

JA (Cao) 2/11

PHYSIOLOGICAL STUDIES ON NUTRITION AND FLOWER BUD INDUCTION IN SOME FRUIT TREES

By

IBRAHIM M. DESOUKY SHEHATA

B. Sc. in Agriculture (Ain Shams University), 1964

M. Sc. in Horticulture (Ain Shams University), 1967

DISSERTATION

Submitted in partial satisfaction of the
requirements for the degree of

DOCTOR OF PHILOSOPHY

in

HORTICULTURE

in the

Department of Horticulture

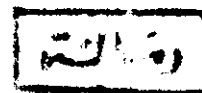
Faculty of Agriculture

Ain Shams University

Cairo, Egypt, U.A.R.

Approved by :

M. M. El-Zayuni
A. L. El-Toni
Zakaria Sidan



Committee in Charge

634
T.M.

1970

A C K N O W L E D G M E N T S

I wish to express my deep gratitude to Dr. ZAKARIA I. ZIDAN, Professor of Pomology, for suggesting the problem and for his kind supervision, constant guidance and encouragement.

I am also indebted to Dr. Shawky E. Maximos, Assistant Professor of Pomology, for his joint supervision, kind help and valuable suggestions.

To Dr. A. L. El-Tomi, Professor of Hort. and Head of the Department, I extend my deep appreciation for his encouragement and kind help during the whole course of the investigation.

XXXX XXXX

XXX

C O N T E N T S

	<u>Page</u>
I. INTRODUCTION	1
II. REVIEW OF LITERATURE	3
III. MATERIALS AND METHODS	33
IV. RESULTS AND DISCUSSION	48
A- Flower bud induction	
1. Grapefruit	48
2. Olive	61
3. Pear	73
4. Plum	86
5. Pomegranate	98
B- Seasonal changes in some of the leaf constituents :.....	114
1. Olive	114
2. Plum	127
C- Back translocation of nutrients from the leaf to the tree prior to leaf abscission	142
1. Grapefruit	142
2. Olive	154
3. Plum	166
D- Yearly tree loss of dry matter and nutr- ients through shed organs	179
1. Olive	179
2. Plum	187
V. SUMMARY AND CONCLUSIONS	200
VI. LITERATURE CITED	211

ARABIC SUMMARY

I-INTRODUCTION

Fruit growing gains great attention in many countries all over the world. This is primarily due to the high capital invested in such industry. In the UAR, acreage of fruit orchards has been increasing at a rather high rate, especially in the newly reclaimed areas during the past few years. This reflects the higher needs for fruits to meet both local consumption and exportation to foreign markets for hard currency.

A better understanding of the fruit tree physiology, no doubt, leads to better orchard management and finally to higher returns.

Determining the time of flower bud induction is highly needed in fruit trees. Such period plays a vital role in the ultimate yield and hence the profit of the fruit grower. Such information is valuable for the proper timing of cultural practices intended for regulating crop production. Furthermore, it helps scientists to give a thorough investigation of the physiology and biochemistry of this critical period of flowering. It is of interest to add here, that when studying bud development in plants it is now usual to discriminate between the induction period (when the flower

inducing stimulus is beginning to operate) and the onset of morphological differentiation. From the literature, it seems that most of the information on flower formation is confined largely to reports of the results of histological work on the time of flower differentiation.

This work was started with the hope of determining this very critical period of flowering (Flower bud induction) in some evergreen as well as some deciduous fruit trees. The method of branch ringing and defoliation was used for this study. The tree nutritional status during such period was also elucidated.

Furthermore, the work included a general study of some nutritional aspects such as the seasonal changes of some of the leaf constituents, seasonal loss of nutrients through shed tree organs and back translocation of mineral elements to the tree prior to leaf abscission. Such information on the tree behavior helps a great deal in proper orchard management.

Of evergreen trees, olives and grapefruits and of deciduous trees, pears, plums and pomegranates were involved in this investigation.

