Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
ISSN Online 2286-1580, ISSN-L 2285-5653

EVOLUTION RESEARCH ON THE INFLUENCE OF MICORRHIZA ON CULTURE OF WATERMELONS WITH PLANTS GRAFTED ON SANDY SOILS FROM SOUTHERN OLTENIA

Iulian RĂȚOI[1], Vasile TOMA[1], Mihaela CROITORU[1], Nicolae LASCU[2], Valerian HĂNESCU[2], Emanuela Cristina VLADU[2]

[1]Research–Development Centre for Agricultural Plants on Sands – Dăbuleni, Street Victoriei, 130, Code 207220, Dăbuleni, County Dolj, Romania. Tel. 040 251 334 402, e-mail: ccdcpndabuleni@yahoo.com
[2]Faculty of Agriculture and Horticulture, Craiova

Corresponding author email: iulianratoi@yahoo.com

Abstract

Treatment of the soil with micorrhizal fungi on plants directly from the experimental field not led to higher levels of production instead when the inoculation is done directly in the hotbed there have been large increases in production. The production was dependent of the dose of inoculum, 33.1% in the case of inoculation with 50 micorrhizal spores to 10 grams of soil, and 73,1% in the case of inoculation with 100 micorrhizal spores to 10 grams of soil. Inoculation with fungi micorrhizal has proved to be beneficial and of average weight fruit. The spore of weight of fruit from the treated variants comparative untreated variant is the effect of arbusculare micorrhiza, which enhancing the ability of absorption, but also the quantity of nutrients, led to an acceleration of the photosyntetic process and default to shorten the length of maturity of the fruit. The rate of colonization in the case of variants with the inoculation of micorrhizal fungi was associated with organic fertilisation and was much reduced comparative to the untreated variant.

Key words: *grafting, micorrhiza, sandy soils, watermelons.*

INTRODUCTION

The role of arbusculare micorrhiza in the life of plants grown was the attention of many researchers [Abbott LK, Robson, 1982 AD.].
Research on the use of arbusculare micorrhiza in organic cultivation technology of watermelons on sandy soil could not effectuated in our country. The results of the world had other objectives and focused on other species and other conditions ecopedoclimatical [N.C. Schenck, 1984; N. C. Schenck, Yvonne Perez, 1988].
From previous research has shown that organic substance in the soil, which is more than 1% concentration, influenced negative the effect of arbusculare micorrhiza [Aliasgharzadeh et al., 2001; Mohammad et al., 2003; Mathur et al., 2007] and large concentrations of potassium from manure, slowing translocation carbohidrates in plants [Saint-Étienne et al., 2006].
Cavagnaro Tr., et. al., 2003; Javot h., 2007, were occupied by the study of the relationship between micorrhiza and nutrients from the soil and have reported the existence of negative correlations induced on the relationship of phosphorus and nitrogen micorizale mobile in organic and mineral fertilisers but whose strength is over 10-15% from phosphorus and nitrogen in soil naturally existing, and Daniela Popa et al., 2007, studied the rate of colonization of micorrhiza species *Glomus intraradices*. Also, Daniela Popa et al., 2008, tried to stabilise the heaps of slag and ashes by using micorrhizal fungi.

MATERIAL AND METHOD

Research has effectuated in the period 2009-2011. In 2009 the inoculation of spores was made directly to the experimental field, at 30 days from planting. The results obtained in the first year of experimentation determined the modification of experimental variants. Thus, in the years 2010 and 2011 inoculation made at seedling, after grafting and before the planting in the field.

Experimental variants in 2009

V1-unfertilized, untreated control;
V2-micorrhizal treatment;
V3-30 t/ha of manure treatment + micorrhizal treatment;
V4-60 t/ha of manure treatment + micorrhizal treatment;
V5-ground treatment with Maxiroot 10 l/ha;
V6- micorrhizal treatment + treatment by Maxiroot 10 l/ha.

