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Assessment of Soil Phosphorus Availability Affected by Different Amounts of Phosphorus Fertilizers in Soils underSugarcane Culture in Khozestan Province, Iran.

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ABSTRACT

There is a little information about the effect of phosphorus fertilizer on simultaneous increasing of dissolved and absorbable phosphor. The goal of this research was the investigation of relationship between added phosphorus to soil and the increase of dissolved and absorbable phosphorus and its effect on absorbable Fe and Zn concentration in soils under sugarcane culture. This research was conducted as Randomized Complete Blocks Design with 6 factorial treatment structures 0, 25, 75, 125, 375 and 1100mg P/Kg soil(phosphorus salt was Potassium Mono Phosphate) and 3 time periods, 20, 50 and 60 days. Compound samples of soil were prepared of sugarcan fields. Different concentrations of phosphor were added to fields and samples, in field capacity conditions, were kept at mentioned times in incubator by temperture of 25ºc. Results showed by increasing addition of phosphorus concentration to soil, the concentration of absorbable, dissolved and fixedphosphorus increased and absorbable concentration of Zn and Mn decreased. By adding phosphorus fertilizer to soil, one part of it caused increasing dissolved and absorbable phosphorus and remainder part percipitated in soil. Accordingly, 55.64 % and 18.35% of phosphorus fertilizer were transformed to absorbable form respectively in 30 and 10 days.

Key words: absorbable phosphorus, dissolved phosphorus, fixed phosphorus.

Introduction

Phosphorus is one of major elements and it is the most important element in production and it is one of important elements in soil fertility. It usually uses for providing plants' requirment. Because of high capacity of soil in absorbing phosphor, the mobility of phosphorus is low in soil so that all used phosphorus fertilizers in soil can't be available for plant. The phosphorus that exists in soil solution must be continuously decomposed, except this condition, there won't be sufficient phosphorus in available for plant to complete its growth. Favourable growth of sugarcan is too much affected by available amount of phosphorus in soil. Because of the importance of absorbable P, Zn and Mn for plant growth, accecc the relation among the amount of absorbable phosphorus by soil particles and the concentration of this element in soil solution and its effect on mentioned elements has more important.

In alkaline soils, the formation of calcium phosphate percipitation is the major factor in decreasing phosphorus absorbability in soil. In result, existance of initial phosphorus or phosphorus addition to soil in high amounts can't be reagent offavaourable availability of plant to phosphorus but true management in using phosphate fertilizes and absorbability of them by plants has more important. In 2000, Karimian said because of phosphorus fertilizers using in last 30 years, most of agronomy soils in Iran have high amounts of absorbable phosphorus[1]. Jalali and Kalahchi, 2005, accessed the phosphorus availabilty in soil that was caused by adding different amounts of phosphorus fertilizers to Hamadan province soils[2]. Kovar and Barber 1988 said the formation of Calcium Phosphate percipitation in alkaline soils is the major factor in decreasing phosphorus absorbability in soils[3].

Materials and Methods

1 comound soil sample was prepared of a horizon (0-40cm) of fields under sugarcan culture in Shooshtar. Samples were air-dried then 2-mm sieve was used for sieving samples and the physicochemical properties of them, as bellow, were measured. Soil texture was determined based on the standard of USDA method by hydrometer[4].

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Dissolved phosphorus was extracted by distilled water(ratio of soil to water 1:5) and absorbable phosphorus was extracted by Sodium Bicarbonate solution 0.5 M in pH=8.5 . The mixture by soil-solution ratio 1:20 was shaked 0.5hr [5]. Then this mixture was reduced by accorbic acid [6] and measured by spectroscopy set. The measurment of pH[7] and EC[8] was done in the extraction of 1:5 and CEC was measured by acetate sodium method in pH=8.2[9]. Calcium carbonate was done by reversible titration method by using sodium hydroxide as titrant(Roweel, 1994)[10]. Soil O.C and O.M were measured by Wakely and Black method [11].

Incubation experiment was contained 6 major treatments of fertilizer 0, 25, 75, 125, 375, 1100 mgP per air-dried soil (p_0,p_1, p_2, p_3, p_4, p_5) and 3subsidiary treatments of time 20, 50 and 60 days(t_1, t_2 and t_3). This experiment was done in 3replications on soil samples. Phosphorus was prepared of KH_2PO_4 and used as solution. This experiment was done on 54 plastic pots containing 500gr air- dried soil and the moisture of pots was put in FC by irrigation water of fields. After making phosphorus solution, different levels of phosphorus was added to soil and pot surface was covered. Samples was kept in incubation in time periods of 20, 50 and 60daysand theroom temperture was25-30ºc . Samples moisture was kept in FC level by adding water during incubation period(water EC = 995µs/cm). By passing these times, samples were air-dried and sieved by 2-mm sieve. Dissolved and absorbable amounts of phosphorus were measured by Olsen method and absorbable Zn and Mn in soi were extracted by DTPA and were read by atomic absorbtionset [12].

Results and Discussion

Tables 1 and 2 repectively shows the results of physicochemical analysis of experimented soil sample and variance analysis of treatments in soil. By attention to table 1, soil texture is loamy that more than 0.040 of dominant texture in region is clay-caly loam. In table2, low concentration of initial phosphorus in soil shows high fixation of phosphorus in soil and high pH and high amount of calcium carbonate is a representative of soil alkalinity in region.

Table 1: Physicochemical properties of experimented soil sample.

