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(Short Communication)

Influence of crop residues as liming resources on change soil ph and phosphorous availability in acid soils

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Abstract
An experiment was conducted on acid soils of Ranchi, India, to evaluate the effect of crop residues maize (*Zea mays*), wheat (*Triticum aestivum*), rice (*Oryza sativa*) and soybean (*Glycin max*) as a liming material in acid soil. In the present investigation four crop residues were arranged in completely randomized design (CRD). The results of study indicated that incorporation of crop residues was significantly increase soil reaction (soil pH) during all incubation days than the control treatments. The addition of maize, rice, wheat and soybean crop residues significantly ($P<0.05$) increased phosphorous (P) availability and soil reaction (pH) compared with the initial value. Results revealed that overall, mean of available P during all incubation days was highest in addition of maize residue (26.23 kg ha^{-1}) followed by soybean residue (25.52 kg ha^{-1}) as compared than other treatments. The increasing trend of P mineralization was showed in initial incubation period (7 to 30 days of incubation). Results revealed that incorporation of maize and soybeanresidues in acid soils positively increase availability of P compared with other treatments along with control in acid soils.

Keywords: crop residues, liming resources, soil ph and phosphorous, acid soils

1. Introduction
Soil is most wondrous gift of nature to human society [1]. In India, having about 329 million hactears of total geographical area (M ha) out of which 148 M ha cultivated land are comes under degraded by different agencies, such as water erosion, wind erosion, soil compaction, soil salinity or alkalinity, soil acidity, loss of organic carbon as well as soil fertility. According to Chen *et al.* [2] organic residues (carbon input) can be increased in soil surface and by decomposition decreased with applying residue managements. Crop residues retained on the soil surface providing substrate for the activity of soil micro-organisms, and a source of SOC [3]. Addition of organic resources in soil influence crop productivity, over their effect on soil physical, chemical and biological properties [4]. All of the chemical reactions depend on the pH [5]. The soil reaction (pH) is a measure of the acidity or alkalinity in soils [6]. Noble *et al.* [7] was also reported the acidity/alkalinity process depends on cation content, chemical composition of residues, soil environment and also represents the liming potential of residues. Different edaphic factors such as pH, CEC, organic matter content, biological activity and texture controlled the sequential removal of this.

Phosphorus (P), next to nitrogen, is often the most limiting nutrient for crop production. Phosphorous, play major role in a plant is to store and transfer energy produced by photosynthesis for use in growth and reproductive processes. P is deficient in most acid soils because soluble inorganic P is fixed by Al and Fe oxides [8]. This reaction contributes to reduced amount of P availability to the plants. In order to the exchangeable forms of P is basic to the understanding its dynamics and interaction with acidic soils. This is necessary for the management of P in soils and availability of P is influenced by soil organic matter (SOM), pH, and exchangeable and soluble Al, Fe, and Ca [9]. Phosphorus is generally available to crops at soil pH range from 6.0 to 7.2. When, the pH of soil is less than 6.0, P deficiency increases in most of the crops plants. Continuous use of, liming materials and inorganic P fertilizers such as rock phosphate (RP) and Single Superphosphate (SSP) are applied on the way to infuse Al^{3+} and Fe^{2+} ions in soil. Its approach has not been affordable, while it is much expensive and not good for environmentally. For example, in excess of liming precipitates P ions with Ca as

calcium phosphate, however, application of excessive amount of phosphatic fertilizers causes eutrophication. An acidic soil used in this study was collected from the long-term fertilizer experiment plot of Ranchi, Jharkhand. The experiment was conducted at ICAR-Indian Institute of Soil Science, Bhopal (M.P.). An incubation study was conducted in laboratory at Division of soil fertility and chemistry, IISS, Bhopal. The soils of Ranchi, were selected for examination of the hypothesis and 100 gram well processed soil sample was taken and transferred in 100 ml caring capacity of beakers and subsequently moist at field capacity limits with distilled water and incubated at 25 °C (room temperature) for 90 days of study periods. Crop residue 3.5 gram was taken to maintain approximate equivalent amount of C in each soil. Soil moisture level was maintained throughout the study. Soil sample were analyzed at 7, 15, 30, 45 and 90 days after incubation. The initial soil properties of the experimental soil were analyzed for textural class, soil pH, and available phosphorous (P in ppm). The pH of experimental soil was 4.75 and available P 19.04 ppm. The soil relative proportion of sans, silt and Clay (textural class) content was 66, 9 and 25% respectively and soil comes under sandy textural class.
Soil pH was determined by glass electrode pH meter taking 1:2.5 soil and water ratio (soil: water suspension) after stirring it for 30 minutes as described by [10]. The Soil available P was determined by Bray's method (Bray and Kurtz, 1945) [11].