Experimental variants in 2010 and 2011

V1-unfertilized, untreated control;
V2-unfertilized, + 1 * dose treatment;
V3-unfertilized + 2 dose treatment ;
V4. 30 t/ha of manure + treatment + 1 dose;
V5. 30 t/ha of manure + treatment dose 2 dose.
* 1 Dose has a concentration of inoculum with 50 micorrhizal spores to 10 grams of soil, and 2 doses has a concentration of inoculum with 100 micorrhizal spores to 10 grams of soil. Species of micorrhizal fungi was *Glomus intraradices*.
Experience has been placed by the method of randomized blocks, in 4 repetitions. Experimental plot area is 18 m^2. Hybrids of watermelons were *Montana F1* in year 2009 and *Lady F1* in the 2010 and 2011 years. Grafting is done in splinter on the rootstock *Macis F1*.
Planting grafted seedlings was age 35 days and the number of plants/ha was 5555, distances between rows was 1.8 m and 1 m between plants. For the prevention and control of major diseases were made 4 treatments with Cu SO_4, 0.5% and has been applied to a number of 8 irrigation in the 2009 and 2010 years and 4 irrigation in 2011 year, with rules of watering 300 m^3/ha.

REZULTS AND DISCUSSIONS

In the experimental conditions of 2009, soil treatment with micorrhizal fungi on plants directly from the experimental field has not increased production level, aspect highlighted by comparing the production obtained in untreated variant and treated variant with micorrhiza, dealt with loss of production as a result of treatment with micorrhiza was 4.9 t/ha but in comparison to treated variants with *Maxiroot* and *Maxiroot + micorrhizal fungi*, in which their application has led to a loss of production of 2 .5 t/ha (table 1).

Table 1.Production of watermelons with grafted plants function of fertilized and treatments with micorrhizal fungi (2009 Year)

Variant	Production		Difference	Signification
	t/ha	%	t/ha	
Unfertilized, untreated (Wt.)	32,0	100,0	Mt.	Mt.
Treatment with micorrhizal fungi	27,1	84,7	-4,9	-
30 t/ha manure + micorrhizal fungi	52,5	164,1	+20,5	***
60 t/ha manure + micorrhizal fungi	60,2	188,1	+28,2	***
Treatment with Maxiroot at soil, 10 l/ha	38,0	118,7	+6,0	-
Micorrhizal fungi + treatment with Maxiroot at soil, 10 l/ha	35,5	110,9	+3,5	-

Dl 5% 8,8 Dl 1% 12,6 Dl 0,1% 18,6

Productions were made dependent on the level of organic fertilization and they confirmed the results obtained from the experience on organic fertilization. The largest production (60.2 tonnes/ha) was obtained from the hybrid *Montana F1* by the 60 t/ha of manure, spore of production compared to the untreated, control variant of 28.2 t/ha and 7.7 t/ha compared to organic fertilized variant with 30 t/ha manure.
Results for the 2010 and 2011 years production and years average (tables 2, 3 and 4) were encouraging in that regard the use of micorrhiza to watermelons culture be grafted but also contradictory concerning to the organic fertilization. By inoculation with micorrhizal fungi at seedlings in the 2010 year, the year with the least favourable climatical conditions for plants of watermelons, recorded increases of production compared to untreated and unfertilized variant. The production rise was dependent upon the dose of inoculum, 33.1% being for 1 dose and 73.1% for dose 2. Beneficial effect of micorrhiza disappears or is greatly diminished when injecting is associated with fertilization. Inoculation of the root system at seedling stage proved to be the best in comparison with inoculation in the field.
The treatment of micorrhizal fungi has reduced the effect of 30 t/ha of manure, aspect found in 2011. In the second year of experimentation because to climatical conditions, level of production was higher than that of the 2010 year.

