MENOUFIA JOURNAL OF PLANT PRODUCTION

https://mjppf.journals.ekb.eg/

STUDIES ON GROWTH CYCLES, FLOWERING HABIT AND FRUIT SET OF VALENCIA ORANGE TREES UNDER ENVIRONMENTAL CONDITIONS IN TOSHKA REGION

Rabeh, M.R.M.[(1)]; Sherif, M.M.[(2)] and El-Abassy, M.A. [(2)]

[(1)] Hort. Dept., Fac.of Agric., Menoufia Univ., Shebin El-kom.

[(2)] National Water Research center, Toshka- Abu Simbel City.

Received: Jul. 27, 2022 Accepted: Sep. 18, 2022

ABSTRACT: This work was carried out in the orchard of Toshka Horticultural Research Station, Aswan Governorate. It went on for two successive seasons (2018 and 2019). The work involved six mature Valencia orange trees. The trees were about 15 years old. All the investigated trees were on sour orange rootstocks. The objective of this experiment was studying the behavior of growth of Valencia orange trees grown under Toshka conditions. It was also decided to study the distribution of the newly developing shoots throughout the growth seasons. Results showed that:

- All investigated trees trended to have two growth cycles (spring and summer cycles).
- The spring growth flush (main cycle) took place by the beginning of April till the end of May.
- The summer growth flush took place by the beginning of July till the end of October.
- All the new shoots started to grown slowly, then rapidly and gradually slowed down by the end of the period.
- The Valencia trees tended to bear the flowers on two types of growth. The first type was the new shoots (leafy inflorescences) that developed during April and May.
- The second type was the woody inflorescences that was borne on the old wood developed in the previous years.
- Fruit set was much higher in the leafy inflorescences than that on the woody type.

Key words: Valencia Orange, behavior of growth, fruiting, leafy inflorescences .

INTRODUCTION

Citrus is suggested to be one of the most important fruit crops all over the world. Its ranks the third position between fruit crops and only proceeded with grape and apple. The cultivated citrus species are believed to be motive of tropical and subtropical region of South –East Asia where they have cultivated since remote times. Most of the commercial production is now in subtropical regions with a Mediterranean climate. Citrus is the most important fruit crop in Egypt as far as its acreage, production and exportation potentialities are concerned. Sweet orange is the most widely grown and important between all citrus species. Fruits are eaten fresh and new large quantities are used for making juice which is canned. Essential oils which are obtained from the leaves, flowers and fruit peels are used in different medical and other purposes. The present study was carried out to understand the different growth characteristics and their relation to flowering and fruit set, so that it may be able to formulate a manorial and cultural schedule on sound basis. The purpose of this investigation is to study the behavior of growth of Valencia orange trees grown under Toshka conditions. It was also decided to study the distribution of the newly developing shoots throughout the growth season.

MATERIALS AND METHODS

This investigation was conducted during 2018/2019 and 2019/2020 seasons on 15 years old Valencia orange trees on to sour orange rootstock at the Orchard of Toshka Horticultural Research Station, Aswan Governorate. The trees were uniform in vigor and planted at 5×5 meters apart. The soil of the orchard is well drained sandy with a water table not less than two meters deep. The objective of this experiment was

*Corresponding author: mostafaabbasy11@gmail.com

studying the behavior of growth of Valencia orange trees grown under Toshka conditions. It was also decided to study the distribution of the newly developing shoots throughout the growth season. Six trees were selected at random for this study and the completely randomized system was selected.

The trees received no special treatments during the time of observations.

The work started in the spring of 2018 and 2019 seasons by choosing four uniform branches of about 1 inch in diameter for each branch on each tree in order to study the distribution of the new growth.

To achieve this aspect, newly developing twigs on the chosen branches were counted and recorded at monthly intervals (started by the beginning of April, for determining the growth cycles. Ten new shoots on every tree were labeled at the beginning of spring cycle. Its length were measured at three days intervals for finding out the growth rate.

1-Flowers and flowering habit:

Total number of flowers on new shoots and old wood were calculated. Growth of new shoots, its behavior blossoming and bearing habit were observed.

2- Fruit set and fruiting:

The total number of flowers on new shoots and old wood were counted and old wood were counted and labeled. Total number of fruits on the same inflorescences were recorded two times as follows:

- First: Difficulty after fruit set in July, 2018 and 2019.
- Second: At the beginning of fruit coloring in December, 2018 and 2019.

3-Statistical analysis:

The obtained data were tabulated and statistically analyzed according to Snedecor and Cochran (1990). Data means were compared using the least significant differences (L.S.D.) at 5% of probability.

