https://doi.org/10.29321/MAJ.10.A03763

Uptake of P by *Sorghum vulgare* Pers. as Affected by Nitrogen and Phosphorus Application*

by

R. M. SINGH[1] and S. K. PANCHOLY[2]

Phosphorus has long been recognised as an essential constituent of all living organisms. It performs functions in plant metabolism, structure and reproduction that cannot be performed by any other element. The amount of phosphorus present in the soil is sufficient to meet the requirement of the crop, if available in full amounts, but a larger proportion remains in fixed form and not available to the plant. Past experiments have shown that the recovery of applied phosphate is only 15–20 per cent (Grunes and Krantz, 1958).

The absorption of phosphorus by plants is the result of a multiplicity of processes taking place in the plant and soil. Mc Lean and Hoelscher (1954) noted that the application of fertilizer phosphorus in the soil reduced the availability of soil phosphorus to plants. Krantz and Chandler (1954) stated that in the early stages of growth, seedling absorbed phosphorus at a faster rate from the fertilizer than from the soil, the net result being that in young plants a high proportion of the total phosphorus was derived from the fertilizer as compared to that of later stages of growth.

Increasing the supply of phosphorus in the soil increased the uptake, was reported by Mc Lean (1956) who observed that uptake of phosphorus by different test crops (oats, buckwheat and alfalfa) increased with phosphate application. Larson (1952) reported that P content of oat straw was an indication of quantity of phosphorus applied.

Hanway (1962) reported that nitrogen has a significant effect on the per cent of P in leaves and stalks of corn in both sand and soil cultures; similar observations were also made by William and Hanway (1962).

Materials and Methods: In order to obtain information concerning the uptake of P in *sorghum* as influenced by the application of phosphate and nitrogen, a field experiment was laid out in the *Kharif* season of 1965. Six levels of phosphates (0, 30, 45, 60, 75 and 90 kg. P_2O_5/ha) and four

---

* Contribution from the Department of Agronomy, Rajasthan College of Agriculture, University of Udaipur, Udaipur.

[1] Professor of Agronomy and [2] Post Graduate student respectively.

Received on 3—12—1966.

levels of nitrogen (0, 25, 50 and 75 kg. N/ha) singly and in combination were tried in a randomised block design replicated three times. Half of the N, in the form of ammonium sulphate and the entire doses of phosphate as per treatments were mixed separately and drilled at about 10 cm. depth.

For evaluating the fertility status and physical constituents of the soil of experimental area, soil samples were analysed. The physical and chemical composition are given in Table 1.

TABLE 1. *Mechanical and chemical composition of soil*

Mechanical		Chemical	
Components	Per cent	Constituents	Per cent
Coarse sand	17·65	Total nitrogen	0·0536
Fine sand	23·14	Available phosphorus	0·0016
Silt	42·40	Available potassium	0·0078
Clay	14·00	Organic carbon	0·86
Field capacity	36·41	Electrical conductivity in mm hos/cm at 25°C	0·9
Bulk density	1·54	Cation exchange capacity in meq/100 gm. of soil	14·7
		pH	8·45

P content in leaf and stem was determined colorimetically for determining P uptake at different stages of crop front. The crop was harvested for forage yield at the age of 60 days.

Experimental Results: (i) *Effect of Phosphate application on P uptake:* Uptake of P in plants increased with advance in age irrespective of any treatment. It is evident from the data in Table 2. that the maximum absorption took place between 15 and 30 days of growth. The quantity of P absorped at the age of 30 days amounted to approximately 66 per cent of the total at harvest. Application of P_2O_5 upto 45 kg/ha significantly increased the absorption beyond which no significant differences were observed because of increasing levels of P_2O_5 application except at 60 kg/ha level.

It is, further, evident that P uptake by leaves amounted to approximately half to that of the stems (including sheath) upto 45 days of growth beyond which P content in stems increased making a ratio between leaves and stems to that of 2 : 3. P uptake of leaves at 30 days amounted to approximately 80 per cent P uptake of leaves at 60 days.