Table 2. Production of watermelons with grafted plants function of fertilized and treatments with micorrhizal fungi (2010 Year)

	Production		Difference t/ha	Signification
	t/ha	%		
Unfertilized, untreated (Wt.)	17,1	100,0	Mt.	Mt.
Unfertilized+treatment with 1 dose	22,9	133,9	+5,8	-
Unfertilized+treatment with 2 dose	29,6	173,1	+12,5	**
30 t/ha manure+ treatment with 1 dose	17,1	100,0	-	-
30 t/ha manure+ treatment with 2 dose	20,6	120,4	+3,5	-

Dl 5% 8.6 Dl 1% 12.0 Dl 0,1% 16.7

Table 3. Production of watermelons with grafted plants function of fertilized and treatments with micorrhizal fungi (2011 Year)

Variant	Production		Difference t/ha	Signification
	t/ha	%		
Unfertilized, untreated(Wt.)	50,7	100,0	Wt.	Wt.
Unfertilized+treatment with micorrhiza 1 dose	47,1	92,8	-3,6	-
Unfertilized+treatment with micorrhiza 2 dose	60,5	119,3	+9,8	-
30 t/ha manure+ treatment with 1 dose	51,5	101,5	+0,8	-
30 t/ha manure+ treatment with 2 dose	52,6	103,7	+1,9	-

DL 5% 12,8

One dose of inoculum was not sufficient to increase production, but by doubling the dose has been reported an increase in production by 9.8 tonnes/ha (19.3%) as compared to untreated variant. It is found and this time that treatment with spores of the genus *Glomus intraradices* micorhrizal in seedling stage with organic fertilization associated with 30 t/ha of manure does not have the effect of increasing the level of production. The results of two years of experimentation to support growth of water-melons production using the micorrhiza to grafted plants. Inoculation in seedling stage with larger doses of inoculum (2 dose) determined a spore of production by 33.0% (11.2 tonnes/ha), compared with untreated and unfertilized variant.

Table 4.Production of watermelons with grafted plants function of fertilized and treatments with micorrhizal fungi (Average years 2010-2011)

Variant	Production		Difference t/ha	Signification
	t/ha	%		
Unfertilized, untreated(Wt.)	33,9	100,0	Wt.	Wt.
Unfertilized+treatment with micorrhiza 1 dose	35,0	103,2	+1,9	-
Unfertilized+treatment with micorrhiza 2 dose	45,1	133,0	+11,2	-
30 t/ha manure+ treatment with 1 dose	34,3	101,1	+0,4	-
30 t/ha manure+ treatment with 2 dose	36,6	107,9	+2,7	-

Dl 5% 10,7 Dl 1% 14,4

Inoculation with micorrhizal fungi has proved to be beneficial and of average weight of fruit, in all experimental variants (Table 5).

All these results we consider particularly valuable and will form new points of departure for increasing the rate of inoculation, the best moments and association with different doses of fertilizer. Weight rises made by fruit of the following treaties to control them and explaining variant as arbusculare micorrhiza which effects, enhancing the ability of absorption, but also the quantity of nutrients, led to an acceleration of the process photosynthetic and default to shorten the length of maturity of the fruit. The results of chemical analysis carried out on samples average fruits of watermelons in all experimental variants are given in table 6 and relations of interdependence between variations of these chemical compounds are highlighted the significance of simple correlation coefficients in table 7.

In principle, the relations of the correlation coefficients exposed are those expected, so variations in concentrations of total soluble substance (Brix) are heavily influenced by the variation of dry and grey and the default variations that influence calcium accumulation and significant positive changes in the levels of ash in the ratio of 94,09% (r = 0,97). Also, significant positive influences are variations of calcium (r = 0.75) and high (r = 0.67) over acidity changes.

