	73.33	38.33 fghij
	3 / Dec.	13.33	66.67	80.00	86.67	61.67 abcde
	1/ Jan.	0.00	13.33	53.33	60.00	31.67 hijk
	3 / Jan.	0.00	73.33	100.00	100.00	68.33 abc
	1 / Feb.	60.00	73.33	80.00	80.00	73.33 ab
	3 / Feb.	6.67	60.00	66.67	86.67	55.00 bcdefg
Means (A x C)		8.89 fg	48.15 c	74.07 ab	85.93 a	54.26 a
West Delta (W.D)	3 / Oct.	0.00	73.33	73.33	73.33	55.00 bcdefg
	1 / Nov.	0.00	26.67	73.33	86.67	46.67 efgh
	3 / Nov.	46.67	80.00	86.67	86.67	75.00 a
	1 / Dec.	0.00	0.00	60.00	86.67	36.67 ghij
	3 / Dec.	13.33	53.33	80.00	80.00	56.67 abcdef
	1/ Jan.	53.33	60.00	60.00	73.33	61.67 abcde
	3 / Jan.	20.00	33.33	66.67	73.33	48.33 defgh
	1 / Feb.	6.67	40.00	73.33	80.00	50.00 cdefgh
	3 / Feb.	46.67	60.00	80.00	80.00	66.67 abcd
Means (A x C)		20.74 ef	47.41 c	72.59 b	80.00 ab	55.19 a
Dates of sample		Means (B x C)				Means (B)
3 / Oct.		0.00 l	51.11 bcdef	73.33 ab	73.33 ab	49.44 abc
1 / Nov.		0.00 l	31.11 fghij	57.78 abcde	73.33 ab	40.56 c
3 / Nov.		28.89 fghijk	48.89 cdef	64.44 abcd	75.56 a	54.44 ab
1 / Dec.		0.00 l	24.44 ghijk	57.78 abcde	73.33 ab	38.89 c
3 / Dec.		8.89 jkl	42.22 defgh	66.67 abc	69.39 abc	46.67 abc
1/ Jan		17.78 jkl	35.56 efghi	55.56 abcde	64.44 abcd	43.33 bc
3 / Jan.		6.67 kl	42.22 defgh	62.22 abcd	64.44 abcd	43.89 bc
1 / Feb.		22.22 hijkl	46.67 cdefg	64 44 abcd	64.44 abcd	49.44 abc
3 / Feb		24.44 ghijk	60.00 abcd	63.89 abc	77.78 a	57.78 a

Separation between means by L.S.D (0.05)

Dry weight of buds

Tables (5) summarize dry bud weight of samples collected from various zones at specified dates at dormancy period. It is clear that this weight had significantly increased gradually during this period in the two seasons . Heaviest buds were collected from (N.D) while the lightest from (W.D) in the two seasons. Interaction studies showed insignificant differences during September , October samples between (S.D) and (W.D) buds in the first season. However, in the second one the differences between weight of buds of the two zones were not significant in January & February. Also bud weight did not change significantly in December, January and February in (S.D) in the second season. Nevertheless , it is generally indicated that bud weight increased during dormancy season in the three zones of study.

Table (5): Dry weight of buds during dormancy period First season (1998 - 1999)

Zones (A) Dates(week/month)	North Delta (N.D)	South Delta (S.D)	West Delta (W.D)	Means (A)
4 / Sept.	0.11	0.09	0.02	0.08 e
3 / Oct.	0.12	0.10	0.08	0.10 d
4 / Nov.	0.16	0.14	0.12	0.14 c
3 / Dec.	0.19	0.19	0.15	0.18 b
3 / Jan.	0.31	0.22	0.13	0.24 a
Means (B)	0.18 a	0.15 b	0.11 c	
Separation between means by L.S.D (0.05) Interaction (A x B) L.S.D = 0.03				

Second season (1999 - 2000)

Zones (A) Dates(week/month)	North Delta (N.D)	South Delta (S.D)	West Delta (W.D)	Means (A)
3 / Oct.	0.10	0.16	0.11	0.12 d
1 / Dec.	0.25	0.17	0.13	0.18 c
1 / Jan.	0.34	0.19	0.19	0.24 b
3 / Jan.	0.36	0.25	0.25	0.29 a
Means (B)	0.26 a	0.19 b	0.17 c	
Separation between means by L.S.D (0.05) Interaction (A x B) L.S.D = 0.04				

Total charbohydrates in buds

Table (6) shows the percentage of total charbohydrates in buds at certain dates during dormancy period in the two seasons . Although there is some fluctuaticns in the results, yet it is clear that charbohydrates are generally low at the period of dormancy onset and increased gradually till the end of the period. No clear differences could be noticed between the three zones, however buds of (W.D) has apparently higher percentage of total carbohydrates.

