

**EFFECT OF PHOSPHORUS FERTILIZER RATES
AND FOLIAR SPRAY WITH SOME COMMERCIAL
FERTILIZERS ON GROWTH AND YIELD OF
BROCCOLI GROWN IN SANDY SOILS**

BY

TAMER MOHAMED ANWAR MOHAMED
B.Sc. Agric. Sci. (Vegetable Crops), Fac. Agric., Cairo Univ., 2005

THESIS

**Submitted in Partial Fulfillment of the
Requirements for the Degree of**

MASTER OF SCIENCE

IN

**Agricultural Sciences
(Vegetable Crops)**

**Department of Vegetable Crops
Faculty of Agriculture
Cairo University
EGYPT**

2013

APPROVAL SHEET

**EFFECT OF PHOSPHORUS FERTILIZER RATES
AND FOLIAR SPRAY WITH SOME COMMERCIAL
FERTILIZERS ON GROWTH AND YIELD OF
BROCCOLI GROWN IN SANDY SOILS**

**M.Sc. Thesis
In
Agric. Sci. (Vegetable Crops)**

BY

**TAMER MOHAMED ANWAR MOHAMED
B.Sc. Agric. Sci. (Vegetable Crops), Fac. Agric., Cairo Univ., 2005**

APPROVAL COMMITTEE

Dr. FATHY ABO ELNASR ABO SEDERA

Professor of Vegetable Crops, Fac. Agric., Benha University

Dr. AHMED HASSAN ALI KHEREBA

Emeritus Professor of Vegetable Crops, Fac. Agric., Cairo University

Dr. HASSAN ALI HASSAN

Associate Professor of Vegetable Crops, Fac. Agric., Cairo University

Dr. YASSER MOHAMED AHMED.....

Associate Professor of Vegetable Crops, Fac. Agric., Cairo University

Date: / /2013

SUPERVISION SHEET

**EFFECT OF PHOSPHORUS FERTILIZER RATES
AND FOLIAR SPRAY WITH SOME COMMERCIAL
FERTILIZERS ON GROWTH AND YIELD OF
BROCCOLI GROWN IN SANDY SOILS**

**M.Sc. Thesis
In
Agric. Sci. (Vegetable Crops)**

BY

TAMER MOHAMED ANWAR MOHAMED
B.Sc. Agric. Sci. (Vegetable Crops), Fac. Agric., Cairo Univ., 2005

SUPERVISION COMMITTEE

Dr. HASSAN ALI HASSAN

Associate Professor of Vegetable Crops, Fac. Agric., Cairo University

Dr. YASSER MOHAMED AHMED

Associate Professor of Vegetable Crops, Fac. Agric., Cairo University

Dr. MOSTAFA M. ABUO EL-MAGD

**Emeritus Researcher Professor of Vegetable Crops,
National Research Centre, Dokki, Cairo, Egypt**

Name of Candidate: Tamer Mohamed Anwar Mohamed **Degree:** M.Sc.
Title of Thesis: Effect of Phosphorus Fertilizer Rates And Foliar Spray With
Some Commercial Fertilizer On Growth And Yield Of Broccoli
Grown In Sandy Soils.
Supervisors: Dr. Hassan Ali Hassan
Dr. Yasser Mohamed Ahmed
Dr. Mostafa Mahmoud AbuEl-magd
Department: Vegetable Crops **Approval:** / /2013

ABSTRACT

Two field experiments were carried out during the two successive winter seasons of 2008/2009 and 2009/2010 under newly reclaimed sandy soil at Sadat City, Menoufia governorate, Egypt. The aim of these experiments is to study the vegetative growth, chemical parameters and yield parameters of broccoli plants cv. Condi as influenced by phosphorus fertilizer rates (50, 75, 100 and 125 units of P_2O_5 /fed.) as rock phosphate (22.8 % P_2O_5) applied as soil addition compared with foliar spray 1 g/l with the commercial nutrients Amifol K (potassium oxide 31% , Amino acids 5%), Tradebor (11 % B) and Tradecorp AZ II (Fe 7.5 % , Zn 2.48 % , Mn 3.5 % , Cu 1% , B 0.65 % and Mo 0.3%EDTA), Foliar spray of broccoli plants with Amifol K as minor nutritional fertilizer at a level of 1g/l gained the best plant growth and yield when compared with the other compounds. In the same pattern, the highest total yield as ton/fed., head weight, head diameter as well as chemical contents, viz., ascorbic acid, and total soluble solids of the apical head tissues were recorded with the addition of 100 units of rock phosphate fertilizer. The obtained results indicated that the vigor plant growth expressed as plant height, leaves number, leaf area, fresh and dry weights of broccoli plant were detected with plants supplied with 100 units of P_2O_5 /fed. Also, the chemical contents, viz., ascorbic acid, and total soluble solids of flower tissues followed the same trend of vegetative growth. The interaction between the application rates of phosphate and foliar applications of commercial nutrients had significant effect at P 5% level in all measured parameters in both seasons. The highest values of N, P and K, contents in apical head tissues, head flower yield and vegetative growth properties resulted by broccoli plants which received the phosphorus rate 100 units of P_2O_5 /fed. and sprayed with Amifol K at the dose of 1g/l.

