Zagazig J. Agric. Res., Vol. 44 No. (6B) 2017 2579-2591

Soil and Water Science

http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

EFFECT OF SOME ORGANIC SOURCES AS SOLID AND LIQUID FORMS ON PHOSPHORUS AVAILABILITY IN TWO DIFFERENT SOILS

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Received: 12/10/2017; Accepted: 25/10/2017

ABSTRACT: An incubation experiment was conducted under laboratory condition to study the effect of ordinary super phosphate (OSP) at three different rates (0,30 and 60 kg P fad.$^{-1}$) representing 0,50 and 100% of Recommended Dose (RD), added either singly or combined with various organic manures, *i.e.* compost (Com) at rates of 10 Mg fad.$^{-1}$ (1%) and 20 Mg fad.$^{-1}$ (2%) , chicken manure (CM) and Rabbit manure (RM.) at rates of 5 Mg fad.$^{-1}$ and 10 Mg fad.$^{-1}$ representing 0.5 and 1%, respectively, on phosphorus availability in two different soils. Available phosphorus content was determined through different incubation periods *i.e.,* 10, 30, 60, 90 and 120 days using two different soil types, the first was clayey soil, taken from Abu-Hammad, District Sharkia Governorate and the second one was sandy soil collected from the Farm of the Faculty of Agriculture, El-Khattara County, Sharkia Governorate. The obtained results can be summarized as follows: The values of available phosphorus increased by increasing phosphatic fertilizer rates, which were greater in the clayey soil than in the sandy one. In general available phosphorus values were remarkadly increased after 60 days of incubation for the two investigated soils. The treatment of (50% RD OSP +1% Com. + 1% CM.) as solid form, and (1% Com +0.5% CM +0.5% RM) as liquid form showed more beneficial effect than the treatment of (100% RD OSP) in the case of clayey soil, while the treatments of (2% Com.) as individual solid phase and (50% RD OSP + 1% Com. + 1% CM.) as liquid phase showed more beneficial effect than the treatment of (100% RD OSP) in a sandy soil. Therefore, the use of half of the recommended dose of phosphatic fertilizer combined with organic manures as solid or liquid phase may reduce the phosphatic fertilizer dose, production cost and consequently environmental pollution.

Key words: Incubation, compost, compost tea, solid and liquid forms, phosphatic fertilizer.

INTRODUCTION

It is generally recognized that the chemical behavior of mineral and organic phosphorus fertilizers vary according to their chemical nature and soil condition. From the factors that might affect the chemical and biological transformation of phosphatic fertilizers are soil texture, $CaCO_3$ content, organic matter, soil pH and soil moisture. Actually, the behavior of phosphorus in soils also depends on the rates of phosphatic fertilizer, the nature and rates of applied organic manures as well as the combination of phosphatic fertilizer with organic manures as solid and liquid forms.

Sinegani and Mahohi (2009) studied the effect of incubation time on soil available P, miocrobial P easily soluble and dicalcium phosphate contents. They reported that soil available P significantly decreased from 36.52 mg kg^{-1} to 32.09 mg kg^{-1} in 20 days of incubation in sewage sludge treated soil. This result may be due to the increase of microbial population and P immobilization. After 20 days of incubation, available P increased up to 49.91 and 63.09 mg kg^{-1} in 60 and 90 days of incubation, respectively.

Al-Oud (2011) studied the availability of P from rock phosphate under incubation. He

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concluded that available P was increased by increasing incubation time up to 90 days where the percentage of available P reached 244, 420, 482, 554, 542 and 487% as a result of incubating calcareous soil for a period of 15, 30, 45, 60, 75 and 90 days, respectively. On the other hand, available P was increased after compost application and was reduced gradually by time. The incubation period also plays an important role in production of organic acids which in turn affect the P solubolization process as reported by Ahmed (2014).

Merwad *et al*. (2013) concluded that the average values of available phosphorus increased with the increasing application rates of chicken manure mixed with the decreasing application rates of orange residues in absence of any mineral soil amendments. These results could be due to the higher content of total phosphorus in chicken manure than orange residues.

The current work aims to study the effect of application of phosphatic fertilizer (OSP) at different rates combined with or without organic manures as solid and liquid phases on available phosphorus content during incubation periods *i.e.,* 10, 30, 60, 90 and 120 days in clayey and sandy soils. Also, the main objective is to reduce the recommended dose (RD) of phosphatic fertilizer to reduce the consumption of phosphatic fertilizer and production cost, consequently environmental pollution and soil salinity.

MATERIALS AND METHODS

Soil Samples

The clayey and sandy soils used in this study were sampled from the surface layer (0-30 cm). The clayey soil was taken from Abu-Hammad, District, Sharkia Governorate, while the sandy soil was taken from the farm of the Faculty of Agriculture, El-Khattara District, Sharkia Governorate. Soil samples were air dried and analyzed to determine the physical and chemical properties as shown in Table 1. Particle size distribution of the soil was carried out adapting to the international pipette method (Piper, 1950). The routine chemical analysis of the tested soils were determined according to the method described by Page *et al.* (1982). Characteristics of the solid organic according to Black *et al.* (1965) and tabulated in (Table 2a), liquid organic manure determined to Jodice *et al.* (1983) and tabulated in Table (2b)

Preparation of Organic Manure Extract

Organic manures were air dried, crushed and sieved through 2 mm plastic screen, then slowly mixed in plastic bags for analysis and experimental work. Preparation of organic manure extracts were done at three stages according to (Ingham 2005) as follow: Each solid organic manure was blended with tab water in dilution ratio (1:10 *W/V*). 1 kg of each solid organic manure was put in plastic tank and soaked into 10 liters of tab water. The mixture was turned on the aquarium pump. These mixtures were soaked over 24 hr., and stirred 2 hr., during the next day until the water turned into brown colour and the extracts had no smell. After brewing the mixture, organic manures extracts were strained by using cheesecloth into another tank. These organic manure extracts were kept into open plastic tanks for analysis and experimental work. The characteristics of solid and liquid organic sources are show in Tables 2 a and 2b.

