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EFFECT OF INCUBATION PERIOD OF SINGLE SUPER PHOSPHATE AND POULTRY LITTER ON PHOSPHORUS-FERTILIZER EFFICIENCY

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ABSTRACT

The effect of incubation of Single super phosphate (SSP) along with poultry litter (PL) for various period of time was investigated by growing maize and measuring P-uptake when grown in a alkaline calcarious soils in a pot culture experiment. The dry matter yield of 49 days old plants showed that 3 days incubation of SSP along with PL produced maximum yield over SSP alone. This trend was closely followed by 21-day incubation time. Phosphorus uptake by maize tops and roots were also higher SSP and PL were incubated for 3 to 21 days before application and thereby resulted in significantly higher P-fertilizer efficiency than SSP applied alone.

Key words: Incubation time, Maize, Phosphorus efficiency, mixing

INTRODUCTION

Phosphorus fertilizer efficiency in our soils is reported around 15-20% (Nisar *et al*., 1996). Major portion of applied P is converted to forms not available to plants and it is attributed to high P fixing capacity, high pH and activity of $CaCO_3$. Therefore, in view of low soil fertility status, nutrient management based on utilization of various resources viz, soil, organic, biological and mineral fertilizer with particular reference to arid conditions is necessary, not only in sustaining productivity and soil health but also in meeting fertilizer requirement of different crops (Hedge and Dwived, 1993). The synergistic use of organic and mineral fertilizers increase each other's efficiency (Hussain *et al*., 1992). Farmyard manure generally resulted in higher P-uptake and improved yields, when incorporated into the soil and sufficient time is allowed for its decomposition (Ahmad, 2000, Jadoon *et al*., 2003). mixing of FYM with the fertilizer 24 hours before application or incubation of P+FYM for 15 days have also been reported to increase P-fertilizer efficiency and the yield of crops (Malik *et al.,* 1992, Sarir *et al*., 1992, Saeed *et al*., 1998). The growing poultry industry in Pakistan was estimated to produce more than 3 million tones of litter per year that is cheaply available and integrated use with inorganic fertilizers has resulted in good response to maize and the following wheat (Alam and Shah, 2003, Alam *et al*., 2005). This pot culture experiment was conducted to determine the optimum time of incubation of SSP and PL for improving the P-fertilizer efficiency and increasing the dry matter yield of maize.

MATERIALS AND METHODS

Bulk soil samples (0-20 cm depth) collected from the Nuclear Institute for Agriculture and Biology, Faisalabad was air dried, crushed to pass 2 mm sieve and mixed thoroughly. Representative soil sample was analyzed for some physico-chemical properties (Table 1). Two and a half kilogram of soil was weighed and mixed with 100 mg N kg^{-1} as urea and 5 mg Zn kg^{-1} as zinc sulphate and filled in individual plastic pots lined with polyethylene. Phosphorus was applied to the soil in pots @ 75 mg P kg^{-1} as single super phosphate (SSP) either alone or after blending with poultry litter (PL) @ 5 t $ha^{-1}$and incubating for different times (same day, 3, 7, 14, 21 and 28 days) before application. The poultry litter used in the experiment had following properties (Table 2). The fertilizer SSP was incubated after mixing with poultry litter; the moisture was kept at 20% by weight and placed at room temperature in the laboratory. Each treatment was replicated 3 times and arranged in net-house following completely randomized design. Three seeds of maize (*Zea mays* L. cv. C-20) were sown in each pot and after germination only one plant per pot was grown. The moisture level was maintained at 80% of maximum water holding capacity. After 26 days of sowing, each pot received 100mg N kg^{-1} and 14 days later additional 60 mg N kg^{-1} as urea solution was applied. Plant tops were harvested 49 days after sowing. Roots were separated from soil by gentle washing with tap water, dipped 3 times in deionized water and kept in forced air oven for 3 to 4 days at 70^{o}C. The dry weights of tops and roots were recorded separately.

Chemical analysis: The maize plant tops and roots samples were ground in a Wiley mill and usually one-gram portions were digested in tri-acid mixture (Jackson, 1962). Phosphorus in the digest was determined by measuring the intensity of the metavanadate yellow color using spectrophotometer.

Statistical analysis: The data obtained were analyzed statistically and the means were compared by the Duncan's multiple range test at 5% probability level.

Table 1. Some physico-chemical properties of the experimental soil.

