PHYSIOLOGICAL STUDIES ON STRAWBERRY

By

SHEREN ATA ATALA

B.Sc. Agric.Sci. (Horticulture), Fac. Agric., Ain Shams Univ., 2000
M.Sc. Agric. Sci. (Vegetable Crops), Fac. Agric., Cairo Univ., 2006

THESIS

Submitted in Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

In

Agricultural Sciences
(Vegetable Crops)

Department of Vegetable Crops
Faculty of Agriculture
Cairo University
EGYPT

2015

APPROVAL SHEET

PHYSIOLOGICAL STUDIES ON STRAWBERRY

Ph.D. Thesis
In
Agric. Sci. (Vegetable Crops)

By

SHEREN ATA ATALA

B.Sc. Agric.Sci.(Horticulture) Fac. Agric.,Ain Shams Univ., 2000
M.Sc. Agri. Sci. (Vegetable Crops), Fac. Agric., Cairo Univ., 2006

APPROVAL COMM ITTEE

Dr.SAMIR KAMEL EL-SEIFI.....
Professor of Vegetable Crops, Fac. Agric., Suize Canal University

Dr. SAID ABDALLA SHEHATA.....
Professor of Vegetable Crops, Fac. Agric., Cairo University

Dr. HASSAN ALI HASSAN.....
Associate Professor of Vegetable Crops, Fac. Agric., Cairo University

Date: / /2015

SUPERVISION SHEET

PHYSIOLOGICAL STUDIES ON STRAWBERRY

Ph.D. Thesis
In
Agric. Sci. (Vegetable Crops)

By

SHEREN ATA ATALA

B.Sc. Agric.Sci. (Horticulture) Fac. Agric., Ain Shams Univ., 2000
M.Sc. Agri. Sci. (Vegetable Crops), Fac. Agric., Cairo Univ., 2006

SUPERVISION COMMITTEE

Dr. HASSAN ALI HASSAN
Associate Professor of Vegetable Crops, Fac. Agric., Cairo University

Dr. AHMED HASSAN KHEREBA
Professor of Vegetable Crops, Fac. Agric., Cairo University

Dr. MOSTAFA SALEH EMAM
Head Research, Vegetable Handling Research Department, ARC, Giza

Name of Candidate: Sheren Ata Atala **Degree:** Ph.D.
Title of Thesis: Physiological Studies on Strawberry
Supervisors: Dr. Hassan Ali Hassan
Dr. Ahmed Hassan Khereba
Dr. Mostafa Saleh Emam
Department: Vegetable Crops **Branch:**
Approval: / / 2015

ABSTRACT

This study was carried out during the two successive winter seasons 2011-2012 and 2012- 2013 at sandy soil in a private sector farm at El-Dair village, Qalubia Governorate, Egypt, to investigate the effect of different nitrogen fertilizer levels and foliar spray with Humic acid at 2 l / fed., and Amica at 2 cm^3/ l apply every 15 days with a total of 5 application times during the growing season starting 21days after transplanting and every 15 days on vegetative growth, chemical constituents of plant foliage, fruit yield and quality of strawberry plants cv. Sweet Charlie. A split plot design with three replicates was used where different nitrogen fertilizer levels were arranged in the main plots and foliar spray treatments were arranged in sub plots. Obtained results show that soil addition of 100% of the recommended dose of NPK mineral fertilizers to strawberry plants combined with spraying the plants with Amica at 2 cm^3/ l are recommended to increase the vegetative growth, early maturing and total fruit yield. Moreover, compost at a rate of 100% of the recommended dose of NPK combined with spraying the plants with Amica result in obtaining the highest exportable yield with best quality. On the other hand, the second trail studied the effect of pre-harvest foliar spray with Humic acid and Amica as well as modified atmosphere of (16% O_2 plus 20% CO_2) or vacuum packaging or chitosan at 1.5% and vapor gard at 0.1% as post-harvest treatment on the storability of strawberry fruits cv. Sweet Charlie during storage at 0°C and 95% relative humidity. A completely randomized (factorial) design with three replicates was used. The results indicated that spraying the plants with Amica combined with MAP caused a significant increase in storability concerning weight loss, decay percentage, general appearance, total soluble solid percentage, ascorbic acid, firmness, color, texture, titratable acidity, total sugar content, pH and anthocyanins content and thus can be recommended for preservation of the physical and chemical quality indices of fruits during cold storage up to 15 days.

Key words: Strawberry fruits cv. Sweet Charlie, compost- N fertilizer, Humic acid, Amica, vegetative growth, fruit yield, fruit quality, post harvest, modified atmosphere, chitosan,vacuum, vapor gard, fruit storability.

ACKNOWLEDGEMENT

My high praise and gratitude are addressed to Allah, the almighty. Who enabled me to choose the right path and work diligently to achieve my goals.

I would be honored to convey my deepest thanks and true gratitude to ***Prof. Dr. Ahmed H. Khereba****, Professor of Vegetable Crops, Cairo University, for his supervision, constructive guidance, encouragement and continuous valuable help throughout the course of this investigation and preparation of the manuscript.*

Deep gratitude and thanks is also due to ***Dr. Hassan A. Hassan Associate*** *Professor of Vegetable Crops****,*** *Faculty of Agriculture, Cairo University, for suggesting the problem, scientific supervision, generous help, moral support, cooperation in offering all the facilities for achieving this work, and thesis writing.*

I'm also pleased to mention my sincere thanks and high regards for ***Dr. Mostafa Saleh Emam*** *because of his relentless support and encouragement that he granted me in all the phases of this work.*

I would like to state clearly my great appreciation and respect to all the staff members and technicians of the Vegetable Handling Research Department, Horticulture Research Institute, Agriculture Research Center, Giza, for every help and support throughout my work

My heart full thanks and sincere appreciation to my parents and for their helpful support and encouragement all over my life. I am particularly and deeply grateful to my husband and my children for inspiration and encouragement.

