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Soil micronutrients status of different agroforestry systems in north Bihar

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Abstract
A field-cum lab study conducted on 'soil micronutrients status of different agroforestry systems in north Bihar'. The work took to check out how agroforestry systems act on micronutrient status of soil. The investigation conducted on three agroforestry systems which includes Kadamb (*Anthocephalus cadamba* Miq.) based agrisilvicultural system, Simarouba (*Simarouba glauca* DC) based agrisilvicultural system , Litchi (*Litchi chinensis* Sonn.) based agri horticultural system and one open (without trees). Available micronutrient cations (Copper, Zinc, Iron, Manganese) were analyzed by using DTPA extracting solution. Study revealed that all agroforestry systems has ability to increase micronutrient contents in both (15 cm and 30 cm) depths of soil. It was also noticeable that among the three plantation Simarauba recorded highest micronutrient reviving capability over control plot. Surface soil accounted higher presence of all micronutrients over lower soil in all plots.

Keywords: Soil micronutrients, agroforestry, litchi, Kadamb, Simarouba

Introduction
Micronutrients are considered essential soil elements needed for crop growth, even though they are needed in comparatively little amounts. Micronutrients are directly affect crop growth and development. Indian agriculture production at last half century has risen a significantly growth in crop production by introducing modern agricultural techniques. High yielding varieties of crops and fertilizers has made it easy to produce much more production then before. Earlier, it became possible by applying nitrogenous fertilizers alone, but within a few years, the nutrient stocks in soil were rapidly exhausted and now longer possible to get higher yields by applying only primary nutrients. So, in current time secondary nutrients and micronutrients were become necessary to obtain higher yield to fulfill our demand. Excess application of various fertilizer can hamper our soil and unable to act as a sustainable supply system, which is now a days become major concern. From this aspect agroforestry can play be an important option. Agroforestry improves sustainable soil management via a better nutrient uptake, nutrient release, plant litter deposion, improve soil physical properties, decrease of erosion, buffering of soil temperature and acidity and many more significant services [1]. So it is important to know which agroforestry system suits better in a specific environment.

Materials and Methods
The investigation entitled "Soil Micronutrients status of different agroforestry systems in north Bihar" includes three agroforestry systems as 1. Kadamb (*Anthocephalus cadamba* Miq.) based agrisilvicultural system, 2. Simarouba (*Simarouba glauca* DC) based agrisilvicultural system, 3. Litchi (*Litchi chinensis* Sonn.) based agrihorticultural system and one open (without trees) were taken undertook the study. Kadamb based agrisilvicultural system was 13 years old and tree spacing maintained 5 m x 4 m. There are two sites is located one at Pusa farm and another at Birauli Farm under Rajendra Prasad Central Agricultural University, Pusa, Bihar. Climate is here sub-tropical includes three different seasons rainy (June to September), winter (October-February) and summer (March to May).
Available micronutrient cations (Cu, Zn, Fe, Mn) were extracted from the soil: DTPA (Diethylene triamine penta acetic acid) extracting solution (0.005 M DTPA + 0.1M TEA +0.01 M $CaCl_2$buffered at pH 7.3) in the soil to solution ratio of 1:2 shaken for two hours [2]. The available micronutrients were determined in the clear aliquot with the help of Atomic Absorption Spectrophotometer (Perkin Elmer A Analyst 200). At first 10g soil along with 20ml DTPA solution take in a polyethylene bottle and shake for 2 hrs. Filter through Whatman No. 42 filter paper and measure the micronutrients by atomic absorption spectrophotometer using respective cathode lamps.

Results

Zinc (Zn): There was significantly increase of soil available Zn in all three agroforestry systems over control (Fig-1). Kadamb, simarouba and litchi increased soil Zn in 15 and 30 cm depths as compared to the control plot. There was an increase of soil Zn in simarouba plot over kadamb and kadamb over litchi in 15 cm depth. Decrease of soil Zn from surface to sub-surface soil in kadamb, simarouba and litchi were recorded. Soil Zn in simarouba plantations showed significantly higher value compared to all other agroforestry systems, irrespective of soil depths. Soil Zn varied between 0.78 mg kg^{-1} in surface soil of simarouba to 0.43 mg kg^{-1} in sub-surface soil of control treatment.