Table (6): Percentage of total carbohydrates in buds First season (1998 - 1999)

Zones (A) Dates(week/month)	North Delta (N.D)	South Delta (S.D)	West Delta (W.D)
4 / Sept	7.50	8.60	8.6
3 / Oct.	8.70	9.10	8.0
4 / Nov.	8.00	8.70	8.90
3 / Dec.	8.50	8.50	12.0
3 / Jan.	10.60	12.00	13.7

Second season (1999 - 2000)

Zones (A) Dates(week/month)	North Delta (N.D)	South Delta (S.D)	West Delta (W.D)
3 / Oct.	7.40	8.3	7.3
1 / Dec	8.2	7.9	8.2
1 / Jan.	8.7	8.8	9.9
1 / Feb.	9.5	9.7	10.6
3 / Feb.	8.5	10.7	10.7

General Discussion and conclusion

The results of this study showed slight differences in the rhythm of Anna apple floral bud dormancy in the two seasons and three zones of study. It has been reported by Samih and Lavee (1962) that dormancy initiated in apple in late summer and chilling was effective in breaking rest after plants attained maximum rest.

Results of the two seasons (1998 – 1999 & 1999 – 2000) indicate that various delta zones differ in accumulated CU and G.D.D that, might explain the incidence of slight different dormancy patterns in those zones However, CU did not reach the previously estimated chilling requirements for Anna (326-490 CU) (Stino, 1991) in the two seasons, but it was more in the second than in the first season. Although there is differences between accumulated chilling at various zones yet, the discussed results of forcing at 25 ± 2°C do not indicate any evident and clear endo – dormancy.

It is evident that endo-dormancy did not occur in both (S.D) and (W.D) in the second season . However, in (N.D) the results were not constant to give a clear trend, it could be mentioned that dormancy of bud in the second season could not be caused by endo-dormancy, and is related to other types of dormancy (Lang, 1987) as eco-dormancy and or para-dormancy. In the first season, however, endo-dormancy was not evident in (N.D), but in (S.D) and (W.D) signs of endo-dormancy were noticed in the 4th week September and might be related to incomplete floral organs in this period (Yehia and Hagag, 2000).

Buds increased steadily in weight during dormancy. This was previously discussed byYoung *et al* (1974). Total charohydrates accumulated in buds during dormancy period. Similar results had been reported by Farag *et al* (1981).

The present investigation indicates that dormancy of Anna buds does not follow the regular dormancy pattern discussed by many workers (Amaling and . Amaling 1980 and Lang 1987). It is evident that it passes through different phases and types which is not directly related to chilling. However, G.D.D might play a role as it was higher in the studied period in the first than in the second season. Most apple varieties require a period of heat afterwards to complete the bud break (Young, 1992). However, dormant buds in the field is majorily caused by endo-dormancy.

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تأثير مناطق الزراعة على طرز سكون وتفتح براعم التفاح الآنا في مصر

رمزى جورج استينو- إيمان صبحي عطا الله
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أجري هذا البحث خلال موسمي ١٩٩٨ – ١٩٩٩ & ١٩٩٩ – ٢٠٠٠ على عينات مأخوذة من أشجار تفاح أنا على اصل م.م. ١٠٦ من ثلاث مناطق هي شمال الدلتا ، جنوب الدلتا ، غرب الدلتا في مواعيد مختلفة خلال الخريف والشتاء وقد أخذ في كل تاريخ عقل جانبية من أفرع عمر سنه تحتوى على براعم زهرية جانبية وتم في كل تاريخ وضع هذه العقل في أواني بها ماء في حضانة على درجة ٢٥ م ± ٢ وتم فحص البراعم وحساب النسبة المئوية لتفتح البراعم (مرحلة البرعم الفضي) وقدرت البرودة المتجمعة اقل من ١٠ م° كذلك الحرارة المتجمعة في الثلاث مناطق حتى تواريخ أخذ العينات. أتضح من نتائج البحث انه في الثلاث مناطق وفى السنتين لم تمر البراعم بمرحلة سكون عميق من النوع الذي يلزم لكسره تجمع كمية واضحة من البرودة في المناطق المختلفة وقد ظهر انه في هذه الثلاث مناطق في الموسم الأول وفى شمال الدلتا في الثاني انه خلال أكتوبر ونوفمبر وجود حاله من السكون تم انتهائها بعد ذلك قبل التعرض لكمية البرودة التي سبق تقديرها بأنها لازمه لكسر سكون التفاح الآنا الداخلي العميق ،من الأرجح أن هذا السكون متسبب من عدم استكمال الأعضاء الأساسية الزهرية والتي استكملت بعد ذلك بالتعرض لحرارة متراكمة كافية – ازدادت البراعم في الوزن وأيضا ازدادت كمية الكربوهيدرات الكلية في البراعم أثناء السكون و يبين هذا البحث أن أشجار التفاح الآنا لا تمر في مصر بسكون داخلي عميق – كما أكدته الدراسات المعملية – كما أن عدم تفتح البراعم في الحديقة يرجع إلي طرز آخري من طرز السكون.