Incubation Experiment

An incubation experiment was carried out to study the behavior of ordinary superphosphate (OSP) at different periods *i.e.* 10, 30, 60, 90, and 120 days, as affected by various organic manures, *i.e.* compost (Com.), chicken manure (CM.) and rabbit manure (RM.) as solid and liquid phases in the two tested soils.

The experimental treatments

- 0% RD OSP (Control)
- 50% RD OSP
- 100% RD OSP.
- 2% Com.
- 1%Com. + 1% CM.
- 1%Com. + 1% RM.
- 1%Com. + 0.5% CM. +0.5% RM.
- 50% RD OSP + 2% Com.
- 50% RD OSP. + 1% Com. + 1% CM.
- 50% RD OSP. + 1% Com. + 1% RM.
- 50% RD OSP. + 1% Com. + 0.5% CM. + 0.5% RM.

Table 1. Some physical and chemical properties of the investigated soils

Soil characteristics	Soil location	
	Abu- Hammad	El-Khattara
Soil particles size distribution		
Sand (%)	30.63	91.20
Silt (%)	20.30	2.59
Clay (%)	49.07	6.21
Textural class	Clay	Sandy
$CaCO_3$ (g kg^{-1})	10.00	28.5
Organic matter (g kg^{-1})	16.20	5
pH*	8.20	7.8
EC (dSm^{-1}) **	2.10	1.26
Soluble cations and anions (mmolc l^{-1}) **		
Ca^{++}	7.90	5.36
Mg^{++}	6.10	4.00
Na^{+}	6.90	3.72
K^{+}	0.20	0.23
$CO_3^{=}$	-	-
HCO_3^{-}	3.80	2.8
Cl^{-}	10.90	4.49
$SO_4^{=}$	6.40	6.02
Available P (mg P kg^{-1}soil)	12.60	8.1

* Soil-water suspension 1: 2.5 ** Soil paste extract

Table 2a. Chemical composition of the used solid organic manures

Manure	Characteristics						
	EC**	PH*	OM (g kg^{-1})	C/N	N (g kg^{-1})	P(g kg^{-1})	K (g kg^{-1})
Compost	7.5	4.5	405	7.11	33	19	29.1
Chicken	7.2	7.34	450	3.57	73	18.5	51.2
Rabbit	7.4	3.92	357	3.77	55	33	28.1

* Manure- water suspension 1:5 ** Manure – water extract

Table 2b. Chemical composition of the used liquid organic manures (water extract 1:5) *W/W* manure: water

Manure	Characteristics				
	EC**	PH*	N (mg L^{-1})	P (mg L^{-1})	K (mg L^{-1})
Compost	7.74	2.1	23	22	35.5
Chicken	7.3	3.21	31	14.3	21.6
Rabbit	7.45	2.35	19.2	13.2	24.1

200 grams of the tested soil samples were placed in small plastic containers. Ordinary super phosphate (OSP, 6.5% P) was added at the rates of 0, 30 and 60 kg P fad^{-1} (0, 50 and 100% of recommended dose) (RD) either solely or mixed with compost (com.) at the rates of 10 and 20 Mg $fad.^{-1}$ (1 and 2%), chicken manure (CM) and rabbit manure (RM) at the rates of 5 and 10 Mg fad^{-1} (0.5 and 1%). Treatments of phosphatic fertilizer (100 and 50% RD OSP) and various organic manures as solid or liquid phases at the different rates were replicated two times. The soil moisture content was adjusted at the field capacity through the experimental periods. The plastic containers were covered through the experimental time and incubated at room temperature (±30˚C approximately). Soil samples were taken at intervals of 10, 30, 60, 90 and 120 days, where available phosphorus was extracted using Olsen's method, described by Page *et al.* (1982). The available soil phosphorus was determined using method of Watanabe and Olsen (1975) as follow: 5 grams of soil sample being shaken with 50 ml 0.5 M $NaHCO_3$ solution (pH 8.5) with one gram activated charcoal for 0.5 hour and filtered.

Mg: mega gram (Mg = 10^6g) = 1 metric ton.

RESULTS AND DISCUSSION

Results presented in Table 3 and illustrated in Figs. 1, 2, 3 and 4 demonstrate the effect of applied (OSP) with or without different solid and liquid organic sources on phosphorus availability in the clayey and sandy soils during incubation for successive intervals. In general, Results showed that the investigated various treatments gave increase in the available phosphorus content if compared to control (0% OSP) treatment in the two tested soils. These results may due to the fact that the application of phosphtic fertilizer and various organic manures as solid and liquid phases being a storehouse for essential phosphorus nutrient, these findings are in accordance with those obtained by Basyouny *et al.* (2003) and Merwad *et al.* (2013).

Phosphorus Fertilizer Rates

Results in Table 3 and illustrated in Figs. 1, 2, 3 and 4 revealed that values of available phosphorus in the treated clayey soil with individual addition of 50% RD OSP over the different incubation periods ranged from 28.8 to 64.8 mg P kg^{-1} with an average value of 48.1 mg P kg^{-1}. The corresponding range in the treated sandy soil was 21.6 to 48.8 mg P kg^{-1} with an average of 37.2 mg P kg^{-1}. The corresponding range in the treated clayey soil with singly application of 100% RD OSP over the different incubation periods was from 32.3 to 69.9 mg P kg^{-1} with an average of 55.6 mg P kg^{-1}, while in the treated sandy soil ranged from 29.5 to 69.2 mg P kg^{-1} with an average of 48.0 mg P kg^{-1}. Such results show that the available phosphorus level was greater in the clayey soil than in a sandy one. These results could be due to the great native content of available phosphorus in the clayey soil (Table 1). The solely rate of 100% RD OSP was more efficient than the individual rate of 50% RD OSP in the two studied soils. Therefore, the singly rate of 100% RD OSP could be recommended as a beneficial rate of phosphorus in these soils to attain sufficient available phosphorus content.