Sampling depth (cm)	Soil particles percentage			Soil Texture	EC (ds/m)	pH	P (mg/Kg)	O.C (%)	CEC (cmol+/Kg)	T.N.V (%)	O.M (%)
	Clay	Silt	sand								
0-40	%16	%49	%35	Loam	1.13	8.02	4	0.38	10.13	44	0.66

Variance analysis results of treatments showed that there are significant differences at 5% level among different levels of added phosphorus, different levels of time duration and interaction effects among them on absorbable phosphorus concentration, dissolved phosphorus and absorbable Zn and Mn in soil. The mean difference of treatment effect showed that by increasing phosphorus concentration addition to soil, the concentration of absorbable phosphorus, dissolved phosphorus and fixed phosphorus increased so much that it follows the increasing graph and absorbable Zn and Mn concentration decreased. The most concentration of absorbable phosphorus concentration, dissolved phosphorus and fixed phosphorus were related to treatment of p_5 (figure1,2,3) and the least concentration of absorbable Zn and absorbable Mn were respectively related to treatments p_4 and p_5 (figure 4 and 5).

Table 2: Variance analysis results of treatments effect.

Mean Square \ Change Source	Phosphorus	Time	Phosphorus*Time	Error	Replication
Absorbable P	324528.971*	113948.443*	71727.759*	421.808	257.390
Dissolved P	168.178*	52.177*	32.804*	0.381	0.531^{ns}
Absorbable Zn	0.821*	1.387*	0.896*	0.000	0.000*
Absorbable Mn	1.670*	25.543*	0.880*	0.003	0.005^{ns}
df	5	2	10	34	2

By lasting time, the concentration of absorbable phosphorus, dissolved phosphorus, absorbable Zn and Mn decreased that decrease was seen in treatment t_3 and fixed phosphorus increased in treatment t_3. In assessing the interaction effects of phosphorus increament and lasting time, the most concentration of absorbable and dissolved phosphorus was found in treatment p_5t_1 (1000mg phosphorus and 20 days). By increasing phosphorus in soil and lasting time, phosphorus fixation showed the increasing trend in soil. When phosphorus fertilizer was added to soil, one part of it caused increasing dissolved phosphorus concentration and other part increased absorbable phosphorus concentration in soil (figure1 and 2). Reminder amounts of added fertilizer had percipitated or strongly absorbled by soil so that it hadn't balanced easily by dissolved phosphorus. By increasing phosphorus concentration in soil, the concentration of absorbable Zn and Mn decreased. Also high

CaCO3 and pH, high amounts of bicarbonate in irrigation water and high usage of phosphorus fertilizer in soil have negative effect on absorbability of Zn and Mn and by lasting time, the absorbability of these elements decreased.

By lasting time, absorbable and dissolved concentration of phosphorus decreased (figure 6 and 7). In alkaline conditions, mono calcium phosphate transformed to tri calcium phosphate, that is insoluable, in short time and had effect on phosphorus concentration in soil solution and by lasting time, caused the increment of phosphorus fixation in soil and the decrement of dissolved phosphorus in soil. Phosphorus absorbtion is rapid in initial stages and it is as absorbtion on particle levels and then the absorbtion rate become slow. In this stage, phosphorus percipitates as mineral phosphates and as forms by low absorbability [13].

The relation between time duration and fixed phosphorus in soil showed that by lasting time, the amount of fixed phosphorus increased in soil so much that the most amount of fixed phosphorus was in treatment t_3 and equal to 1682.99mg/kgsoil and the least amount of fixed phosphorus was in treatment of t1 and equal to 1497.30 mg/kgsoil. By increasing pH and the percentage of carbonate calcium in studied soils, changes were seen in phosphorus availability index and by lasting time, this index decreased. This results shows that carbonate calcium particles are an important factor in phosphorus fixation and free calcium carbonate in soil causes decreasing phosphorus activity so that it must be noted in fertilizer suggestions.

Conclusion:

In general, 57.64% and 18.35% of used phosphorus fertilizer were respectively transformed to absorbable phosphorus form during 20-50 days and 50-60days so that 42.36% and 81.65% of used phosphorus fertilizer were respectively transformed to unabsorbable form in soil aftre 30days (time duration between t_1 and t_2) and after 10days (time duration between t_3 and t_4). By increasing phosphorus concentration in soil however the concentration of available phosphorus was increased in soil but it didn’t mean soil efficiency increament of all used phosphorus. Soil alkalinity of region had effect on the absorbability of absorbable P, Zn and Mn in soil and by passing time, caused decresing the absorbability of these elements in soil. By attention to the great supply of lime and low concentration of dissolved phosphate in soils of this region, phosphate must be continuously renewed in soil solution otherwise plant will confront to problem for continuing its growth. In this region, there is a time duration one- week or 20-day between the usage of phosphorus fertilizer and sugarcan and most agronomical plants culture. By attention to this subject that phosphate fertilizer transforms to tri calcium phosphate (TCP) in soil in lower than one-month so that this fertilizer is not availabe for plant and causes decresing phosphorus concentration in soil solution. So that it is better to use phosphate fertilizers only before or near planting time. O.M deficiency in studied soil is one of the effective factors in decreasing phosphorus absorbability and micronutrients. Because of high availability to sugarcan remains and waste after harvesting and remaining a part of them in soil, it is better to use them as a suitable source for increasing O.M is soil. By increasing O.M in soil, the negative effect of $CaCO_3$can be decreased and absorbability of phosphorus and micronutrients will be added. By attention to quick fixation of phosphate fertilizers in region soils, it recommends that phosphate fertilizer overlaying be done in deep soils or as strip culture.

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