https://doi.org/10.29321/MAJ.10.A02680

Madras agric. J. 70 (11) : 732—735 November 1983

INFLUENCE OF DIFFERENT IRRIGATION REGIMES ON THE UPTAKE OF PHOSPHORUS BY FINGER MILLET (*Eleusine coracana* GAERTN) AND ITS DISTRIBUTION IN SOIL*

T. RAVEENDRAN[1], and K. MAYALAGU[2]

An investigation on the influence of different irrigation regimes on the uptake of P by finger millet and its distribution in soil revealed that the treatment with most frequeut irrigation (IW/CPE ratio of 0.90 with 4 cm depth of water) resulted in the highest P content at the maximum tillering and flowering stages combined together and also the P concentration of grain and straw. The lowest P content was recorded with irrigation at IW/CPE ratio of 0.60 with 6 cm depth of water. Irrigation at moderate intervals (IW/CPE ratio of 0.75 with 4 cm depth of water) resulted in the highest uptake of P by the ragi grain and straw and irrigations at the longest intervals IW/CPE ratio of 0.60 with 6 cm depth of wat-r) recorded the lowest uptake values. Values of available P in soil after the crop uptake, was the higheat with irrigations at the longest intervals and lowest in the treatment with irrigations at the longest intervals [and lowet in the treatment with irrigations at the shortest intervals. P content of soil decreased with an increase in soil depth and crop age.

Irrigation water is one of the most costly inputs of a farmer. Irrigating water to crops at the right time and in adequate quantity is one of the vital inputs in crop production. The amount of water in soil affects the uptake, availability and distribution of P in soil. Higher frequency is more important than higher depth of water. Tillering flowering and grain development are the criticol stages during the crop life. Shortage of moisture at these stages results in reductions in yield.

MATERIAL AND METHODS

A field experiment was conducted at Maduri Agricultural College Farm during Kharif season of 1980-81 to investigate the influence of different irrigation regimes on the uptake of P by finger millet (Var. CO 10) and its distribntion in soil with three IW/CPE (irrigation water depth cumulative pan evaporation) ratios (0 60, 0 75 and 0.90) and two irrigation water depths (4 cm and 6 cm). The treatment combinations were as follows :

T_1 : IW/CPE ratio of 0 60 with 4 cm depth of water.

T_2 : IW/CPE ratio of 0.60 with 6 cm depth of water.

T_3 : IW/CPE ratio of 0.75 with 4 cm depth of water.

T_4 : IW/CPE ratio of 0 75 with 6 cm depth of water.

*Forms a part of M. Sc. (Ag.) thesis of first author under the guidance of the second author submitted to and approved by the Tamil Agricultural University.

1 & 2 Research Associate and Associate Professor respectively in the Department of Soil Science and Agri Chemistry, Agricultural College & Res. Institute, Tamil Nadu Agricultural University, Madurai-625 104.

T_6 : IW/CPE ratio of 0.90 with 4 cm depth of water.

T_8 : IW/CPE ratio of 0.90 with 6 cm depth of water.

The experimental field soil belonged to Vyalogam soil series with a pH of 7.5 in 0-15 cm depth (D_1), 7.7 in 15.30 cm depth (D_2) and 7.8 in 30-45 cm depth (D_3) and EC (m. mhos/cm) 0.25 0.20 and 0.16 in D_1, D_2 and D_3 respetively. The bulk density (g/cc) of the soil was 1.58, 1 73 and 1 79 and hydraulic conductivity (cm/hr) was 1.29, 2 43 and 3 15 in D_1, D_2 and D_3 respectively. Ths wilting point (per cent) 24.60 of moisture Available P (kg/ha) in soil was 12.00, 9 00 and 5 00 and organic carbon (per cent) 0 82, 0.45 and 0.32 in D_1, D_2 and D_3 respectively

Plant samples were collected at three stages of crop growth viz., maximum tillering i. e. 25 days after planting (S_I), flowering (S_{II}) and harvest (S_{III}) stages. Chemical analysis for the total P content of the plant samples was carried out by triple acid digestion method (Jackson, 1973) The P uptake by the finger millet grain, straw and the crop were worked out. Soil samples from three depths (D_1= 0-15 cm D_2=15-30 cm and D_3=30 45 were also collected at the above three stages and were analysed for available P. (Olsen's Method, 1954).

