EFFECT OF SOME AGRICULTURAL PRACTICES ON CUCUMBER PRODUCTION UNDER GREENHOUSE CONDITIONS

By

ALAN AZEEZ GIBRAEL

B.Sc. Agric. Sci. (Horticulture), Fac. Agric., Duhok Univ., 2009

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APPROVAL SHEET

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ABSTRACT

Two experiments were conducted during the summer and winter seasons of 2013 to study the effect of grafting using different rootstocks on the yield and quality and chemical analysis of cucumber (*Cucumis sativus* L.) cultivar "Hady" under high and low temperatures**.** The experiments consisted of 5 treatments, 4 rootstocks, namely Bottle Gourd (*Lagenaria siceraria* Standl.), Supper Shintosa (*Cucurbita maxima* Duchesne×*Cucurbita moschata* Duchesne), Squash 3 (*Cucurbita pepo*) and Ferro' *(C. maxima* × *C. moschata*), in addition to non-grafted control. Data were recorded on plant length and physical characters of fruits 30, 60 and 90 days after planting, early and total yield/m2, chemical characters (percentage of dry matter, TSS, total and reducing sugars) of cucumber fruits and percentage of N, P and K in cucumber leaves. The results indicated that Frro rootstock increased plant height, physical characters, early and total yield of cucumber fruits in both summer and winter seasons, as compared with non-grafted control. No significant effect was detected from using rootstocks on N, P and K percentage in cucumber leaves, except grafting cucumber on Bottle Gourd rootstock which significantly increased N% only in the winter season. Chemical contents of cucumber fruits were not affected by grafting in summer season, while Bottle Gourd increased total sugars and Ferro rootstock caused significant increase in the percentage of dry matter and reducing sugars in winter season as compared with non grafted plants.

Key words: Cucumber, grafting, vegetative growth, yield, fruit quality.

DEDICATION

I dedicate my work to my beloved great mom "EGYPT" , martyrs, victims, their families and the youth of 25th revolution who gave their lives ,dreams and hopes for our country bright future as well as to my parents and siblings for all their support and love along the period of my post graduation and all my life .

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INTRODUCTION

Cucumber (*cucumis sativus* L.) is an important and commercially popular cucurbitaceous vegetable crop which hold a very desirable position in the vegetable market,and it is one of the most nutritive vegetables rich in vitamins (vit. C) and minerals such as phosphorus,potassium,calcium ,silica ,magnesium and iron.It is mainly grown for its fruits both in tropics and subtropics of the world.Its fruits are eaten as vegetable, either salad or made into pickled cucumbers (Sumathi *et al.* , 2008).

Cucumber plant is one of major crops cultivated under greenhouses in Egypt; it represents about 75% of the total area of the greenhouses that is about 960 hectare (FAO- Regional working Group Greenhouse Crop Production in the Mediterranean Region-1997). It is a warm-season plant and grows rapidly at 23 to 29°C temperatures. Minimum temperatures should be no lower than19°C and daytime temperature should not exceed 32°C. Hence, cucumber cultivation perform in Egypt in in plastic houses in two growing seasons basically, autumn season, which starts from early September and terminate by end of January or early February, while long autumn plantation starts from mid of October to mid of November that ends by end of April or early May. Plastic houses remain without any benefit to the next autumn. To increase this benefit, farmers cultivate another crop under greenhouses on summer and paint the plastic cover by a white wash to decrease radiant density as well as avoid injuring the plant by high radiant density.

Grafting was traditionally used to refine woody plants, but since more than 50 years it is applied also in herbaceous fruit vegetables. Growing grafted vegetables was first launched in Japan and Korea in the pate 1920_s by grafting watermelon to gourd rootstocks (Ashita, 1927; Yamakawa, 1983). After the first trial, the cultivated area of grafted vegetables, as well as the kinds of vegetables being grafted, has been consistently increased. In the beginning, grafting was adopted to reduce the effect of soilborne disease like Fusarium wilt (Marukawa and Takatsu, 1969; Ryu *et al*.,1973; Choi *et al*., 1980; Yamakawa, 1983; Itagi, 1992; Crinò *et al.*, 2007; Lee *et al.*, 2010). However, at present, grafting is being used for improving yield (Kacjan-Marsic and Osvald, 2004) , enhancing nutrient uptake (Ruiz *et al*., 1997 ; Colla *et al*., 2010) , improving water use efficiency (Cohen and Naor, 2002 ; Rouphael *et al*., 2008a) , reducing uptake of pollutants from agricultural soils (Otani and Seike 2006, 2007) and increasing the flowering and seed production (Lardizabal and Thompson, 1990).