Table 5. The weight average fruit of watermelons with grafted plants function of fertilization and treatments with micorrhizal fungi (Years 2010-2011)

Variant	Fruit average weight	
	(Kg)	**(%)**
Unfertilized, untreated (Wt.)	5,816	100,0
Unfertilized+treatment with 1 dose	6,106	104,9
Unfertilized+treatment with 2 dose	6,490	111,5
30 t/ha manure+ treatment with 1 dose	6,272	107,8
30 t/ha manure+ treatment with 2 dose	5,896	101,3

Table 6. The results of chemical analysis effectuated at edible part of fruit at watermelons in harvesting moment

V*	Brix Brix	Dry substance (g%g fresh substanc)	Cinders	Ca	Acidity **	K
			(mg %g fresh substance)			
1	6,52	7,67	52,75	5,94	56,42	8,44
2	7,43	8,34	59,6	7,4	58,22	9,6
3	8,57	9,53	62,6	7,71	58,3	10,48
4	6,66	8,12	57,82	7,14	59,21	11,37
5	6,63	8,18	58,37	7,21	59,02	11,46

* Variant

**Acidity is expression in mg citric acid/100 g fresh substance

Based on correlation coefficients, the most significant, were considered regression curves of these interdependence. Thus, in the case of total soluble solids in relations with independent total dry matter, the values of experimental data obtained in repetition of variants V2 and V3 (micorrhizated with doses of 50 and 100 spores to grow 10 g soil) are distributed on the upper slope of regression curves (Fig. 1).Experimental data values recorded variations micorrhizated and organic fertilized, V4 and V5, it is situated on the inferior slope of the regression curves, in the immediate vicinity of the cloud of points representing the values of version control.

The rate of colonization in the case of variants with the inoculation of micorrhizal fungi was associated with organic fertilisation was much reduced compared to the unfertilized variant. As a result of the lack of performance in the case of variant production may be fertilized on account of adverse effects induced by some elements of the manure on the rate of colonization and the symbiotic process by reducing the rate of multiplication of micorrhizal spore grains.

Table 7. Coefficients to simple correlation between chemical compounds chemical analysated in fruits of watermelons

	Brix	Dry substance	Cinders	Ca	Acidity	K
Brix	1,00					
Dry substance	0,95	1,00				
Cinders	0,80	0,89	1,00			
Ca	0,65	0,76	0,97	1,00		
Acidity	0,12	0,30	0,61	0,75	1,00	
K	0,04	0,31	0,53	0,62	0,67	1

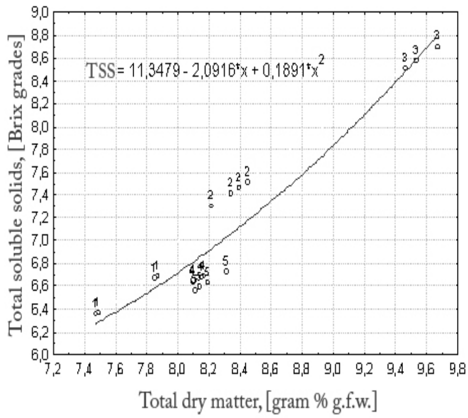

Fig. 1. Function and curve regression interlinkages Brix-SU

The same researchers have reported the existence of negative correlations induced on the micorrhizal relationship of phosphorus and mobile nitrogen from organic and mineral fertilisers where the concentration exceed 10-15% from phosphorus and nitrogen in soil. From the economic point of view, by reducing costs due to the supply and implementation of fertilizers, these issues seem to be encouraging as regards the use of micorrhizal fungi in biological culture of watermelons.

Calcium is extremely important for maintaining of shoots vigour, stalks and stems of plants and the same time reconciled nutrient absorption through membrane by the cellular plasma (Bennett, W.F., 1996). Contribute to the development and cell division and, most importantly, there is a positive nitrogen metabolism and translocation of carbohidrates processes, solving such requirements and default processes photosynthetic micorrhizal fungi growth needs in glucose metabolism. Calcium can be considered as part of the cell wall that connects through a process of making from carburising steels a significant factor of vigour and increase the storage period of the fruit of watermelons. At least in the case of watermelons, the viability of plants is closely linked to their concentration in calcium.