Sources and Rates of Organic Manures

Solid organic sources

In the absence of ordinary super phosphate (OSP), the general average values of available phosphorus in the treated clay soil with (2% Com), (1% Com + 1% CM), (1% Com + 1% RM) and (1% Com + 0.5% CM + 0.5% RM) over the different incubation periods ranged from 43.4 to 79.5, 30.7 to 83.5, 34.9 to 76.7 and 59.2 to 71.5 with averages of 61.3, 62.4, 56.4 and 66.5 mg P kg^{-1}, respectively. The corresponding ranges of the same treatments in the sandy soil were 48.2 to 65.9, 32.7 to 67.0, 29.1 to 90.4 and 28.1 to 72.1 with averages of 57.7, 52.0, 54.4 and 51 mg P kg^{-1}, respectively.

The beneficial effect of different solid organic sources on an average content of available phosphorus followed the order (1% Com. +0.5% CM. + 0.5% RM.) > (1% Com. +1% CM.)> (2% Com.) > (1% Com. +1% RM.), in the clayey soil and (2% Com.) > (1% Com. +1% RM.)> (1% Com. + 1% CM.) > (1% Com. + 0.5% CM. +0.5% RM.) in the sandy soil.

Liquid organic sources

In the absence of ordinary super phosphate (OSP), the general average of available phosphorus in the clayey soil treated with (2% Com), (1% Com + 1% CM), (1% Com + 1% RM)

Table 3. Effect of phosphatic fertilization and various solid and liquid organic sources on available phosphorus (mg p kg^{-1}) in the two tested soils during incubation periods

Treatment	Incubation period (day)										Average	
	10		30		60		90		120		Clay soil	Sandy soil
	Clay soil	Sandy soil	Clay soil	Sandy soil	Clay soil	Sandy soil	Clay soil	Sandy soil	Clay soil	Sandy soil		
0% RD OSP (control)	27.9	22.2	17.8	17.5	18.3	21.6	28.8	34.1	56.0	40.0	29.8	27.1
50% RD OSP	43.0	28.0	28.8	21.6	61.0	41.2	42.8	46.3	64.8	48.8	48.1	37.2
100% RD OSP	53.9	33.7	32.3	29.5	69.9	49.9	53.8	57.7	68.2	69.2	55.6	48.0
Solid organic sources												
2% Com	62.1	57.7	43.4	48.2	79.5	65.3	50.7	51.4	70.8	65.9	61.3	57.7
1% Com + 1% CM	53.1	41.3	30.7	32.7	83.5	53.8	63.9	67.0	80.9	65.2	62.4	52.0
1% Com + 1% RM	43.1	29.1	34.9	29.4	76.7	77.2	61.2	45.6	66.1	90.4	56.4	54.4
1% Com + 0.5% CM + 0.5% RM	69.3	34.2	59.2	28.1	71.5	59.2	64.0	72.1	68.3	61.4	66.5	51.0
50% RD OSP + 2% Com	49.2	32.6	30.0	26.3	100	66.0	77.1	43.8	65.5	59.0	64.4	45.5
50% RD OSP + 1% Com + 1% CM	50.8	39.4	40.6	35.4	97.7	81.8	77.4	51.9	73.6	61.5	68.0	54.0
50% RD OSP + 1% Com + 1% RM	45.9	28.8	38.2	30.5	80.1	71.7	60.9	59.0	55.6	60.0	56.1	50.0
50% RD OSP + 1% Com + 0.5% CM + 0.5% RM	53.9	46.8	43.6	32.0	89.6	69.9	54.9	58.6	72.4	67.1	62.9	54.7
Liquid organic sources												
2% Com	35.7	25.0	29.8	24.6	79.7	64.6	65.2	50.7	62.7	58.9	54.6	44.8
1% Com + 1% CM	50.4	40.3	32.4	29.4	71.6	62.8	55.5	70.2	66.1	50.6	55.2	50.7
1% Com + 1% RM	34.1	29.2	28.8	27.1	79.7	68.0	45.6	37.0	59.6	40.1	49.6	40.3
1% Com + 0.5% CM + 0.5% RM	45.3	29.9	30.5	31.3	84.3	78.1	52.2	47.0	90.6	57.6	60.6	48.8
50% RD OSP + 2% Com	35.8	34.1	22.1	32.1	81.2	70.9	46.6	45.0	84.2	55.4	54.0	47.5
50% RD OSP + 1% Com + 1% CM	43.8	40.7	35.0	30.5	78.3	67.6	68.6	62.3	77.1	53.7	60.6	51.0
50% RD OSP + 1% Com + 1% RM	36.4	39.1	27.4	24.2	74.1	59.4	48.7	56.5	69.2	62.1	51.2	48.3
50% RD OSP + 1% Com + 0.5% CM + 0.5% RM	62.5	30.7	40.5	33.6	72.2	65.2	53.0	38.7	66.1	56.5	58.9	44.9

RD= Recommended dose Com. =Compost manure CM. = Chicken manure RM. =Rabbit manure (OSP) =Ordinary super phosphate

