

## Interaction between alfalfa (*Medicago sativa* L.) mycorrhizal roots traits and heavy metals (Cd, Co and Pb)

Mohammad Rezvani<sup>1</sup>, Mohammad Reza Ardakani<sup>2</sup>, Faezeh Zaefarian<sup>3</sup>, Farhad Rejali<sup>4</sup>, Ghorban Noormohammadi<sup>5</sup>, Ali farmarzi<sup>6</sup>

<sup>1</sup>Department of Agronomy and Plant Breeding, Agricultural College, Islamic Azad University, Ghaemshahr Branch, Iran.

<sup>2</sup>Department of Agronomy and Plant Breeding, Agricultural College, Islamic Azad University, Karaj Branch, Iran.

<sup>3</sup>Agricultural and natural Resources university Mazandaran, Sari, Iran.

<sup>4</sup>Soil and Water of Research Institute, Tehran, Iran.

<sup>5</sup>Department of Agronomy, Agricultural College, Islamic Azad University, Sciences and Research Branch, Tehran, Iran.

<sup>6</sup>Department of Agronomy and Plant Breeding, Agricultural College, Islamic Azad University, Miyaneh Branch, Iran.

Contact name: mohammad rezvani, E-mail: m\_rezvani52@yahoo.com.

### ABSTRACT

There are contrast ideas about interaction of plant roots and heavy metals. Therefore, for investigation of root reaction to inoculation with mycorrhiza in contaminated land an experiment was conducted under greenhouse conditions in a 2×8 factorial completely randomized design, with three replicates in 2007. First factor was without inoculation (I0) and inoculation (I) with *G. mosseae*. Second factor was seven levels of heavy metals contaminants (Cobalt (Co)=50 mg kg<sup>-1</sup>, Cadmium (Cd)=8 mg kg<sup>-1</sup>, Lead (Pb)=400 mg kg<sup>-1</sup> dried soil, CoCd, CdPb, PbCo and PbCoCd) plus control (C) (without contamination). Results indicated inoculated plants with *G. mosseae* had produced more mycorrhizal root dry weight and mycorrhizal root length in heavy metals contaminated soil. This topic showed under heavy metal stress mycorrhiza caused enhancement of root biomass and length that can help to root in stressful soil condition. Our findings were agreed with view of point that mycorrhiza by increment of length and biomass of root supports plants in heavy metals contaminated land.

KEYWORDS: Mycorrhiza, Alfalfa, Heavy metals, Root traits

### INTRODUCTION

Mycorrhizae are considered to be plant symbioses of great importance in promoting nutrient and heavy metals uptake (Smith and Read, 1997). Soil inoculation with *G. mosseae* has significantly enhanced plant growth and biomass production in limestone mine spoils (Rao and Tak, 2002).

### MATERIALS AND METHODS

The experiment was under greenhouse conditions in a 2×8 factorial completely randomized design, with four replicates in 2007. The first factor was inoculation (I) or without inoculation (I0) with *G. mosseae* inoculum and the second factor consisted of seven levels of contaminations (Co, Cd, Pb mg kg<sup>-1</sup> dried soil, CoCd, CdPb, PbCo and PbCoCd) plus control (C) (without contamination). Mycorrhizal colonisation index, root length and mycorrhizal root length were calculated.

### RESULTS

#### Root length

The root length in IC treatment (*G. mosseae*+control) was more than others. IPbCd and IpbCo produced minimum root length (Table 1). Investigation of different contaminants effect (Cd, Cr, Cu, Ni and Zn) on alfalfa growth indicated root length and biomass that were grown in Cd contaminated soil was more than control (Peralta-Vida et al., 2004). Also, Jiang et al., (2000) received 0.01 mol Cd reduced onion (*Allium sativum*) root growth.

### Mycorrhizal root length

Results showed IC treatment had maximum mycorrhizal root length and contaminants were reduced root length and mycorrhizal colonization and ultimately mycorrhizal root length (Table 1).

**Table 1.** Means comparison of interaction effect between inoculation and contaminants by Duncan's Multiple Range Test. I0: Non-inoculated plants and I: Inoculated plants with *G. mosseae* and C: Control. Same letters indicate non-significant differences between treatments ( $\alpha=0.05$ ).

Traits	Inoculation	Contaminants							
		C	Co	Cd	Pb	CoCd	PbCd	PbCo	PbCoCd
Root length	I0	42 <sup>cdef</sup>	45.75 <sup>ab</sup>	44.75 <sup>abc</sup>	45.25 <sup>abc</sup>	39.75 <sup>efg</sup>	38.5 <sup>fg</sup>	43 <sup>bcd</sup>	39.25 <sup>fg</sup>
	I	48.25 <sup>a</sup>	44.75 <sup>abc</sup>	40 <sup>defg</sup>	38.5 <sup>fg</sup>	43.5 <sup>bcd</sup>	38.5 <sup>fg</sup>	38.25 <sup>g</sup>	40.75 <sup>fg</sup>
Mycorrhizal root length	I0	67.5 <sup>cde</sup>	80.18 <sup>ab</sup>	54.98 <sup>hi</sup>	17.78 <sup>de</sup>	59.35 <sup>fgh</sup>	56.56 <sup>gh</sup>	64.2 <sup>ef</sup>	55.03 <sup>h</sup>
	I	86.1 <sup>a</sup>	74.58 <sup>bc</sup>	69.98 <sup>de</sup>	64.3 <sup>ef</sup>	71.35 <sup>cd</sup>	68.48 <sup>cde</sup>	62.5 <sup>dfg</sup>	67.08 <sup>de</sup>
Mycorrhizal root dry weight	I0	17.4 <sup>5b</sup>	9.59 <sup>d</sup>	8.1d <sup>ef</sup>	8.92 <sup>de</sup>	6.84 <sup>fg</sup>	5.88 <sup>gh</sup>	7.95 <sup>ef</sup>	5.31 <sup>h</sup>
	I	23.41 <sup>a</sup>	11.9 <sup>c</sup>	12.48 <sup>c</sup>	12.17 <sup>c</sup>	9.52 <sup>d</sup>	9.05 <sup>de</sup>	16.06 <sup>ef</sup>	8.89 <sup>de</sup>

### Mycorrhizal root dry weight

Interaction effect between inoculation and contaminants revealed IC had maximum rate of mycorrhizal root dry weight. But, in contaminated soils root dry weight and mycorrhizal colonization by *G. mosseae* were reduced. This reduction decreased mycorrhizal root dry weight (Table 1). Janouskova et al., (2005) results showed that adding Cd reduced root and shoot dry weight both transgenic and non-transgenic tobacco mycorrhizal plant.

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