RESULTS AND DISCUSSION

P Uutake : P content of finger millet plants at stages S_I and S_{II} ranged from 0 225 to 0 325 per cent and significantly influenced by the treatment irrigations (Table 1). Irrigations at IW/CPE ratio of 0.90 with 4 cm depth of water (T_6) resulted in the highest P content (0.325 per cent) and irrigation at the longest interval (T_3) resulted in the lowest P content (0.225 per cent) in the plant at S_I and S_{II} stages combined together. But T_5 was on par with the treatment T_6. It was observed that P content of finger millet grain and straw was relatively the highest under the treatment T_6 and lowest under T_3. The concentration of P in grain and straw was higher in the treatments receiving relatively frequent irrigations than in the treatments receiving irrigations at longer intervals The higher concentration of P in treatments T_6 and T_5 might be explained by possibly the higher uptake of P from soil with higher P availability resulting from more frequent irrigations The results are in line with the findings of Cherian (1968) and Mandal and Khan (1975).

P uptake by grain, straw and the crop (Table 1) was the highest with irrigations at the most frequent intervals. Treatment T_6 with 16.04 kg P/ha recorded the highest value in grain and the treatment irrigated at IW/CPE ratio of 0 75 with 4 cm depth of water recorded the highest uptake values by straw and the whole crop. The T_2 recorded the lowest values of P uptake by grain, straw and also the total P uptake.

It was observed that a positive relationship existed between the quantity of water supplied and the uptake of P by grain ($r=0.63^{**}$) and straw ($r=0.71^{**}$). The highest total P uptake under the treatments T_5 and T_6 (receiving irrigations at shorter inter-

vals) might probably be due to the higher P availability in soil be because of low mositure stress conditions prevailing in soil. Due to supply of irrigation water at longer intervals, the moisture stress created in soil might have resulted in the lowest P uptake under treatment T_5. The results corroborate with the findings of Haddock (1952) and Watanabe *et al.* (1960). Rajagopal (1969) also reported similar results. The results are also in line with the findings of Sonawanshi and Goswami (1980).

P distribution in soil

Data on available P content of soil at different depths and stages of crop growth are furnished in Table 2. Treatments receiving irrigations at more frequent intervals registered lower values of available P remaining in soil than those of longer intervals. Higher values of available P remaining in soil under treatments T_2, T_4 and T_1 might be the result of poor uptake of P by the crop from soil (Table 2) under high moisture stress conditions prevailing in soil due to irrigations at the longest intervals (T_5) or due to relatively less irrigation water supplied (T_1).

The reason for the lowest amount of available P in soil might be the result of higher uptake of P due to high soil moisture status in the root zone of crop the treatments T_3 and T_5 (Mantab *et al.* 1972; Mahapatra and Patrick, 1969; Mandal and Khan, 1975) The treatment irrigations were observed to significantly affect the available P content of soil at the three depths studied. Surface soil (D_1) recorded the highest value and the D_3 recorded the lowest value of available P in soil under all treatments. Higher values of available P at the top soil might probably be due to higher clay and organic matter content compared to lower depths.

The available P content in soil was the highest at maximum tillering stage and the lowest at harvest under all treatments. It might be the result of continuous removal of P by the finger millet crop. The results were in accordance with the findings of Ramanathan and Kirshnamoorthy (1973).

The authors thank the Indian Council of Agricultural Research for awarding the Junior Research Fellowship to the first author during his M. Sc. (Ag.) programme.

