

**EFFECT OF TRANSPLANTING AND
SUPPLEMENTARY IRRIGATION ON THE
IMPROVEMENT OF CANOLA PRODUCTIVITY
UNDER RAINFED CONDITIONS IN THE
NORTH WESTERN COAST**

BY

WAHBY MOHAMED HASSANY AHMED

B.Sc. Agric. Sc. (Agronomy), Assiut University, 1994

M.Sc. Agric. Sc. (Agronomy), Ain Shams University, 2000

A thesis submitted in partial fulfillment
of
the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

**Agricultural Science
(Agronomy)**

Department of Agronomy
Faculty of Agriculture - Ain Shams University

2005

Approval Sheet

EFFECT OF TRANSPLANTING AND SUPPLEMENTARY IRRIGATION ON THE IMPROVEMENT OF CANOLA PRODUCTIVITY UNDER RAINFED CONDITIONS IN THE NORTH WESTERN COAST

BY

WAHBY MOHAMED HASSANY AHMED

B. Sc. Agric. Sc. (Agronomy), Assiut University, 1994

M.Sc. Agric. Sc. (Agronomy), Ain Shams University, 2000

This thesis for Ph.D. degree has been approved by:

Prof. Dr. Ahmed Awad Mohamed

Professor of Agronomy, Faculty of Agriculture, Suez
Canal University

Prof. Dr. Nemat Abdel Aziz Noureldin

Prof. Emeritus of Agronomy, Faculty of Agriculture, Ain
Shams University

Prof. Dr. Adel Mahmoud Ahmed Abo-Shetaia

Professor of Agronomy, Faculty of Agriculture, Ain
Shams University

Prof. Dr. Abd-El-Azim Ahmed Abd-El-Gawad

Prof. Emeritus of Agronomy, Faculty of Agriculture, Ain
Shams University

Date of examination: 17 / 4 / 2005

**EFFECT OF TRANSPLANTING AND
SUPPLEMENTARY IRRIGATION ON THE
IMPROVEMENT OF CANOLA PRODUCTIVITY
UNDER RAINFED CONDITIONS IN THE
NORTH WESTERN COAST**

BY

WAHBY MOHAMED HASSANY AHEMAD

B.Sc. Agric. Sc. (Agronomy), Assiut University, 1994

M.Sc. Agric. Sc. (Agronomy), Ain Shams University, 2000

Under the supervision of :

Prof. Dr. Abd-El-Azim Ahmed Abd-El-Gawad

Prof. Emeritus of Agronomy, Department of agronomy,
Faculty of Agriculture, Ain Shams University (Principal
supervisor)

Prof. Dr. Adel Mahmoud Ahmed Abo-Shetaia

Professor of Agronomy, Department of agronomy, Faculty of
Agriculture, AinShams University

Prof. Dr. Hassan Khlil Hassan

Research Prof. Agronomy Unit, Department of Plant
Production, Desert Research Center, Cairo, Egypt

ACKNOWLEDGEMENT

I wish to express my appreciate, gratitude and deep thanks to **Dr. Abd-El-Azim Ahmed Abd-El-Gawad**, Professor of Agronomy Department, Faculty of Agric. Ain Shams Univ.; **Dr. Adel Mahmoud Ahmed Abo-Shetaia**, Professor and Head of Agronomy Department, Faculty of Agric., Ain Shams Univ., and **Dr. Hassan Khlil Hassan** Researcher Prof. of Agronomy, Desert Research Center, for their supervision, guidance, valuable discussions throughout the whole period of this investigation, suggesting the problem, valuable information and preparation of the thesis to its final form. Without continuous efforts and help this thesis would have not to be accomplished.

Particular thanks are extended to the staff members of Agronomy Department, Faculty of Agriculture, Ain Shams University, Cairo, Egypt and also to all staff members of Agronomy Unit, Plant Production Department, Desert Research Center, El-Matariya, Cairo, Egypt, for their interest and kind help.

ABSTRACT

Wahby Mohamed Hassany. Effect of Supplementary Irrigation and Transplanting on Canola Productivity under Rainfed Conditions at North Western Coast of Egypt. Unpublished Ph.D. of Science, Thesis, Agronomy Department, Faculty of Agriculture, Ain Shams University, 2005.