Keywords: Broccoli, rock phosphate fertilizer rates, foliar application, commercial nutrients (Amifol k ,Tradebor and Tradecorp AZ II), vegetative growth, yield.

ACKNOWLEDGMENT

First of all, I thank Allah for helping me and giving me the health to fulfill this work.

*I would like to express my deep gratitude and appreciation to. **Dr. Hassan A. Hassan**, Associate Professor of Vegetable Crops, Faculty of Agriculture, Cairo University, for his scientific supervision, suggesting the problem and constructive guidance.*

*Deep gratitude is due to **Dr. YASSER Mohamed AHMED** Associate Professor of Vegetable Crops, Faculty of Agriculture, Cairo University for his supervision, unlimited help, and encouragement and advises throughout the whole work.*

*Thanks are due to **Dr. Mostafa M. ABOU EL-MAGD**, Researcher Professor of Vegetable Crops , Department of Vegetable, National Research Centre, Dokki, Cairo, Egypt for providing facilities and conducting this research.*

*I also thank **Dr. Taha Talat Elshorbgry**, Researcher Professor of Vegetable Crops, Department of Vegetable National Research Centre, Dokki, Cairo, Egypt for providing the potentials to conduct this research.*

The author wishes to extend his special thanks to all staff members of vegetable crops Department, Faculty of Agriculture, Cairo University, for their valuable assistance and cooperation during the course of the investigation.

*Special deep appreciation is given to my great mother **Mrs. Layla Sholkami Mohamed**, my late father, my wife **Yasmina Gamal Nosser**, my brothers **Ahmed and Mahmoud**, my aunt, my best friend **Mohamed Hanfy Hassan** and all my family and friends. Also I feel deeply grateful to my dear country Egypt.*

CONTENTS

	Page
INTRODUCTION	1
REVIEW OF LITERATURE	4
1. Effect of phosphorus fertilizer	4
a. Vegetative growth characteristics.....	4
b. Chemical composition of plant foliage	5
c. Total yield and its components.....	6
d. Physical and chemical quality of curd	7
2. Effect of commercial fertilizers	8
a. Vegetative growth characteristics	8
b. chemical composition of plant foliage	8
c. Total yield and its components	9
d. Physical and chemical quality of curd	10
MATERIALS AND METHODS	11
1. Treatments	12
a. Foliar spray with some commercial nutrients.....	12
b. Phosphorus fertilizer rates.....	12
2. Data recorded	15
a. Measurements of plant growth.....	15
b. Chemical contents of plant growth	15
c. Yield and quality of heads.....	16
d. Chemical measurements of heads	16
3. Statistical analysis	16
RESULTS AND DISCUSSION	17
1. Vegetative growth characteristics	17
a. Effect of foliar spry with commercial nutrients.....	17
b. Effect of Rock phosphate fertilizer rates.....	20
c. Effect of the interaction.....	20
2. Chemical composition of broccoli plant foliage	21
a. Effect of foliar spry with commercial nutrients.....	21
b. Effect of Rock phosphate fertilizer rates.....	24
c. Effect of the interaction.....	25
3. Total yield and its components	25
a. Effect of foliar spry with commercial nutrients.....	25
b. Effect of Rock phosphate fertilizer rates.....	26

c. Effect of the interaction.....	30
4. Physical head quality	30
a. Effect of foliar spry with commercial nutrients.....	30
b. Effect of Rock phosphate fertilizer rates.....	33
c. Effect of the interaction.....	34
5. Chemical head quality	34
a. Effect of foliar spry with commercial nutrients.....	34
b. Effect of Rock phosphate fertilizer rates.....	37
c. Effect of the interaction.....	37
SUMMARY	39
REFERENCES.....	45
ARABIC SUMMARY	

