IDENTIFICATION OF SOME CUCURBITACEOUS ROOTSTOCKS FOR VEGETABLE CROPS IN ROMANIA

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ABSTRACT

This study aimed to identification of some rootstocks for cucurbitaceous vegetables and their influence on cultures. These vegetables (cucumber, watermelon, melon) are very popular crops in Romania. Vegetable crops are very sensitive to climatic vagaries, so fluctuation in climatic parameters at any phase of growth can affect the yield. Grafting on *Cucurbitaceae* is a method which has improved and spread quickly during the past years, a similar approach to crop rotation, a practice meant to increase productivity, resistance or tolerance to soil diseases and pests, as well as to abiotic factors and at increasing fruit quality. The research was conducted at the Horting Institute, Bucharest, Romania. Several aspects are taken into account in the use of rootstocks: environmental adaptability, quality fruit, resistance/tolerance for soil diseases and pests, drought, floods, soil salinization, heavy metal content, organic pollutants. Some resistant rootstocks have been identified worldwide (PS1313, RS841, bottle-gourd, NUN-9075, Argentario, PI296341 and others). Several rootstocks are very used in Romania for conventional and ecological crops (UG 29A, Shintoza, Emphasis, Cobalt and others). Following the studies undertaken on research trials in the greenhouses, many rootstock genotypes were selected and tested in the Horting Institute and some results are presented in this paper.

Keywords: *cucumber, hipobiont, quality, resistance, watermelon, yield*

INTRODUCTION

Soilborne pathogens are very destructive in vegetables crops and one of the most limiting factors to farmer's income. Their management worldwide has been based on pre- plant soil fumigation with methyl bromide, a compound whose phase-out procedure was initiated in the Montreal Protocol (1992) due to its hazardous effects on the environment. Methyl bromide is probably the only fumigant that is effective against nematodes, weeds, pathogens, insects and rodents. Since 1972 the consumption of methyl bromide has started in Romania in greenhouses. According to Montreal Protocol (1997), methyl bromide, as an ozone-depleting compound, has been scheduled to be phased out of production, importation and use as an agricultural chemical in developed countries by 2005 and in developing countries by 2015. In Romania the use of methyl bromide in soil treatments for plant protection (fumigation applications) is banned from 2002 January 1st and the use

of methyl bromide in storage applications is banned from 2005 January 1st (Gov Ordinance no. 89/1999, approved by Law no. 159/2000, art. 9). Research has therefore been focused on finding effective alternatives to this fumigant in order to control soilborne pathogens [1].

The advantages of vegetable grafting have been noticed by many workers. Grafts were used to induce resistance against low and high temperatures, enhance nutrient uptake, increase synthesis of endogenous hormones, improve water use efficiency, reduce uptake of persistent organic pollutants from agricultural soils, improve alkalinity tolerance, raise salt tolerance and limit the negative effect of heavy metal toxicity. Grafting can also exhibit excel-lent tolerance to serious soil-borne diseases, such as those caused by *Fusarium*, *Verticillium*, *Phytophthora*, *Pseudomonas*, *Didymella bryoniae*, *Monosporascus cannonballus* and nematodes even though the degree of tolerance varies considerably with the rootstocks [8].

Due to limited availability of arable land, the high demand for off-season vegetables and the intensive farming practices with limited crop rotations, vegetables are often cultivated under unfavourable conditions (salinity, water stress, alkalinity, heavy metals and excessive amounts of trace elements). Plants exposed to adverse chemical soil conditions exhibit various physiological and biochemical disorders, leading to stunted growth and severe yield loss. Numerous attempts using traditional breeding programs have been made to overcome problems due to adverse soil chemical conditions, but commercial success has been very limited. At present, the major efforts are being directed toward the genetic transformation of plants. As a rapid alternative to the relatively slow breeding methodology aimed at increasing vegetable crop tolerance to an abiotic stress, grafting high-yield genotypes onto selected rootstocks could be a promising tool [3].

Cucurbitaceous vegetables (cucumber, watermelon, melon) are very popular crops in Romania, but its are very sensitive to climatic vagaries, so fluctuation in climatic parameters at any phase of growth can affect the yield.

The cucurbitaceous grafting is useful in Romania. The rootstock have a big resistance to *Meloidogyne* spp. and *Fusarium* spp. attack, compared to the ungrafted cultivars. Sensivity to diseases and pest has imposes introduction grafting onto resistant rootstocks.

This study regarding identification of some cucurbitaceous rootstocks for vegetable crops in Romania is important to highlight some resistances and yield of cultivars. The researches in the cucumber, watermelon and melon grafting field began at Horting Institute, Bucharest, Romania in 2002 and have continued up to now; researches are in evolving in this domain.

MATERIALS AND METHODS

The experience was carried out in the Protected Culture Laboratory from Research and Development Institute for Processing and Marketing of the Horticultural Products – Horting, Bucharest, Romania.