Copper (Cu): In all the three agroforestry systems had significant increase in soil available Cu status then control plot (Fig-2). All agroforestry systems including control shows decrease in soil Cu in lower depths than surface soil. Soil Cu in kadamb, simarouba and litchi plantations increased in both soil depths over control. Soil Cu in simarouba had higher over Litchi whereas litchi had higher over kadamb plantation in 15 and 30cm depths. Reduction of soil Cu from surface (15cm) to sub-surface (30cm) soil in kadamb, simarouba and litchi were found. Among the different agroforestry systems simarouba plantations were found significantly higher soil Cu than all other treatments in 15 cm and 30 cm soil depths. Soil Cu varied from 0.9 mg kg^{-1} in surface soil of simarouba based agroforestry system to 0.6 mg kg^{-1} in sub-surface soil of control plot.

Manganese (Mn): Results revealed that in all the three agroforestry systems had significant increase in soil available Mn status then control plot (Fig-3). All agroforestry systems including control shows decrease in soil Mn in lower depths than surface soil. Soil Mn in kadamb, simarouba and litchi plantations increased in both soil depths over control. Soil Mn in simarouba had higher over kadamb whereas kadamb had higher over litchi plantation in 15 cm depth. Reduction of soil Mn from surface (15cm) to sub-surface (30cm) soil in kadamb, simarouba and litchi were recorded. Among the different agroforestry systems simarouba plantations were found significantly higher soil Mn than all other treatments irrespective of all soil depths. Soil Mn varied from 3.7 mg kg^{-1} in upper soil of simarouba plantation to 1.2 mg kg^{-1} in lower soil of control treatment.

Iron (Fe):
All the three agroforestry systems had showed significant increase in soil Fe status then control plot (Fig-4). All agroforestry systems including control shows decrease in soil Fe in lower depths than surface soil. Soil Fe in kadamb, simarouba and litchi plantations increased in 15 and 30 cm depths over control. Soil Fe in simarouba had higher over litchi whereas litchi had higher over kadamb plantation in 15 and 30cm depths, respectively. Reduction of soil Fe from surface (15cm) to sub-surface (30cm) soil in kadamb, simarouba and litchi wereconfirmed. Among the different agroforestry systems simarouba plantations were found significantly higher soil Fe than all other treatments in 15 cm and 30 cm soil depths. Soil available Fe varied from 8.5 mg kg^{-1} in surface soil of simarouba based agroforestry system to 3.9 mg kg^{-1} in sub-surface soil of control plot.

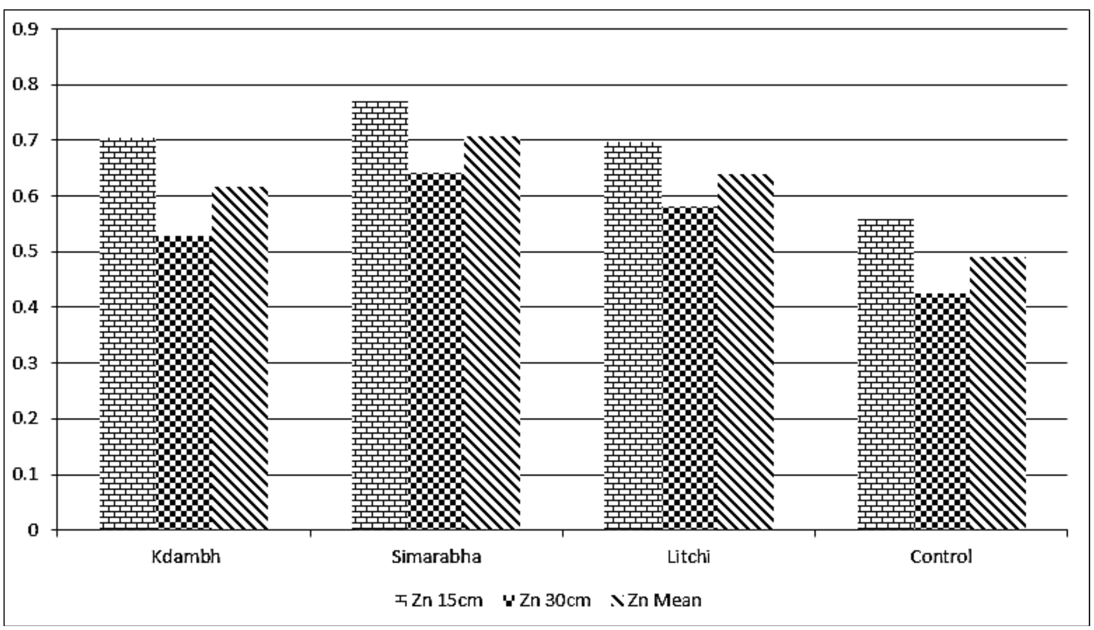

Fig 1: Effects of different agroforestry systems on soil zinc.