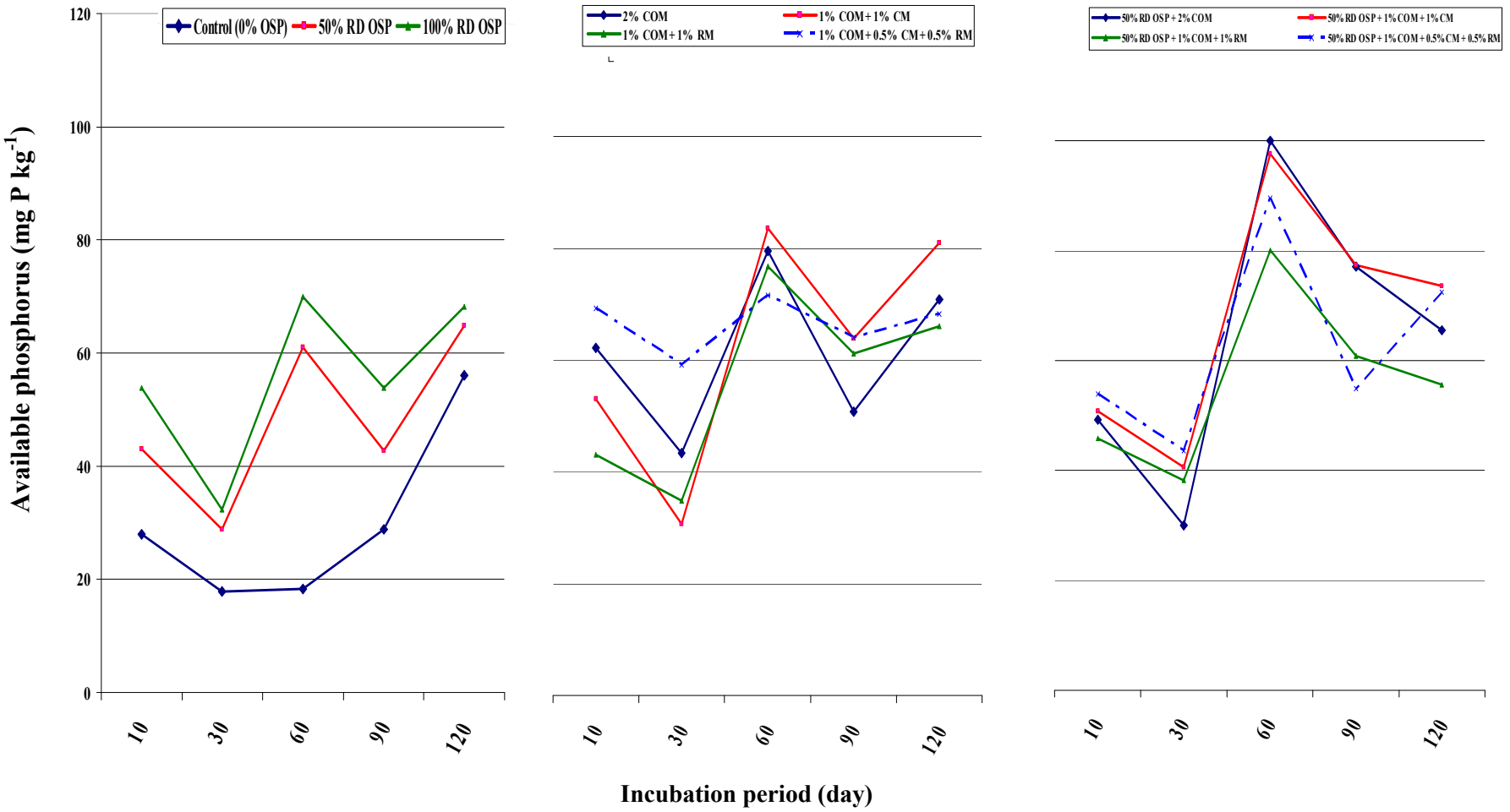

Fig. 1. Effect of phosphatic fertilization and various solid organic sources on available phosphorus (mg P kg^{-1}) in clay soil during incubation periods

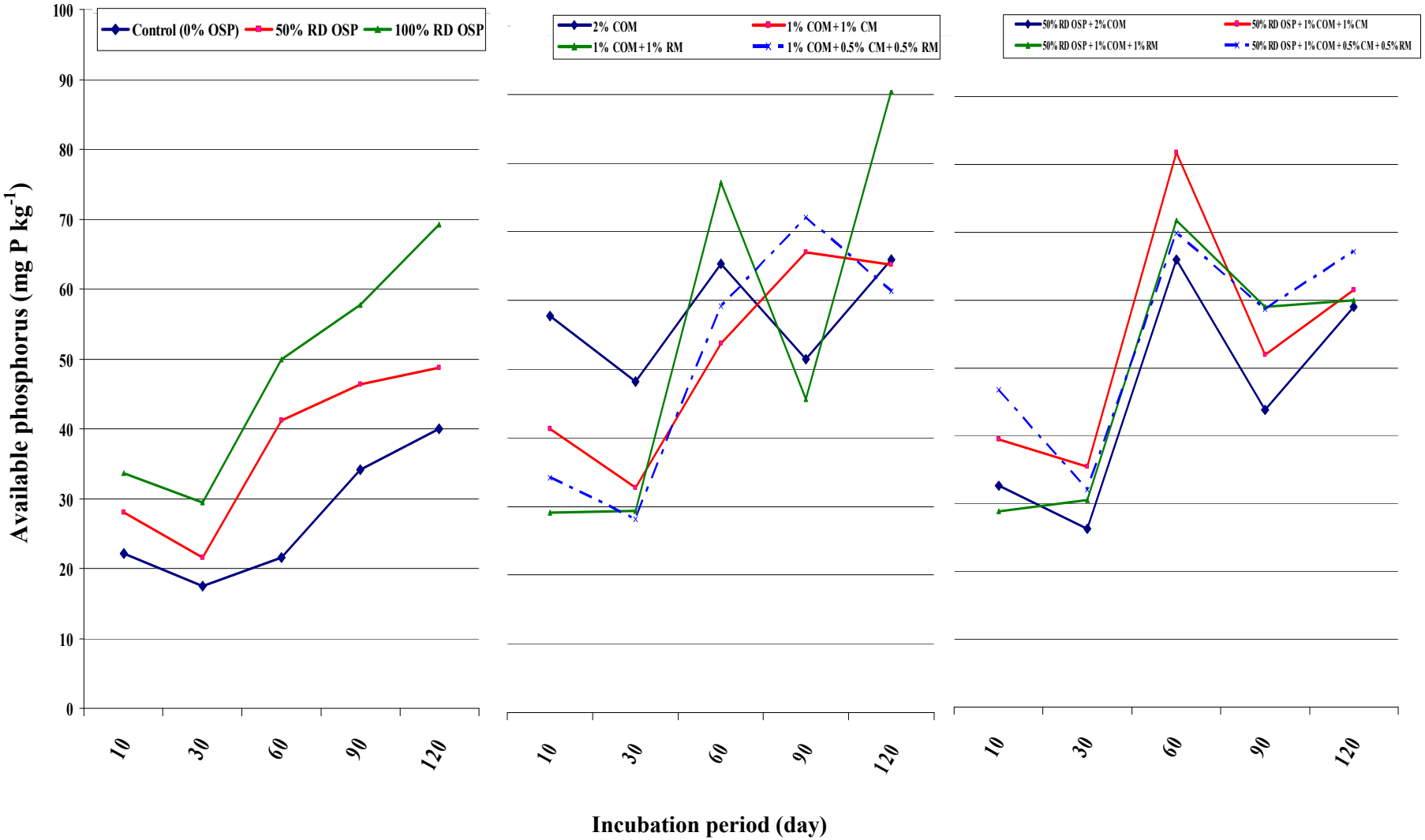

Fig. 2. Effect of phosphatic fertilization and various solid organic sources on available phosphorus (mg P kg^{-1}) in sandy soil during incubation periods

