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RESEARCH ARTICLE

ELEMENTAL ANALYSIS OF SUNFLOWER ROOT ROTS DISEASE IN DIFFERENT TREATED ROOTS BY USING ICP-OES METHOD

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ABSTRACT

Sunflower oil is widely used in cooking, food processing, cosmetics, pharmaceutical and chemical industries. Plants depend on some metals as micronutrients for human growth. In the present study, Four different sunflower varieties namely CO-4, CO-5, HYCO-2 and TCSH-1 are grown in different trial plots with three treatments viz., control (T_1), chemical fertilizer (T_2) and organic manure (T_3). Trial plots roots are collected field wide using standard procedures. Roots are subjected to ICP-OES analysis and the elemental status (Na, K, Mg, Fe, Cu, Zn and Mn) of the disease roots are estimated and the results are discussed.

INTRODUCTION

Sunflower (*Helianthus annuus L.)* is one of the most important oilseed crops high quality edible oil containing 40-50% oil and 15-21% protein. It is easy to cultivate and grow in different conditions and soils but obtaining high yield with good quality heavily relies on soil nutritional condition (Lopez-Valdez *et al.,* 2011). In recent years there is a high negative impact due to the usage of agro-chemical on both human and environmental challenging, the agriculturalists demanding for an alternative (Shanthi *et al.,* 2012). Many economically significant plants including legumes, vegetables, fruits and fiber crops are attacked by *M. phaseolina*, a causal agent of charcoal rot disease (Kunwar and Sin, 1986; Sinclair and Backman, 1986; Smith and Carvil, 1997). Estimates of yield reduction due to charcoal rot in the US were 1.98, 0.28, and 0.49 million metric tons in 2003, 2004, and 2005, respectively. *Macrophomina phaseolina* is the most fungal pathogens affecting sunflower in Egypt (Purkayastha *et al*., 2006). The aim of the present study was the investigation of the elemental concentration for sunflower root rot disease roots by using ICP-OES analytical method. This method is mainly used for the determination of elements like Na, K, Mg, Fe, Cu, Zn and Mn.

MATERIALS AND METHODS

Sample collection

In the present study, four different varieties of sunflower, namely CO-4, CO-5, HY CO-2 and TCSH-1 were obtained from oil seed research centre (TNAU), Coimbatore, Tamilnadu, India. All the varieties were grown in two soil location (red and sandy) in kharif season. In the fields three manure treatments such as control T_1 (without any manure treatment), T_2 (Chemical fertilizer) and organic manure treatment T_3 (farme yard manure and neem cake). From these fields, root rot disease roots are collected at flowering stage by adopting a standard procedure (Jain *et al.,* 1995). Fig. 1 shows root rot disease roots in different treatments.

Sample preparation

The root sample is dried at 60°C, ground to fine powder and subjected to digestion with the tri-acid method (HNO_3, HSO_4 and $HClO_4$ mixture). Nitric-perchloric acids digestion method. One gram of oven dried powdered sample is transferred to a Teflon beaker and 10 ml concentrated nitric acid and 2.5 ml concentrated perchloric acid are added. The sample is then brought very slowly to boiling on a hot plate and heated to dryness. If sample blackening occurred during the fuming stage, nitric acid is added drop wise. The sample is then cooled and redissolved in 10 ml distilled water and 1 ml concentrated hydrochloric acid and brought to volume in a 25 ml volumetric flask. The solution is then analyzed against calibration curves established. The prepared plant samples were subjected to ICP-OES and Flame photometry analysis. The present work has been performed using Perkin ELMER OPTIMA 2100 DV model inductively coupled plasma optical emission spectrometer in the centre of advanced study CAS in marine biology, Annamalai University, India.

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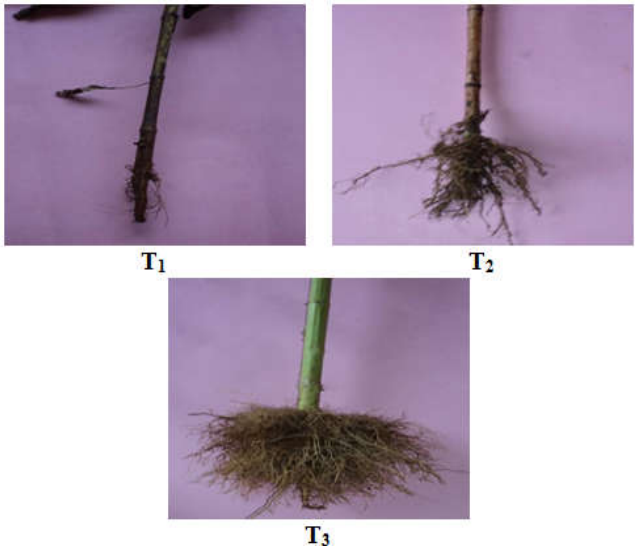

Fig.1 Root rot disease root for three treatments

RESULTS AND DISCUSSION

Four varieties of sunflower root rot samples have been subjected to ICP-OES and Flame photometer. The plant sample analyses are found to show quantitative amount of the following elements viz., Na, K, Mg, Fe, Cu, Zn and Mn are present in various disease roots raised in two different soils, with three treatments. The concentration of elements in different treatments of sunflower root rots diseases roots are shown in Tables 1-7.