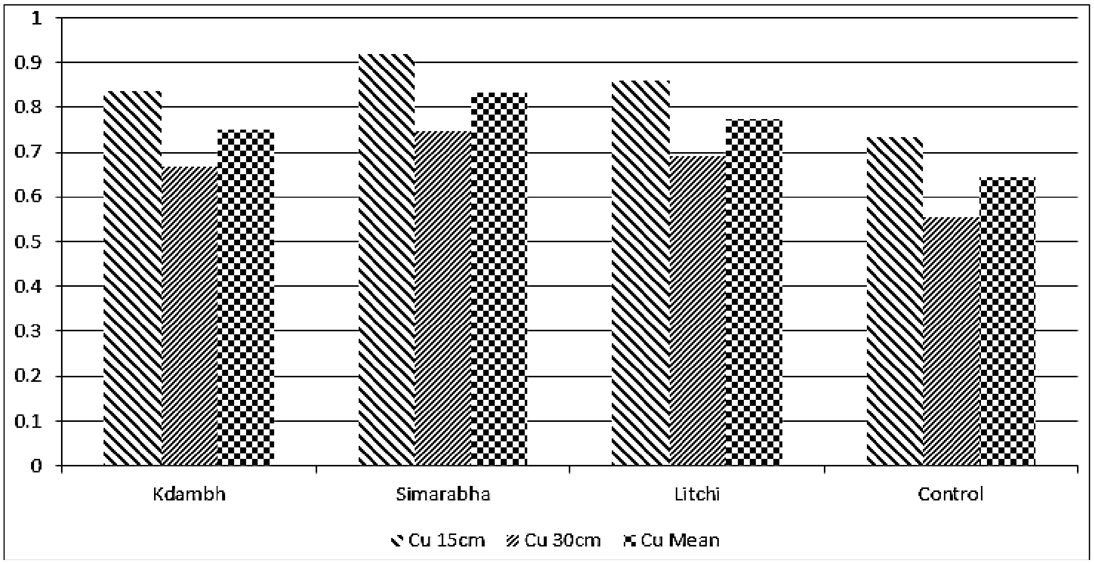

Fig 2: Effects of different agroforestry systems on soil copper.

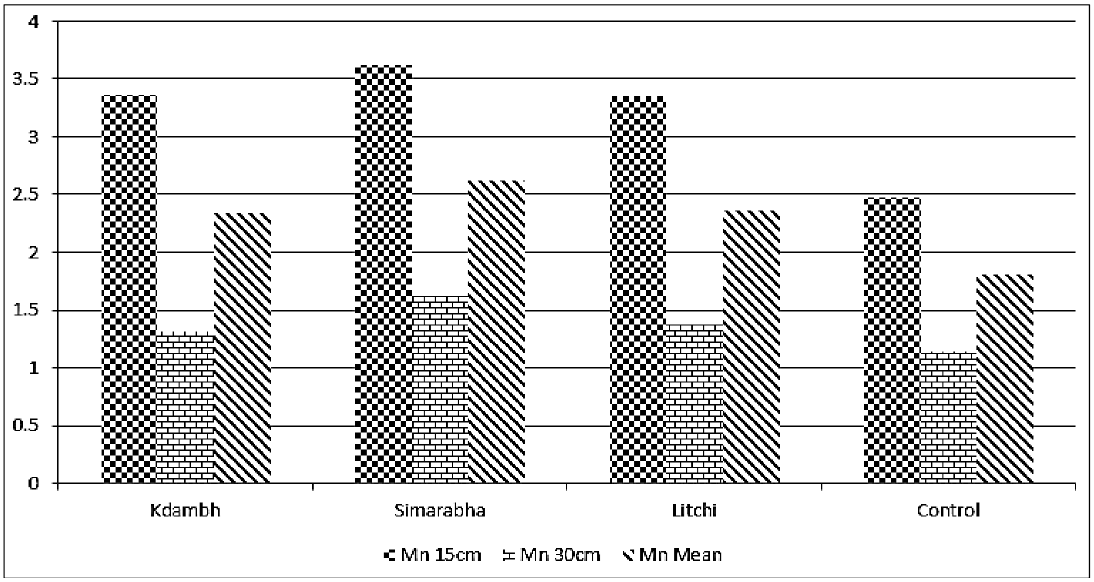

Fig 3: Effects of different agroforestry systems on soil manganese.