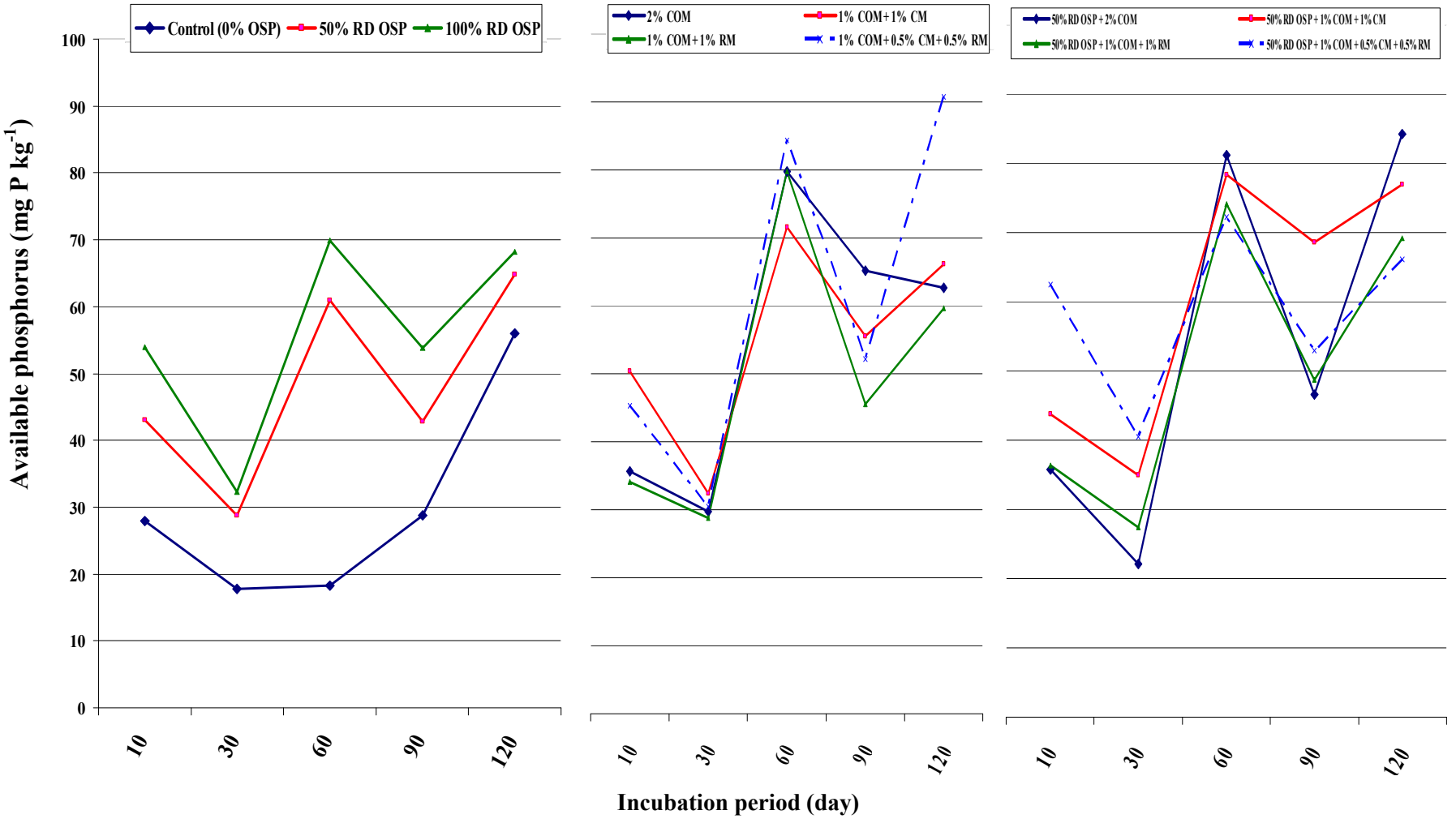

Fig. 3. Effect of phosphatic fertilization and various liquid organic sources on available phosphorus (mg P kg^{-1}) in clay soil during incubation periods

