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Crop Residues and Its Influence On Soil Properties – A Review

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ABSTRACT
In sustainable agriculture, one of the most relevant objective is to maintain and restore the soil fertility. Continuous cropping of the land with inorganic fertilizer alone causes decline in soil organic matter and loss of inherent fertility. This has led to the renewed interest in use of organic manures as sources of soil organic matter. Among the available organic sources, crop residues are the most important sources of nutrients to the crop in addition to improving soil health.The application of organic matter alone to soil is not a complete substitute for inorganic fertilizer and vice-versa and their roles are complementary to each other. The knowledge on nutrient release from crop residues and their influence on physical, chemical and biological properties would be very much helpful in proper management of crop residues. This review focuses on soil properties as influenced by crop residue management.
Key words: *Crop residues, soil properties, nutrient availability and biological activity*

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INTRODUCTION

Incorporation of crop residues alters the soil environment, which inturn influences the microbial population and activity in the soil and subsequent nutrient transformations. It is through this chain of events that management of crop residues regulates the efficiency with which fertilizer, water, and other reserves are used in a cropping system. Another feature of rice-based cropping system in the tropics is the inherent conflict between maximizing short term production at minimum cost versus providing sustainable health and long term productivity of the soil. One reason for this conflict is the general below average economic condition of the farmers practicing rice based cropping systems. In the tropics, crop residues have, in fact played a pivotal role in the maintenance of soil resources at acceptable levels because these are the major sources of carbon inputs.

The Ministry of New and Renewable Energy, Government of India has estimated that about 500 million tons of crop residues are being generated every year (Agarwal *et al*., 2016). The increasing constraints of labour and time under intensive agriculture have led to the adoption of mechanized farming in rice based cropping systems, which leaves large amounts of crop residues in the fields. As crop residues interfere with field operations for the next crop, farmers often prefer to burn the residues. In addition to environmental pollution, burning results in large losses of organic carbon, plant nutrients and also harms beneficial soil organisms (Katyal, 2002). Hence, the need of the hour is to incorporate the crop residues into soil to enhance carbon sequestration, improve soil health and reduce greenhouse gas emissions. A better understanding of the impact of crop residue management on the soil properties is needed in order to manage agricultural land sustainably.

INFLUENCE OF CROP RESIDUES ON SOIL PHYSICAL AND PHYSICO-CHEMICAL PROPERTIES

Bulk Density and Water Holding Capacity

A long-term fertilizer experiment conducted by Chaudhary *et al*. (2017) in rice-wheat cropping system at Punjab Agricultural University, Punjab on sandy loam soil revealed that the incorporation of straw + NPK increased total soil porosity (46.3%) and decreased the bulk density (1.42 Mg m^{-3}) upto 0-15 cm when compared to 100% NPK treated plots (43.1%, 1.51 Mg m^{-3}, respectively).

An experiment conducted on utilization of crop residues as compost for improving soil physical properties revealed that maize stover compost recorded maximum total porosity (49.05%) followed by rice compost (47.87%) over control (43.23%) (Barus, 2016).

pH and Electrical Conductivity (EC)

The lowest soil pH (7.70) was observed with soil incorporation of wheat straw and green manure in alluvial soil due to the production of organic acids during decomposition. Electrical conductivity of the soils was not significantly influenced by the incorporation of organics **(**Dhar *et al*., 2014). Shahrzad *et al*. (2014) reported an increase in pH and electrical conductivity of soil with incorporation of crop residues.

Anilkumar *et al.* (2012) reported that the application of FYM, wheat straw and green manure along with inorganic fertilizers decreased the soil pH and soluble salt concentration as compared to the fertilizers alone.

Organic Carbon

A field experiment was conducted on long-term fertilizer experiment on rice-wheat cropping system at Punjab revealed a significantly higher organic carbon content (4.19 g kg^{-1}) due to straw incorporation + NPK over 100% NPK treated plots (5.14 g kg^{-1}) (Chaudhary *et al*., 2017).

Kong (2014) observed that reduced tillage coupled with residue mulching increased the SOC, soil aggregation, water infiltration rate and soil water retention while, decreasing bulk density near the soil surface. Verma and Pandey (2013) noticed that significantly higher organic carbon content was recorded with rice residue incorporation + 30% excess recommended NPK.

