Plant Archives Volume 20 No. 2, 2020 pp. 3723-3726 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

PATH AND CORRELATION ANALYSIS OF YIELD CONTRIBUTING TRAITS AND GRAIN YIELD IN RICE CROP

Muthukumararaja. T* and M.V. Sriramachandrasekharan

Department of soil science and Agricultural Chemistry, Faculty of Agriculture, Annamalai university, (Tamilnadu), India.

Abstract

The present examination was undertaken to study the extent of interrelationship and direct and indirect effect of component characters on grain yield of rice. A field experiment was conducted in zinc deficient soil belonging to soil series: Kondal series (Typic Haplusterts) at the farmer‘s holding during the kharif season of year 2012. The treatment consists of two factors viz., Factor A - Zinc levels (mg kg^{-1}) Zn_0 - 0, Zn_1 - 2.5, Zn_2 - 5.0 and Zn_3 - 7.5 and Factor B- Zinc sources S_1 - Zinc sulphate (Zn - 21%), S_2 - Zn-EDTA (Zn - 12%), S_3 - Zn humate (Zn - 9%). The design was FRBD with three replications. Observations were recorded for three quantitative characters. The results revealed that Interrelationships between the parameters were worked out through simple correlation analysis. Path analysis was worked to find out direct and indirect relationship between zinc fractions with DTPA-Zn, zinc uptake and rice yield. Thus priority should be given to these characters during selection rice yield improvement.

Key words: Correlation, Direct effect, Indirect effect, Path analysis.

Introduction

Rice is the staple food for about 50 percent of the world's population (72.7 billion) that resides in Asia where 90 percent of the world's rice is grown and consumed. It is an important staple food that provides 66 to 70 percent body calorie intake of the consumers (Barah and Pandey, 2005). On a global basis, rice provides 21 percent of energy and 15 percent of protein requirement of human population (Depar *et al*., 2011). Correlation analysis is a biometrical technique to find out the nature and degree of association between various physico-chemical traits indicating yield, while path analysis split the correlation coefficient into direct and indirect effect so as to measure the relative contribution of each variable towards yield. Since yield is a complex trait and its manifestation is overseen by many factors, it is logical to expect that a number of plant traits together contribute to augment yield. Henceforward, keeping the above aspect in mind, efforts were made to establish interrelationship among various yield contributing traits and also their contribution towards grain yield of rice. Therefore, the present study was undertaken with an objective to study correlation among the yield contributing traits and direct and indirect effects, among yield contributing traits in rice crop.

Materials and Methods

A field experiment was conducted in zinc deficient soil belonging to soil series: Kondal series (Typic Haplusterts) at the farmer's holding during the kharif season of year 2012. Before imposition of treatments, the soil used in the experiment had the following properties viz., pH-8.50, EC-0.92 dSm^{-1}, organic carbon-5.41 $g.kg^{-1}$, CEC-43.2 c mol(p^+) kg^{-1}, $CaCO_3$- 4.3%, $KMnO_4$-N- 302 kg ha^{-1}, Olsen-P- 19.0 kg ha^{-1}, NH_4OAc-K- 603 kg ha^{-1} and DTPA-Zn-0.60 $mgkg^{-1}$ (Vertisol). The treatment consists of two factors viz., Factor A - Zinc levels (mg kg^{-1}) Zn_0-0, Zn_1-2.5, Zn_2-5.0 and Zn_3-7.5 and Factor B- Zinc sources S_1 -Zinc sulphate (Zn-21%), S_2-Zn-EDTA (Zn-12%), S_3-Zn humate (Zn-9%). The design was FRBD with three replications. Twenty seven days old rice seedling var ADT 43 was transplanted in the main field. All the plots received uniform dose of 120 kg N ha^{-1}, 40 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} applied through urea, SSP and muriate of potash respectively. Grain and straw yield was recorded at harvest and expressed as kg ha^{-1}. In order to estimate various Zn

***Author for correspondence :** E-mail: saradhakirankumar@gmail.com

fractions in soil, sequential extraction of soil samples (at harvest stage) was performed following the procedure of (Sarkar and Deb, 1982). Zinc present in different forms was analysed using atomic absorption spectrometer and calculates the zinc uptake.

Results and Discussion

Simple correlation

Relationship among soil zinc fractions and with DTPA-Zn, grain zinc uptake and grain yield was evaluated by simple correlation (Table 1). The simple correlation value among soil zinc fractions ranged from 0.788 to 0.962. The lowest correlation was found between water soluble zinc with exchangeable zinc (r=0.788**) and the highest correlation was found between water soluble Zn and occluded-Zn (r=0.962**). The water soluble and exchangeable Zn (the major pool of available DTPA-Zn) had strong correlation with all other zinc fractions and exchangeable zinc had better and higher correlation with other zinc fractions compared to water soluble zinc. Water soluble zinc and exchangeable zinc had highest correlation with organic bound zinc followed by total and residual Zn. However, in total prespective, the different zinc fractions had significant and positive correlations among themselves.