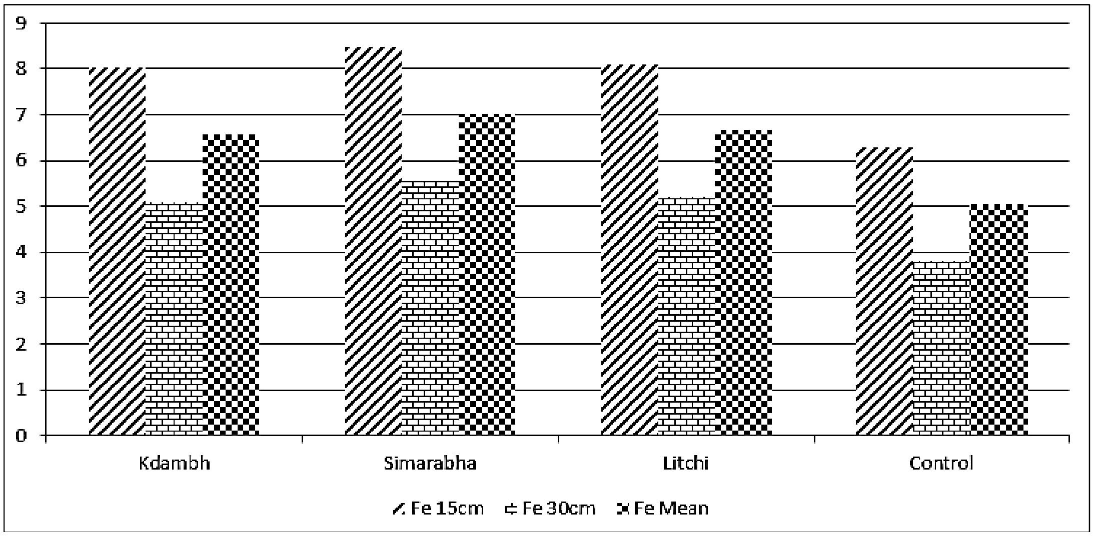

Fig 4: Effects of different agroforestry systems on soil iron.

Discussion

There was significant increase of soil available zinc (Zn), manganese (Mn), copper (Cu), iron (Fe) in kadamb, simarouba and litchi based agroforestry systems over control as shown in Fig: 1-4. Singh *et al.* (2007) [3] and Yadav *et al.* (2008) [4] observed tree litter fall returns good amounts of Zn, Fe, Mn and Cu, similarly Costa *et al.* (2018) [5] reported higher soil Fe in agroforestry field over control one. Decrease of soil Zn, Mn, Cu, Fe from surface to sub-surface soil had confirmed, irrespective of treatments. Similar results reveled from the works of Aggarwal *et al.* (2005) [6] and Costa *et al.*, (2018) [5]. Some plant micro-nutrients has more chances to leaching down easily, which could be recycled by develop deep root systems of trees [7]. In different treatments soil Zn, Mn, Cu and Fe varied 0.77-0.42, 3.62-1.14, 0.92-0.56 and 8.46-3.81 mg kg^{-1}, respectively. Tree species varied in amounts and quality of litter fall depositions, which may leads to variations of soil nutrient contents in different agroforestry system soil.

Conclusion

It can be concluded that, all four micronutrients availability rose due to agroforestry development in all soil depths. It was also found that differences of soil micronutrient contents in different plantations. Forest tree based agroforestry systems (simarouba and kadamba) has higher ability to recycle plant nutrients over fruit tree (lichi) based agroforestry system. Surface soil contents higher micronutrients in all treatments including control treatment. Agroforestry recycle plant micro-nutrients in a better way through deep root system and large litter fall, over conventional agriculture system. Agroforestry system development could be taken over crop production as stable and revival option for soil sustainability.

References

1. Young A. Agro forestry for soil conservation. Wallingford: CAB international. Retrieved from http://www. worldagroforestry.org, 1989.
2. Lindsay WL, Norvell WA. Development of a DTPA soil test for zinc, iron, manganese, and copper. Soil Science Society of America Journal. 1978; 42:421-428.
3. Singh B, Gill RIS, Kaur N. Litter fall and nutrient return in poplar plantation varying in row directions and spacings. Indian Journal of Agroforestr. 2007; 9(1):33-37.
4. Yadav RS, Yadav BL, Chhipa BR. Litter dynamics and soil properties under different tree species in a semi-arid region of Rajasthan, India. Agroforestry Systems. 2008; 73:1-12.
5. Costa END, Souza MFL, Marrocos PCL, Lobão D, Silva DML. Soil organic matter and CO_2 fluxes in small tropical watersheds under forest and cacao agroforestry., 2018, https://doi.org/10.1371/journal.pone.0200550
6. Aggarwal V, Kumar K, Sidhu PS. Sptial changes in some soil properties under litchi and mango plantations. Communications in Soil Science and Plant Analysis. 2005; 36:17-18.
7. Jobbagy EG, Jackson RB. The distribution of soil nutrients with depth: global patterns and the imprint of plants. Biogeochemistry. 2001; 53(1):51-77.