REFERENCES

CHERIAN, E. C. M. GARY and S. M. LARRY. 1968. Nutrient uptake by low land rice under flooded and non flooded conditions. *Agron. J.* 60 : 554-57.

HADDOCK, R J. 1952. The influence of soil moisture condition on the uptake of phosphorus from calcareous soils by sugar beet *Soil Sci. Soc. Am. Proc* 16 : 235-38

JACKSON, M. L. 1973 *Soil Chemical Analysis* Prentice Hall of India (Pvt.) Ltd., New Delhi

MAHAPATRA, I. C and W. N. PATRICK 1969 Inorganic phosphate transformation in water logged soils. *Soil Sci.* 101 : 281-98.

MANDAL, L N. and S K KHAN, 1975. Influence of moisture regimes on the transformation of recently applied phosphate in soil and its availability in rice crops V. Indian Soc. *Soil Sci.* 23 : 379-83.

MANTAB, S. K., A. R. SWOBODA, C. L. GODFRE and G W THOMAS. 1972. Phosphorus diffusion in soil II. The effect on P uptake by plants *Soil. Sci. Soc. Am. Proc.* 36 : 55-57

OSEN, S R, C V. COLE, F. S. WATANABE and A L DEAN. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. Circular No 939, USDA

RAJAGOPAL, C. K. 1969. The influence of soil moisture stress on the nutrient uptake of ragi. Madras *agric. J.* 56 : 642-52.

RAMANATHAN, K. M. and K. K. KRISHNA MOORTHY. 1973. Study on the progressive changes in phosphorus availability in different soils at successive growth stages of rice Madres agric. *J.* 60 : 768-771.

SOMAWANSHI, R B and N. N. GOSWAMI. 1980. Yield and uptake of phosphors by wheat as affected by soil moisture and levels and method of phosphorus application. *J. Indian Sdc. Soil Sci.* 28 : 131-34

WATANABE, D S S. R. OLSEN and R. E. DANIELSON. 1960 Phosphorus availability as related to soil moisture *Soil Sci.* 3 : 450-56.

Table 1 P Content at tillering and flowering stages, Grain and straw and uptake by grain and straw of finger millet Co. 10

Treatments	P content (%)			P uptake (Kg/ha)				
	S_I	S_{II}	Mean of $S_I + S_{II}$	Grain	Straw	Grain	Straw	Total
T_1	0 334	0.168	0 251	0 320	0.124	8.81	12 59	21.20
T_2	0 312	0.138	0.225	0.290	0.094	8.19	8.57	17.56
T_3	0 402	0.216	0.309	0.400	3.140	14.97	15.93	30.90
T_4	0.252	0.166	0.259	0.370	0.088	11.36	11.28	22 64
T_5	0.424	0 226	0.325	0 450	0.160	16.04	13.73	28 57
T_6	0.306	0.206	0 306	0.380	0.138	13 44	12.80	24.20
SEd			0 027	0 035	0.017	1.56	2.82	
CD (P=0.05)			0.054	0 028	0.012	1.07	1.93	

Table 2. Atvrlable P Content in soil (kg/ha) at differnet soil deeths and corp stages

Treatments	D_1			D_2			D_3		
	S_I	S_{II}	S_{III}	S_I	S_{II}	S_{III}	S_I	S_{II}	S_{III}
T_1	31.00	25.20	17.20	26.00	17.60	7 40	21 00	13.80	5.80
T_2	33 40	23 80	15.40	17 20	10.60	10.60	22.60	17.00	5.20
T_3	25 80	17 00	12.80	22.80	14.60	4.80	15.80	12.80	4.60
T_4	30.20	25.60	14.00	24.60	22 40	9 10	21.00	17.40	4.80
T_5	22.40	20.00	11 80	22.20	16.20	7.20	18.00	13.40	4.20
T_6	28 80	26.60	18.40	28.20	20.40	13.20	23.40	12.00	4.40

	SE D	CD (P=0.5)
Treatment	0 78	1 53
Depth	0.55	1.08
Stage	0.55	1.08