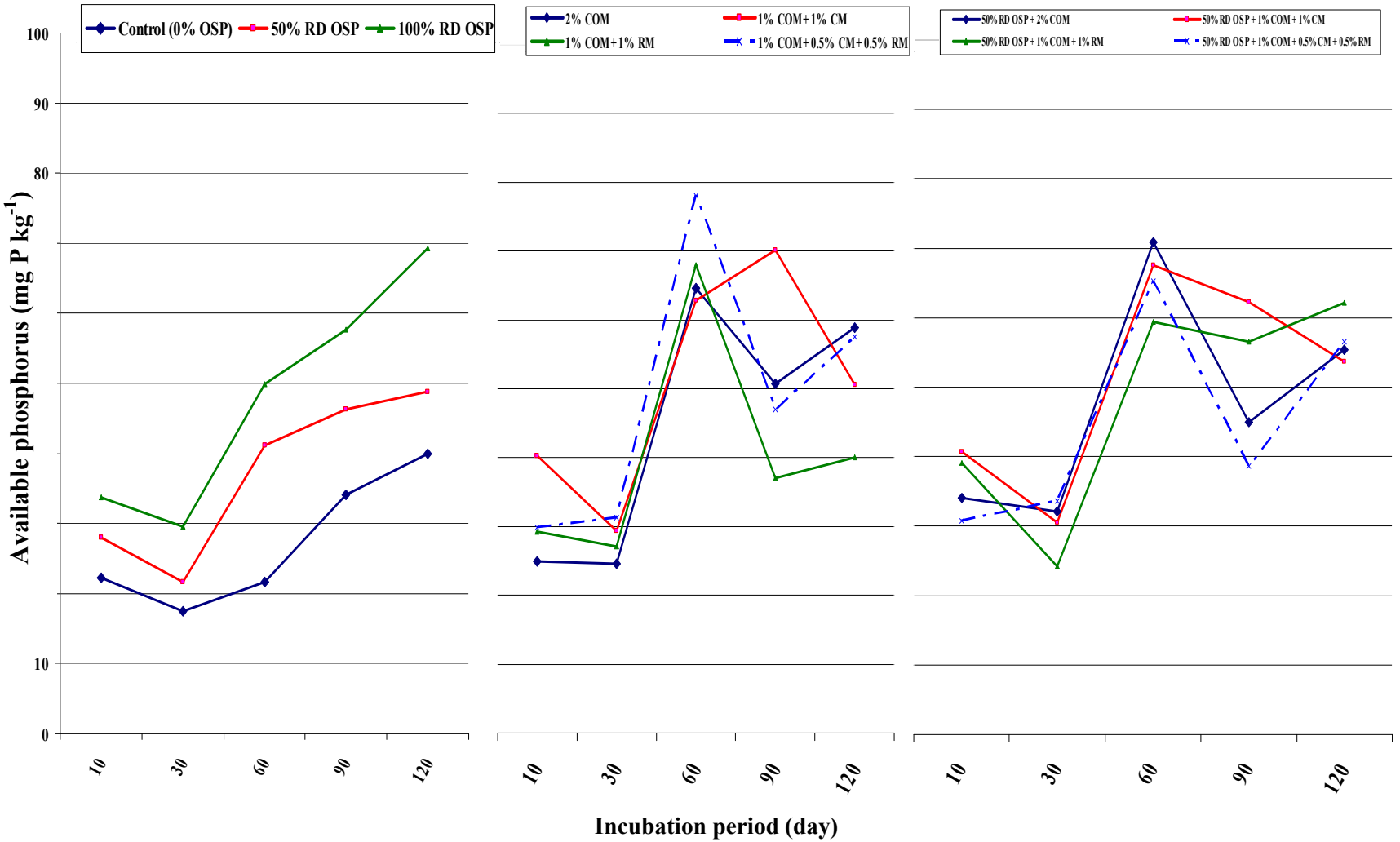

Fig. 4. Effect of phosphatic fertilization and various liquid organic sources on available phosphorus (mg P kg^{-1}) in sandy soil during incubation periods

and (1% Com + 0.5% CM + 0.5% RM) over the different incubation periods ranged from 29.8 to 79.7, 32.4 to 71.6, 28.8 to 79.7 and 30.5to 90.7 mg P kg^{-1} with an average of 54.6, 55.2, 49.6 and 60.6 mg P kg^{-1}, respectively. The corresponding ranges of the same treatments in a sandy soil were 24.6 to 64.6, 29.4 to 70.2, 27.1 to 68.0 and 29.9 to 78.1 mg P kg^{-1} with an averages of 44.8, 50.7, 40.3 and 48.8 mg P kg^{-1}, respectively.

The beneficial effect of different liquid organic sources on an average content of available phosphorus followed the order (1% Com. +1% RM.) > (1% Com. +0.5% Cm. +0.5% RM.) > (2% Com.)> (1% Com. +1% CM) in the clay soil and (1% Com. +1% CM) > (1% Com. +0.5% Cm. +0.5% RM.) > (2% Com.) (1% Com. +1% RM.) in sandy soil.

Generally, such results suggested that the content of available phosphorus in the tested soils is depended on the type of organic manure as solid and liquid phases, chemical composition and decay rate of the organic manure as well as the role of soil type in retention and / or release soil available phosphorus. These findings are in agreement with those obtained by Montasser (1987), Mohamed *et al.* (1991), Merwad (2009), Silber *et al.* (2010) and Merwad *et al*. (2013). Such results showed that the available phosphorus content as affected by organic manures as solid and liquid phases was greater in the clayey soil than in a sandy one. These results could be attributed to the great native content of available phosphorus, organic matter and clay fraction in a clay soil (Table 1).

Combined Treatments

Solid organic sources

results shown in Table 3 reveal that, in the presence of 50% OSP and various solid organic sources, the general averages of available phosphorus in the treated clay soil with (50% RD OSP + 2% Com.), (50% RD OSP + 1% Com. + 1% CM.), (50% RD OSP + 1% Com. + 1% RM.) and (50% RD OSP + 1% Com. + 0.5% CM. + 0.5% RM.) over the different incubation periods ranged from 30.0 to 100, 40.6 to 97.7, 38.2 to 80.1 and 43.6 to 89.6 mg P kg^{-1} with an average of 64.4, 68.0, 56.1 and 62.9 mg P kg^{-1}, respectively. The corresponding ranges of the same treatments in the sandy soil were 26.3 to 66.0, 35.4 to 81.8, 28.8 to 71.7 and 32.0 to 69.9 mg P kg^{-1} with averages of 45.5, 54.0, 50.0 and 54.9 mg P kg^{-1}, respectively.

The beneficial effect of different solid organic sources on the average content of available phosphorus followed the descending order (50% RD OSP + 1% Com. +1% CM) > (50% RD OSP + 2% Com.) > (50% RD OSP + 1% Com + 0.5% Cm. +0.5% RM.) > (50% RD OSP +1% Com. +1% RM), in the clay soil and (50% RD OSP+1% Com+0.5% CM. +0.5% RM.)> (50% RD OSP +1% Com. +1% CM.) > (50% RD OSP + 1% Com. +1% RM) > (50% RD OSP+2% Com.) in the sandy soil.

