Indian Journal of Agricultural Sciences **84** (3): 349–55, March 2014/Article

Bio-chemical amelioration effects on physico-chemical dynamics of sodic soils under rice (*Oryza sativa*) –wheat (*Triticum aestivum*) cropping system

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Received: 29 November 2012; Revised accepted: 23 January 2014

ABSTRACT

The effect of *dhaincha* (*Sesbania aculeata*) as first crop on physico-chemical dynamics and productivity of "B" class sodic soils was assessed on farmer's field under rice-wheat cropping system to generate the knowledge of sodic soil management for increasing the soil and crop productivity for sustainable crop production in sodic soil environment. The experiment was laid out in randomized block design at ten sites having six treatment combinations of different doses of gypsum and green manuring with sesbania under two cropping sequences, i e sesbania-rice (*Oryza sativa* L.) -wheat (*Triticum aestivum* L.) and rice-wheat. Cultivation of sesbania with gypsum significantly decreased the surface soil pH from 9.3 to 8.6 and increased the hydraulic conductivity from 0.3×10^{-3} to 3.7×10^{-3} cm/hr and buildup of soil organic matter by increasing organic carbon content from 0.20 % to 0.22 % through growing of sesbania. Sesbania green manure also increased the available water content in the soil system, which enhanced soil moisture availability for longer period. As a result, rice crop yield increased by 16.2 % in sesbania-rice- wheat cropping system in comparison to rice–wheat cropping sequence because of synergistic effect of sesbania with gypsum. Consequently, residual effect of sesbania green manuring alone and in combination with gypsum significantly enhanced the wheat grain yield by 42.5 % and 72.5 % and 80% in T_4, T_5 and T_6 treatments respectively during first year in sesbania–rice-wheat cropping sequence as compared to control. In consecutive second year, rice and wheat grain yields further enhanced by 8.1 % and 2.71% respectively, under sesbania –rice -wheat than that of rice –wheat cropping sequence. Under sesbania-rice- wheat and rice-wheat-sesbania cropping sequence, rice and wheat grain yield were similar. Hence, inclusion of *Sesbania aculeata* as green manure either before or after rice-wheat cropping sequence is equally better to improve the soil physical dynamics and crop productivity of 'B' class sodic soils in Indo-Gangetic region of Uttar Pradesh.

Key words: Green manuring, Physico-chemical dynamics, Reclaimed sodic soils, Rice, Sesbania, Wheat

Salt-affected soils are becoming a serious challenge for food and nutritional security in the developing world. As per FAO/UNESCO soil map of the world, a total of 953 m ha covering about 8 per cent of the total land surface is suffering from salinity/sodicity (Szabolcs 1979). Rice-wheat cropping systems of the Indo-Gangetic plains (IGP) are of immense importance for food security in South Asia. Rice–wheat cropping sequence is most suitable in partially reclaimed sodic soils. A large area in sodic soils has declined in their productivity in the IGP. This is the emerging threats to the sustainability of rice-wheat systems in sodic soil environment. Recent estimates indicate that 6.73 m ha (NRSA, CSSRI, NBSSLUP 2006) area is affected by soil salinity and sodicity in India. In IGP of Uttar Pradesh, owns approximately 1.37 million hectares of sodic lands, which is about 36% of the sodic land of the country in India (CSSRI 2007-08).

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Soil containing excessive salts of sodium carbonate and having sufficient exchangeable sodium to interfere with growth of most crops are called sodic soils/alkali soils. These have pH of the soil saturated paste more than 8.5, ESP 15 or more and ECe limitless if resulting from salts capable of alkaline hydrolysis. Small, marginal and resource poor farmers own sodic soils the growth of crop plants is adversely affected because of impairment of physical conditions, disorder in nutrient availability and suppression of biological activity due to high pH and sodium percentage. The sodic soils of the Indo-Gangetic plains are generally gypsum ($CaSO_4.2H_2O$) free, but are calcareous, with $CaCO_3$ increasing with depth, which is present in amorphous form in concretionary form, or even as indurate bed at about 1 m depth. The accumulation of $CaCO_3$ generally occurs within the zone of fluctuating water table. The dominant clay mineral is illite. The processes which target the dissolution of $CaCO_3$ have significant role in reclaimation of sodic soils. Crops like rice helps in reclaiming sodic soils (Chhabra and Abrol 1977).