Table 1. Sodium (Na) concentration of sunflower root rot disease roots in different soil (ppm)

Varieties	Red Soil			Sandy Soil		
Season: Kharif	T_1	T_2	T_3	T_1	T_2	T_3
Co-4	10.820	7.910	4.200	15.830	13.960	9.590
Co-5	11.760	8.510	6.290	12.510	9.620	5.490
HyCo2	11.140	8.020	6.470	11.990	9.510	5.970
TCSH-1	12.100	8.220	6.340	15.600	13.480	9.250
Mean	11.455	8.165	5.825	13.983	11.643	7.575
SD	0.581	0.263	1.086	2.014	2.407	2.144

Table 2. Potassium (K) concentration of sunflower root rot disease roots in different soil (ppm)

Varieties	Red Soil			Sandy Soil		
Season: Kharif	T_1	T_2	T_3	T_1	T_2	T_3
Co-4	72.550	77.560	91.500	63.000	69.900	79.410
Co-5	66.970	75.540	115.170	78.220	86.020	108.680
HyCo2	66.410	90.530	99.430	59.550	87.730	115.990
TCSH-1	68.460	93.250	110.360	68.430	77.420	99.120
Mean	68.598	84.220	104.115	67.300	80.268	100.800
SD	2.773	8.964	10.682	8.146	8.254	15.845

Table 3. Magnesium (Mg) concentration of sunflower root rot disease roots in different soil (ppm)

Varieties	Red Soil			Sandy Soil		
Season: Kharif	T_1	T_2	T_3	T_1	T_2	T_3
Co-4	18.360	11.320	5.953	25.170	21.600	18.080
Co-5	10.920	7.436	7.029	21.670	10.510	6.592
HyCo2	14.530	7.860	5.135	22.430	12.110	7.360
TCSH-1	17.140	8.610	6.880	24.740	14.130	10.030
Mean	15.238	8.807	6.249	23.503	14.588	10.516
SD	3.292	1.745	0.882	1.715	4.904	5.254

Table 4. Iron (Fe) concentration of sunflower root rot disease roots in different soil (ppm)

Varieties	Red Soil			Sandy Soil		
Season: Kharif	T_1	T_2	T_3	T_1	T_2	T_3
Co-4	2.857	2.807	2.312	11.510	9.036	4.055
Co-5	2.028	2.206	2.238	9.291	3.862	3.117
HyCo2	2.854	2.572	2.194	9.867	3.522	5.318
TCSH-1	2.981	2.142	2.042	12.070	7.121	5.341
Mean	2.680	2.432	2.197	10.685	5.885	4.458
SD	0.439	0.314	0.114	1.318	2.654	1.077

Table 5. Copper (Cu) concentration of sunflower root rot disease roots in different soil (ppm)

Varieties	Red Soil			Sandy Soil		
Season: Kharif	T_1	T_2	T_3	T_1	T_2	T_3
Co-4	0.084	0.107	0.141	0.152	0.254	0.462
Co-5	0.122	0.388	0.909	0.424	0.661	0.756
HyCo2	0.078	0.156	0.585	0.396	0.546	0.733
TCSH-1	0.096	0.221	0.686	0.541	0.714	0.814
Mean	0.095	0.218	0.580	0.378	0.544	0.691
SD	0.019	0.123	0.323	0.163	0.206	0.157

Table 6. Zinc (Zn) concentration of sunflower root rot disease roots in different soil (ppm)

Varieties	Red Soil			Sandy Soil		
Season: Kharif	T_1	T_2	T_3	T_1	T_2	T_3
Co-4	0.215	0.342	0.444	0.438	0.514	0.634
Co-5	0.390	0.526	1.579	0.355	0.428	0.526
HyCo2	0.281	0.365	0.483	0.384	0.587	0.682
TCSH-1	0.241	0.431	0.936	0.378	0.618	1.032
Mean	0.282	0.416	0.861	0.389	0.537	0.719
SD	0.077	0.082	0.528	0.035	0.085	0.219

Table 7. Manganese (Mn) concentration of sunflower root rot disease roots in different soil (ppm)

Varieties	Red Soil			Sandy Soil		
Season: Kharif	T_1	T_2	T_3	T_1	T_2	T_3
Co-4	0.132	0.296	0.335	0.069	0.079	0.088
Co-5	0.080	0.223	0.340	0.081	0.094	0.097
HyCo2	0.127	0.186	0.291	0.087	0.117	0.089
TCSH-1	0.221	0.301	0.472	0.091	0.121	0.098
Mean	0.140	0.252	0.360	0.082	0.103	0.093
SD	0.059	0.056	0.078	0.010	0.020	0.005