Properties	Value
pH (1:1)	8.32
EC (1:1)	0.32 d S m^{-1}
Organic matter	0.79%
$CaCO_3$ equivalent	3.59%
Texture	Silt Loam
AB-DTPA P	1.64 mg kg^{-1}
Total –N	0.052%

Table 2. Composition of poultry litter used in the study

pH (1: 10)	**EC 1:10) $dS.m^{-1}$**	**% N**	**% P**	**% OC**	**N / P**	**C / N**	**C / P**
9.2	**4.3**	**1.8**	**0.81**	**13.68**	**2.2**	**7.6**	**16.9**

Phosphorus fertilent. In case of roots, 3-day incubation resulted in highest P-uptake, followed by 14 and 21days incubation period, but it was not significantly different to SSP alone treatment. Trivedi *et al*. (1995) reported that P+FYM incubated treatment resulted in increased P-uptake than application of P alone in groundnut. Similarly, Saeed *et al*. (1998) also found significant improvement in P-uptake due to 15-day incubated P+FYM treatment in wheat as well as in maize crops. Higher P-uptake with incubated treatment has been attributed to release of native P as a result of acids produced during decomposition as well as the chelating effect of organic complex with P. A prolonged incubation time (28 days) resulted in subsequently reduced P-uptake by both tops and roots. This decreased P-uptake may be due to formation of organic phosphate complexes during incubation that may temporarily withhold the available P. Moreover, organic matter has been reported to increase P retention in soil by giving rise to new adsorption sites in association with cations (Wier and Soper, 1963).

Table 3. Effect of time of incubation of PL and SSP on P concentration, P-uptake and P-fertilizer efficiency by maize grown in pots.

Treatment (Incubation time)		Roots		Tops		
		P conc. (mg kg^{-1})	P-uptake (mg pot^{-1})	P conc. (mg kg^{-1})	P-uptake (mg pot^{-1})	PFE (%)
T0	Control	1209 a	0.78 b	1285 a	2.91 c	-
T1	SSP alone	1244 a	4.53 a	1346 a	15.87 b	6.92 b
T2	Same day	1379 a	5.03 a	1725 a	20.53 ab	9.40 ab
T3	3 days	1196 a	5.51 a	1522 a	24.97 a	11.76 a
T4	7 days	1225 a	4.81 a	1650 a	23.20 ab	10.82 a
T5	14 days	1270 a	5.27 a	1819 a	25.72 a	12.17 a
T6	21 days	1148 a	5.16 a	1495 a	23.30 ab	10.88 a
T7	28 days	1196 a	4.53 a	1644 a	20.83 ab	9.56 ab

Figures within each column sharing common letter do not differ significantly at $p < 0.05$ as determined by DMR test.

P efficiency: incubation time of SSP along with PL significantly affected P-fertilizer efficiency (PFE) in maize. In case where incubation time was shorter (same day, T2) or longer (28 days, T7) the P-efficiency was not significantly different than that of SSP alone whereas 3 to 21 days of incubation produced significantly higher PFE than application of SSP alone. Thus, SSP and PL should preferably be incubated for 3 to 21 days only for obtaining maximum P-efficiency of the applied fertilizer; this much incubation time was sufficient to result in higher dry matter yield as compared to application of SSP alone.

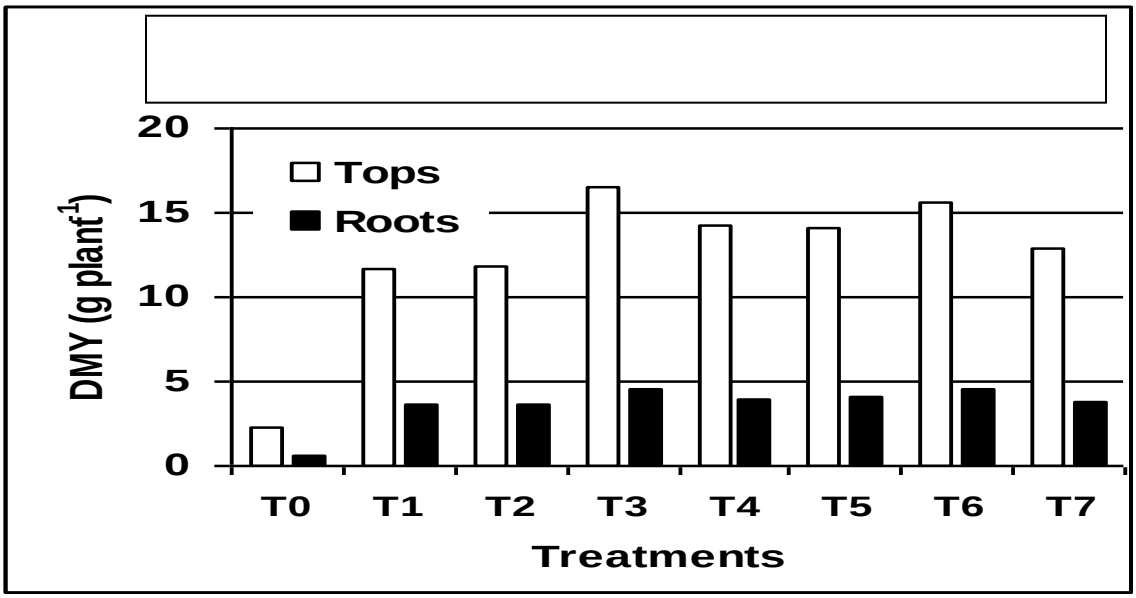

Fig.1.Effect of period of incubation of PL and SSP on dry matter yield of maize.

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