Liquid organic sources

results shown in Table 3 reveal that, in the presence of (50 %RD OSP) and various liquid organic sources, the general average of available phosphorus in the clayey soil treated with(50 %RD OSP + 2% Com), (50% RD OSP+1% Com+1% CM.), (50%RD OSP+1% Com+1% RM) and (50%RD OSP + 1% Com+0.5%CM. +0.5% RM.) over the different incubation periods ranged from22.1 to 84.2, 35.0 to 78.3, 27.4 to 74.1 and 40.5 to 72.2 with averages of 54.0, 60.6, 51.3 and 58.9 mg P kg^{-1}, respectively. The corresponding ranges in the sandy soil for the same treatments were 32.1 to 70.9, 30.5 to 67.6, 24.2 to 62.1 and 30.7 to 65.2 with averages of 47.5, 51.0, 48.3 and 44.9 mg P kg^{-1}, respectively. The beneficial effect of different liquid organic sources on an average content of available phosphorus followed the order (50% RD OSP + 1% Com. +1%CM) > (50% RD OSP + 1% Com + 0.5% CM.+ 0.5% RM)> (50% RD OSP + 2% Com.) > (50% RD OSP +1% Com. +1% RM.), in the clay soil and (50% RD OSP+1% Com. +1% CM)> (50% RD OSP +1% Com. +1% RM.)> (50% RD OSP + 2% Com.))> (50% RD OSP+1% Com+0.5% CM. +0.5% RM.) in the sandy soil.

The treatment (50% RD OSP +1% Com. + 1% CM.) as solid and liquid phases had more beneficial effect than the treatment (100% RD OSP) under the condition of the clayey soil, while in the sandy soil the treatment (2%Com.) as solid phase and the treatment (50% RD OSP +1% Com. +1% CM) as a liquid phase appeared the best beneficial effect than the treatment

(100% RD OSP), therefore, the use of 50% of the recommended dose of phosphatic fertilizer (OSP) mixed with organic manures as solid and liquid phases may reduce the phosphatic fertilizer dose,production cost, environmental pollution and soil salinization.

Time of Incubation

Solid organic sources

After 10 days, the greatest value of available phosphorus (69.3 mg P kg^{-1}) was found with the treatment of (1% Com. +0.5% CM. +0.5% RM.) in the clayey soil, while in the sandy soil, the greatest value of available phosphorus(57.7 mg P kg^{-1}) was realized with the treatment (2% Com.), in the meantime the lowest ones (43.1 and 28.8 mg P kg^{-1}) were observed with the treatment (1% Com. + 1% RM) and (50% RD OSP +1% Com.+1%RM) in the two tested soils. Halajnia *et al*. (2009) reported that the application of CM (cattle manure) along with inorganic phosphatic fertilizer increased the recovery of applied P.

After 30 days, the treatments of (1% Com. +05% CM+0.5% RM) and (2% Com.) in the clayey and the sandy soils gave the greatest values of available phosphorus (59.2 and 48.2 mg P kg^{-1}) while the lowest ones 30.0 and 26.3 mg P kg^{-1} were found with the treatment (50% RD OSP + 2% Com.) in both clay and sandy soils.

After 60 days, the treatments of (50% RD OSP+ 2% Com.) and (50% RD OSP+ 1% Com. + 1% CM.) gave the greatest values of available phosphorus (100 and 81.8 mg P $kg^{-1)}$, while the lowest ones (71.5 and 53.8 mg P kg^{-1}) were found with the treatments of (1%Com. +0.5% CM. +0.5% RM) and (1% Com.+1% CM) in the clayey and sandy soils, respectively.

After 90 days, the greatest value of available phosphorus 77.4 and 72.1 mg P kg^{-1} were obtained with the treatment (50 % RD OSP+ 1% Com. +1% CM.) in the clayey soil and the treatment (1% Com. +0.5% CM +0.5% RM) in sandy one, while the lowest one 50.7 and 43.8 mg P kg^{-1} were observed with (2% Com.) and (50% RD OSP +2% Com.) in the clayey and the sandy soils, respectively.

After 120 days, the treatments (1% Com. +1% CM.) and (1% Com. +1% RM.) gave the highest values of available phosphorus 80.9 and 90.4 mg P kg^{-1}, while the lowest ones 55.6 and 59.0mg P kg^{-1} were found in the treatments (50% RD OSP+ 1% Com. +1% RM.) and (50% RD OSP +2%Com.) in the clayey and the sandy soils, respectively.

Liquid organic sources

After 10 days, the greatest values of available phosphorus 62.5 and 40.7 mg P kg^{-1}were found with the treatments of (50% RD OSP +1% Com. + 0.5% CM.+0.5% RM.) and (50 % RD OSP + 1% Com. + 1% CM.) in the clayey and the sandy soils, respectively, while the lowest ones (34.1 and 25.0 mg P kg^{-1}) were observed with the treatments (1% Com, + 1% RM.) and (2% Com.) in the clay and the sandy soil, respectively.

After 30 days, the treatments (50% RD OSP + % Com. 0.5% CM+0.5%RM) achieved the greatest values of available phosphorus (40.5 and 33.6 mg P kg^{-1}) in the clayey and the sandy soils, respectively while the lowest ones 22.1 and 24.2 mg P kg^{-1} were found with the treatments of (50 % RD OSP + 2% Com.) and (50 % RD OSP + 1% Com. + 1% RM.) in the clayey and the sandy soils, respectively.

After 60 days, the treatment (1% Com. + 0.5% CM. +0.5% RM) realized the maximum values of available phosphorus 84.3 and 78.1 mg P kg^{-1} in the clayey and the sandy soils, respectively, while the lowest ones 71.6 and 59.4 mg P kg^{-1} were found with the treatment (1% Com. +1% CM.) and (50% RD OSP +1% Com. +1% RM.) in both clayey and the sandy soils.

After 90 days, the greatest values of available phosphorus (68.6 and 70.2 mg P kg^{-1}) were obtained with the treatments of (50 % RD OSP + 1% Com. + 1% CM.) and (1% Com. + 0.5% CM.) in clayey and sandy soils, respectively, while the lowest ones (46.6 and 37.0 mg P kg^{-1}) were found with the treatments of (50 % RD OSP + 2% Com.) and (1% Com. + 1% RM.) in clayey and sandy soils, respectively.

