PHYSIOLOGICAL STUDIES CONCERNING FOLIAR NUTRITION AND FLOWER BUD INDUCTION IN ALMONDS

By

SANAD EL SAYED MOHAMED HABIB
B. Sc. Agric., (Cairo University) , 1964
M. Sc. Hort., (Cairo University) , 1969

DISSERTATION

Submitted in Partial Fulfilment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY
in
HORTICULTURE

Department of Horticulture
Faculty of Agriculture
Ain - Shams University

1975

The Thesis of

Sanad El Sayed Mohamed Habib

is Approved

By :

Committe in charge

Date : / / 1975

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

The writer wishes to express his deepest gratitude to Professor Dr. S. Maximos in the Horticulture Department, Faculty of Agriculture, Ain-Shams University, for his supervision, encouragement, kind help, and useful criticism during this work and the preparation of this manuscript.

Deep thanks are also due to Professor Dr. S. T. Boulos in the Plant Production Department, Desert Institute, Ministry of Agriculture and Land Reclamation for his supervision, encouragement, kind valuable advice and useful help during carrying out this work.

Sincere thanks are also due to Dr. H. Tawfik Professor of general Botany in the Department of Plant Pathology, Faculty of Agriculture, Ain-Shams University, for his valuable help.

C O N T E N T S

	Page
INTRODUCTION	1
REVIEW OF LITERATURE	3
MATERIALS AND METHODS	11
RESULTS	21
I. Foliar absorption of urea sprays	21
II. Effect of urea foliar fertilization on the almond tree	24
1. The effect of urea foliar fertilization on flowering, fruiting and fruit quality...	24
a. Flower bud induction	24
b. Flower bud differentiation.	30
c. Fruit set	51
d. The yield	54
e. The fruit characteristics..	56
2. The effect of urea foliar fertilization on the vigour of almond trees..	61
a. Tree vigour	61
b. Leaf structure	66
i. The effect on the palisade tissue ...	71
ii. The effect on the spongy tissue ...	72

Page

The effect of urea foliar fertilization on some major contents 73

a. Total carbohydrate reserves in the shoots... 73

b. Total nitrogen percentage in the leaves ... 79

DISCUSSION 84

SUMMARY AND CONCLUSION 91

REFERENCES 96

Arabic Summary

*****

LIST OF TABLES

Table		Page
1	The total amount of rainfall (mms) during the years of study...	13
2	Total nitrogen in almond leaves sprayed with urea solution	22
3	Flower buds opening in the spring as percentage of total sprouting buds on girdled and defoliated branches	25
4	Effect of urea foliar fertilization on percentage induced flower buds at the time of bud opening ...	28
5	Distribution of different stages of flower bud differentiation of Non pareil variety as affected by different rates of urea fertilization	46
6	Distribution of different stages of flower bud differentiation of Drake variety as affected by different rates of urea fertilization	48
7	Fruit set as affected by urea foliar fertilization..	52
8	The yield of almond trees as affected by urea foliar fertilization	55
9	Fruit and kernal characteristics of Non pareil almonds as affected by urea foliar fertilization ...	57

Table | Page

10 Fruit and kernal characteristics of Drake almonds as affected by urea foliar fertilization... 58

11 The almond tree vigour as affected by urea foliar fertilization 62

12 almond leaf properties as affected by urea foliar fertilization 67

13 Seasonal changes in total carbohydrates in Non pareil shoot as affected by urea foliar fertilization (1971 season) 74

14 Seasonal changes in total carbohydrates in Non pareil shoot as affected by urea foliar fertilization (1972 season) 75

15 Seasonal changes in total carbohydrates in Drake shoot as affected by urea foliar fertilization (1971 season) 76

16 Seasonal changes in total carbohydrates in Drake shoot as affected by urea foliar fertilization (1972 season) 77

17 Seasonal changes in total nitrogen of Non pareil leaves as affected by urea foliar fertilization ... 80

18 Seasonal changes in total nitrogen of Drake leaves as affected by urea foliar fertilization ... 81

LIST OF FIGURES

Figure		Page
1	Total nitrogen percentage in almond leaves sampled at different intervals before and after application of urea solution to the foliage...	23
2	Flowering buds as percentage of total sprouting buds in the spring on branches ringed and defoliated at various dates as affected by urea foliar fertilization	26
3	Percentage of flowering buds as affected by urea foliar fertilization...	29
4	Fruit set percentage as affected by urea foliar fertilization	53
5	The yield of almond trees as affected by urea foliar fertilization...	53
6	The weight of the kernel as affected by urea foliar fertilization...	59
7	The weight of the fruit as affected by urea foliar fertilization...	60
8	Oil content in almonds kernel as affected by urea foliar fertilization...	60