INFLUENCE OF CROP RESIDUE AND COMPOST ON NUTRIENT AVAILABILITY

Available Macronutrients

Alamgir and Marschner (2016) studied the changes in phosphorus pools over three months in two soils amended with legume residues from South Australia. Residue addition increased the percentage of resin and microbial P with greater changes induced by faba bean (25.7 and 9 %) and chickpea (8.1 and 11.9 %) than with white lupin residues (4.6 and 2.5 %), respectively in Monarto soil.

Verma *et al*. (2016) reported that nutrient management practices had a significant effect on N and sulphur content and plots receiving integrated sources [100% NPK + 25% N through FYM), 100% NPK + green manure (sesbania), 100% NPK + crop residues (previous crop)] showed higher mineral nitrogen and sulphur content than control.

Pandiaraj *et al*. (2015) conducted an experiment on crop residue management in a silt loam soil and observed higher mineral nitrogen content of 8.99 μg g^{-1}, 10.08 μg g^{-1} and 12.14 μg g^{-1} during 2009, 2010 and 2011 respectively with incorporation of residues over no residues incorporation (7.79, 8.86 and 9.02 μg g^{-1}), respectively.

An experiment was conducted during *rabi*, 2008-09 at Research Farm of Allahabad Agricultural Institute, Uttar Pradesh in an alluvial soil. The highest available N (206.7 kg ha^{-1}), P (14.6 kg ha^{-1}) and K (212.7 kg ha^{-1}) values were recorded with addition of straw in combination with green manure while, the lowest values were associated with inorganic fertilizer treated plots (170.4, 12.4 and 207.2 kg ha^{-1} of N, P and K, respectively) in wheat crop (Dhar *et al*., 2014).

Kumar *et al.* (2011) conducted a long-term experiment using crop residues and observed higher available sulphur content (26.6 mg kg^{-1}) in compost treated plots compared to 100% NPKS (23.0 mg kg^{-1}). Radhakumari and Srinivasulareddy (2011) reported that post harvest soil fertility status with regard to available macronutrients was superior with incorporation of fieldbean crop residues followed by incorporation of cowpea, clusterbean and greengram.

Rameshchandra (2011) reported significant increase in available nitrogen (152 kg ha^{-1}), phosphorus (23.1 kg ha^{-1}) and potassium (245 kg ha^{-1}) content with crop residue incorporation over 100% RDF (158, 23.9 and 249 kg ha^{-1}, respectively) after second crop in different cropping sequences.

DTPA Extractable Micronutrients (Fe, Mn, Zn and Cu)

The incorporation of crop residues in soil significantly increased the concentration of DTPA extractable Cu (1.83 mg kg^{-1}) (Shahrzad *et al*., 2014). The DTPA extractable Fe significantly increased with the application of 100% NP along with organics as compared to 100% NP alone. However, incorporation of crop residues did not significantly increase the DTPA extractable Zn, Mn and Cu in soil (Kumar *et al*., 2012).

Subehia and Sepehya (2012) conducted an experiment on long term nutrient management during *kharif* at Palampur, Himachal Pradesh on silty clay loam soil in rice-wheat cropping system. The amount of Fe, Mn, Cu and Zn was found to be maximum with incorporation of RDF + 25 % RDF through wheat straw (52.89, 32.95, 2.30 and 0.63 mg kg^{-1}, respectively), which were significantly higher than recommended dose of fertilizer (45.45, 30.45, 2.33 and 0.49 mg kg^{-1}).

INFLUENCE OF CROP RESIDUES ON BIOLOGICAL ACTIVITY OF SOILS

MICROBIAL POPULATION

Karache *et al*. (2013) recorded that the use of organics along with chemical fertilizers increased overall microbial populations and the enzyme activity in soil. Significantly higher fungal (108×10^3 CFU g^{-1}) and bacterial (261.1 × 10^5 CFU g^{-1}) population was recorded with application of arecanut residue + cow dung (Tangjang *et al*., 2012).