After 120 days, the treatments (1% Com. + 0.5% CM. +0.5% RM) and (50 % RD OSP + 1% Com. + 1% RM) gave the highest values of available phosphorus (90.6 and 62.1 mg P kg^{-1}) in the clayey and the sandy soils, respectively while the lowest ones 59.6 and 40.1 mg P kg^{-1} were found with the treatment (1% Com. + 1% RM) in both of clayey and sandy soils, respectively.

As general , the available phosphorus values were remarkedly increased after 60 days of incubation for all treatments as solid and liquid phases in the clayey and sandy soils, except the control treatment (0%RD OSP) which gradually increased the available phosphorus content up to 120 days of incubation.

Results showed that after 30 days of incubation, the available phosphorus content decreased for all studied treatments (solid and liquid phases) in the two soils under study, then increased after 60 days but decreased again after 90 days for all the tested treatments in the two tested soils, except the control (0% RD OSP) in both the two soils , then again increased after120 days for most treatments in both the two soils, except some treatments (50% RD OSP+2% Com.), (50% RD OSP +1% Com. + 1% CM.) and (50%RD OSP+1%Com.+1%RM.) as solid phase in the clayey soil and the treatment (2% Com) as liquid phase in the clayey soil and the treatments (1% Com.+1% CM.) and (1%Com. +0.5% CM. + 0.5% RM.) in the sandy soil as solid phase and the treatment (1% Com + 1% CM) and (50% RD OSP + 1% Com.+ 1% CM.) as liquid phase in the sandy soil.

The decrease in available phosphorus content after 30 days in the studied soils may be attributed to phosphorus assimilation by microorganisms. Mohamed (1990) and Merwad *et al.* (2013) suggested a possibility for fixation of released phosphorus from applied organic manures. The increase in the available phosphorus content in the two studied soils after 60 days may be due to mineralization of organic phosphorus and solving action of some produced organic and inorganic acids during organic manure decay Montasser (1987), Mohamed *et al.* (1991) and Merwad *et al.* (2013) stated that the decay of organic residues change the status of phosphorus sorption by soils. The reduction in available phosphorus content after 90 days in the two studied soils depend on the type of organic manure , decay rate of organic manure source and/or immobilization rate of available phosphorus in soil.

Such results may suggest that the phosphorus liberation in available form is dependent on nature of applied organic materials and mineralization of organic phosphorus as well as the positive effect of the organic residues decay products and microbial activates.

In general, it could be concluded that the treatment of (50% RDOSP +1% Com. +1% CM.) as solid while the previous treatment and (1% Com. +0.5% CM.+0.5% RM.) as liquid phases may be more beneficial under the condition of the clayey soil under study, in the meantime the treatments (2% Com.) as solid phase and (50% RD OSP +1% Com. +1% CM.) as liquid phase may be more favourable in the sandy soil.

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تأثير بعض المصادر العضوية الصلبة منها والسائلة على تيسر عنصر الفوسفور في نوعين من التربة

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تم إجراء تجربة تحضين تحت ظروف المعمل لدراسة تأثير سماد السوبر فوسفات العادي بمعدلات صفر, ٣٠, ٦٠ فو كجم للفدان (صفر، ٥٠, ١٠٠% من الجرعه الموصي بها)، إما منفردا أو مخلوطا بمصلحات التربة العضوية مثل سماد الكمبوست بمعدل ١٠، ٢٠ ميجاجرام/الفدان (١% و ٢%) وسماد الدواجن وسماد الأرانب بمعدلات ٥ ، ١٠ ميجا جرام/الفدان (٠,٥ و١%) كمصادر عضوية صلبة وسائلة علي محتوي التربة من الفوسفور الميسر خلال فترات تحضين مختلفة وهي (١٠-٣٠-٦٠-٩٠-١٢٠ يوم) في أرضين مختلفتين، الأولى أرض طينية أخذت من منطقة أبو حماد - محافظة الشرقية والثانية كانت أرض رملية تم الحصول عليها من مزرعة الخطارة التابعه لكلية الزراعه - جامعه الزقازيق – محافظة الشرقية و يمكن تلخيص النتائج المتحصل عليها كالتالي: وجد أن قيم الفوسفور الميسر تزداد بزيادة معدلات السماد الفوسفاتي في الأراضي تحت الدراسة، وأن محتوى الفوسفور الميسر في الأرض الطينية كان أعلي منها في الأرض الرملية, وارتفاع قيم الفوسفور بعد ٦٠ يوم من بداية التحضين في الأرضين الطينية والرملية وأن المعاملة (٥٠% من المعدل الموصي لسماد سوبر الفوسفات العادي +١% سماد الكمبوست +١% سماد الدواجن) كصورة صلبة والمعاملة (١% كمبوست + ٠,٥% سماد دواجن + ٠,٥% سماد الأرانب) كصوره سائلة أعطت تأثيرا مفيدا أكثر من المعاملة (١٠٠% من المعدل الموصي به لسماد سوبر الفوسفات العادي) في الأرض الطينية تحت الدراسة, بينما المعاملة المنفرده (٢% سماد الكمبوست) كصورة صلبة والمعاملة (٥٠% من المعدل الموصي لسماد سوبر الفوسفات العادي +١% سماد الكمبوست +١% سماد الدواجن) كصورة سائلة أعطت تأثيراً مفيداً أعلى من المعاملة (١٠٠% من المعدل الموصي به لسماد سوبر الفوسفات العادي) في الأرض الرملية تحت الدراسة، ونستنتج من ذلك أن إستخدام نصف المعدل الموصي به من سماد سوبر الفوسفات العادي مختلطا مع مصادر عضوية في صورتها الصلبة أو السائلة منها يؤدي إلى تقليل كمية السماد الفوسفاتي المعدني المضاف وتكلفة الإنتاج وبالتالي التقليل من التلوث البيئي.

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