TABLE 2. *Uptake of P (kg/ha) at different stages of growth as influenced by phosphorus application*

Treatments	15 days Total	30 days			45 days			60 days			Forage yield q/ha
		Leaves	Stalks	Total	Leaves	Stalks	Total	Leaves	Stalks	Total	
P_0	0·32	3·75	7·20	10·95	4·08	8·00	12·08	4·95	10·09	15·04	420·82
P_{30}	0·38	4·40	8·69	13·09	4·96	9·24	14·20	5·43	12·71	18·14	440·86
P_{45}	0·47	4·42	10·00	14·42	4·98	10·37	15·35	5·88	15·91	21·79	460·60
P_{60}	0·74	4·45	10·01	14·46	5·12	11·07	16·19	6·05	15·12	21·17	497·01
P_{75}	0·78	4·80	9·99	14·79	5·37	12·10	17·47	5·99	16·00	21·99	473·71
P_{90}	0·81	4·41	10·16	14·57	5·70	13·13	18·83	6·43	16·74	23·17	467·50
S.E.M. ±	0·13	0·14	0·15	0·18	0·10	0·18	0·18	0·19	0·17	0·19	8·32
L.S.D. at 5 %	0·38	0 39	0·46	0·53	0·30	0·53	0 53	0·55	0·51	0·55	23·57

Maximum forage yield was obtained by the application of 60 kg P_2O_5 kg/ha which was significantly higher than yields under other treatments application beyond this level did not increase the yield.

(ii) *Effect of N application of P uptake:* Table 3 indicates that the application of N has significantly increased the uptake of P by plants, however, application of 50 kg N/ha and higher doses had a much more beneficial effect than 25 kg N/ha. The uptake continued to increase with advance in age. Application of N at higher levels (50 kg and 75 kg N/ha) increased the P uptake appreciably at the earlier stages of growth especially upto 30 days amounting to 75 per cent of the total at harvest (60 days).

TABLE 3. *Uptake of P (kg/ha) at different stages of growth as influenced by N application*

Treatments	30 days			45 days			60 days			Forage yield q/ha
	Leaves	Stalks	Total	Leaves	Stalks	Total	Leaves	Stalks	Total	
N_0	3·04	5·68	8·72	3·22	8·27	11·49	4·05	9·55	13·60	332·8
N_{25}	4·20	8·06	12·26	4·41	9·87	14·28	5·71	13·00	18·71	405·0
N_{50}	4·68	10·60	15·28	5·35	11·72	17·07	6·33	14·21	20·54	[474·9
N_{75}	5·84	12·18	18·02	6·31	12·60	18·91	7·07	16·42	23·49	618·3
S.E.M. ±	0·11	0·19	0·17	0·10	0·15	0·21	0·11	0·14	0·19	6·72
L.S.D. at 5 %	0·32	0·55	0·52	0·28	0·46	0·64	0·31	0·41	0·55	19·19

The proportion of P uptake by leaves and stalks followed the same trend as it happened in the case of phosphate application *i. e.* at earlier stages leaves and stalks absorbed equal amounts of P whereas at harvest stalks accumulated approximately 70 per cent of the total P.

The forage yield was significantly increased by the application of increasing levels of N, the maximum being at 75 kg N/ha level.

(iii) *Recovery of P from fertilizer:* Recovery of P from the fertilizer has been calculated by determining the total uptake of P under each level and subtracting from them the uptake of P under control. Assumptions have been made that the absorption of P from the soil phosphorus remained the same in all treatments, *i. e.* the absorption of P from the soil phosphorus was not affected by the application of fertilizer phosphorus. The values in Table 4. indicate that the recovery from the fertilizer P was maximum (34·6 per cent) at 45 kg P_2O_5/ha level. It was, however, the same (23·8 and 23·6 per cent) at 30 and 60 kg P_2O_5/ha levels respectively and it further dropped with further increase in the fertilizer application.

TABLE 4. *Recovery of P (per cent) of added Phosphate*

Treatments	P uptake kg/ha	Increase over control kg/ha	Percent recovery of added P
P_0 (0)	15·04	...	...
P_{30} (13)*	18·14	+ 3·10	23·8
P_{45} (19·5)	21·79	+ 6·75	34·6
P_{60} (26)	21·17	+ 6·13	23 6
P_{75} (32·5)	21·99	+ 6·95	21·4
P_{90} (39)	23·17	+ 8·13	20·8

* In paranthesis actual elemental P added through fertilizer is given.

Discussion: It was observed that the uptake of P by plants at the earlier stages of growth (30 days) was about 66 per cent of the value at harvest (60 days). In other words uptake of P ranged between 0·4 kg and 0·5 kg/ha per day under varying levels of phosphate application as against 0·3 kg/ha per day under control. Though the total uptake increased with advance in age with a maximum at the age of 60 days but the rate of P uptake worked out only 0·25 kg/ha per day under control and from 0·3 kg to 0·39 kg/ha per day under increasing levels of phosphate application. It is therefore inferred that the uptake was faster at earlier stages than the later ones.

Since the uptake was very much lower under control as against phosphate fertilized plots, it is evident that the increase in P uptake has resulted because of fertilizer P. This finding is in close conformity with those of Mc Lean and Hoelscher (1954), Mc Lean (1956) and Larson (1952).