Rameshchandra (2011) reported that crop residue incorporation increased the population of total bacteria (8.2 log_{10} CFU g^{-1}), fungi (4.88 log_{10} CFU g^{-1}) and actinomycetes (3.69 log_{10} CFU g^{-1}) soil compared to 100% NPK (8.03, 4.76 and 3.69 log_{10} CFU g^{-1}, respectively) were observed in microbial counts.

Dehydrogenase Activity

Pathak *et al.* (2015) recorded positive and significant differences in biological properties in terms of dehydrogenase and alkaline phosphatase activities due to green manuring and crop residue incorporation. Maximum dehydrogenase activity (4.6 mg TPF kg^{-1} soil 24 h^{-1}) and phosphatase activity (7.4 mg PNP kg^{-1} soil 24 h^{-1}) were observed in the treatment having 75 per cent RDF with crop residue compared to 75% RDF (25 mg TPF kg^{-1} soil 24 h^{-1} and 3.8 mg PNP kg^{-1} soil 24 h^{-1}, respectively).

Dadhich *et al.* (2012) reported that the microbial activity of soil showed a positive trend in the treatments in which composts were applied. The top three ranked treatments, in terms of dehydrogenase activity were pigeonpea stover compost, chickpea stover compost and mustard stover compost.

INFLUENCE OF CROP RESIDUES ON GROWTH AND YIELD OF DIFFERENT CROPS

Barus (2016) studied the effect of crop residues as composts for improving upland rice productivity in acid soil. The combination of rice husk biochar and straw compost was found to show better effect than single applications on rice production components *viz*., plant height (123.9 cm), grain per panicle (211.8) and yield (4.875 t ha^{-1}).

Field experiments were carried out during 2010-2012 in *kharif* and summer seasons in moderately shallow and dark reddish brown clay soils. The application of 75% NPK + 25% NPK supplied through paddy straw treated with cow dung slurry @ 5% + *Trichodermaharizianum* @ 5 kg ha^{-1} + *Pleurotus* sajor caju @ 5 kg ha^{-1} treated plots recorded significantly higher yield of grain (7201 kg ha^{-1}) and straw (9000 kg ha^{-1}) yield compared to application of 100% NPK alone (6896 kg ha^{-1} and 8609 kg ha^{-1}, respectively) (Sannathimmappa, 2015).

An experiment was conducted by Shah *et al*. (2015) during the *rabi* season of the years 2004-05 and 2005-06, to evaluate the effect of crop residue management practices and nitrogen levels on yield of wheat on loamy sand soil at Anand. The significantly highest grain (5472 kg ha^{-1}) and straw (8164 kg ha^{-1}) yield of wheat was obtained under the incorporation of wheat straw @ 5 t ha^{-1} + 20 kg N and 20 kg P_2O_5 ha^{-1} at 30 DBS as compared to rest of treatments.

