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Effect of Available Soil Moisture on the Uptake of Nutrients by Maize

BY

M. NADANAM[1] and Y. S. MORACHAN[2]

ABSTRACT

A field experiment was conducted with maize Hi-starch under five levels of available soil moisture and uniform doses of N, P and K fertilisers to study the uptake of N, P, K, Ca and iron. The results indicated that there was decrease in percentage of nitrogen with age of plants and increase with decrease in soil moisture regime. The percentage of P was more in the lower moisture regimes and decreases with the maturity of crop. Potash uptake was more in the lower moisture regime and calcium and iron percentage decreases as the crop reaches maturity.

INTRODUCTION

The uptake of nutrients in crops varies not only with the stages of growth but also with soil moisture stress. While it is already understood that differences in soil moisture regimes cause differences in yield of grain, in this paper, the differences in the uptake of nutrients in the different contexts of soil moisture regimes have been sought to be ascertained.

MATERIALS AND METHODS

A field trial in randomised blocks was laid out in garden lands of the Central Farm, Agricultural College and Research Institute, Coimbatore during July-October 1969 with a plot size of 4.8 × 4.2 m. After thorough preparation of the soil to tilth, a basal fertilisation was done at 66.75 : 66.75 : 44.50 (NPK) kg per ha Hi-starch was the variety of maize sown in the trial. Thirty days after sowing, 44.50kg N was top-dressed to the crop.

The main treatments of the trial included five regulated levels of soil moisture regime throughout the stand of the crop. The wilting point and the field capacity on moisture equivalent basis were found out by the method of Bouyoucos. Accordingly two values representing the 0 and 100 per cent availability of soil moisture were respectively 10.24 and 20.84 per cent soil-moisture availability were 0,20,40,

1. Assistant Agronomist 2. Professor and Head, Department of Agronomy, Tamil Nadu Agricultural University Coimbatore 641003.

60 and 80 per cent corresponding to 10.24, 12.36, 14.48, 16.60 and 18.72 per cent soil-moisture content of the soil. The plots were irrigated through polythene lined channels as and when necessary to maintain the different moisture levels in the plots upto 90 days from sowing. Soil-moisture was estimated everyday using speedy Moisture-tester and standardised with gravimetric method. The water-requirements took into account the amount of rainfall received during the crop growth and the seepage loss recorded with the help of the Effective Rainfall apparatus (Ramdas, 1960).

Leaf samples were drawn at random on the 30 and 60 days of sowing and harvest stage from each plot. After proper drying in oven, the samples were ground to powder. Grain samples were also collected by the same method. From the samples obtained each time, estimations were made on the content of nitrogen, phosphorus, potash, calcium and iron by the following methods.

The total nitrogen content was estimated by microkjeldahl method and expressed as percentage. From the same plant samples, the total phosphorus content was estimated by Colorimetric method (Jackson, 1967). From the extract prepared for phosphorus estimation, the potash was estimated by Eel flame photometer using potash filter (Tolth and Prince, 1949).

From the same extract neutralised for potash estimation, calcium was estimated using Eel. flame photometer with calcium filter. The iron content was estimated after making triple acid extract from the plant example and by using iso amyl alcohol and potassium thiocynate and the colour developed was messured colorimetrically (Ward and Johnstone, 1962).

RESULTS AND DISCUSSION

Nitrogen content of leaves was high at the beginning and decreased with the age of crop. This is in conformity with the findings of Kirby (1969). The analysis of leaf at the three stages of growth did not show significant differences in N-content due to levels of soil-moisture. However, the data show that there is tendency to leave more nitrogen in that leaf than in the grain in the high moisture levels of 60 and 80 per cent compared to lower moisture levels. This may be considered as inhibition of a metabolic process for protein synthesis at high soil moisture levels as observed by Lapshina and Mosolv (1967).

Phosphorus content at the different stages of sampling varied significantly due to soil-moisutre levels. On the 30th day of the crop the leaf phosphorus from the samples of the zero and 40 per cent moisture-regimes were higher than from the other soil-moisture regimes. On the 60th day of crop, 40 percent moisture regime was still the best for phosphorus. At harvest stage 0 and 20 per cent soil moisture regimes held the highest content of phosphorus in the leaf. In the grain, the differences in the content of phosphorus were not affected by the treatments. There was decrease in P cont-

TABLE 1. Nutrients content in different levels of moisture

	Levels of moisture					S. E.	C. D.
	I_0	I_1	I_2	I_3	I_4		
Nitrogen per cent							
A	3 65	3.62	3.61	3.43	3.59	0.14	NS
B	2.95	2.59	2 97	2.91	2.97	0.186	,,
C	1.76	1.90	1.90	2.16	2.15	0.127	,,
D	1.70	1.60	1.29	1 55	1 29	0.14	,,
Phosphorus per cent							
A	0.154	0.139	0.153	0.143	0.144	0 003	0.009*
B	0.0733	0.0988	0 0992	0.0922	0.728	0.0600	0.0187*
C	0.0661	0.0692	0.0544	0.05190	0.0566	0 0566	0 0115*
D	0.0650	0.0650	0.059	0.051	0.059	0.0032	NS
Potash per cent							
A	3.97	4.31	4.39	4.34	4.24	0.16	,,
B	2.52	2.33	2.31	2.22	2.11	0.01	,,
C	2.12	2.21	1.88	1.92	1.74	0 9	0.27*
D	0.71	0.74	0.72	0.75	0.77	0.0003	NS
Calcium per cent							
A	0.62	0.64	0.64	0.63	0.64	0.02	,,
B	0.49	0.49	0.43	0.44	0.45	0.03	,,
C	0.55	0.65	0.58	0.60	0.62	0.03	,,
D	0.13	0.13	0.09	0.12	0.12	0 04	,,

Table 1 [Continued]

	Levels of moisture					S. E.	C. D.
	I_0	I_1	I_2	I_3	I_4		
Iron [ppm]							
A	172	183	175	188	184	1.61	5.0*
B	152	150	145	151	135	5.53	NS
C	97	97	95	97	94	1.44	,,

A : Leaf sample on 30th day; B : Leaf sample on 60th day; C : Leaf sample on harvest stage

D : Grain sample.

* Significant at 5% level N S : Not Significant

ent of the leaf as the crop aturmde. These observations on phosporus in the plant are in conformity with the findings of Stubblefield and De Turk (1940).

With regard to potash, there was difference in uptake for different moisture levels on 30th day. While there was a tendency to increase in the uptake of potash at lower moisture levels than at the higher moisture levels that was not statistically significant. At harvesting stage, the potash uptake was found to be significantly more in the lower moisture levels than in the higher mosture levels.

Calcium content in the plant sample on 30th day. 60th day and at harvest stage did not vary significantly between the different moisture levels. In the grain analysis also, it was found that there was no difference in the calcium contents between different moisture levels. On the scrutiny of the different stages of growth it was seen that there was decrease in the calcium uptake as the crop approached maturity.

The analysis of iron from the sample on 30th day, indicated that the iron content was more in the higher moisture levels than in the lower moisture levels while on 60th day and harvest stage, the differences in uptake were not significant between the moisture levels Although, there was no apparent difference between the treatments in respect of uptake of iron at different stages of crop, there was a decline in the rate of uptake of iron from the 30th day to harvest stage. As a result, chlorosis was observed at about 60th day and the chlorotic plants were significantly higher in the higher moisture levels than in the lower levels.

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