LIST OF TABLES

NO.	Title	Page
1.	Some physical and chemical properties of the investigated soil.....	13
2.	Some chemical characteristics of the studied Nile compost.....	13
3.	Some chemical characteristics of the studied of feldspar and rock phosphate.....	14
4.	Effect of phosphorus fertilizer rate, foliar spray with some commercial fertilizers and their interactions on Vegetative growth aspects during 2008/2009 season	18
5.	Effect of phosphorus fertilizer rate, foliar spray with some commercial fertilizers and their interactions on Vegetative growth aspects during 2009/2010 season	19
6.	Effect of phosphorus fertilizer rate, foliar spray with some commercial fertilizers and their interactions on chemical content of plant leaves during 2008/2009 season	22
7.	Effect of phosphorus fertilizer rate, foliar spray with some commercial fertilizers and their interactions on chemical content of plant leaves during 2009/2010 season	23
8.	Effect of phosphorus fertilizer rate, foliar spray with some commercial fertilizers and their interactions on yield during 2008/2009 season.....	27
9.	Effect of phosphorus fertilizer rate, foliar spray with some commercial fertilizers and their interactions on yield during 2009 / 2010 season	28

10.	Effect of phosphorus fertilizer rate, foliar spray with some commercial fertilizers and their interactions on heads physical and chemical quality during 2008/2009 season	31
11.	Effect of phosphorus fertilizer rate, foliar spray with some commercial fertilizers and their interactions on heads physical and chemical quality during 2009/2010 season	32
12.	Effect of phosphorus fertilizer rate, foliar spray with some commercial fertilizers and their interactions on chemical content of flowers during 2008/2009 season	35
13.	Effect of phosphorus fertilizer rate, foliar spray with some commercial fertilizers and their interactions on chemical content of flowers during 2009/2010	36

INTRODUCTION

Broccoli (*Brassica oleracea* L. var. *Italica*) is a member of the Brassicaceae family as a wild form of this family. Broccoli is an Italian vegetable, native to the Mediterranean region, cultivated in Italy in ancient roman times and about 1720 in England and it was cultivated as commercial crop around 1923 (Decoteau, 2000). However, due to increase in its popularity, there is a trend to increase cultivation by farmers as well as consumption by consumers. Broccoli is an important vegetable crop and has high nutritional and good commercial value (Yoldas *et al.*, 2008). It is low in content of sodium, fat free and calories, high in vitamin C and good source of vitamin A, vitamin B2 and calcium (Decoteau, 2000). Nowadays, broccoli attracted more attention due to its multifarious use and great nutritional value (Salunkhe and Kadam, 1998; Talalay and Fahey, 2001; Rangkadilok *et al.*, 2002 and 2004). Broccoli is a rich source of health promoting phytochemicals (Chun *et al.*, 2005). Epidemiological studies have shown an inverse association between the consumption of brassica vegetables and the risk of cancer (Day *et al.*, 1994). Of the case-controlled studies, 56% demonstrate a strong association between increased broccoli consumption and the protection against cancer (Podsędek, 2007). For these reasons, the cultivation of broccoli started to spread lately where Egypt is ranking the fifteenth in the world production with a total production of 130,000 tones valuing more than 31 million dollars while China is the top world producer of broccoli (FAO Statistics, 2009). Despite the growing importance of cultivating

broccoli under Egyptian conditions, very little studies have been carried out on enhancing the growth and production of such crop under local agricultural conditions. For this reason, growers are playing safe by adding extra amount of fertilizers in order to avoid any possible loss in production. However, the new trend in modern agricultural production requires efficient, sustainable and environmentally sound fertilizer management practices in order to save environment and human health. Among these environmental sound practices is the application of biological growth promoting substances.

Broccoli buds were found to be a rich source of most minerals especially of K, S, P, Mg and micro-elements (Aboul-Nasr and Ragab, 2000). Growing broccoli in the newly reclaimed soils is faced by various problems, such as cultivars, fertilization, low amounts of available nutrients and low organic matter content as well as poor hydrophilic, chemical and biological properties of the soil.

Most of the areas that have been put under reclamation and planned to be cultivated in Egypt are sandy and calcareous soils with alkaline PH. Under such conditions, considerable amounts of the available forms of phosphorus are usually subjected to rapid transformation to less available or unavailable forms. Therefore, the heavy application of phosphate fertilizers is a routine work necessary to supply the plant with the required amount of phosphorus (Mehana and Abdul Wahid, 2000).

Many reports indicated that phosphorus is playing a great role to improve the plant growth of some solanaceae family

(eggplant, tomato, potatoes pepper .etc.) whereas, they reported that phosphorus fertilizer had a significant effect on plant growth and its yield. As well as the different forms of phosphorus affected the physical and chemical properties of vegetable fruits

Nkoa *et al.* (2002) found that using mineral fertilizer (N, P and K) increased broccoli vegetative growth, yield and quality. Mineral fertilizer improves growth and yield of broccoli due to the role of nitrogen, phosphorus and potassium on the meristematic activity. Many investigators found that using mineral fertilizer (N, P and K) increased vegetative growth (Singh and Akhilesh- Singh, 2000) and yield and quality (Nkoa *et al.*, 2001; Tolba, 2005 and Babik and Elkner 2002).