The biological material used was different cucurbitaceous hybrids and varietes, scions: Cicerio, Fondant, Dochița, Vasko, Sorento, Romanza, Top Gun, Zodiac, Baronesa, Dulce Dăbuleni, Oltenia, De Dăbuleni watermelons, Gina, Raymond melons, Mathilde, Mirabelle, Lenara, Kybria cucumbers) and some rootstocks: ES113, ES30900, ES113, Argentario, Macis, TZ148, Shintoza, Batora, Emphasis, Pelops, Nimbus, Carnivor, Aurora - NIZ 54-07, Cobalt.

The research was carried out through a documentation study and works on different biological materials in cultures from greenhouse (observations, biometric determinations, biochemical component analyzes (soluble dry substance, acidity, soluble carbohydrates, vitamin C).

RESULTS AND DISCUSSION

Identification of some cucurbitaceous rootstocks worldwide

Grafting the watermelon cultivar Fantasy onto Strongtosa pumpkin rootstock (*Cucurbita maxima* Duch. × *C. moschata* Duch.) ameliorated the decrease of shoot weight and leaf area due to increased salinity, in comparison with ungrafted plants. Other experiments demonstrated that grafted Crimson Tide watermelon on squash (*C. maxima*) and two bottle gourd (*Lagenaria siceraria* (Molina) Standl.) rootstocks had higher plant growth than ungrafted plants under saline conditions. Similarly, two melon cultivars grafted onto three hybrids of squash (*C. maxima* Duch. × *C. moschata* Duch.) exhibited higher yield compared with ungrafted ones when grown under saline conditions (4.6 dS m-1). However, other researchers reported that the sensitivity to salinity was similar between grafted and ungrafted plants of melon, watermelon and cucumber as a result of the different *Cucurbita* rootstocks used in their studies. Cucumber plants grafted onto *C. moschata* had lower Na+ and higher Cl- contents in the leaves; grafting decreases the concentrations of Na+, but not Cl- in the leaves of melon and watermelon. In cucurbits, grafted mini-watermelons on a commercial pumpkin rootstock (*C. maxima* Duch. × *C. moschata* Duch. PS 1313) revealed higher yields (more than 115% total and 60% marketable) when grown under conditions of deficit irrigation, compared with ungrafted plants. There are differences in the agronomical, physiological and biochemical responses between grafting combinations of watermelon plants (Ingrid) grafting onto two bottle gourd rootstocks (Macis and Argentario) and two pumpkin (P360 and PS1313) rootstocks, and exposed to two levels of nutrient solution pH, specifically 6.0 or 8.1 dS m-1. Plants grafted onto pumpkin rootstocks and exposed to an excessively high external pH level were capable of maintaining higher net assimilation rates, strong capacity to accumulate Fe in the aerial part and a better plant nutritional status (higher P and Mg) in the shoot tissue, in comparison with those grafted onto bottle gourd rootstocks and the ungrafted plants [3].

The use of reciprocal grafting between drought-tolerant luffa rootstock and sensitive cucumber indicated that plant resistance to drought was mainly dependent on luffa rootstock. Antioxidant compounds (vitamin C and lycopene) in mini-watermelon were also higher in Ingrid/PS1313 grafting combination than in non-grafted control, irrespective of the irrigation regime used [6].

The root system of Pat 81 adapts to the needs of the aerial part of the Piel de Sapo scion, displays a high level of resistance to *Monosporascus cannonballus* (similar to RS 841), and provides the plant with more healthy roots, with a higher root/vine biomass ratio compared with non-grafted Piel de Sapo [4].

Watermelon Crimson sweet scion was grafted onto three different rootstocks (*Cucurbita* NUN-9075, *Lagenaria* Argentario, and citron watermelon PI296341). The NUN-9075 rootstock performed better than other rootstocks; hence, it is recommended as the best rootstock [5].

Potential rootstocks with special features of resistance against biotic and abiotic stresses identified by some researchers [7]: *Cucumis hydrix, C. ficifolia, Cucurbita moschata x C. maxima* for cucumber, PI 124111, PI124112 (*Cucumis melo* var. *momordica, Cucumis*), *C. trigonus, C. metuliferus, C. pustulatus* for musk melon, *Cucurbita lundelliana, Benikasa hispida,* Wax gourd for pumpink and commercial rootstocks for biotic stresses (*Fusarium oxysporum* – sp. *niveum*, *cucumerinum*, *melonis* and *lagenariae* and nematodes *Meloydogine* – sp. *incognita* and *halpa*) in cucurbits: Shintoza, Strongtoza, Figleaf gourd, Bottle gourd, Wax gourd, Bur cucumber, AH cucumber.