It is further evident (Table 2.) that the uptake of P continued even beyond 45 days though it was a small increase under control, but in phosphate fertilized plots it was appreciable, which indicates that plant roots may continue to absorb P if available. This view is supported by Dean and Fried (1956).

It is, further, evident (Table 3.) that the application of N has significantly increased the P uptake. The uptake at early stages amounted to 75 per cent of the total on account of application of N at 50 kg or 75 kg/ha. It is a higher value in comparison to the value for phosphate application. The application of N has significantly increased the P uptake by plants at harvest as compared to control, This finding is in close conformity to those of Hanway (1962).

The recovery of P from added fertilizer (Table 4.) indicates that a very high recovery of P was obtained at 45 kg P_2O_5/ha level, beyond which though the recovery decreased the uptake of P continued to increase with increase in the phosphate fertilization. Though the maximum forage yield was obtained by the application of 60 kg P_2O_5/ha but the maximum uptake was observed at 90 kg P_2O_5/ha level of application. However, at all levels of phosphate application the recovery was higher than expected. This observation lends support to the findings of Grunes and Krantz (1958), and of Rennie and Mitchell (1954) who obtained a maximum recovery of 38 per cent with a minimum of 19 per cent of applied phosphate.

Summary and Conclusions: To determine the availability of native and added phosphate an experiment was laid out comprising of 6 levels of P_2O_5 (0, 30, 45, 60, 75 and 90 kg/ha) and 4 levels of N (0, 25, 50 and 75 kg/ha) singly and in combination. P uptake at different stages of growth was worked out. The following conclusions were drawn:

1. Increasing levels of Phosphate application increased the uptake, the maximum being at 90 kg P_2O_5/ha.

2. Application of nitrogen increased the availability of native as well as applied phosphate. Maximum P uptake occurred at 75 kg N/ha level. This correspondingly increased the forage yield also.

3. Recovery of applied phosphate ranged between 20·8 and 34·6 per cent, the latter being at 45 kg P_2O_5/ha level. Recovery decreased with increasing levels of phosphate application.

4. The rate of P uptake was maximum at the early stage of plant growth between 15 and 30 days of growth period. This amounted to 66 per cent of the total at harvest. P content of leaves was about 80 per cent at 30 days to that of at 60 days.

REFERENCES

Dean, L. A., and M. Fried 1956 Soil and fertilizer Phosphorus in crop nutrition. *Soil Sci. Soc. Am. Proc.*, **20**: 43-58.

Grunes, D. L., and B. A. Krantz	1958	Nitrogen fertilization increases nitrogen, phosphorus and potash concentration in oats. *Agron. J.*, **50**: 729-32.
Hanway, J. J.	1962	Corn growth and composition in relation to soil fertility I, II, and III, *Agron. J.*, **54**: 145-8, 217-22, and 222-9.
Krantz, B. A. and W. V. Chandler	1954	Fertilize corn for higher yields. *North Carolina Agr. Exp. Sta. Bul.* 366.
Larson, W. E.	1952	The effect of phosphate fertilization upon the yield and composition of oats and alfalfa grown on phosphate deficient Iowa soils. *Agron. J.*, **44**: 357-61.
Mc Lean, E. O.	1956	Factors affecting yield and uptake of phosphorus by different crops. *Soil Sci.*, **80**: 181-90.
——— and J. E. Hoelscht	1954	Factors affecting yield and uptake of P by different crops. *Soil Sci.*, **78**: 453-62.
Rennie, D. A. and J. Mitchell	1954	The effect of nitronen addition on fertilizer phosphorus availability. *Canadian J. Agr. Sci.*, **34**: 353-63.
William, F., and J. J. Hanway	1962	Effect of N on P absorption by Corn. *Agron. J.*, **54**: 437-12.

Soils of the Sugarcane Development Centres in Coimbatore District (Madras)

by

C. RATNAM [1], K. KHALEEL AHMED [2], N. S. VENKATARAMAN [3], S. S. SUBRAMANIAM [4] and B. HABIBULLAH [5]

Introduction: Coimbatore district is the third largest sugarcane growing tract in the Madras State, with 45,846 acres under sugarcane, the major portion of which extends over the taluks of Coimbatore and Udumalpet. The soil survey of sugarcane tracts was undertaken during the year 1961-62 and was confined to the sugarcane soils of these two taluks alone the results of which are presented. The object of the survey was to classify the soils of the cane areas of the district into major broad soil divisions.

[1] Soil Survey Officer,

[2] to [5] Soil Survey Assistants, Agricultural College and Research Institute, Coimbatore-3.

Received on 25—7—1966.