CONCLUSIONS

1. Vesiculare-arbusculare micorrhiza has positive effects in the intensification of processes of plant growth and development of watermelons.
2. The most difficult but also the most important inoculation process is the optimal timing of inoculation, which has implications for the speed and degree of colonization of roots. This ecotechnology has never been tested (in the world) on watermelons, the results of these experiments are essential in determining stages of technological process. This research has established that inoculation of seedlings before planting with increased doses (100 spores to 10 g soil), determine the best rate of colonization with favourable implications on production of watermelons.
3. The species *Glomus intraradices* fungal used in this study convinced the vasculare effects of arbusculare micorrhiza on intensification metabolic processes of plants colonized harsh conditions, particularly in sandy land. As a result, micorrhiza has resulted in getting production increases of 33% compared to version unfertilized and untreate
4. Micorrhiza can be applied in the field of culture and be as generally of all horticultural plants with all the benefits that brings with it. Applicability of this colony does not refer strictly to the horticultural production but in its quality, protection of plants and even to maintain the health of the soil, these are a few aspects to which micorrhiza, can be raised to the rank of eco-technology.

This research emphasized the need to decrease the dosage of organic fertilization when used associate the micorrhiza with organic fertilizers. Results from the need to retain the control of calcium/potassium ratio in favour of calcium, which favours the maximum levels of carbohydrates collections, collections with major implications for the quality of water-melons but very favorable and sustainability colony of micorrhiza.

REFERENCES

[1] Abbott LK, Robson AD., 1982 - *The role of vesicular arbuscular mycorrhizal fungi in agriculture and the selection of fungi for inoculation*. Aust J Agric Res 33:pp.389–408.

[2] Aliasgharzadeh N., Saleh Rastin N., Towfighi H., Alizadeh A., 2001 – Occurence of arbuscular mycorrhizal fungi in saline soils of the Tabriz plain of Iran in relation to some physical and chemical properties of soil. Mycorrhiza 11:pp. 119-122.

[3] Cavagnaro TR, Smith FA, Ayling SM, Smith SE., 2003 - *Growth and phosphorus nutrition of a Paris-type arbuscular mycorrhizal symbiosis*. New Phytol 157(1):pp.127–134.

[4] Javot H, Pumplin N, Harrison MJ, 2007 - *Phosphate in the arbuscular mycorrhizal symbiosis: Transport properties and regulatory roles*. Plant Cell Environ 30(3):pp.310–322

[5] Mathur N., Singh J., Bohra S., Vyas A., 2007 – Arbuscular mycorrhizal status of medicinal halophytes in saline areas of Indian Thar Desert. International Journal of Soils Sciense 2, pp. 119-127.

[6] Mohammad MJ., Hamad SR., Malkani HI., 2003 – Population of arbuscular mycorrhizal fungi in semi-arid environment of Jordan as influenced by biotic and abiotic factors. Journal of Arid Environments 53 : pp. 409-417.

[7] Popa Daniela, V.Hănescu, M. Coyne, 2007 - *Study of the colonization rate with Glomus intraradices to the plants of Phaseolus vulgaris, cultivated on the ashes dumps.* Analele Universităţii din Craiova, vol.XXXVII/A, pp. 322-325.

[8] Popa Daniela, Hănescu V., Grebenişan Irina, Câmpeanu Carmen, Constantin Carolina, Apostol Tiberiu, 2008 - *Aplicaţii ale proceselor micorizale în stabilizarea haldelor de zgură şi cenuşă*, Editura Universităţii din Craiova

[9] Saint-Etienne L., Paul S., Imbert D., 2006 – Arbuscular mycorrhizal soil infectivity in a stand of the wetland tree Pterocarpus officinalis along a salinity gradient. Forest Ecology and Management 232: pp. 86-89.

[10] Schenck N. C., 1984 – Methods and Principles of Mycorrhizal Research. Published by The American Phytopathological Society, 3340 pilot knob Road, Sf. Paul, Minnesota 55121, USA.

[11] Schenck N. C., Yvonne Perez, 1988 – Manual for identification of VA mycorrhizal fungi. Second edition. INVAM 1453 Field Hall, University of Florida, Gainnesville, Florida 32611.

EX·TERRA·AVRVM