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Research Article

INCORPORATION OF WHEAT CROP RESIDUES BY ROTAVATOR TO IMPROVE THE SOIL HEALTH

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Abstract- Burning crop residue after harvesting of wheat crop to minimize obstruction in sowing of succeeding crop is a common practice of Malwa plateau being used in approximately one lakh ha in Shajapur, alone, which deteriorates soil health. Wheat is a main crop of Rabi after gram. Crop residues effect on yield of soybean were studied at farmers field under on farm trial (OFT) program in 2008 and 2009 with following treatments such as (a) in situ mixing of wheat crop residue by the rotavator (CRMR) and (b) burning of wheat crop residues in the field (CRB). Observation revealed that increasing pattern of organic carbon from 0.38 to 0.40 % in two years which is main source of microbial activity which ultimately enhances nutrient availability in field and produced higher grain yield in CRMR i.e., 38.93% higher than CRB.

Keywords- Rotavator, Soybean, Crop Residues and Organic Content

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Introduction

Soybean wheat is a main cropping system on vertisol soils of Malwa region of Madhya Pradesh. In this region, a conventional crop establishment practice in soybean involves sowing by sweep blade type seed drill. This practice involves excessive tillage and field free from the residue of the previous crop. But wheat is harvested by combine harvester; it leaves 25-30 cm high stubble and spreads the straw on the ground [1]. This wheat straw remains in field un-decomposed during the May and June months due to lack of moisture. When the sowing of soybean in the last week of June with the onset of monsoon rains, the residue create obstruction in sowing and residue immobilizes the nitrogen applied to soybean and crop continuously suffers. Handling of wheat crop residues, before planting soybean crop is emerging as a major management problem of the farmers in Malwa Region. The farmers practice, particularly in Malwa Plateau, is to simply burn the residues in the field to facilitate the convenient tillage operation for preparation of field and sowing of soybean crop. The burning of crop residue is not only detrimental to soil biota but may also affect the sustainable crop production in addition to polluting the atmosphere. The best alternative will be to recycle the crop residues into agricultural land to improve soil health and crop productivity. Crop residues return carbon (C) to the soil, which improves soil structures, improves the ability of the soil to hold nutrients and water holding capacity. Returning crop residues to soil is the most economical and ecological means of conserving soil and water and sustaining crop production [2]. To shun the practice of burning straw in the field, the better option would be to chop it into small pieces and incorporate in the soil. Hence, incorporation of these residues and later on its decomposition determines the availability of the nutrient. It was observed that extent of residue incorporation was maximum (99%) while operating the rotavator with the shield in the lowered position [3].

To consider the above points, this study was planned to mix the wheat crop residue in the field by the rotavator. Hence, an On Farm Trial was finalized to incorporate this wheat residue in the soil and to determine the effect of crop residue incorporation on growth and yield attributes of soybean under soybean wheat cropping systems in Malwa of Madhya Pradesh. The adoption of machine in farming operation as land preparation, residue management, plant protection, harvesting, threshing, on farm value addition of crop and use of power for the various operation viz. irrigation etc [4] is increasing day by day as it resulted in saving of cost of production and increasing net income of the farmers [5].

Materials and Methods

Field experiments were conducted at farmer's field of adopted village satgoan during *Kharif* season of 2008 and 2009 to solve the burning problem of wheat residue and to see the effect of these residues on the productivity of the soybean. The village Satgoan is situated on Shajapur- Kanad road just 9 km away from Shajapur. At the time of experiment soil samples were collected and tested to know the organic content and fertility status of the soils. The soils of the experimental fields were medium black soil with 7.5 pH, low in organic content (0.35%) and available N (170 kg/ha), medium in available P_2O_5 (19 kg/ha) and available K_2O (385 kg/ha).

Fig-1 Wheat crop residue mixing in the filed by rotavator

Two treatments were considered for this study viz. (a) in situ mixing of wheat crop residue by the rotavator (CRMR) and (b) burning of wheat crop residues in the field (CRB). Soybean JS 95-60 was grown with these two treatments in randomized block design having five replications with plot size of 2000 m^2. Wheat residues were burned in the field just after harvesting the crop in the April month. Another plot was kept to mix the crop residue in the soil by rotavator.

A 6-flange, 1.2 m wide rotavator was used for experiment, which cuts the soil and residue through a number of rotary tines or knives mounted on a horizontal shaft. It consists of a power driven shaft on which knives or tines are mounted to cut the soil and residue. Sharp edged L-shaped blades were used, which were mounted on the fixed flange of the rotor. The depth of penetration was kept 10 cm for this experiment.

