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Anusuiya Panda
Department of Soil Science and Agriculture Chemistry, IGKV, Raipur (C.G.), India

Awanish Kumar
ICAR-Indian Grassland and Fodder Research Institute, Jhansi (U.P.), India

RK Bajpai
Department of Soil Science and Agriculture Chemistry, IGKV, Raipur (C.G.), India

LK Shrivastava
Department of Soil Science and Agriculture Chemistry, IGKV, Raipur (C.G.), India

Correspondence
Anusuiya Panda
Department of Soil Science and Agriculture Chemistry, IGKV, Raipur (C.G.), India

(*Short Communication*)

Effect of crop residues as liming materials on soil pH in *Alfisols* of Ranchi

Anusuiya Panda, Awanish Kumar, RK Bajpai and LK Shrivastava

Abstract
An experiment was conducted on *Alfisols* of Ranchi, to assess the impact of crop residue as a liming material in acid soil. In the present investigation four crop residues maize (*Zea mays*), wheat (*Triticum aestivum*), rice (*Oryza sativa*) and soybean (*Glycin max*) were tested in completely randomized design. The incorporation of *Zea mays, Oryza sativa, Triticum aestivum and Glycin max* crop residues significantly ($P<0.05$) increased soil pH compared with the initial value and no significant difference was observed between the EC of initial value with residue amended soils. Incubating soils for longer period of time resulted in slight increase in soil pH as compared to control. Results revealed that incorporation of soybean and rice residues in Alfisol (acid soil) positively increase soil pH as compared to other residue treatment (maize and wheat residue) along with control.

Keywords: crop residues, liming materials, soil pH, *Alfisols*

Introduction
Soil acidity is one of the most yield-limiting factors for global agriculture production systems. Soils affected by acidity are estimated at 4 billion ha, representing 30% of the total land area of the world [1]. Soil acidity affects nearly 50 percent of the world's potentially arable land, particularly in humid tropics [2] and it is quantified on the basis of hydrogen (H^+) and aluminum (Al^{3+}) concentrations of soil water suspension. For crop production, however, soil acidity is a complex of numerous factors involving nutrient/element deficiencies and toxicities, low activities of beneficial microorganisms and reduced root growth which limits absorption of nutrients and water [3]. Acid soil conditions generally prevail in areas of high rainfall because of the leaching of the basic cations like Ca^{2+}, Mg^{2+}, and K^+ etc. in the lower soil horizons. Acid soils, which are soils with a pH of 5.5 or lower in 1:1 water extract are one of the most important limitations to agricultural production worldwide [4]. Many other factors contribute to injuriousplant physiology and soil physico-chemical behaviors; however, in acid soils with a high mineral content and aluminium ions (Al^{3+}) is the major cause of toxicity for the plant. Soils become acidic for several biotic and abiotic reasons. Aluminium, hydrolyzed in water to produce protons [5]. The most common source of hydrogen is the reaction of aluminum ions with water. The equation for this reaction in very acid soils (pH<4.0) is:

$$Al^{3+} + H_2O = Al(OH)^{2+} + H^+$$

The aluminium ions (Al^{3+}) present vary with pH. Potassium chloride extracted Al and Al saturation has an inverse relationship with pH [6]. Indications of Al toxicity are similar to those of nutrient deficiency possibly due to the inhibition of root growth affected by the action of Al at the maristamatic tissue of root. Increased soil acidity causes solubilization of Al, which is the primary source of toxicity to plants at pH below 5.5 [7, 8, 6]. Al toxicity is the one of the most important factor, being a major constraint for crop production on 67% of the total acid soil area [9].

An acidic *Alfisol* (U.S. Soil Taxonomy) 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 Alfisols of Ranchi acidic soil, 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.

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] and electrical conductivity was determined by taking supernatant liquid of soil water suspension prepared for pH determination by using electrical conductivity (EC) meter [11].

Results and discussion

The initial pH of the un-amended acid soils of Ranchi was (control) 4.75 (Table1). The highest increase in soil pH (7.79) was recorded at 15 days of incubation under soybean residue incorporation, which was significantly higher followed by rice residue than the other treatments combinations. In case of Ranchi soil, residue of crops other than soybean and rice did not make any significant change in soil pH. 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 (Fig. 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 [12]. Changes in soil electrical conductivity (EC) with the application of maize, rice, wheat and soybean crop residues were measured periodically during the incubation experiment. No significant difference between the EC of initial and amended soils were recorded at the end incubation study. This is in conformity with the finding of Novak *et al* [13].

Table 1: Physico-chemical properties of experimental soil

S. No.	Particulars	Soil Initial Values
1.	Sand (%)	66
2.	Silt (%)	9
3.	Clay (%)	25
4.	Soil pH	4.75
5.	EC (dSm^{-1})	0.13

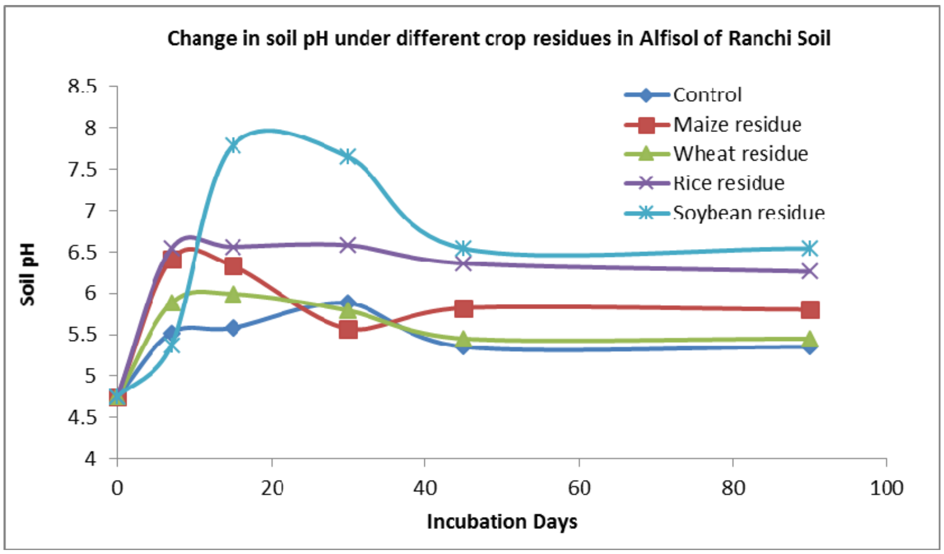

Fig 1: Changes in soil pH under different crop residues in *Alfisols* of Ranchi soils during incubation periods

It was observed from the incubation study that leguminous crop residue (particularly soybean) is one of the most potential amendments for reclamation of acid soil and also transformation of nutrients under acidic soil conditions. The results coming from Ranchi soil (*Alfisols*) indicated that legume residue could be as effective for remediation of low soil pH. In conclusion, if the goal is to increase soil reaction and reduced Al^{3+} toxicity in acid soil quickly, then the use of crop residue as an organic amendment could be considered as a viable option and the choice of a legume crop residue should be recommended.

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