RESULTS AND DISCUSSION

1- Distribution of growth cycles of Valencia orange trees:

Results concerning growth cycles of Valencia orange trees, during 2018 and 2019 seasons are presented in Tables (1 –a) and (1 –b). It could be seen that, in general, the Valencia orange trees tended to have two growth flushes.

The first growth flush (main cycle) took place by the beginning of April till the end of May. The second growth flush started by the beginning of July till the end of October. It is observed that the new growth which took place during April and May 2018 and 2019 (spring flush) was all vegetative shoots. Being the majority of all the new shoots developed all the year round. It is observed that these new the new growth with took place during April and May 2018 and 2019 (spring flush) was all vegetative shoots, being the majority of all the new shoots developed all the year round. Showed the highest percentage of the new growth.

The remaining new shoots that developed by July till October, gave less percentage of the total new growth.

Data in Tables (1– a) and (1 – b) clearly shows that the percentage of the new vegetative shoots (% of total) that developed during April 2018 and 2019 was 60.87% and 85.03%, respectively. It is also seen from data in the same Tables (1 – a) and (1 – b) that the percentage of the vegetative shoots (% of total) that developed during May 2018 and 2019 was 34.66 % and 12.26%, respectively. As regards the new shoots (second cycle of growth) that developed during the remaining period of the season, the percentage of total was 1.09% and 0.07% during July 2018 and 2019; 1.06% and 0.32% during August; 1.24% and 1.48% during September; and 1.11% and 0.83% during October 2018 and 2019, respectively.

Taking all the new shoots that developed on the trees, it could be seen from the data in Tables (1–a) and (1–b) that on the whole, the percentage of the new shoots (% of total) that developed during April and May 2018 was 95.49% while it was 97.29% in 2019. In case of the remaining

new shoots (second cycle of growth) that developed on the trees from July till October, the percentage of the new shoots (% of total) that developed during July, August, September and October 2018 was 4.5% while it was 2.7% for the same period in the season 2019.

Results obtained in this present study agree with those of Yamdagni (1986), Khalil (2012) and El-Zayat *et al.,* (2017).

2- Growth rate of the new shoots:

Data concerning the growth rate of the new shoots that developed on the Valencia orange trees are presented in Table (2). It is seen from the data that the shoot growth under the observations started by the beginning of April and ceased to grow by the beginning of May, a period of one month approximately. It is observed from the data in Table (2) that the mean length of the new shoots that developed by the beginning of April was 1.22 cm and reached a length of 6.06 cm during 2018, while it was 1.16 cm and reached 5.26 cm during 2019. All new shoots started to grow slowly them rapidly and gradually slowed down by the end of the time of the observations.

It is also seen from the data in Table (2) that the mean length of the new shoots was 6.06 cm during 2018, being much better than the new shoots developed during 2019 which was 5.26 cm. The growth rate which was better during 2018 than 2019, may be due to the less number of the new shoots that developed on the trees during 2018.

3- Flowering habit of Valencia orange trees:

Results concerning flowering habit of Valencia orange trees are presented in Table (3) and. It could be seen that in general, the Valencia orange trees tended to bear the flowers on two types of growth. The first type was the leafy flowering shoots that developed on the trees during April and May. The shoots started all vegetative. These new shoots bore the flowers when they were about three months old (end of June). The second type was the old wood (leafless flowering shoots) which developed in the previous years. These old wood bore the new growth that developed during April and May.

It is seen from the data in Table (3) that the mean number of flowers borne on the new shoots i.e. leafy flowering shoots (spring flush) was 2634 flowers during 2019. It is also seen that the mean number of flowers borne on the wood was 738 during 2018, while it was 4647 flowers during flowers during 2018, while it was 438 during 2019. The percentage of flowers (% of total) that was borne on the leafy flowering shoots that developed during April and May was 78.54% in 2018 while it was 90.48% in 2019. The percentage of flowers (% of total) that was borne on the old wood was 21.47% during 2018 while it was 9.52% in 2019.

It could be seen from the data in Table (3) that the total number of flowers that was borne on the new shoots was about four times the number of flowers borne on the old wood during 2018 while it was about eleven times during 2019. It is also seen from the data in Table (3) that the spring vegetative shoots (leafy flowering shoots) which started to grow by April bore more flowers than the old shoots for both the two seasons 2018 and 2019.

Table (3) clearly shows that the new shoots (leafy flowering shoots) that developed during April and May was significantly superior to the old wood as regards the percentage of bearing flowers on the Valencia orange trees.