2. Results and discussion

Results reveled that soil pH was significantly affected at 7 days after incubation (DAI), 15, and 30 DAI (Table 1). Soil pH as affected by treatments is summarized in Table 1. At 7, 15, and 30 DAI, the organic crop residues significantly increased soil pH compared with the control. The increase in soil pH was due to the fast dissociation of protons (hydrogen ions, H^+) and exchange between the soil colloids and the amended organic residues [12, 13]. The reduction in exchangeable soil acidity, exchangeable Al^{3+}, and Fe^{2+} moderately relays to the increase in soil pH. Increase in pH resulted in the precipitation of exchangeable and soluble Al and Fe as insoluble Al and Fe hydroxides, thus reducing the concentrations of Al and Fe in the soil solution [14]. Results revealed that the potential of crop residues for decrease H^+ ions activity is showed following trends, soybean > rice > maize > wheat residues. The increase in soil pH was higher in the beginning of the study thereafter it decreased gradually till completion of at 90 days incubation study (Table 1). The maximum rise in soil pH was observed after one week of incubation thereafter a slight decrease in soil pH was recorded till the termination of incubation study. In general, incorporation of leguminous crop residue have higher ash alkalinity due to the unbalanced uptake of cations and anions, and thus have greater amelioration effects on soil acidity than non-leguminous organic plant materials[15].
Results indicated that significant difference of the available soil P fractions at 7, 15, and 30 DAI (Fig. 1). Available Brays P is easily soluble insoil solution forplant uptake. Acid soils are generally deficient in available P. The addition of maize, rice, wheat and soybean crop residues significantly ($P<0.05$) increased phosphorous (P) availability and soil reaction (pH) compared with the initial value. Results revealed that overall, mean of available P during all incubation days was highest in addition of maize residue (26.23 kg ha^{-1}) followed by soybean residue (25.52 kg ha^{-1}) as compared than other treatments. In acid soils, the mineralizable P loosely bound with Al and Fe oxides of phosphates (which are available to plants) are precipitated into highly insoluble aluminium phosphate (Al-P) and iron phosphate (Fe-P) which is not available to plants. It is also directly related to the dynamics of P bounding in soil. It represents a nonspecific adsorption and ligand exchange on mineral edges. The initial P status of incubated soil of Ranchi was 19.5 ppm. The organic amendments acid soils increased solubility of fixed P, (Al-P and Fe-P) compared with control. This observation is consistent with that of Lee *et al*. [16] who was reported that significant increase available P after application of organic amendments.

Table 1: Changes in soil pH under different crop residue management in acid soils of Rachi

Treatment	Mean value of soil pH days after incubation (DAI)					
	0	7	15	30	45	90
Control	4.75	5.52^a	5.58^a	5.88^a	5.35^a	5.35^a
Maize residue	4.75	6.41^c	6.33^c	5.57^a	5.82a^b	5.8^a
Wheat residue	4.75	5.88^d	5.99a^b	5.79^a	5.45a^b	5.45^a
Rice residue	4.75	6.54b^c	6.56b^c	6.58^a	6.36a^b	6.26^a
Soybean residue	4.75	5.37^a	7.79^d	7.65^c	6.54^d	6.54^b