REVIEW OF LITERATURE

A: Flower bud induction :

The subject of flower bud induction and differentiation has attracted the attention of a very large number of investigators. This is certainly due to its great importance to fruit growers everywhere. The majority of those workers dealt only with flower bud differentiation. Only a few dealt with induction using a method similar to that used in the present study.

Period of flower bud induction :

Evergreen trees:

A simple and convenient method of periodic ringing and defoliating of branches was used to determine the approximate time of flower initiation by Furr et al. (1947). In adult Cleopatra mandarin trees time of flower initiation was found to be around December.

Studying the time of fruit bud formation in grapefruit, Ahmed and Khan (1951), stated that the examination during 1947 - 48 of 540 buds from three Marsh grapefruit trees at Lyallpur showed that blossom - bud differentiation coincided with the initiation of new growth in the spring. They found that the active period of different-

iation occurred over a fortnight from February fifteenth to March first.

Hartmann (1951), found that flower differentiation in the olive occurred in March, about eight weeks before full bloom. He found little or no variations among the 3 varieties studied or among the 5 localities from which samples were collected.

Noro and Inoue (1952), considered the date of flower bud initiation in Mission olive as that on which sepal primordia were first observable, and the time of inflorescence initiation as that on which the terminal bud differentiated into 3 flower buds. These two events both occurred on April 25 in 1951 and full bloom followed on June 3. In 1950 the dates were April 17 and May 28, respectively.

Sergeeva (1952), showed that floral differentiation in olive occurred about 2 months before full bloom.

Torrise (1952), found that flower bud differentiation in lemon had already started at the beginning of January in the varieties Monachello and Feminello.

Hartmann and Hoffman (1953), found that flower bud differentiation in olives occurred in Mid-March, and full

bloom occurred about 8 weeks later in Mid-May.

Fujita and Yagi (1955), in Japan working with 50-year-old Satsuma orange trees, found that differentiation of flower buds was first observed on March 26 and coincided with bud burst. It is presumed that induction occurred during the week preceding that date.

Fujita and Yagi (1956), in a different study reported that flower bud differentiation in Satsuma orange was first visible on March 16. The differentiation of flower buds in Washington Navel and Genoa lemon started in Mid-December or early January and continued for about 4 months until late March. In Valencia, Fukuhara and New summer oranges buds started to differentiate in late January, early February and mid-March respectively.

Working with March grapefruit, Furr and Armstrong (1956), found that the approximate percentage of buds in which floral induction had occurred up to different dates was determined in large numbers of buds by ringing and completely defoliation through December and by subsequently recording the number of shoots that appeared on the treated branches in the following February. They added that on trees with a normal crop, floral induction had started by the first

of September and progressed at a slightly increasing rate through December. On trees from which the fruits were removed in June, induction had started by early August and the percentage of buds that produced flowering shoots increased **markedly** during fall and early winter. They also found that girdling the trunks of uncropped trees in August or September greatly increased the rate of floral induction in early fall and winter. The results suggest that the simple ringing - and defoliating method used in this study is apparently reliable and may prove useful in obtaining information on the time of flower bud induction in citrus.

In China Liu and Wu (1957), working with 26 to 27 year old sweet orange trees found that the initiation began in the 3rd week of November. They added that the warm and dry weather in the Autumn and Winter advanced bud differentiation and flowering.

Ito et al (1958), in Japan found that blossom bud differentiation in Unshiu trees occurred on March 22, 1956 and later on March 23, 1957, following the time of meristematic activity. They also added that defoliation had no effect on time of differentiation. In Washington Navel oranges flower differentiation was apparent in material

collected on January 21, following meristemetic activity observed on January 10.

Iwasaki et al (1959), working on Satsoma orange in Japan, found that flower bud differentiation generally begins in the middle of August and continues until the end of March. He also found that lemon trees, which flower continuously differentiate flower buds a little earlier than Satsoma orange.

Flower bud induction and differentiation in the Shamouti (Jaffa) orange was studied by the microscopic and the ringing - defoliation techniques by Avalon and Monselise (1960). They found that the induction stimuli were only little operative during November and December but attained their maximum efficiency early in January. They also found that "predifferentiation" stages could be detected by microscopic observations only in late January. They stated that when studying bud development in plants, it is usual to discriminate between the induction period, when flower induction stimulus is beginning to operate, and the onset of morphological differentiation.