It must be borne in mind, from the observations, that the new shoots that developed on the trees from July till October did not bear any flowers. All the flowers that developed on the new growth as well as the old wood were perfect. It is also noticed that flowering and fruiting lessened with increasing age of wood.

Results obtained in the present study are in harmony with those of many investigators Hume (1985), Wilde and Cory (1985), Kim (1996); Rose *et al.,* (1999) and Ebrahiem (2001).

Table (1 – a): Distribution of new growth of Valencia orange trees (Each Figure is an average of four branches) Average number of twigs per branch

Month	April		May		July		August		September		October		Total	
Tree No.	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
1	93.25	242.75	30.00	16.75	2.75	0.00	2.25	0.75	1.75	3.25	0.75	2.00	130.75	265.5
2	79.50	88.25	41.25	22.25	0.00	0.50	1.25	0.50	0.75	3.00	2.25	1.00	125.00	115.50
3	45.50	117.25	41.00	17.75	1.00	0.00	0.75	0.50	0.00	2.75	1.75	1.00	90.00	139.25
4	135.25	179.25	49.75	23.00	2.25	0.00	0.00	1.50	7.00	2.50	1.75	1.00	196.00	207.25
5	61.00	144.75	47.00	13.75	0.25	0.00	1.75	0.25	1.50	2.00	0.75	1.25	112.25	162.00
6	91.25	164.00	63.75	31.25	3.25	0.00	2.00	0.00	1.00	1.25	1.25	2.75	162.50	199.25
Mean	84.29	139.37	45.45	19.12	1.58	0.08	1.33	0.60	2.00	2.46	1.42	1.50	136.08	181.45
L. S. D. at 5 % :			2018				15.39							
			2019				24.28							

Table (1-b) : Distribution of new growth of Valencia orange trees (Each Figure is an average of four branches) Percentage of total

Month	April		May		July		August		September		October	
Tree No.	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
1	71.32	91.43	22.94	6.31	2.10	0.00	1.72	0.28	1.34	1.22	0.57	0.75
2	63.60	76.41	33.00	19.26	0.00	0.43	1.00	0.43	0.60	2.60	1.80	0.86
3	50.55	84.20	45.55	12.75	1.11	0.00	0.83	0.36	0.00	1.97	1.94	0.72
4	69.01	86.49	25.38	11.09	1.14	0.00	0.00	0.72	3.57	1.21	0.89	0.48
5	54.34	89.35	41.87	8.49	0.22	0.00	1.56	0.15	1.33	1.23	0.67	0.77
6	56.15	82.31	39.23	15.68	2.00	0.00	1.23	0.00	0.62	0.63	0.76	1.38
Mean	60.83	85.03	34.66	12.26	1.09	0.07	1.06	0.32	1.24	1.48	1.11	0.83
L. S. D. at 5 % :			2018				5.50					
			2019				3.45					

Table (2) : Growth rate of new shoots cm. (Mean of 10 shoots for each tree) .

Tree No.	1		2		3		4		5		6		Total		Mean	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
10l 4	1.22	1.18	1.26	1.20	1.20	0.95	1.29	1.14	1.18	1.26	1.17	1.24	7.32	6.97	1.22	1.16
13l 4	2.26	1.88	2.04	1.87	2.06	1.66	2.26	1.86	2.00	2.06	2.06	1.79	12.68	11.12	2.11	1.85
16 l 4	3.36	2.67	3.03	2.72	3.20	2.48	3.10	2.67	2.85	3.25	2.97	2.56	18.51	16.35	3.09	2.73
19 l 4	4.62	3.58	4.06	3.56	4.63	3.21	4.08	3.31	3.68	4.01	4.06	3.19	25.13	20.86	4.19	3.48
22 l 4	5.36	4.36	4.66	4.27	5.61	3.83	4.70	3.87	4.34	4.57	4.96	3.76	29.63	14.66	4.94	4.11
25 l 4	5.82	4.97	5.03	4.65	6.32	4.26	5.11	4.31	4.88	4.95	5.51	4.24	32.67	27.39	5.45	4.57
28 l 4	6.12	5.38	5.30	5.00	6.68	4.58	5.40	4.68	5.21	5.22	5.87	4.55	34.58	29.41	5.76	4.90
1 l 5	6.30	5.62	5.51	5.17	6.94	4.86	5.59	4.97	5.41	5.41	6.07	4.77	35.82	30.80	5.97	5.13
4 l 5	6.39	5.72	5.63	5.25	7.03	5.01	5.66	5.15	4.50	5.51	6.15	4.88	36.36	31.53	6.06	5.26
7 l 5	6.39	5.72	5.63	5.25	7.03	5.01	5.66	5.15	4.50	5.51	6.15	4.88	36.36	31.53	6.06	5.26