Due to short period of insufficient seasonal rainfall and their erratic distribution, supplementary irrigation and transplanting technique are very important under rainfed conditions. Therefore, three trials were conducted at Maryut and El-Hammam, NWC during 2000/2001 and 2001/2002. These trials were carried out to study the response of canola crop (*Brassica napus*, L. var. Pactol) to one, two or three supplementary irrigations, transplanting canola transplants at 4, 6 or 8 weeks age as well as direct seeding as control and plant density of 8, 16 and 24 plant/m².

Results indicated that two supplementary irrigations had a positive effect for the most studied growth characters at El-Hammam location particularly in the second sampling date comparing with one irrigation. Moreover, two supplementary irrigations at both locations, in most cases, were enough to obtain sufficient seed yield per plant or fed., oil yield/fed., number of bearing branches/plant, biological yield and rain use efficiency, RUE, (kg seed/fed./mm). However, 1000-seed weight significantly increased with increasing supplementary irrigations.

Transplanting canola transplants at any age had a significant increase in all growth traits either at first or second sample in two growing seasons at both locations. The same results were obtained for seed or oil yields/feddan and RUE as

well as yield attributes as compared with the traditional sowing by direct seeding. Moreover, 1000-seed weight and seed weight/siliquae of canola transplants at 8 weeks surpassed significantly the other treatments. However, number of seeds/siliqua was decreased with increasing transplanting ages.

Although, plant height and fresh weight/plant and chlorophyll content were not affected significantly by plant density, however, dry weight/plant was decreased with increasing plant densities. While, leaf area index and rain use efficiency were increased with increasing plant densities from 8 to 24 plants/m² at both samples in two growing season in both locations. However, plant density did not show obvious trend on seed or oil yields per fed., although seed yield/plant was decreased with increasing plant density. Biological yield and RUE for straw or biological yield were increased significantly with increasing plant density at both locations in two growing seasons.

The first and second order interactions between the studied factors had a positive effect on most growth traits as well as yield and its attributes. Thus, transplanting technique of canola crop as alternative technique of planting seed directly, may be suitable option under rainfed conditions coupled with two supplementary irrigations.

Key words: Canola (*Brassica napus*), Rainfed, Supplementary irrigation, Transplanting, Transplants age, Plant density.

CONTENTS

	Page
INTRODUCTION	1
REVIEW OF LITERATURE	3
I- Effect of supplementary irrigation:	3
1- Growth parameters of canola plants.	4
2. Yield and its attributes.	5
II- Effect of transplanting:	12
1- Growth parameters of canola plants.	13
2. Yield and its attributes.	13
III- Effect of plant density:	16
1- Growth parameters of canola plants.	16
2. Yield and its attributes.	17
MATERIALS AND METHODS	26
RESULTS AND DISCUSSION	36
A. Growth parameters:	36
1-Effect of supplementary irrigation	36
2- Effect of transplanting canola transplants at different ages	38
3. Effect of plant density	42
4- Effect of the interaction between supplementary irrigation and transplanting age of canola	46
5- Effect of the interaction between supplementary irrigation and plant density	50
6- Effect of the interaction between age of transplant and plant density:	52
B. Yield and its attributes	61
I- Effect of supplementary irrigation:	61
1-Yield attributes of Pactol canola variety	61
2-Yield components of Pactol canola variety	61
3- Seed, biological, oil yields and oil (%)	64
4- Rain use efficiency (RUE)	66