CONTENTS

LIST OF TABLES

INTRODUCTION

There are three major strawberry producing regions in Egypt, Elkalubia, Elbehira (south of Eltahrir District) and Ismailia. The total cultivated strawberry area occupies about 12,000 hectare of farmland in Egypt with a total production quantity of about 200,000 ton, and the quantity of exported strawberry in 2009 was 66,992 ton (FAO, 2009), i.e., Egypt exported 33.5 % from its total strawberry production in 2009. Fruit yields of strawberry cultivars depend on soil fertility and water availability during growing season. Therefore, to obtain uniform high yield of good quality fruits it is essential to provide adequate nutrients for proper plant nourishment (Sharma, 2002).

Conventional agriculture practices utilize high-yield crop cultivars, chemical fertilizers and pesticides, irrigation and mechanization (Asami *et al.*, 2003). Organic cultured strawberries produced higher root/canopy ratio in compare to conventionally cultured strawberries produced (Palomaki *et al.*, 2002). Several plant composts and manures were used by (Turemis, 2002), who found that the earliest strawberry bloom occurred with poultry manure and all the composts accelerated bloom date compared to control.

Recently, using macro and micro nutrients through foliar fertilization is preferable to avoid not only nutrients fixation in the soil, but also leaching during irrigation. Now, in Egypt there are many foliar fertilizers including the most macro and micro elements usually used to correct any defect in the soil. Foliar

supplements of fertilizers can compensate for the constraining effects on nutrient availability and uptake usually presented in the new reclaimed lands (El-Habbasha *et al.*, 2012).

Strawberries are also susceptible to water loss, bruising and mechanical injury due to soft texture and lack of a protective rind. To reduce spoilage, metabolism, and deterioration and to extend the shelf life, strawberry fruit should be kept at 0°C after harvest (Hernandez-Munoz *et al.*, 2006).

The aim of the present work was to evaluate the potential of pre-harvest different rate of organic fertilizers and foliar spray with Humic acid and Amica as well as modified atmosphere or vacuum packaging or chitosan and vapor gard as post-harvest treatment in preserving the quality and storability of strawberry fruits.

REVIEW OF LITERATURE

1. Field experiment

a. Vegetative growth characteristics

(1) Effect of organic nitrogen fertilizer

Different studies indicated that application of compost manure to strawberry field play an important role as soil amendment, improving plant nutrition and enhancing plant growth (Pinamonti *et al*., 1997). In this respect, Wang and Lin (2002) indicated that growing cvs. Allstar and Honeoye of strawberry in 100% compost manure significantly enhanced plant growth when used as soil supplement. In addition, adding half strength of peter nutrient solution (50%fetilizer) to a mixture of 50% soil +50% compost was effective and significantly increased plant dry weight to approximately double that of the control (without compost). Arancon *et al*. (2003) reported that using vermicompost produced (commercial product from cattle manure, marked food waste and recycled paper waste) at a rate of 5 or 10 t /ha significantly increased leaf area, number of suckers and shoot weight compared to the recommended inorganic fertilizer at a rate of 85-155-125 kg NPK/ha.El- Araby *et al*. (2003) reported that strawberry cv. Camarosa, planted in sandy soil was significantly affected by organic fertilizer (manure). They observed that increasing organic manure from zero to 25 m^3 / feddan (fed) significantly increased ($P \leq 0.05$) number of leaves, leaf area, foliage fresh weight and dry weight per plant in both seasons. They added that the data of the interaction between mineral nitrogen fertilizer and organic fertilizer cleared that 400 kg

N/fed +25 m^3 manure / fed. resulted in the highest values regarding the vegetative growth characters. Arancon *et al.* (2004) studied the effect of vermicomposts at rates of 5 or 1 t/ha on growth of strawberry plants cv. Chandler grown under plastic hoop tunnels. It was found that vermicompost application significantly increased strawberry growth including increases up to 37% in leaf areas and 37% in plant shoot compared to the control treatment (inorganic NPK fertilization , 85-155-125 kg/ha). El-Sayed (2004) found that all biofertilizers and NPK levels increased strawberry plants fresh and dry weight as well as average leaf area. Ezzo (2004) studied the effect of poultry litter at rate of 10, 20 and 30 m^3 / fed on vegetative growth parameters of strawberry plants cv. Camarosa and Sweet Charlie. He found that the maximum plant height, fresh and dry weight of different plant parts were obtained when used organic fertilizer at a rate of 10 or 20 m^3 / fed without significant differences compared with control treatment (recommended dose).Preusch *et al.* (2004) concluded that soil and compost treatments affected strawberry plant growth and dry weight but source of litter did not. In this concern, fresh compost of poultry litter (PL) increased leaf area , leaf and crown dry weights compared with dry compost of PL when added at 151.2 kg N/ha. Abu-Zahra and Tahboub (2008a) compared the effect of cattle, poultry and sheep manure in addition to 1:1:1 mixture of the three, with that of chemical fertilizers on strawberry cultivar camaroza. They found that the highest vegetative growth was obtained in the conventional treatment. Abo Sedera *et al.* (2009) found that using mineral N fertilizer alone or with compost at the recommended dose