Table (3) : Number and percentage of flowers borne on Valencia orange trees (Each Figure is an average of four branches per tree)

Type of shoots		Number of flowers		Percentage of total	
Tree No.		New shoots	Old wood	New shoots	Old wood
1	2018	2759	975	73.89	26.11
	2019	6822	276	96.11	3.89
2	2018	2374	460	83.77	16.23
	2019	2937	554	84.13	15.87
3	2018	1911	680	73.75	26.25
	2019	3653	695	84.02	15.98
4	2018	3719	599	86.13	13.87
	2019	5349	429	92.58	7.42
5	2018	1990	375	84.14	15.86
	2019	4032	352	91.97	8.03
6	2018	3051	1337	69.53	30.47
	2019	5090	322	94.05	5.95
Total	2018	15804	4426	471.21	128.79
	2019	27883	2628	542.86	57.14
Mean	2018	2634	738	78.54	21.47
	2019	4647	438	90.48	9.52
L.S.D. at 5 %	2018	705		9.05	
	2019	1271		6.69	

4 -Fruit set %:

Results concerning fruit set of Valencia orange trees are presented in table (4). It is evident from the data that fruit set was much higher in the new shoots "new wood" than that in the old shoots "old wood" during both the two seasons of the study (2018 and 2019). Usually both types of bloom are present, and they appear frequently on the same branch. The term "old wood" is inaccurate, because the axes on which the flowers are borne in this instance are very short and leafless (Hume, 1985). The expression "old wood" will be referred to, in this study, as leafless inflorescence, while the "new wood " or " new shoots " bloom as leafy inflorescence. Results in Table (4) clearly shows that the leafy type of inflorescences occurred in a much greater portion than the leafless type (woody). The percentage of fruit set of the new shoots " new wood " was 41.1 %, while it was 31.5 % for the old wood during 2018. The percentage of fruit set of the new shoots " new wood " was 31.0 %, while it was 22.7 % for the " old wood " during 2019. It could be concluded then that most of the inflorescences appearing on Valencia orange are of the leafy type, although more work in needed before this conclusion become valid.The present results are conformity with the finding of Hume (1985), Ferguson (1994), Sourous (1995), El–Khassas (1996) and Rouse (2017).

5-Fruiting:

Results concerning fruiting 0f Valencia orange trees are presented in Table (5). It is seen from the data that the percentage of fruiting (% of total) was 21.9% for the new shoots while it was 12.3 % for the old wood in the first season. The percentage of fruiting (% of total) was 15.0%for the new shoots while it was 8.9% for the old wood during second season .It is rather clear that fruiting percentage of the new shoots was much higher than the old wood , being almost double during the two seasons 2018 and 2019. Results obtained in this present study agree with many investigators Hume (1985), Sourour (1995), EL-Kkassas (1996), Kim Rouse et al., (1999), Yuhn (2003) and Rouse (2017).

Table (4) : Fruit set percentage (After full bloom)

Tree No.	1		2		3		4		5		6		Total		Mean	
Type of shoots	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
New shoots	44.7	29.7	33.7	38.3	46.8	38.6	41.2	25.5	45.9	29.3	34.2	24.7	246.5	186.1	41.1	31.0
Old shoots	35.4	18.1	37.0	28.0	37.1	23.3	24.4	21.4	21.4	30.7	24.2	24.5	189.1	137.5	31.5	22.7
L.S.D. at 5 %			2018		5.5											
			2019		6.4											

Table (5) : Fruiting percentage at the beginning of coloring time (March)

Tree No.	1		2		3		4		5		6		Total		Mean	
Type of shoots	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
New shoots	24.0	13.1	21.5	15.9	24.5	16.6	21.0	14.9	21.7	15.6	18.8	14.1	131.5	90.2	21.9	15.0
Old shoots	11.5	8.9	12.4	11.0	12.4	9.7	13.3	9.4	11.9	8.1	12.0	6.5	73.5	53.6	12.3	8.9
L.S.D. at 5 %			2018		2.1											
			2019		1.9											

REFERENCES

Ebrahiem, T. A. (2001). Some studies on flowering in citrus. The Proceeding of the Fifth Hort., Ismailia, Egypt, 24- 28 March pp 113- 118.

El- Khassas, S. E. (1996). Some studies concerning flowering in citrus. Ph.D. Thesis, Fac. of Agric., Assiut Univ., Egypt.

El- Zayat, H. E.; Ibrahim, F.E. and El- Etreby, S. M. A. (2017). Studies on the citrus fruits. I- Effect of two stages of maturity on the composition and analysis of lime fruits. Egyptian Journal of Agricultural Research, 95 (3): 1131- 1143.

