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Effect of Agriculture Crop Residue Burning on Environment and Soil Health

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Abstract

There are 115 million operational holdings in the country and about 80 % are marginal and small farmers. To fulfill the basic needs of house hold including food, feed, fodder, fiber, etc. were an attention about bio intensive cropping system (BICS). Global warming and its consequences are amongst the most serious problems of the present century. Agricultural crop residue burning contribute towards the emission of greenhouse gases (CO_2, N_2O, CH_4), air pollutants (CO, NH_3, NOx, SO_2, NMHC), volatile organic compounds, particulates matter and smoke thereby posing threat to human health. Total amount of residue generated in 2008–09 was 620 Mt out of which ~15.9% residue was burnt on farm. Rice straw contributed 40% of the total residue burnt followed by wheat straw (22%) and sugarcane trash (20%). Conservation agriculture and recommended management practices (RMPs) collectively are helpful to offset part of the emissions due to unscientific agricultural practices. An intensive agricultural practice during the post-green revolution era without caring for the environment has supposed to be played a major role towards enhancement of the greenhouse gases. Due to increase in demand for food production the farmers have started growing more than one crop a year through repeated tillage operations using conventional agricultural practices and they burn remaining crop residue which increases pollution.

Keywords: *Crop Residue, Burning, Environment, Soil Health*

Introduction:

India is an agricultural country and generates a large quantity of agricultural wastes. Amount will increase in future as with growing population there is a need to increase. Agricultural residues are the biomass left in the field after harvesting of the economic components *i.e.*, grains. Large quantities of crop residues are generated every year, in the form of cereal straws, woody stalks, and sugarcane leaves/tops during harvest periods. Processing of farm produce through milling is also produces large amount of residues. These residues are used as animal feed, residential cooking fuel and industrial fuel. However, a large portion of the crop residues is not utilized and left in the fields. The disposal of such a large amount of crop residues is a major challenge. To clear the field rapidly and inexpensively and allow tillage practices to proceed unimpeded by residual crop material, the crop residues are burned *in situ.* Farmers choose for burning because it is a quick and easy way to manage the large quantities of crop residues and prepare the field for the next crop well in time. Agricultural residues burning may emit significant quantity of air pollutants like CO_2, N_2O, CH_4 and emission of air pollutants such as CO, NH_3, NOx, SO_2, NMHC, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and particulate matter like elemental carbon at a rate far different from that observed in forest fire due to different chemical composition of the crop residues and burning conditions (Zhang *et al.*, 2011, Mittal *et al.*, 2009). Several researchers have estimated the emission of different species from crop residue burning using IPCC factors, but they have covered only few gaseous pollutants (N_2O, CH_4, NOx, and SO_2) (Venkataraman *et al.*, 2006; Sahai *et al.*, 2007); or from a specific area and crop (Badrinath *et al.*, 2006; Sahai *et al.*, 2007). Burning of crop residues also causes nutrient and resource loss.

Major Disadvantages of Crop Residue Burning: The crop residue burnt on farm in different states is highly variable depending upon the usage pattern in the respective states. According to IPCC the 25% of the crop residues are burnt on farm. In the present study the fraction of crop residue subjected to burning ranged from 8-80% for rice due across the states. In the states of Punjab, Haryana and Himachal

Pradesh 80% of rice straw was burnt *in situ* followed by Karnataka (50%) and Uttar Pradesh (25%), which can be attributed to the mechanized harvested with combine harvesters. Approximately 23% wheat straw was taken as fraction burnt in the state of Haryana, H.P, Punjab, and U.P. and for rest of the states it was 10%.

1. Effect of crop residue burning on environment: Agricultural crop residue burning contribute toward the emission of green house gases (CO_2, N_2O, CH_4), air pollutants (CO, NH_3, Nox, NMHC, Volatile organic compounds), particulates matter and smoke there by posing threat to human health. In the present study, a state-wise inventory of crop residue burnt in India and the air pollutants emitted was prepared using the inter-governmental panel on climate change (IPCC) national inventory preparation guideline for the year 2008-09. Total amount of residue generated in 2008-09 was 620 Mt. out of which 15.9% residue was burn on farm. Rice straw contributed 40% of the total residue burnt followed by wheat straw (22%) and sugarcane trash (20%), burning of crop residues emitted 8.57 Mt of Co, 141.15 Mt of Co2, 0.037 Mt of Sox, 0.23 Mt of Nox, 0.12 Mt of NH3 and 1.46 Mt NMVOC, 0.65 Mt of NMHC, 1.21 Mt of particulate matter for the year 2008-09. The variability of 21.46% in annual emission of air pollutants was observed from 1995 to 2009.

2. Effect of crop residue burning on soil health: Burning of crop residue on the soil surface reduces soil micro-organisms. Wheat straw burning 50% of the bacterial population up to 2.5 cm cut. Burning of crop residue amount and activity of enzymes involved in the cycle of mineral elements in the soil is reduced. Burning of crop residue increased soil pH. This is an increased of soluble salts from the soil. Burning stubble also caused a slight reduction in the amount of phosphorus and potassium soil and seed atmosphere (Structure, aggregation, mechanical strength and bulk density). Fire destroyed remnants of organic matter and this directly affects the structure and soil granulation side effects. Burning of crop residue not only leads to pollution but also results in loss of nutrients present in the residues. The entire amount of C, approximately 80–90% N, 25% of P, 20% of K and 50% of S present in crop residues are lost in the form of various gaseous and particulate matters, resulting in atmospheric pollution. In the present study the amount of different nutrients lost due to on farm burning of rice straw, wheat straw and sugarcane trash were also estimated. Maximum loss of nutrient was due to sugarcane trash burning followed by rice and wheat straw. Burning of sugar cane trash led to the loss of 0.84 Mt, rice residues 0.45 Mt and wheat residue 0.14 Mt nutrient per year out of which 0.39 Mt was nitrogen, 0.014 Mt potassium and 0.30 Mt was phosphorus.