Figure		Page
9	Shoot length as affected by urea foliar fertilization	63
10	Number of leaves per shoot as affected by urea foliar fertilization....	64
11	Leaf area as affected by urea foliar fertilization...	65
12	Seasonal changes of total carbohydrates (as gms glucose) in almond shoot as affected by urea foliar fertilization...	78
13	Seasonal changes of total nitrogen in Non pareil leaves as affected by urea foliar fertilization. ...	82
14	Seasonal changes of total nitrogen in Drake leaves as affected by urea foliar fertilization. ...	83

****

LIST OF PLATES

Plate		Page
1	Vegetative (v) and generative (g) buds shown more than one bud at the leaf axil...	31
2	I.S. in dormant bud (stage 1)...	32
3.	L.S. in the bud at the doom shape (stage 2)	34
4.	L.S. in the buds at stage (3)...	35
5	L.S. in the buds at stage (4)...	36
6	L.S. in the buds at stage (5)...	37
7	I.S. in the flower bud at stage (6)..	38
8	L.S. in the flower bud at stage (7)..	40
9	T.S. at the basal part of the flower bud at stage(7)	41
10	L.S. in the flower bud at stage (8)..	42
11	L.S. in the flower bud at stage (9)..	43
12	L.S. in the flower bud at stage (10).	44
13	T.S. in Non pareil leaf showing the effect of different rates of urea foliar fertilization on the leaf structure...	68
14	T.S. in Drake leaf showing the effect of different rates of urea foliar fertilization on the leaf structure...	69

****

I N T R O D U C T I O N

Almond (Prunus amygdalus L.) is one species of the "Rosaceae" family. The almond has been cultivated from time immemorial. It is thought to be native to the Medeterranean basin.(5). There are many references to almond in the Scriptures for it occurred freely in Palestine in a more or less wild state. Almonds were among the presents taken down to Egypt by the sons of Jacob. Nawadays almond is exported mainly from Spain, Italy, France, Portugal, Moracco, the Canary Islands and Persia (23).

Almond trees can thrive on almost all types of soils providing adequate draingage. It can grow satisfactory in slightly saline soils and under conditions of low soil moisture (21). On the other hand, some varieties of almond are more sensitive to salinity than others, e.g. Texas variety is more sensitive than Non pareil (8).

In Egypt, almond is grown with a fair degree of success on the Northern coast from Alexandria Westward in addition to the coastal strip of Sinai and Arish Valley. Most almond cultivation are located in arid regions where many other fruit trees fail to grow. Yet, maximum yield could not be

obtained in these regions unless we supply these trees with their sufficient requirements of water and nutrients.

In the present investigation the major aim was to study the ability of supplying the almond trees with urea nitrogen as foliar sprays since soil application could not be adapted where the rains which are the main source of water supply, are scarce and only limited within a certain period (from October to April). Another major aim in this investigation was to study the effect of urea foliar fertilization on flower bud induction and differentiation as well as fruiting of the tree.

REVIEW OF LITERATURE

The absorption of urea sprays

Nowadays, urea foliar fertilization has became a popular method of applying nitrogen to some horticulture crops. Hamilton et al. (22) in 1943 mentioned that in many areas in the United States, nitrogen fertilization of apple trees by spraying them with urea solution has become an established practice. They added that this method of application gave more rapid response than soil application of other fertilizers. Furthermore, Baynton (6) and Fisher (16,17 and 18) found similar results from their field experiments.

As for the ability of stone fruit trees to absorb and and benefit from urea foliar sprays, Proebsting (33) mentionned that these trees have generally absorbed only a little urea and showed negligible response.

Data concerning the ability of almond leaves to absorb and utilize urea foliar nitrogen are scarce in the available literature. Norton and Childers (29) working on Mission almond seedlings grown in sand culture in crocks covered with vinylite caps to prevent contamination by urea spray dust or rain water, showed that urea sprays applied at 5 lb and 10 lb per 100 gallons caused less leaf drop late in the

season, slightly darker green and a significant decrease in growth. They added that almond trees proved to be more sensitive than peach and were almost defoliated by urea at 1.0% which was the maximum tolerated without foliar burning by peach. Walker and Fisher (40) reported that the biuret impurity in the urea products was associated with the injury since there was no apparent injury with the crystal urea spray.

Flower bud induction and differentiation

Angiola (3) mentioned that the first external change of future almond flower buds was observed in mid-May. A change of the apical meristem occurred at the end of July. The beginning of the formation of the individual flower parts was marked by a sudden stop of the apical formation of leaf initials. The last of which ceased growth and lost their meristematic character remaining as small protuberances of the apex. The apex first flattened at the top and ceased to grow, assuming the form of a cup. From the edge of the cup to the bottom, different floral organs were differentiated in the following order : calyx, coralla, stamen and ovary. In the later half of October, the flower was completely formed, then its further growth and histological differentiation took place. At the end of January pollen grains were