Ferguson, J.J. (1994). Growth of orange shoots. Proc. of the Florida State, Hort. Soc., 107: 29-32.

Hume, L. J. (1985). Fruit set in sweet orange in relation to flowering habit. New Zealand J. of Agric. Res., (4): 475- 486.

Khalil, M. K. (2012). Studies on citrus trees under the irrigation system of middle Egypt. Journal of Applied Science Research, (February): 901- 914.

Kim, Y. Y. (1996). Studies on the growth and fruiting of orange trees. J. of the – Korean Soc., for Hort. Sci., 37: 1: 70- 76.

Rouse, R. E. (2017). Fruit set in sweet orange (C. sinensis), the influence of inflorescence-leaves. Hort science, 52 (7): 972- 978.

Rouse, R. E.; Obreza, T. A. and Sherrod, J. B. (1999). Investigations on flowering and fruiting problems sweet lime (Tanaka). 1- Flowering and fruiting *C. limetta* characteristics. Proc. of the Florida State Hort. Soc., 112: 46- 50.

Snedecor, G.W. and Cochran, G.W. (1990). Statistical Methods. The Iowa State Univ., 7th ed., 507 p.

Sourour, M. M. (1995). Flowering habits, girdling and leaf area in relation to fruiting in citrus. M. Sc. Thesis, Fac. of Agric., Alexandria Univ.

Wilde, S. A. and Cory, R. B. (1985). Relation of growth to fruit in citrus. Oxford IBH, New Delhi, India, PP. 94- 105.

Yamdagni, R. (1986). Sprout growth on citrus. J. of Res., 16 (3): 233- 239

Yuan, R.C.; Hartmond, U.; Grant, A. and Kebder, W. J. (2001). Investigations on the cause and control of alternate bearing of Unshiu orange trees. III- Effect of fruiting in the previous season on flower formation. Journal of the American Society for Horticultural science, 126 (4): 414- 419.

دراسات علي دورات النمو وطبيعة التزهير والعقد وإثمار أشجار البرتقال الفالنشيا تحت الظروف البيئية بمنطقة توشكي

مجدي رابح محمد رابح[١]، محمد محمود شريف[٢]، مصطفي عبد الرحيم العباسي[٢]

[١] قسم البساتين –كلية الزراعة – جامعة المنوفية – شبين الكوم .

[٢] المركز القومي لبحوث المياه- توشكي – مدينة ابوسمبل .

الملخص العربي

أجريت هذه الدراسة خلال موسمي (٢٠١٨-٢٠١٩) و (٢٠١٩-٢٠٢٠) على ستة أشجار من البرتقال الفالنشيا عمرها ١٥ سنة ومطعومة على أصل النارنج في مزرعة محطة بحوث البساتين بتوشكى محافظة أسوان.

وذلك بغرض دراسة توزيع النموات الحديثة على مدار العام، وتحديد عدد دورات النمو ومواعيد حدوثها تحت الظروف المحلية لمنطقة توشكى، ومقدرة هذه النموات على حمل المحصول وطبيعة الأزهار وحمل الثمار.

وأمكن التوصل للنتائج التالية:

- أعطت الأشجار دورتي نمو إحداهما في الربيع والأخرى في الصيف.
- بدأت دورة نمو الربيع (الدورة الرئيسية) مع بداية شهر أبريل حتى نهاية شهر مايو.
- بدأت دورة الصيف من بداية شهر يوليو حتى نهاية شهر أكتوبر.
- توقفت نموات دورة الربيع عن النمو بعد شهر تقريباً من بداية تفتحها.
- هذه النموات بدأت نموها ببطء ثم نمت سريعاً، وبقرب النهاية أصبح نموها بطيء تدريجياً.
- تحمل الأزهار في أشجار البرتقال الصيفي نوعين من النموات، الأول هو النموات الحديثة (نورات ورقية) والتي تكونت في شهري أبريل ومايو من نفس العام.
- هذه النموات الحديثة (النورات الورقية)حملت الأزهار عندما وصل عمرها حوالي ثلاثة أشهر (في أواخر شهر يونيو).
- النوع الثاني هو النورات الخشبية التي تكونت على الخشب القديم الذي تكون في السنوات السابقة.
- عادة يوجد كل من النوعين من النورات متلازمين على نفس الفرع.
- نسبة العقد كانت أعلى كثيراً في حالة النورات الورقية عن النورات الخشبية خلال موسمي الدراسة.
- معظم النموات التي تكونت على أشجار البرتقال الصيفي كانت نورات ورقية.