Result and discussion:

There was a significant decrease in organic C, polysaccharide, NIL-N, and available P contents, but a significant increase in water-stable aggregates and NO_3-N content when the residue-burning treatment was compared to the normal spring incorporation of combine stubble.

The increase in water-stable aggregates was mainly in the 0.50- and 0.25-mm size fraction. Compared to the normal spring incorporation of combine stubble, the addition of straw increased the percent water-stable aggregates. Burning of the residue decreased the organic C, the NO_3-N, and polysaccharide contents of the soil. Burning of the residue affected the water stable aggregate percentage in the unfertilized plots but not in the fertilized plots. Fertilizer increased the percent of water stable aggregates under the chopped straw treatment within the fertilizer treatment. Burning the residues had no effect on available P.

Table1. The effect of burning of crop residue at on chemical and physical properties of the Ap horizon.

Properties	Treatment	
	Not burned	Burned
pH in CaCl,	7.6a	7.4a
Organic C (%)	1.48 a	1.47 a
Total N (%)	0.168 a	0. 160 a
C/N	8.8 a	9.2a
Chelating resin-extractable C (% of organic C)	21.9 a	18.ia
Polysaccharides (mg/100 g)	261 a	231 b
Water-stable aggregates (%)	29.8 a	22.1 b
NH,-N (ug /g)	3.68 b	5.33 a
NOr-N (ug/g)	24.5 a	27.6a
Available P (ug/g)	8 .38 t	12.68 a

a-b Between columns, any two means followed by the same letter do not differ significantly (P > 0.05) I Each value represents the average of four samples.

We typically discourage burning because adequate crop residue is one of the most important factors for healthy and productive soils. Crop residue can provide a protective layer for soil erosion by wind or water, can increase the organic matter and water holding capacity of the soil, and can provide "feed and forage" for earth worms. When crop residue is burned all of those benefits are lost, plus other damage may be done.

Dhiman *et al*., (1999) reported that organic carbon; available P and K were highest where an additional

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FYM application was made. Jaiswal and Singh, 2001 found that Nitrogen at 120 kg N ha-1 increased the nitrogen uptake by 41.9 and 34.8 per cent over 60 kg N ha-1 in grain and straw, respectively. Higher uptake of N might be due to better established roots, better plant growth and yield under increased N level. Zibilske *et al*., (2002) found that residue retention has been found to increase the concentration of P in the top soil. This can be attributed to redistribution of P mined from the lower soil layers. Laroo *et al*. (2007) revealed that N uptake was significantly influenced due to different levels of N application. Based on the total N uptake (grain + straw), there was 49.9, 63.9 and 70.4 per cent increase in N uptake over the control with 50, 100 and 150 kg N ha-1, respectively. Kukal *et al.* (2009) also observed that SOC concentration in the 0–60 cm soil profile was higher under FYM application (1.8 to 6.2 g kg–1) followed by NPK application (1.7 to 5.3 g kg–1) when compared to control plots. Application of bio-inoculants and retention of crop residues conjointly help maintain C and N balance in soil and enhance labile C pool in rice-legume rice cropping systems (Thakuria *et al.,* 2009).

It has been reported that standing residues are more effective than flat residues in reducing erosion by reducing the soil surface friction velocity of wind and intercepting the satiating soil particles (Hagen, 1996). (Bertol *et al*., (2007) revealed that residue retention on the soil surface can also provide physical soil protection against water and soil loss. Araya *et al*., (2011) found that after 3 years of wheat (*Triticum* sp.)-teff (*Eragostis tef*) rotation, soil loss and runoff were significantly lower in permanent raised beds with 30% standing stubble compared to furrows without surface residue and CT without surface residue. This was explained by increased aggregate stability and the mulching effect of the standing stubble, consistent with the results of Gebreegziabher *et al*., (2009) and Oicha *et al*., (2010).

Plate:1 crop residues burning in kalatalab village field kota (Rajasthan), India

Conclusion and Future Prospects:

This study presents the national and state wise estimates of air pollutants emitted from field burning of crop residues in India. The major states where maximum amount of crop residues were burnt on farm are Punjab, U.P., Haryana and M.H. rice, wheat, and sugarcane are the major crops whose residues are subjected to on farm. Large scale burning of crop residues from rice-wheat system of Punjab, Haryana and western U.P. is a matter of serious concern not only for GHG emission but also for problem of pollution. Agricultural residue burning is a national problem now as well as it also leads to global warming. This problem requires extensive research and innovative way for secure future. Satellite imaging and remote sensing data show large swathes of fire in central, southern and eastern India. Higher rates of mechanization of harvesting and crop diversification, resulting in shorter periods of fields lying fallow, have perhaps also contributed to this increase in crop residue burning. To overcome this major problem Government should provide awareness programs for farmers. These types of programs will be “BEST TREASURE FOR OUR NATION”.

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