II- Effect of transplanting ages:	68
1-Yield attributes of Pactol canola variety	68
2-Yield components of Pactol canola variety	70
3- Seed, biological, oil yields and oil (%)	70
4- Rain use efficiency (RUE)	74
III- Effect of plant density:	74
1-Yield attributes of Pactol canola variety	74
2-Yield components of Pactol canola variety	77
3- Seed, biological, oil yields and oil (%)	79
4- Rain use efficiency (RUE)	82
IV-Effect of the interaction between supplementary irrigation and canola transplanting at different ages:	82
1- Yield attributes of Pactol canola variety	82
a- Plant survival percentage at harvest	82
b- Plant height at harvest	85
c-Height of the first branch	87
d- Number of bearing branches/plant	87
2-Yield components of Pactol canola variety	90
a- Number of seed/silique	90
b- Seed weight/silique	92
c- 1000-seed weight	92
3- Seed, biological, oil yields and oil (%)	94
a- Seed yield/plant	94
b- Seed yield/fed.	97
c- Biological yield per fed	100
d- Oil percentage	103
e- Oil yield/fed.	103
4- Rain use efficiency (RUE)	107
a- RUE for biological yield	107
b- RUE for seed yield	109
c- RUE for straw yield	111

V- Effect of the interaction between supplementary irrigation and plant density:	113
1- Yield attributes of Pactol canola variety	113
a- Plant survival percentage at harvest	113
b- Plant height at harvest	113
c- Height of the first branch	116
d- Number of bearing branches/plant	118
2-Yield components of Pactol canola variety	118
a- Number of seed/silique	118
b- Seed weight/silique	121
c- 1000-seed weight	123
3- Seed, biological, oil yields and oil (%)	125
a- Seed yield/plant	125
b- Seed yield/fed.	127
c- Biological yield per fed	130
d- Oil percentage	130
e- Oil yield/fed.	133
4- Rain use efficiency (RUE)	136
a- RUE for biological yield	136
b- RUE for seed yield	138
c- RUE for straw yield	138
VI- Effect of the interaction between canola transplanting at different ages and plant density	140
1- Yield attributes of Pactol canola variety	140
a- Plant survival percentage at harvest	140
b- Plant height at harvest	140
c- Height of the first branch	144
d- Number of bearing branches/plant	146
2-Yield components of Pactol canola variety	148
a- Number of seed/silique	148
b- Seed weight/silique	150
c- 1000-seed weight	150

3- Seed, biological, oil yields and oil (%)	153
a- Seed yield/plant	153
b- Seed yield/fed.	155
c- Biological yield per fed	158
d- Oil percentage	158
e- Oil yield/fed.	161
4- Rain use efficiency (RUE)	164
a- RUE for biological yield	164
b- RUE for seed yield	164
c- RUE for straw yield	167
VII- Effect of the interaction between supplementary irrigation, canola transplanting at different ages and plant density on seed yield	167
SUMMARY	176
REFERENCES	188
ARABIC SUMMARY	

LIST OF TABLES

No. of Table	Page
1- Rainfall distribution (mm) and dates of the supplementary irrigation during 2000/2001 and 2001/2002 growing seasons at Maryut and El-Hammam locations.	27
2- Sowing dates of the nursery and field experiment as well harvesting dates during 2000/2001 and 2001/2002 at Maryut and El-Hammam locations.	29
3- The characteristics of canola transplants of different ages at transplanting date.	30
4- Mechanical and chemical properties of soil at Maryut and El-Hammam locations.	30
5- Meteorological data of the two growing season 2000/2001 and 2001/2002 at Maryut location.	33
6- Effect of supplementary irrigation coupled with rainfall on certain growth parameters of Pactol canola variety and rain use efficiency at 6 and 9 weeks from transplanting at El-Hammam location.	37
7- Effect of transplanting ages on certain growth parameters of Pactol canola variety and rain use efficiency at 6 and 9 weeks from transplanting at Maryut and El-Hammam locations.	39
8- Effect of plant density on certain growth parameters of Pactol canola variety and rain use efficiency at 6 and 9 weeks from transplanting at Maryut and El-Hammam locations.	43
9- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting ages on certain growth parameters of Pactol canola variety and rain use efficiency at 6 and 9 weeks from transplanting, at El-Hammam location.	47
10- Effect of the interaction between supplementary irrigation coupled with rainfall and plant density on	