The purpose of grafting in vegetable crops also has been greatly expanded beyond reduction the infection by soil borne diseases it is now being used to improve resistance against abiotic stresses like drought (Bhatt *et al*., 2002), salinity (Chung and Choi, 2002; Santa Cruz *et al*., 2002; Fernández-García *et al*., 2004a, b; Estan *et al.*, 2005 Martinez-Rodriguez *et al*., 2008; He *et al*., 2009 ; Martínez-Ballesta *et al.* 2010), flooding (Yetisir *et al*., 2006) , heat (Abdelhafeez *et al*., 1975; Rivero *et al.*, 2003a,b) and low (soil) temperatures (den Nijs, 1980, 1984; Tachibana, 1982; Zijlstra and den Nijs, 1987; Bulder *et al*., 1991; Rivero *et al.*, 2003b; Venema *et al*., 2008). Because of these

beneficial effects of grafting, the cultivation of grafted plants in crops like tomato, eggplant and pepper and cucurbits (melon, cucumber, watermelon and pumpkin) has increased in recent years (Lee and Oda, 2003 ; Martínez-Ballesta *et al*., 2010; Lee *et al.*, 2010; Flores *et al*., 2010; Rouphael *et al*., 2010) .

At present, most of the watermelon *(Citrullus lanatus* (Thunb.) Matsum & Nakai), Oriental melons (*Cucumis melo* var. *makuwa* Makino), greenhouse cucumber (*Cucumis sativus* L.), and several Solanaceous crops in Korea and Japan are grafted before being transplanted to the field or greenhouse (Ryu *et al.*, 1973; Lee, 1989; Ito, 1992; Kurata, 1992). Grafting restricts input of agrochemicals against soil borne pathogens and is, therefore, considered an environment friendly cultivation technique, which is strongly recommended for integrated crop management systems (Rivard and Louws, 2008). However, the impact of grafting on cucurbits includes not only stronger resistance against pathogens but also a higher tolerance to abiotic stress conditions such as salinity, heavy metal, nutrient stress, thermal stress, water stress, organic pollutants, and alkalinity (Masuda and Gomi, 1984; Rouphael *et al*. 2008 a,b; Savvas *et al*., 2009 & 2010; Schwarz *et al*., 2010; Colla *et al*., 2010a,b,c, & 2011). Grafting in cucurbits also enhanced water and nutrient uptake (Marukawa and Takatsu, 1969; Heo, 1991; Kato and Lou, 1989; Kim and Lee, 1989) and increased plant vigor and extended the duration of economical harvest time (Itagi, 1992; Ito, 1992; Jeong, 1986; Kim and Lee, 1989).

Because of its low-temperature sensitivity, which includes numerous physiological disorders under suboptimal temperatures, cucumber is either cultivated year-round indoors in greenhouses or as a typical summer crop outdoors in summer. The production of cucumber in plastic houses becomes very low during the coldest months in Egypt (Januray and February). To solve this problem in greenhouses in European countries are heated in winter months. Due to secrecy of energy and increasing energy prices in addition to world concern about environmental problems related with CO_2 emissions from the combustion of fossil fuel, heating solution is not economic. A simple option to decrease the greenhouse temperature is the breeding of new cultivars that are better adapted to low temperatures. As a fast alternative for the relatively slow breeding process aimed to lower the energy demand of tomato, grafting of existing elite commercial cultivars onto selected rootstocks is regarded as a promising tool (Heuvelink and Kierkels, 2005).

The present investigation aimed to study the effect of grafting using different rootstocks on the cucumber yield and quality under high and low temperatures.

REVIEW OF LITERATURE

1. Effect of grafting on vegetative growth

It is well know that rootstocks affect the growth of scion plants. In vegetable crops, grafting is often introduced to give the crop vigor. Several reports showed that plant grafting resulted in improving vegetative growth of cucurbits (Mounir, 1965; Shimada and Nakamura, 1977; Arisawa *et al*, 1980; Okimura *et al,* 1986; Weng *et al,* 1993; El-Aidy *et al.,* 1996; Gaafer, 1996; Abd-Alla, 2002; and El-Semellawy, 2005).

Cucumber and melon grafted onto *Cucurbita pepo* var.*ovifera* gave a stronger and rapidly growth of the scion than grafting on *Cucurbita ficifolia*, but it caused an early death of scion (Groenwegen, 1953). In other studies, it was found that grafted cucumber on *Cucurbita ficifolia* had a larger root system (Carlesson, 1959) and grew faster than ungrafted one (Den Nijs, 1981). Similarly, grafting cucumber plants onto pumpkin plants (grown in sandy culture) promoted production of a larger dry mass (Shimada and Moritani, 1977). Shimada and Moriya (1977) found that cucumber plants grafted onto pumpkin resulted in a greater plant height and dry weight than those plants grafted onto parent rootstock. In the same tendency, Den Nijs (1980) found that cucumber plants grafted onto *Cucurbita ficifolia* rootstock grew faster than non grafted ones. It was observed by Tachibana (1982) that cucumber (*Cucumis sativus* L.) grafted on *Cucurbita ficifolia* rootstocks and also on different genotypes of *Sicyos angulatus*, which are resistant to low temperatures, enhances growth. In another study, Den Nijs (1984) stated that grafting cucumber plants