Fig-2 Crop residue mixed in the field

Soybean crop was sown accordingly to the treatments in the last week of June. Crop was sown by the sweep blade type seed cum ferti drill at a depth of 5 cm with a row to row distance of 30 cm and seed rate of 80 kg ha-1. In this seed drill sweep blade was fitted on the rear tines to cover the seed by soil as well as make a small ridge on which soybean plants emerge. This ridge also facilitates the seed to germinate easily [6]. The recommended fertilizer doses of N, P_2O_5 and K2O were 20, 60, 20 kg ha^{-1} for soybean, respectively applied by urea, single super phosphate and murate of potash. Integrated weed management and Integrated Pest management were done as per recommendations. The crop was harvested when grains almost matured and all leaves dropped after dying. Growth parameter and grain yield were taken in the respective field maintaining proper way. Randomly selected 10 plants from each plot were taken to measure the height of the plants and pods per plant. Grain yield and straw yield were determined by harvesting an area of 1 sq m of the experimental plot separately expressed in q ha^{-1} Soil samples were also taken after the harvesting to test organic carbon in the soil. The walkley and black method [7] was used to calculate the organic carbon.

Specification of the Rotavator:-

Particulars	Specification
Working width in mm	1248
Working Depth in mm	152
Power Required	29.84 kW
PTO (rpm)	540
Rotor (rpm)	210
Weight in kg	280
Number of blades	30
Number of flange	6
Hitching	Three point linkage
Depth control	By skid both side

Results and Discussions

The average field capacity of the rotavator was found 0.27 ha/hr at 3.6 forward speed of tractor and average extent of residue incorporation was observed 90.8% in CRMR but in case CRB it was 0%. Because all wheat crop residues burned in the CRB. The field capacity of sweep blade type seed cum ferti drill was found 0.55 and 0.42 ha/hr in CRB and CRMR respectively. It was found lower in the CRMR due to obstruction created by residue and clogging of seed cum ferti drill. It requires more time to clean the sweep blade and tines frequently.

Performance result

S.No.	Particulars	Observation
1.	Area	0.20 ha
2.	Subsequent crop	Soybean
3.	Operating crop residue	Wheat
4.	Field capacity	0.30 ha/h
5.	% of residues incorporation	90.8%
6.	Tractor speed	3.6 km/ha

The data presented in [Table-1] revealed that the plant height at 60 days after sowing was significantly influenced (21.63%) by residue incorporate through rotavator during both the year. It was observed that plant height in CRB and CRMR were 45.03, and 54.77 cm. The crop residues significantly influenced the number of pods/plants, which was observed higher in CRMR (39.6 pods/plant) and minimum in CRB (29.9 pods/plant) in year 2008 and 2009. This may be happened due to the decomposition of crop residue fast in the CRMR, because rotavator reduces the size of wheat residue. The data also revealed that that CRMR lead significant enhances on the grain yield of soybean during both the years. The average grain yield observed in CRMR (highest 19.97 qt/ha) was 45.94% higher than CRB (minimum 13.4qt/ha). The higher grain yield under CRMR was due to the higher plant height, number of pods/plant. Similar results were also obtained by [8] and [1] in wheat. Straw yield varied significantly with residue incorporation [Table-1]. The straw yield was observed in treatment CRMR 28.99q ha-1and in treatment CRB it was found 21.39q ha-1. Similar findings were reported by [5]. The data showed [Table-1] that there was significant difference in case of organic carbon percent among various treatments. The CRMR recorded maximum organic content (0.41%) and minimum (0.33%) was in CRB. Our finding corroborates with the finding of [9]. The observation also revealed increasing pattern of organic carbon from 0.35 to 0.40 % in two years, which is main, source of microbial activity, which ultimately enhances nutrient availability in field, and produce higher yield.

Fig-3 Incorporation of wheat residue by Rotavator

Fig-4 Wheat crop residue burned in the field

Table-1 *Effect of different treatment on growth and yield of soybean*

Treatments	Plant height (cm)		Pods / Plant No		Straw yield (q/ ha)		Grain yield (q/ ha)	
	2008	2009	2008	2009	2008	2009	2008	2009
CRB	44.7	45.3	30.49	29.39	21.37	21.41	14.22	13.82
CRMR	54.8	54.8	38.81	40.47	29	28.99	18.26	19.2
% change	22.60	20.97	27.29	37.70	35.70	35.40	28.41	38.93

Conclusion

Burning of crop residue in the open air can be stopped by incorporate in the soil through the rotavator. The crop residues incorporate by rotavator was found best to improved soil health due to decomposition of organic matter. The result revealed that increasing pattern of organic carbon from 0.38 to 0.40 % in two years, which is main source of microbial activity, which ultimately enhanced nutrient availability in field and gave higher yield. (CRB: 14.02 q / ha T2: 18.75 q/ha of soybean crop) over control plots. It was also observed that crop residues significantly influenced the plant height, Pods per plant and straw yield.

Conflict of Interest: None declared

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