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EFFECT OF DIFFERENT P SOURCES ON PHOSPHORUS TRANSFORMATION AND AVAILABILITY IN MIXED BLACK CALCAREOUS SOIL

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ABSTRACT

An incubation experiment was conducted to study the transformation of applied phosphorus into various inorganic P fractions in a mixed black calcareous soil. There were three P sources viz., single superphosphate (SSP) diammonium phosphate (DAP) and Mussoorie rock phosphate. Phosphorus was applied at the rate of 60 kg P₂O₅ ha⁻¹ at field capacity moisture level. These were maintained upto 60 days for transformation and inorganic P fractions were determined at 15 days interval. The concentration of different P forms was higher with DAP followed by SSP. There was continuous increase in the P fractions with advancing incubation time upto 45 days. However, phosphorus availability was increased upto 60 days irrespective of P source. DAP resulted in highest per cent recovery into inorganic P fractions. Ca-phosphate was the dominant P form followed by RS-P, Fe-P and Al-P in all the P sources. All the P fractions were highly correlated with available P in soil. Ca-phosphate showed highest r value (0.80). The contribution of Ca-P towards P-availability was 64 per cent. The combination of different P fractions were also highly correlated with available P in soil.

KEY WORDS : 'P' Sources, Phosphorus, Transformation, Availability, Black Calcareous soil

A knowledge on the transformation of applied phosphorus into specific inorganic forms is important as crop plants obtain most of the fertilizer phosphorus from reaction products and not from the applied source as such. The availability of these forms of P to plant is considered as a function of its capacity, intensity and rate factor. The nature of reaction products formed due to P transformations in the soil are influenced by several factors such as the nature of fertilizers added, microclimate of the rhizosphere, physico-chemical properties of the soil such as pH, CaCO₃ etc. Keeping this in view, an experiment was conducted to study the transformation and availability of P as influenced

MATERIALS AND METHODS

An incubation experiment was conducted in a completely randomised design with three replications. The treatments included three P sources viz., single superphosphate (SSP), diammonium phosphate (DAP), Mussoorie rock phosphate (MRP) applied at 60 kg P₂O₅/ha and maintained at field capacity moisture level for 60 days. The soil samples were analysed for inorganic P forms after 15, 30, 45 and 60 days of incubation. Inorganic P forms, Al-P, Fe-P, RS-P and Ca-P were determined from the soils using Chang and Jackson (1957) procedure as modified by Peterson and Corey (1966). The per cent recovery of

RESULTS AND DISCUSSION

The data on transformation of native and applied P into various forms with advancing time are given in Table 1.

Aluminium phosphate

There was little variation in Al-P with different P sources. The maximum value of Al-P (22.3 ppm) was recorded at 45 days with DAP. In general, all P fractions were increased with incubation time upto 45 days and thereafter declined except in control. The per cent recovery of Al-P ranged from 6.05 to 18.1 ppm with different P sources (Table 2). The per cent recovery was maximum in DAP (18.1%) followed by SSP (13.9%). Mussoorie rock phosphate showed lowest recovery (6.05%).

Iron phosphate

DAP resulted in highest (43.5 ppm) Fe-P at 45 days of incubation. Fe-P concentration was

increased with advancing time till 45 days and thereafter declined with all P sources. The percentage recovery of Fe-P varied between 9.07 to 24.8 ppm with MRP and DAP, respectively.

Reductant soluble phosphate

The variation in the amounts of RS-P was noticeable when measured at different timings during incubation period. RS-P was increased continuously in control and upto 45 days of incubation with different P sources. The per cent recovery of RS-P was maximum (43.11%) with DAP and it was lowest (10.34%) with MRP.

Calcium phosphate

Ca-P fraction was dominant irrespective of the P sources and interval (Table 1). It was maximum (131.9 ppm) in DAP followed by SSP (126.4). The transformation of added P into Ca-P was much higher than other inorganic P fractions (Table 2). The per cent recovery of added P into Ca-P ranged

Table 1. Transformation of native and applied P into various forms with time

Source	Time (days)	P fractions (ppm)				Available P (ppm)
		Al-P	Fe-P	RS-P	Ca-P	
Control	0	15.4	35.3	48.1	108.4	12.1
	15	16.2	36.5	49.5	111.1	13.1
	30	17.2	37.1	50.4	112.3	13.6
	45	18.4	37.8	52.1	113.1	14.3
	60	18.9	38.5	53.0	113.7	14.9
DAP	15	18.4	39.2	54.7	123.1	16.7
	30	20.0	41.0	58.9	129.8	19.0
	45	22.3	43.5	61.7	131.9	21.3
	60	20.6	42.8	60.8	129.6	22.1
SSP	15	17.8	39.0	57.2	121.9	15.8
	30	19.2	40.8	58.6	125.0	18.6
	45	21.3	42.7	60.5	126.4	19.6
	60	20.4	40.5	59.4	123.1	20.5
MRP	15	17.6	38.7	52.0	118.5	16.9
	30	18.9	40.0	54.4	120.2	17.8
	45	20.9	42.5	56.8	121.8	18.9
	60	20.3	40.5	56.2	120.3	20.9
CD (P=0.05)		0.17	0.39	0.43	0.87	0.14

Table 2. Per cent recovery of added P into inorganic P forms as affected by different P sources

Source	Time (days)	P fractions (ppm)			
		Al-P	Fe-P	RS-P	Ca-P
DAP	15	9.50	12.70	22.50	59.61
	30	12.71	17.01	38.04	78.60
	45	18.10	24.80	43.11	83.79
	60	7.60	19.05	36.82	71.32
SSP	15	6.64	11.66	34.01	48.41
	30	8.76	16.08	36.71	57.63
	45	13.90	21.50	37.70	58.94
	60	6.64	9.40	29.50	65.21
MRP	15	6.05	10.40	10.34	32.84
	30	8.15	12.61	18.00	35.14
	45	12.10	20.13	21.20	38.61
	60	6.35	9.07	14.63	29.72
CD (P=0.05)		1.21	1.84	3.34	3.41

DAP : Diammonium phosphate; MRP : Mussoorie rock phosphate; SSP : Single superphosphate

Table 3. Correlation of available P with inorganic P fractions

Source	Correlation with available P			
	Al-P	Fe-P	RS-P	Ca-P
DAP	0.64**	0.74**	0.58*	0.80**
SSP	0.68**	0.72**	0.61**	0.78**
MRP	0.61**	0.69**	0.54*	0.77**

* Significant at 5% level; ** Significant at 1% level

DAP : Diammonium phosphate;

MRP : Mussoorie rock phosphate; SSP : Single super phosphate

from 29.72 to 83.79 which indicated that the Ca-P was the primary reaction product during P transformation.

Several workers reported similar trends of added P transformation into inorganic forms as Al-P, Fe-P, RS-P and Ca-P. (Shanmugam, 1989., Singaram and Kothandaraman, 1993).

Available P

In general, P availability was increased with advancing time upto 60 days irrespective of P source. DAP recorded maximum P availability (22.1 ppm) at 60 days interval. All the P fractions were highly correlated with available P in soil. The

correlation co-efficients are reported in Table 3. Ca-P showed highest r value (0.80). The contribution of Ca-P towards P availability was 64 per cent. The combination of different P fractions were also highly correlated with available P in soil. On the basis of the amounts of P transformed into various inorganic P fractions, it can be said that in addition to Ca-P, Al-P and Fe-P were also acting as source of available P in calcareous soils.

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