The grain yield was significantly influenced by different zinc fractions as indicated by correlation coefficients. The highest correlation was with Occ-Zn (r=0.963**) followed by water soluble Zn (r=0.955**), Total Zn (0.945**), Com-Zn (r=0.940**), Res-Zn (r=0.939**), organically bound Zn (r=0.911**) and Exch-Zn (r=0.872**). Correlation of soil zinc fractions removed by ammonium acetate, cupric acetate, HCl soluble, organically bound and residual Zn was positive and significant with zinc uptake in grain and straw, yield and DTPA-Zn. Here complexed, organic bound, water soluble and exchangeable Zn had higher effect followed by occluded and residual Zn on the above properties. Although all the zinc fractions are in equilibrium with each other, their availability to the plants depends upon their magnitude, soil conditions and the stage of crop growth. As the concentration of the readily available form of zinc in the soil falls due to the plant uptake or lost through other means, zinc present in other forms undergo transformation to maintain the concentration of the former at equilibrium (Vasudeva and Ananthanarayana, 2001). On waterlogged soils, the different forms of soil zinc are likely to undergo transformation affecting zinc availability to the rice plants. (Verma and Subehia, 2005) and (Naria, 2008), also reported the existence of similar relationship.

Path analysis

The direct and indirect effect of soil zinc fractions on DTPA-Zn, Zn uptake and rice yield was examined using path coefficient analysis (Table 2). This is done to quantify the extent and direction of influence of zinc in the solid phase matrices on zinc uptake, DTPA-Zn and rice yield. The data on examination in (Table 1) showed significant positive correlation between grain zinc uptake with water soluble Zn (r=0.940**), exchangeable Zn (r=0.836**), complexed Zn (r=0.890**), organic bound Zn (r=0.864*), occluded Zn (r=0.954**) and Residual Zn (0.906**). But when effect was partitioned into direct and indirect effect, the direct effect of water soluble and exchangeable zinc was low while organically bound had the highest value. The direct effect of complexed zinc and occluded zinc on zinc uptake was negative. The individual effect of all other soil zinc fractions through

Table 1: Simple correlation matrix showing the relationship between soil zinc fractions and DTPA-Zn, grain zinc uptake and yield.

	Water soluble Zn	Exchan-geable Zn	Compl-exed Zn	Organic Bound Zn	Occlu-ded Zn	Resid-ual Zn	Total Zn	DTPA Zn	Yield	Grain zinc uptake
Vertisol										
Water soluble Zn	1									
Exchangeable Zn	0.788**	1								
Complexed Zn	0.890**	0.809**	1							
Organic Bound-Zn	0.855**	0.925**	0.859**	1						
Occluded Zn	0.962**	0.843**	0.879**	0.937**	1					
Residual Zn	0.869**	0.904**	0.890**	0.987**	0.956**	1				
Total Zn	0.885**	0.914**	0.881**	0.990**	0.964**	0.998**	1			
DTPA-Zn	0.962**	0.863**	0.946**	0.914**	0.949**	0.926**	0.935**	1		
Yield	0.955**	0.872**	0.940**	0.911**	0.963**	0.939**	0.945**	0.987**	1	
Grain zinc uptake	0.940**	0.836**	0.890**	0.864**	0.954**	0.906**	0.911**	0.951**	0.984**	1

*Significant at 5 % level, ** Significant at 1% level

Table 2: Path coefficients among grain zinc uptake, DTPA-Zn, yield and soil zinc fractions.

Sl. No.	Effect of soil zinc fractions	Grain zinc uptake	DTPA -Zn	Yield
I	**Water soluble zinc**			
	Direct effect	0.10828	1.201	0.12829
	Indirect effect via exchangeable zinc	0.28056	-0.327	0.50816
	Indirect effect via complexed zinc	-0.06486	0.020	-0.07059
	Indirect effect via organic bound zinc	0.39954	0.135	0.23586
	Indirect effect via occluded zinc	-0.03714	-0.093	-0.02348
	Indirect effect via residual zinc	0.01129	0.028	-0.01564
II	**Exchangeable zinc**			
	Direct effect	0.33563	-0.392	0.60790
	Indirect effect via water soluble zinc	0.09052	1.004	0.10724
	Indirect effect via complexed zinc	-0.01617	0.005	-0.01760
	Indirect effect via organic bound zinc	0.36920	0.125	0.21795
	Indirect effect via occluded zinc	-0.03029	-0.076	-0.01915
	Indirect effect via residual zinc	0.04590	0.116	-0.06355
III	**Complexed zinc**			
	Direct effect	-0.18331	0.056	-0.19953
	Indirect effect via water soluble zinc	0.03831	0.425	0.04539
	Indirect effect via exchangeable zinc	0.02961	-0.035	0.05362
	Indirect effect via organic bound zinc	0.33907	0.115	0.20016
	Indirect effect via occluded zinc	-0.03283	-0.083	-0.02076
	Indirect effect via residual zinc	-0.0600	-0.151	0.08307
IV	**Organic bound zinc**			
	Direct effect	0.65415	0.221	0.38616
	Indirect effect via water soluble zinc	0.06614	0.733	0.07836
	Indirect effect via exchangeable zinc	0.18942	-0.221	0.34309
	Indirect effect via complexed zinc	-0.09502	0.029	-0.10342
	Indirect effect via occluded zinc	-0.03895	-0.098	-0.02463

