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ROOT ACTIVITY OF RICE AS INFLUENCED BY ZINC APPLICATION

Radioisotopes have been of great value in studies connected with distribution and activity of roots. A number of isotope procedures have been used to study the root systems of food crops and document the response of roots to changes in the soil environment (Rennie *et al.*, 1971).

Significant differences in root activity and distribution among high yielding rice varieties, using tracers, have been reported by many workers. Most of the active rootsremain within the first 5 cm depth and decrease progressively with depth (Kammath 1971, Bhattacharjee *et al.*, 1974 and Subbarao and Sathe, 1974). Kumaraswamy *et al.* (1977) reported that 55 to 75 per cent of rice roots are concentrated in the soil zone covered by 10 cm lateral distance and 16 cm depth from the base of the plant and £0 to 85 per cent in the soil zone covered by 15 cm lateral distance and 24 cm depth. IR 20, a shallow rooted, high yielding variety, has a very high root density around the plant base but the root growth both vertically and laterally, is limited (Yoshida, 1981).

Paramanandam (1982) reported that Zn application increased root and shoot dry weight, content and uptake of N and K as well as grain yield. Our aim was to study the effect of zinc on the root activity and root distribution pattern of low land rice.

A microplot experiment was conducted in the wetlands of TNAU, Coimbatore during 1982 wet season (June-July). The soil was clay loam and was medium in N, low in P and Zn and high in K with a pH of 8.2. The treatments involved two levels of $ZnSO_4$ viz., 0 and 25 kg/ha. There were 18 replications. The plot size was 6 x 4m and the variety used for the experiment was IR 20. The root activity and distribution of rice was studied employing ^{32}P absorption technique. For this purpose the rhizosphere of a plant was subdivided into six zones being the combinations of two vertical distances (10 cm and 20 cm) and three lateral distances (10 cm, 15 cm and 20 cm).

To study the root activity in each zone separately, each plot was further divided into six microplots of 1 m^2, leaving a border of 0.5 m around each microplot. IR 20 rice was raised using standard procedures and techniques. The root activity was studied at panicle initiation stage.

Carrier free ^{32}P as orthophosphoric acid in dilute HCl solution was further diluted with distilled water, thoroughly homogenised with potassium sulphate and capsules were prepared. The potassium sulphate with ^{32}P was then uniformly filled in 1200 gelatinous capsules (tested for easy dissolution in water) and used for placement. At panicle initiation, the field was drained and the central hill was selected in each microplot. All the surrounding plants upto a radial distance of 0.5 m were carefully removed. Four equidistant holes (2 cm diameter) were dug around the hill at four sides with a special device to vertical and lateral distances corresponding to the above treatments and one capsule was dropped into each hole to give a total activity of 26 mCi per plant.

Plant samples were collected at 10 days after ^{32}P capsule placement, dried, powdered and 1 g material was made into briquettes with the help of a caver laboratory press at 12 psi. The radioactivity in the briquettes was determined using a Geiger Muller counter and expressed as counts per minute after correction for back ground activity. The amount of radioactivity recorded was considered to be indicative of root activity at the depth at which tracer was placed in the soil. The percentage distribution of active roots in the six soil zones was worked out as follows.

$$\text{The percentage distribution of active roots in a particular zone} = \frac{\text{radioactivity recorded in the zone} \times 100}{\text{Total radio activity recorded for the six zones}}$$

The total root activity of a plant was considered to be the sum of the radioactivity recorded in the six zones. The statistical analysis was carried out after effecting suitable transformation of the data for each zone as well as the total counts of all the six zones together. As a comparison of the result with and without transformation of the data did not differ qualitatively the original data were analysed and presented.

Biometric observations and nutrient uptake were also recorded using standard procedures and technique, but not presented in this paper.

a) Root activity pattern

Data on root activity of rice as influenced by zinc application studied at three lateral distances (10, 15 and 20 cm) and two vertical distances (10 and 20 cm) are presented in Table 1. The root activity was increased considerably by application of zinc in all the root zones studied The total root activity measured in terms of cpm hill was 24 per cent more in treated plants compared to control. A more or less similar response with respect to root activity was observable in every individual portion of the root zone considered for the study. Thome (1957) reported that Zn is essential for the synthesis of the auxin IAA. The role of IAA to trigger meristematic activity of plants is very well known. It may be noted that the soil of the experimental site was deficient in zinc. The above results indicate the beneficial effect on Zn to enhance the root activity of rice. The increased root activity resulted due to Zn application has reflected on the growth and nutrient uptake of rice (Table 2). The plant height, tiller production, root/shoot ratio and N uptake of rice (data not presented) were more when the crop was supplied with zinc. Paramanandam (1982) also observed similar response of rice to applied zinc.

