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STUDY OF INDUCTIVELY COUPLED PLASMA-OPTICAL EMISSION SPECTROMETRY (ICP-OES) ON ROOTROT DISEASE OF SUNFLOWER ROOTS

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ABSTRACT

Sunflower is an annual plant belongs to the Compositae (*Asteraceae*) family. Four different sunflower varieties namely CO-4, CO-5, HYCO-2 and TCSH-1 were grown in different trial plots with three treatments viz., control (T1), chemical fertilizer (T2) and organic manure (T3). Trial plots roots were collected field wise using standard procedures. Roots were subjected to ICP-OES analysis and the elemental statuses of the disease roots were estimated. A correlation between the elements (Na, K, of disease plants with reference to manure treatment and different varieties had been attempted. It could be suggested that lowering the concentration of Na, and increasing the concentration of K, were found in diseases roots in all treatment .

Keywords: *Sunflower, Spectrometry,Plasma, Disease*

1. INTRODUCTION

In the past few decades, the determination of minerals and trace elements are important to enhance production efficiency in plants and foods [Rodrlguez and Morales *et al.*, 2011]. The various elements transfer to the food chain of humans is significantly affected by the geological origin of the soils and the groundwater basin, as well as the living area of the trace elements like Fe, Mn, Cu and Zn are essential micronutrients with a variety of biochemical functions in all living organisms. However, the benefits of these micronutrients may be completely reversed if they are present at high concentrations [UmranHicsonmez*et al.*, 2021]. A number of mineral ions are recognized as essential plant nutrients that are directly incorporated into organic compounds synthesized by the plant [Musaozcan*et al.*, 2016].Essential and toxic elements get into human beings through air, water as well as through the food chain. One of the important links is edible plants where microelements enter the plant through the foliage (as external deposits) and the root system. The term toxic elements is used to characterize not only real toxic substances that have poisonous effects on organisms even at low concentrations, but also the elements being essential for the organisms which have harmful effect at excessive concentrations in the organisms [Markert*et al.*, 1997; Bockries 1977; Kist 1987; Bowen 1979; LuthianaMarkert*et al.*, 2010]. The trace elements, which are essential for plant growth, although required in very small quantities, are equally important as the major nutrient elements in producing healthy plant growth.

2. MATERIALS AND METHODS

2.1.1Sample collection

In the present study, four varieties of sunflower, namely CO-4, CO-5, HY CO-2 and TCSH-1 were obtained from G.B. Pant University of Agriculture &Technology,Pantnagar, Uttarakhand, India. All the varieties were grown in two soil location (red and sandy) in kharif and rabi season. In the fields three manure treatments such as control T1 (without any manure treatment), T2 (Chemical fertilizer) and organic manure treatment T3 (farm yard manure and neem cake). From these fields, root rot disease roots were collected at flowering stage by adopting a standard procedure (Jain et al. 1995). Fig. 3.3 shows root rot disease roots in different treatments.

2.1..2 Sample preparation

The root samples were dried at 60°C, ground to fine powder and subjected to digestion with the tri-acid method (HNO3, HSO4 and HClO4 mixture). In 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 were added. The sample was then brought very slowly to boiling on a hot plate and heated to dryness. When blackening was occurred to the sample during the fuming stage, nitric acid was added drop wise.

The sample was then cooled and dissolved in 10 ml distilled water and 1 ml concentrated hydrochloric acid and brought to volume in a 25 ml volumetric flask.The solution was then analyzed against calibration curves established. The prepared plant samples were subjected to ICP-OES and Flame photometry analysis.

3. RESULTS AND DISCUSSION

Four different treated varieties of sunflower root rot samples have been subjected to ICP-OES and Flame photometer. The root samples analyses are found to show quantitative amount of the following elements viz., Na, K, Mg, Fe,. They are present in various disease roots raised in two different soils, with three treatments and in two seasons.

The elemental concentrations of Na, K, Mg, Fe, from different diseased root samples subjected to two different soil treatments are determined. Root infection is found to vary among the treatments. The highly infected plants are found in control soil. It is observed that root infection is lower in plants grown with organic manure treatment followed by chemical fertilizer treatment [KiranBala*et al.*, 1989]. The results of the ICP-OES method 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 all the organic treated root samples. The concentration of elements in different treatments of sunflower root rots diseases roots are shown in Tables 3.4–3.17 and Figs.3.4-3.17. It is also observed that the number of diseased plants is at a minimum in organic manure treated field (T3) compare to the other treated fields (T1 and T2).

Table3.4:Sodium(Na)concentrationofsunflowerrootrotdiseaserootsinkharifseason(ppm).