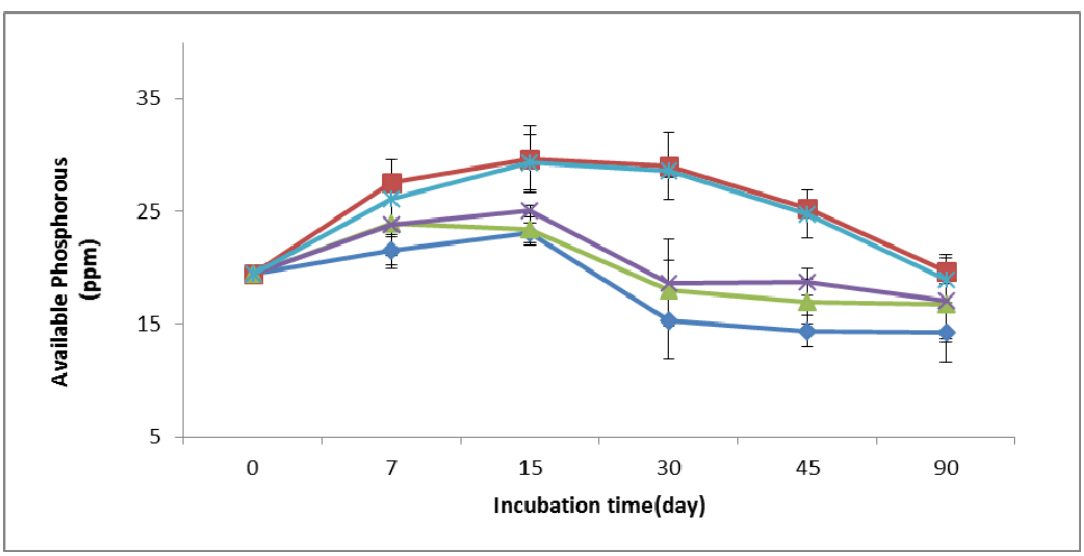

Fig 1: Changes in availability of P under different crop residues in acid soils of Ranchi during incubation periods

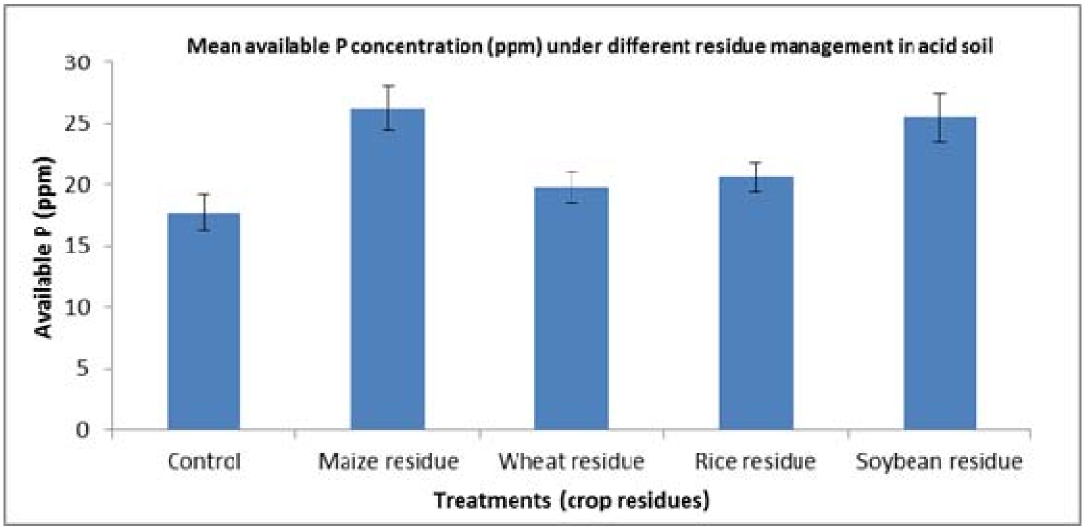

Fig 2: Changes in availability of P under different crop residues in acid soils of Ranchi during incubation periods

3. Conclusion

Amending acid soils with crop residues increased available Bray P concentration. This was possible because the organic amendments increased soil pH, and, at the same time, they reduced exchangeable soil acidity as well as exchangeable Al^{3+}, and Fe^{2+} concentration in soil solution. As the increased soil reaction (pH) the organic amendments (residues of crops) efficiently fixed oxides Al^{3+}, and Fe^{2+}as a replacement for of soluble phosphate. The findings suggested that the organic crop residues improved soil physico-chemical properties in a way that enhanced the availability of P and reduced soil acidity in this study.

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