certain growth parameters of Pactol canola variety and rain use efficiency at 6 and 9 weeks from transplanting, at El-Hammam location.	51
11- Effect of the interaction between transplanting ages and plant density on certain growth parameters of Pactol canola variety and rain use efficiency at 6 and 9 weeks from transplanting, at Maryut location.	53
12- Effect of the interaction between transplanting ages and plant density on certain growth parameters of Pactol canola variety and rain use efficiency at 6 and 9 weeks from transplanting, at El-Hammam location.	55
13- Effect of the interaction between transplanting ages and plant density on certain growth parameters of Pactol canola variety and rain use efficiency at 6 and 9 weeks from transplanting at Maryut location.	57
14- Effect of supplementary irrigation coupled with rainfall on yield attributes of Pactol canola variety at Maryut and El-Hammam locations.	62
15- Effect of supplementary irrigation coupled with rainfall on yield components of Pactol canola variety at Maryut and El-Hammam locations.	63
16- Effect of supplementary irrigation coupled with rainfall on yield of Pactol canola variety at Maryut and El-Hammam locations.	65
17- Effect of supplementary irrigation coupled with rainfall on rain use efficiency of Pactol canola variety at Maryut and El-Hammam locations.	67
18- Effect of transplanting age on yield attributes of Pactol canola variety at Maryut and El-Hammam locations.	69
19- Effect of transplanting age on yield components of Pactol canola variety at Maryut and El-Hammam locations.	71

20- Effect of transplanting age on yield of Pactol canola variety at Maryut and El-Hammam locations.	72
21- Effect of transplanting age on rain use efficiency of Pactol canola variety at Maryut and El-Hammam locations.	75
22- Effect of plant density on yield attributes of Pactol canola variety at Maryut and El-Hammam locations.	76
23- Effect of plant density on yield components of Pactol canola variety at Maryut and El-Hammam locations.	78
24- Effect of plant density on yield of Pactol canola variety at Maryut and El-Hammam locations.	80
25- Effect of plant density on rain use efficiency of Pactol canola variety at Maryut and El-Hammam locations.	83
26- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on plant survival at harvest (%) of Pactol canola variety at Maryut and El-Hammam locations.	84
27- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on plant height (cm) of Pactol canola variety at Maryut and El-Hammam locations.	86
28- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on height of the first branch (cm) of Pactol canola variety at Maryut and El-Hammam locations.	88
29- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on number of bearing branches per plant of Pactol canola variety at Maryut and El-Hammam locations.	89

30- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on number of seeds per siliqua of Pactol canola variety at Maryut and El-Hammam locations.	91
31- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on seed weight per siliqua (mg) of Pactol canola variety at Maryut and El-Hammam locations.	93
32- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on 1000-seed weight (g) of Pactol canola variety at Maryut and El-Hammam locations.	95
33- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on seed yield per plant (g) of Pactol canola variety at Maryut and El-Hammam locations.	96
34- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on seed yield per fed. (kg) of Pactol canola variety at Maryut and El-Hammam locations.	98
35- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on biological yield per fed. (ton) of Pactol canola variety at Maryut and El-Hammam locations.	102
36- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on oil (%) of Pactol canola variety at Maryut and El-Hammam locations.	104
37- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on oil yield per fed. (kg) of Pactol canola variety at Maryut and El-Hammam locations.	105

38- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on rain use efficiency for biological yield (kg/fed./mm) of Pactol canola variety at Maryut and El-Hammam locations.	108
39- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on rain use efficiency for seed yield (kg/fed./mm) of Pactol canola variety at Maryut and El- Hammam locations.	110
40- Effect of the interaction between supplementary irrigation coupled with rainfall and transplanting age on rain use efficiency for straw yield (kg/fed./mm) of Pactol canola variety at Maryut and El-Hammam locations.	112
41- Effect of the interaction between supplementary irrigation coupled with rainfall and plant density on plant survival at harvest (%) of Pactol canola variety at Maryut and El-Hammam locations.	114
42- Effect of the interaction between supplementary irrigation coupled with rainfall and plant density on plant height (cm) of Pactol canola variety at Maryut and El-Hammam locations.	115
43- Effect of the interaction between supplementary irrigation coupled with rainfall and plant density on height of the first branch (cm) of Pactol canola variety at Maryut and El-Hammam locations.	117
44- Effect of the interaction between supplementary irrigation coupled with rainfall and plant density on number of bearing branches per plant of Pactol canola variety at Maryut and El-Hammam locations.	119