REFERENCES

1. Agarwal, A., Dintwa, E and Joshi, P. 2016. Analysis of agro-residue burning and present scenario in key areas of northern plains in India. *International Journal of Advanced Research*. 4(3): 1499-1509.
2. Alamgir, M and Marschner, P. 2016. Changes in P pools over three months in two soils amendedwith legume residues. *Journal of Soil Science and Plant Nutrition*. 16(1): 76-87.
3. Anilkumar, Rita, D., Kumar, P., Jhorar B.S and Phogat V.K. 2012. Long term effect of organic materials and fertilizers on soil properties in pearl millet- wheat cropping system. *Indian Journal of Agricultural Research*. 46(2): 161-166.
4. Barus, J. 2016. Utilization of crops residues as compost and biochar for improving soilphysical properties and upland rice productivity. *Journal of Degraded and Mining Lands Management*. 3(4): 631-637.
5. Chaudhary, S., Dheri, G.S and Brar, B.S. 2017. Long-term effects of NPK fertilizers and organic manures on carbon stabilization and management index under rice-wheat cropping system. *Soil and Tillage Research*. 166: 59–66.
6. Dadhich, S.K., Pandey., A.K., Prasanna, R., Nain, L and Kaushik, B. D. 2012. Optimizing crop residue-based composts for enhancing soil fertility and crop yield of rice. *Indian Journal of Agricultural Sciences.* 82(1): 85–88.
7. Dhar, D., Ashim, D., Nirmalendu, B., Niladri, P., Shrikant, B and Thomas, T. 2014. Residual effect of crop residues on growth, yield attributes and soil properties of wheat under rice-wheat cropping system. *Indian Journal of Agriculture Research*. 48 (5): 373-378.
8. Katyal, J.C. 2002. *Convocation Address*. December 5, 2002. Punjab Agricultural University, Ludhiana, India, College of Agriculture. 1-11.
9. Kharache, V.K., Patil, S.R., Kulkarni, V.S and Katkar, R.N. 2013. Long term integrated nutrient management for enhancing soil quality and crop productivity under intensive cropping system on vertisols. *Journal of the Indian Society of Soil Science*. 61(4): 323-332.
10. Kong, L. 2014. Maize residues, soil quality, and wheat growth in China. *Agronomy for Sustainable Development*. 34 (2): 405-416.
11. Kumar, M., Yaduvanshi, N.P.S and Singh, Y.V. 2012. Effect of integrated nutrient management and soil fertility status in reclaimed sodic soils. *Journal of the Indian Society of Soil Science*. 60(2): 132-137.
12. Kumar, V., Pandey, A.K., Prasad, R.K and Prasad, B. 2011. Long-term influence of organic and inorganic sulphur and fertility levels on yields, distribution and build-up of sulphur under rice-wheat cropping system in calciorthents. *Journal of the Indian Society of Soil Science.* 59(3): 278-282.

13. Pandiaraj, T., Selvaraj, S and Ramu, N. 2015. Effects of crop residue management and nitrogen fertilizeron soil nitrogen and carbon content and productivity ofwheat (*Triticum aestivum* L.) in two cropping systems. *Journal of Agricultural Sciences and Tecnology*. 17: 249-260.
14. Pathak, D.V., Ram, K.G., Yadav, P.K and Yadav, S.S. 2015. Effect of green manuring and residue incorporation on soil properties and seed yield of rapeseed mustard. *International Journal of Farm Sciences.* 5(4): 70-77.
15. Radhakumari, C and Srinivasulureddy, D. 2011. Sustainable nitrogen management in rice based cropping system. *Indian Journal of Agricultural Research.*45(2): 93-103.
16. Rameshchandra. 2011. Effect of summer crops and their residue management on yield of succeeding wheat and soil properties. *Journal of the Indian Society of Soil Science*. 59(1): 37-42.
17. Sannathimmappa, H.G., Gurumurthy, B.R., Jayadeva, H.M., Rajanna, D and Shivanna, M.B. 2015. Effect of paddy straw based integrated nutrient management practices for sustainable production of rice. *Journal of Agriculture and Veterinary Science.* 8(1): 74-77.
18. Shah, K.A., Tandel, B.M and Nayaka, P. 2015. Growth, yield and nutrients content and uptake bygrain and straw of wheat as affected by differentresidue management practices and nitrogen levels. *The bioscan*. 10(1): 385-389.
19. Shahrzad, K., Mahmoud, K., Hossein, A.K., Mehran, H and Majid, A. 2014. Effect of incorporation of crops residue into soil on some chemical properties of soil and bioavailability of copper in soil. *International Journal of Advanced Biological and Biomedical Research*. 2(11): 2819-2824.
20. Subehia, S.K and Sepehya, S. 2012. Influence of long-term nitrogen substitution through organics on yield, uptake and available nutrients in a rice-wheat system in an acidic soil. *Journal of the Indian Society of Soil Science*. 60(3): 213-217.
21. Verma, B.C., Datta, S.P., Rattan, R.K and Singh, A.K. 2016. Long term effect of tillage, water and nutrient management practices on mineral nutrient, available phosphorus and sulphur content under rice-wheat cropping system. *Journal of the Indian Society of Soil Science.* 64(1): 71-77.
22. Verma, N.K and Pandey, B.K. 2013. Effect of varying rice residue management practices on growth and yield of wheat and soil organic carbon in rice-wheat sequence. *Global Journal of Science Frontier Research Agriculture and veterinary Sciences*. 13(3): 33-38.

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