The results show that the elements of Na, Mg and Fe are found in lower concentrations and the higher concentrations of K, Cu, Zn and Mn are found in diseases roots in all treatments. It is observed that the number of diseased plants are at a minimum in organic manure treated field (T_3) compared to the other treated fields (T_1 and T_2). Sodium is one of the macro nutrients to all the plant materials. Sodium along with calcium is very harmful to plant growth (Narayanaswamy and Gokulakumar, 2010). In Kharif season, the amount of Na in all treatments various from 5.825 ppm to 11.455 ppm (Red soil) and 7.575 ppm to 13.985 ppm (Sandy soil) respectively, in sunflower root rot diseases roots. It has been observed that the higher concentration of sodium in T_1 treatment obtained from root rot diseases roots when compared to the other treatments as followed by T_2 and T_3. Potassium is an essential nutrient and has an important role in the growth of plants, and in the synthesis of amino acids and proteins (Malik and Srivastava 1982). In Kharif season, the amount of K in all treatments various from 68.598 ppm to 104.115 ppm (Red soil) and 67.300 ppm to 100.800 ppm (Sandy soil) respectively, in sunflower root rot diseases roots. It has been observed that the

higher concentration of potassium in T_3 treatment obtained from root rot diseases roots when compared to the other treatments as followed by T_2 and T_1 (Narayanaswamy and Gokulakumar, 2010; Jayaraman and Alagudurai 2003). Magnesium is an essential element for macronutrients, which are essential to human health and nutrition. Magnesium plays a significant role in photosynthesis, carbohydrate metabolism, nucleic acids and chlorophyll synthesis and binding agents of cell walls (Mohamed, 1999). It has been observed that the concentrations of magnesium in all treatments in sunflower root rot disease are found to vary between 6.249 ppm to 15.238 ppm (Red soil) and 10.516 ppm to 23.503 ppm (Sandy soil) respectively, in Kharif season. The higher concentration of magnesium in T_1 treatment obtained from root rot diseases roots when compared to the other treatments as followed by T_2 and T_3(Narayanaswamy and Gokulakumar, 2010; Singh and Singh, 2003).

Iron is necessary for photosynthesis and is present as an enzyme cofactor in plants. Iron deficiency can result in interveinal chlorosis and necrosis. It has been observed that the concentrations of Fe in all treatments in sunflower root rot disease are found to vary between 2.197 ppm to 2.680 ppm (Red soil) and 4.458 ppm to 10.685 ppm (Sandy soil) respectively, in Kharif season. The higher concentration of iron in T_1 treatment obtained from root rot diseases roots when compared to the other treatments as followed by T_2 and T_3.

Copper is an essential enzymatic element for normal plant growth (Adriano 1986). Cu is necessary for the production of proteins and is important for reproduction. In Kharif season, the amount of Cu in all treatments various from 0.095 ppm to 0.580 ppm (Red soil) and 0.378 ppm to 0.691 ppm (Sandy soil) respectively, in sunflower root rot diseases roots. It has been observed that the higher concentration of copper in T_3 treatment obtained from root rot diseases roots when compared to the other treatments as followed by T_2 and T_1.

Zinc is an essential trace element for plant growth and also plays an important role in various cell processes including normal growth. Zinc is an essential micronutrient with access to plant metabolism (Paivoke, 2003). It has been observed that the concentrations of Zn in all treatments in sunflower root rot disease are found to vary between 0.282 ppm to 0.861 ppm (Red soil) and 0.389 ppm to 0.719 ppm (Sandy soil) respectively, in Kharif season. The higher concentration of zinc in T_3 treatment obtained from root rot diseases roots when compared to the other treatments as followed by T_2 and T_1.

Manganese is necessary for photosynthesis including the building of chloroplasts. Manganese deficiency may result in coloration abnormalities, such as discolored spots on the foliage. It has been observed that the concentrations of Mn in all treatments in sunflower root rot disease are found to vary between 0.140 ppm to 0.360 ppm (Red soil) and 0.082 ppm to 0.093 ppm (Sandy soil) respectively, in Kharif season. The higher concentration of manganese in T_3 treatment obtained from root rot diseases roots when compared to the other treatments as followed by T_2 and T_1.

Conclusion

In this present study clearly indicated that the macro and micro elemental concentrations of all treatments of sunflower root rot disease roots were studied by ICP-OES method. The quantitative amount of the following elements *viz*., Na, K, Mg, Fe, Cu, Zn and Mn are present in various disease roots raised in two different soils, with three treatments. Hence the variation in elemental concentration will be compared among treatments in diseased roots. The elements of K, Cu, Zn and Mn are high and Na, Mg and Fe are lower in T_3 treatment when compared to the other treated fields as followed by T_1 and T_2. It is observed that the number of diseased plants are at a minimum in organic manure treated field (T_3) compared to the other treated fields (T_1 and T_2). All the sandy soil root rot disease roots values are slightly higher than red soil treated root samples.

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