Khan (1960), found that flower bud differentiation in mango extended from mid August to the end of October for all

flushes except the July flush in which differentiation took place in November.

Sing and Dhuria (1960), observed the first evidence of flower bud differentiation in sweet lime on January 28, in 1958, and January 22, in 1959 with the commencement of growth. They also found that the earlier flushes manifested a higher percentage of differentiated buds than those of later flushes, and the apical buds more in number than the lateral buds.

Gaffer (1962) studied flower bud induction in Navel, Valencia oranges and Beladi mandarin using the ringing and defoliation method. His results indicated that flower bud induction in the 3 varieties started early in August and September but at a slow rate. It then increased with time till flowering period. He also found that the largest percentage of induction took place during the few months preceding the flowering season.

Randahawa and Chopra (1964), found that the first evidence of blossom bud differentiation in mandarin var. Kaula was observed on January 27, with the commencement of growth. They also recommended that all cultural operations, aimed to increase the bearing of mandarin, must be performed before the growth initiated in the spring, i.e. before

the actual time of blossom and differentiation.

Minessy et al (1965), indicated that flower initiation occurred in late February in seedy guava, whereas in seedless guava it occurred in March.

Nasr and Minessy (1966), found that flower differentiation in olives took place in December in the Shemlaly variety and in January in the Mission variety.

Troncoso (1967), working in the region of Pisa, found that until mid - February, the internal structure of the apical tissues was the same in all buds, but after that date centres of activity were apparent in the axial region of buds which eventually formed inflorescences.

Bakr (1970), working on guava found that buds which produced flowers on ringed and defoliated shoots were markedly observed on November 15 in the seedy variety and in January 15 in the seedless variety. The percentage of such buds in seedy and seedless trees, however, increased towards March 1st.

Deciduous trees :

Scarmuzzi (1953), defoliated the branches of plum, peach, cherry, apple and pear at various dates in the spring and summer of 2 consecutive years. He found that the differ-

entiation of flower buds occurred over a considerable period, in general becoming irreversible in June, July and August. He also indicated that specific and varietal differences in time of differentiation were less marked than those for individual varieties from year to year.

Ullah (1954), studied the time of differentiation in the peach at Lyallpur and in C.O. Smith at Palampur in 1945-47. He found that the time of flower bud differentiation at Lyallpur ranged from the first week of August to late September and at palampur from the first to the third week of July. The difference in season was attributed to climatic factors.

Nesterov (1959), found that apple flower buds began to form at the end of June, and by September and October were fully differentiated.

Shoemaker and Teskey (1959), mentioned that flower bud induction in the apple bud took place about the time when the leaf that subtended it became nearly full grown. This was almost a year before the flower opened. They also stated that the exact time of flower initiation varied with the variety, location, season and to some extent with soil and other factors. They suggested that the treatment to which tree was subjected had an influence on whether a bud became a shoot bud or a flower bud.

Molnar (1960 and 1962), found that the initiation of apricot flower buds in Hungaria started at the end of July and they were fully differentiated by the end of October.

Basso (1962), found that, in Precoce di Toscana apricot variety on myroblan rootstock in Italy, flower bud differentiation began between June 10 and June 20 in two successive years. He stated that this was very much earlier than the dates recorded in most of the literature on apricot flower bud differentiation.

Fulford (1962), in his study on apple buds, found that flower induction in Miller's seedling occurred after the spur leaves had ceased expansion, but in Laxton's Superb there was a delay of several weeks. He suggested that this delay was probably associated with the vigorous, late growing shoot typical of Laxton's Superb.

Khalil (1961), (1962), in Italy found that flower initiation began in the last week of May in Merlot and in the first week of June in Barbera grapes.

Neumann (1962), found that flower bud differentiation for apple in Russia began at the end of June or beginning of July, and by November the carpels or stamens were found. He also reported that the start and rate of differentiation were