organic bound zinc was highest and positive. While indirect effect of all zinc fractions via occluded and complexed zinc was negative. With respect to DTPA-Zn, the direct effect of water soluble Zn, complexed Zn, organically bound Zn and residual Zn was positive with water soluble zinc showed the highest value which was confirmed by the highest and significant positive correlation it had with DTPA-Zn (r=0.962**). Though the direct effect of exchangeable zinc was negative for DTPA-Zn, the correlation with DTPA-Zn was significant and positive (r=0.863**) indicating its indirect effect through other fractions was high. The direct and indirect effect of occluded zinc on DTPA-Zn was found to be negative. The direct effect of organic bound zinc and indirect effect via water soluble and complexed zinc on DTPA-Zn was positive. The residual zinc had non-significant positive direct and indirect effect on DTPA-Zn.

Water soluble Zn, exchangeable Zn, organic bound, occluded Zn had significant positive correlation with rice yield as indicated by high total effect. Among the soil zinc fractions, direct effect of exchangeable zinc was highest followed by organic zinc and water soluble zinc. The indirect effect of all zinc fractions via exchangeable zinc was also highest with respect to rice yield. The direct effect of organic bound zinc and indirect effect via water soluble and exchangeable zinc was positive while through complexed and occluded zinc was negative. The direct effect and indirect effect of complexed, occluded and residual zinc on rice yield was negative. The data emanated from path analysis indicated that rice yield, zinc uptake and DTPA-Zn ion in lowland rice soil was largely controlled by water soluble, exchangeable and organic bound zinc compared to other fractions in soil.

Path analysis between different soil zinc fraction with grain yield, zinc uptake and DTPA-Zn facilitates in understanding the equilibrium relationship of zinc in soils and the pathway by which applied zinc passes between the pools before it is finally becomes available to the plant. The direct effect of zinc fractions in Vertisol on grain yield, zinc uptake and DTPA-Zn was positive with respect to water soluble Zn, exchangeable Zn, organically bound Zn and complexed Zn, while it was negative with respect to occluded Zn and residual Zn. Indirect effect of water soluble and exchangeable Zn through complexed Zn and occluded Zn on zinc uptake, grain yield and DTPA-Zn was negative, while through other fractions was positive. This indicates that available zinc was reduced due to fixation with amorphous and crystalline oxides.

Thus in soils with low available zinc, water soluble, exchangeable zinc and organically bound zinc form the major pathway by which applied zinc passes between different form and finally reach the plant. Similar view was expressed by (Sriramachandrasekharan and Mathan, 1993).

Conclusion

A examination of the results of both correlation and path analysis revealed that most important characters accounting for cause and effect relationship on rice yield, zinc uptake and DTPA-Zn ion in lowland rice soil was largely controlled by water soluble, exchangeable and organic bound zinc compared to other fractions in Vertisol. Hence, due emphasis should be given to these traits while formulating selection criteria to bring improvement in yield as well as grain quality.

References

Barah, B.C. and S. Pandey (2005). Rainfed rice production systems in Eastern India: An on farm diagnosis and policy alternatives. *Indian J. Agrl. Economics*, **60(1):** 110-136.

Depar, N., I. Rajpar, M.Y. Hemon, H. Imtiaz and Zia-Ul-Hasan (2011). Mineral nutrient densities in some domestic and exotic rice genotypes. *Pak. J.Agric. Agrl. Eng. Vet. Sci*., **27:** 134-142.

Naria, J.N., J.V. Polara, B.A. Golakiya and A.V. Rajani (2008). Dynamics of zinc fractions in calcareous soils of Saurashtra region of Gujarat. *Asian J. Soil Sci*., **3(1):** 8-10.

Sriramachandrasekharan, M.V. and K.K. Mathan (1993). Different forms of zinc from zinc sources in lowland rice growing soil. *J. Indian Soc. Soil Sci*., **41(4):** 791-792.

Sarkar, A.K. and D.L. Deb (1982). Zinc fractions in rice soils and their contribution to plant uptake. *J. Indian Soc. Soil Sci*., **30:** 63-69.

Vasudeva, M. and R. Ananthanarayana (2001). Soil tests for available zinc and their relation with inorganic zinc fractions in acid soils of Karnataka. *Madras Agric. J*., **88:** 371-374.

Verma, S. and S.K. Subehia (2005). Zinc availability in an acid alfisol as influence by long term cropping in a wet temperate zone of Western Himalayas. *Agropedology*, **15:** 95-99.