Identification of some cucurbitaceous rootstocks in Romania

The work was carried out in an experimental greenhouse; this greenhouse is specialized in producing vegetables seedlings, it is protected against condense by a double layers cover with an under pressure air layer as thermal insulator and it is equipped with a system for shadowing, ventilation and cooling of the grafting room. The greenhouse has two rooms: first room for plant growth and second room for grafting and callusing (Figures 1 and 2).

Figure 1. Room for plant growth

Figure 2. Room for grafting and callusing

The rootstocks used for cucurbit grafting are F1 hybrids from the Nunhems, Syngenta, Clause Vegetable Seeds, Rijk Zwaan, Nickerson Zwaan companies, which have also companies in Romania (Figure 3).

Carnivor, Emphasis, Macis, Vitalley, Nimbus, UG 29A

Figure 3. Cucurbitaceous rootstocks

The rootstocks with special features of resistance against biotic and abiotic stresses identified for cucumber, watermelon and melon crops in Romania by the researchers from the Horting Institute are F1 hybrids (*C. moschata* x *C. maxima* and *L. siceraria*): ES113, ES30900, ES113, Argentario, Macis, TZ148, Shintoza, Batora, Emphasis, Pelops, Nimbus, Carnivor, Aurora - NIZ 54-07, Cobalt and others.

The results at watermelons (Cicerio) grafting onto the ES30900 rootstock showed:

- a significant difference between standard plants crop and grafted plants crop (over 34t/ha),
- an improvement of commercial quality at grafted plants (88,9% and respective 93%, Class I watermelons); watermelons from non-grafting plants has an average percentage of Class I watermelons of only 69,90%,
- in grafted watermelons, dry matter content was reduced on average by 1,5% and total carbohydrate content was the lowest with 0,66%; practically the nutritional value of watermelons expressed by dry matter content and total carbohydrates is the same for both culture systems,
- the grafted plants showed resistance to attack of *Fusarium oxysporum* and *Meloidogyne incognita* comparing with non-grafted watermelons plants where the level of *Fusarium oxysporum* attack was of 0,56% and of 0,80 % for *Meloidogyne incognita* [2].

The Mathilde cucumbers grafted onto the TZ148, Shintoza and Batora rootstocks have vigour, resistant and big production compared with the non-grafted Mathilde cucumbers.

The grafting did not change significantly the fruits quality of grafted melons (Gina F1 and Raymond F1 grafted onto the Aurora–NIZ 54-07 F1 (*L. siceraria*) rootstock); at some biochemical components (soluble dry substance, acidity, soluble carbohydrates, vitamin C) are not existing significant differences between variants compared to the control non-grafted variants.

An experience was realized out on a collection consisting from two Romanian scions, melon (Fondant variety) and watermelon (Dochiţa variety) obtained at Research and Development Station for Vegetable Growing, Buzău, Romania and two rootstocks, bottle gourd – *L. siceraria* (Emphasis F1) and inter-specific hybrid squash – *C. maxima* x *C. moschata* (Cobalt F1). These grafting combinations are optimal plants for crops from Romania. Other experiences were carried out with cucurbits plants, different F1 hybrids (Mirabelle, Lenara, Kybria cucumbers; Vasko, Sorento, Romanza, Top Gun, Zodiac, Baronesa watermelons) or different Romanian watermelon varieties (Dulce de Dăbuleni, Oltenia, De Dăbuleni) grafted on F1 hybrid rootstocks (Pelops, Nimbus, UG29A and others). In all the research, the rootstocks have had yield, quality and resistance to abiotic and biotic stress factors.

CONCLUSION

In conclusion, the use grafted cucumber, watermelon, melon plants, the grafting combinations (scions x rootstocks) researched in the Horting Institute, may be recommended for the crops in Romania.

Several rootstocks are very used in Romania for conventional and ecological crops (UG 29A, Shintoza, Emphasis, Cobalt and others).

Following the studies undertaken on research trials in the greenhouses, many rootstock genotypes were selected and tested in the Horting Institute and some rootstocks are presented in this paper, F1 hybrids (*C. moschata* x *C. maxima* and *L. siceraria*) from from the Nunhems, Syngenta, Clause Vegetable Seeds, Rijk Zwaan, Nickerson Zwaan companies and others: ES30900, TZ148, Shintoza, Batora, Aurora - NIZ 54-07, Emphasis, Cobalt.

These rootstocks have had good results by grafting with some scions: Cicero, Fondant, Dochița watermelons, Gina, Raymond melons, Mathilde cucumber.

Based on the above mentioned results, it can be said that the rootstocks played a important role in plant resistance/tolerance to soil disease and pest, yield and fruit quality.

The results showed that cucurbitaceous grafting on the suitable rootstock has positive effects on the crops compared to the non-grafted cucurbitaceous.

The research in the cucurbitaceous grafting domain at Horting Institute are in evolving for the development of the ecological crops.

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