Varieties	RedSoil			SandySoil		
	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
HYCO-2	11.140	8.020	6.470	11.990	9.510	5.970
TCSH-1	12.100	8.220	6.640	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	2.047	2.144

Table3.5:Sodium(Na)concentrationofsunflowerrootrotdiseaserootsinrabiseason(ppm)

Varieties	RedSoil			SandySoil		
	T_1	T_2	T_3	T_1	T_2	T_3
CO-4	22.052	18.230	12.675	28.246	16.721	11.176
CO-5	25.460	20.486	14.289	25.002	12.470	8.476
HYCO-2	24.714	19.987	15.646	24.873	11.997	8.974
TCSH-1	26.147	19.024	14.873	29.031	14.076	11.024
Mean	24.593	19.432	14.371	26.788	13.816	9.913
SD	1.792	1.005	1.260	2.161	2.131	1.388

Sodium(Na)

Sodiumisamicronutrientthataidsinmetabolism,specificallyinsynthesisofchlorophyll.Sodiumionsplayadiverseandimportantroleinmanyphysiologicalprocesses(Mane*etal*2010).Sodiumalongwithcalciumaccumulated underacidconditionareveryharmfultoplantgrowth.AlowquantityofNaisnecessaryforplantgrowth(Thangavelu*etal.*,2013).TheuptakeofNaisnormallylimitedbecauseNaisnotanessentialelement,exceptincertainsalt-tolerantplants[Spickett*etal.*,1993].

Sodiumisfoundtobevaryingfrom5.825ppmto11.455ppmand7.575ppmto13.985ppmatredandsandysoilsdifferenttreatedrootsrespectivelyinkharifseason.

InRabiseason,theamountofNainalltreatmentsvariesfrom14.371ppmto24.593ppm(Redsoil)and9.913ppmto 26.788ppm(Sandysoil)respectively,insunflowerrootrotdiseasesroots.IthasbeenobservedthatthehigherconcentrationofsodiuminT$_1$treatmentachievedduetorootrotdiseasesrootswhencomparedtotheothertreatmentsT$_2$andT$_3$inbothseason.

Excesssodiuminthesoillimitstheuptakeofwaterduetodecreasedwaterpotential,whichmayresultinwilting;similarconcentrationsinthecytoplasmcanleadtoenzymeinhibition,whichinturncausesnecrosisandchlorosis.Toavoidtheseproblems,plantsdevelopedmechanismsthatlimitsodiumuptakebyroots,storethemincellvacuoles,andcontrolthemoverlongdistancesexcesssodiummayalsobestoredinoldplanttissue,limitingthedamagetonewgrowth.

Table3.6:Potassium(K)concentrationofsunflowerrootrotdiseaserootsinkharifseason(ppm).

Varieties	RedSoil			SandySoil		
	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
HYCO-2	66.410	90.530	99.430	59.550	87.730	115.990
TCSH-1	68.460	93.530	110.360	68.430	77.421	99.120
Mean	68.598	93.250	104.115	67.300	80.268	100.800
SD	2.773	84.220	10.682	8.146	8.254	15.845

Table3.7:Potassium(K)concentrationofsunflowerrootrotdiseaserootsinrabiseason(ppm)

Varieties	RedSoil			SandySoil		
	T_1	T_2	T_3	T_1	T_2	T_3
CO-4	75.061	80.453	93.412	68.001	72.465	86.754
CO-5	69.245	78.004	99.754	78.641	81.074	98.346
HYCO-2	68.884	83.121	95.008	59.008	84.631	102.479
TCSH-1	68.031	85.781	98.634	69.321	76.786	100.670
Mean	70.305	81.840	96.702	68.743	78.739	97.062
SD	3.211	3.357	2.986	8.034	5.271	7.0077

Potassium(K)

Potassiumpromotesgeneralvigour,diseaseresistanceandsturdygrowth.Potassiumdeficiencycausesstuntedgrowthwithleavesclosetogether(RodSmith,2013).Itisintimatelyconnectedwithcarbohydrateformationintheleavesandtheparenchymaofstems[JayaramanandAlagudurai,2013].Inthisstudy,potassium(K)inkharifseasonsamplesis68.598ppmto104.115ppmand67.300ppmto100.800ppminredandsandysoilsdifferenttreatedrootsrespectively.Inrabiseasonsample,potassiumvariationamongalltreatedredandsandysoilsrootrotdiseaserootsrangesfrom70.305ppmto96.702ppmand68.743ppmto97.062ppmrespectively.TheconcentrationofpotassiumishigherinT$_3$treatementrootrotdiseaserootsinbothseasons(redandsandysoil)whencomparedtoothertwotreatments.Potassiumdeficiencymaycausenecrosisorinterveinalchlorosis.K^+ishighlymobileandcanaidinbalancingtheanionchargeswithintheplant.Italsohashighsolubilityinwaterandleachesoutofrockyorsandysoils.Thiswatersolubilitycanresultinpotassiumdeficiency.Potassiumservesasanactivatorofenzymesusedinphotosynthesisandrespiration.Potassiumisusedtobuildcelluloseandaidsinphotosynthesisbytheformationofachlorophyllprecursor.Potassiumdeficiencymayresultinhigherriskofpathogens,wilting,chlorosis,brownspotting,andhigherchancesofdamagefromfrostandheat.

4. CONCLUSION

The quantitative estimation of the levels of some macro and micro elements present in diseased roots was done by using inductively coupled plasma optical emission spectroscopy (ICP–OES) technique. This analysis shows the presence of Na, K, in varying amounts in root rot disease roots in the three different treatments. Quantitative estimation of the above elements has been carried out by inductively coupled plasma optical emission spectrometric technique. This study shows that some macro- and micro elements such as K,are very much needed todevelop T3 to reduce root rot disease as evidenced by the elemental analysis carried out in treatment T3. Hence from this study it is inferred that by lowering the concentrations of Na, increasing the concentrations of K, in the soil coupled with organic manure treatment (T3) may very much reduce the occurrence of root rot disease.

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