Table 1

Root activity pattern (cpm/hill) at panicle initiation stage as influenced by Zn application

Treatment	V0-10	V10-20	L0-10	L10-15	L15-20	V10L10	V10L15	V10L20	V20L10	V20L15	V20L20	Total activity of the entire root zone
Zn_0	9901	2385	9212	2732	342	7622	2065	216	1634	670	125	12268
Zn_1	12249	3088	11341	3527	428	9242	2679	287	2102	848	139	15254
SEm	216	50	204	82	15	211	72	14	50	49	8	231
CD (0.05)	633	145	598	238	42	618	210	41	146	142	NS	675

V = Vertical depth from surface (cm) L = Lateral distance from the plant (cm)

Table 2

Effect of zinc on plant characters at panicle initiation stage (South west monsoon, 1982)

Treatment	Plant height (cm)	Number of tillers	Root/shoot ratio	N uptake kg/ha
Zn_0	51.4	10.3	0.22	57.8
Zn_1	53.2	11.1	0.25	64.5
SEm	0.5	0.23	0.01	1.76
CD (0.05)	1.43	0.66	0.03	5.14

b) Active root distribution percentage

The data on percentage distribution of active roots at three lateral distances and two vertical distances are presented in Table 3. Zinc application did not influence the percentage distribution of active roots of IR 20 rice in any of the root zones studied. This may mean that though applied zinc can increase the root activity of rice considerably, it will not change the percentage distribution of active roots in different zones. Similar non-significant effect on percentage distribution of rice roots due to N application has been reported by Kumaraswamy (1977).

Nearly 60 per cent of the total active roots were confined to within 10 cm laterally and vertically from the plant. Roughly 80 per cent of the roots forage within 10 cm from the surface. IR 20, a shallow rooted high yielding rice variety has a very high root density around the plant base, but the root growth both vertically and laterally is limited (Yoshida, 1981).

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References

Bhattacharjee, D. P , Ramakrishnayya, G. and Murthy, K. S. 1974. Root distribution study of rice varieties by ^{32}P injection techniques under soil moisture deficit. *Proc. Symp. Uses of Radiations and Radioisotopes on Studies of Plant Nutrition, GB Pant University of Agriculture and Technology, Pantnagar,* 569–577

Kammath, M. B. 1971. Classification of some wheat and paddy varieties according to root distribution pattern. *Proc. int. Symposium on Use of Isotopes and Radiation in Agriculture and Animal Husbandry Research, IARI, New Delhi*

Table 3

Active root distribution (%) at panicle initiation stage as influenced by zinc
(South west monsoon season 1982)

	V0–10	V10–20	L0-10	L10-15	L15–20	V10L10	V10LT5	V10L20	V20L10	V20L15	V20L20
Zn_0	80.5	19.5	75.1	22.1	2.8	62.1	16.6	1.7	13.0	5.4	1.1
Zn_1 -	799	20.1	74.1	23.2	2.8	606	17.5	1.8	13.5	5.6	1.0
SEm	0.3	0.3	0.4	0.4	0.1	0.6	0.3 .	0.09	0.3	0.2	0.06
CD (005)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Kumaraswamy, K., Natarajan, C. P., Subramaniam, T. L., Balasubramanian, S., and Krishnamoorthy, K. K. 1977. Studies on the root distribution of rice *(Oryza sativa* L.) varieties using ^{32}P plant injection technique. *Madras agric. J.* 64: 285-289

Paramanandam, P. 1982. Investigation on the effect of zinc (labelled) and gypsum application on the yield and uptake of various nutrients by rice var. IR20 in sodic soil. M. Sc. (Ag.) thesis. Tamil Nadu Agricultural University, Coimbatore

Rennie, D. A., Warembourg, F. and Paul, E. A. 1971. Study of root system of crop plants and native vegetation using radiotracers. *Proc. int. Symposium on Use of Isotopes and Radiation in Agriculture and Animal Husbandry Research, IARI, New Delhi,* 597

Subbarao, W. and Sathe, A. 1974. Root activity of 11 high yielding varieties of rice. *Proc. Symp. Use of Radiations and Radioisotopes in Studies of Pant Nutrition, GB Pant University of Agriculture and Technology, Pantnagar,* 578-586

Yoshida, S. 1981. Mineral nutrition of rice. *Fundamentals of Rice Crop Science.* International Rice Research Institute, Los Banos, Philippines