REVIEW OF LITERATURE

In order to have a wide view on the effect of phosphorus and commercial fertilizers on vegetative growth, chemical composition of plant foliage, yield and its quality of broccoli plants the review of literature must be sub divided under the following items:

1. Effect of phosphorus fertilizer

a. Vegetative growth characteristics

Many investigators studied the favorable effect of phosphorus fertilizers on vegetative growth characteristics of different vegetable crops.

In this respect, Thakur *et al.* (1991) indicated that the highest rate of phosphorus (150 kg/ha) gave the best plant vegetative growth of cauliflower represented as stalk length, leaf size, plant weight, number of leaves / plant as well as the total fresh weight of plant. Redy (1996) reported that seedling fresh weight, leaf area and stem diameter of cauliflower plant were linearly increased in response to the main effect of both nitrogen and phosphorus application of 490 and 980 mg/plot for each, respectively.

In addition, Abou El- Salehein and Ahmed (1998) stated that applying ruler phosphate at the rate of 100 kg P₂O₅/ fed., enhanced the development of the vegetative growth (plant height and dry matter accumulation) of snap bean plants. Moreover, Wani and Korde (1998), on garlic, found that applying rock phosphate enhanced plant height and plant dry weight. In this connection, Abd El- All (1999) indicated that increasing levels of phosphorus up to 60 kg P₂O₅/ fed., increased

vegetative growth parameters, i.e., plant height, number of leaves and total fresh weight per plant. Sharma *et al.* (2002) indicated that plant height and number of branches per plant was significantly increased with increasing the concentration of both nitrogen and phosphorus fertilizers up to the highest used level (240 kg N and 60 kg P₂O₅ / ha.). In this regard, Basel *et al.* (2008), on broccoli, reported that increasing inorganic fertilizer from 30 up to 60 kg/ha increased number of leaves per plant. In addition, such treatments produced slightly higher fresh and dry weights of shoot.

Kandil and Gad (2009) stated that broccoli growth characters were significantly influenced by different mineral fertilizers. The highest plant height, branches and leaves number per plant and leaves area were solution recorded by plants which supplied with nutrients kin formula (19: 19: 19) fertilizer. Also, Islam *et al.* (2010) on broccoli reported that organic manure plus mineral phosphorus fertilizer increased all vegetative growth characters.

b. Chemical composition of plant foliage

With regard to the effect of phosphorus fertilizer on some chemical constituents of plant foliage expressed as chlorophyll formation and macro- elements (N, P and K) content. Eid and Mohamed . (1989) on cauliflower found that chlorophyll content of leaves was increased with increasing N&P application level up to 80 kg N + 64 kg P₂O₅ / fed., In this respect, Abd El- All (1999) indicated that increasing level of phosphorus application from 0, 30 up to 60 kg P₂O₅ /fed., significantly, and steady increased chlorophyll a, b and total chlorophyll content of leaves. In addition, Abou El-Salehein and

Ahmed (1998), on snap bean, stated that applying rock phosphate at the rate of 100 kg P_2O_5 /fed., enhanced the chemical contents of N, P and K elements. Also, Abd El- Salam (1999) working on sweet fennel found that increasing phosphorus rates increased mineral (N, P and K) uptake by plant.

c. Total yield and its components

As for the effect of phosphorus application on total produced yield and its components, Lancaster *et al.* (1985) showed that the total yield of broccoli was increased with increasing phosphorus level up to 800 Lb/ acre. In addition, Peck and Macdonals (1986) also working on broccoli found that the highest total yield was increased progressive, with increasing phosphorus fertilizer application up to 336 kg calcium super phosphate / ha. In this regard, Sharma (2001) studied the performance of different broccoli cultivars (Green Head, Samridhi, DPGB 12 and American Selection) under different levels of N, P and K rates (0 and 60, 45 and 15 kg/ ha.; 90, 60 and 30 kg / ha.; 120, 75 and 45 kg/ha and 150 kg/ha.; 90 , 60 kg / ha, respectively). Obtained results showed that the maximum values for yield and quality characteristics were obtained at the highest N, P and K levels (150, 90 and 60 kg/ha., respectively), Kandil and Gad (2009) reported that all mineral solution fertilizers gave a significant synergistic effect for the yield parameters, i.e., head weight per plant and heads weight per fed., of broccoli compared with the control. The best treatments of broccoli yield were recorded by using mineral solution fertilizers formula (14: 19: 19) followed by formula (19: 19: 19) followed by formula (10: 19: 40). Recently, Islam *et al.* (2010) indicated that application of