

Original Research Article

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Growth and Productivity of Wheat as Influenced by Crop Residue Incorporation under Rice-wheat, Guar-wheat and Cotton-wheat Cropping Systems

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ABSTRACT

Keywords

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A field experiment was conducted during May 2018 to April 2020 at Agricultural Research Farm of Guru Kashi University, Talwandi Sabo, Bathinda. The experiment was carried out by incorporating kharif crops viz., rice, guar, cotton and rabi crop viz., wheat residues. There were twelve treatments in randomized block design with three replications. Incorporation of crop residues (rice straw and wheat straw) resulted in better growth and significantly increased grain yield of wheat. Application of guar and wheat straw to wheat crop results in higher growth attributing characters viz., plant height, number of effective tillers, spike length, number of grains spike⁻¹, grain yield and straw yield of wheat.

Introduction

Conservation agriculture involving zero or minimum-tillage and innovations in crop residue management (CRM) to avoid straw burning should assist in achieving sustainable productivity and allow farmers to reduce nutrient and water inputs, and reduce risk due to climate change. High yields of the irrigated RW system have resulted in production of huge quantities of crop residues (CRs). Crop residues generally left over plant parts of crops after harvest and threshing are important natural resources. The crop residue recycling helps in converting the surplus farm waste into useful products to meet the nutrient

requirements of crops apart from improving the ecological balance of crops production system, but burning of rice straw is common in north-western parts of India causing nutrient losses, and serious air quality problems affecting human health and safety. About 82% of rice residue produced is burnt in the field after harvesting rice by combine harvester, resulting in the substantial loss of plant nutrient there in. Singh *et al.*, (1996) reported beneficial effect of rice straw on wheat yield incorporated 3 weeks before sowing of wheat in clay loam soil. Several studies also revealed that incorporation for crop residue improved not only physical, chemical and biological properties of soil but

also increased wheat yield over burning in the long term experiments. The burning of crop residue and continuous use of chemical fertilizer may cause environment pollution.

Long-term studies of the residue recycling have indicated improvements in physical, chemical and biological health of soil. In intensive cropping system timely agricultural operations are key factors to get maximum returns. The farmers are, therefore, gradually shifting from traditional methods to mechanized farming.

Rice-wheat system has considerable significance to India's food self-sufficiency and food security, but due to intensive application of chemical fertilizer and excessive use of pesticides and irrigation water, the quality of soil health and quality of water become deteriorated day by day which lead to the reduction of crop productivity.

To avoid this problem farmers resort to burning of crop residues, which not only lead to loss of huge biomass but also cause environmental pollution. Farmers in northwest India dispose a large part of rice straw by burning in situ. A large portion of the residues, about 140 million tonnes, is burned in field primarily to clear the field from straw and stubble after the harvest of the preceding crop. The problem is severe in irrigated agriculture, particularly in the mechanized rice-wheat system.

The main reasons for burning crop residues in field include unavailability of labour, high cost in removing the residues and use of combines in rice-wheat cropping system especially in the Indo-Gangetic plains (IGP). So there is a need to adopt ways and means to manage these valuable resources. Incorporation of crop residues alters the soil environment, which in turn 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.

Materials and Methods

The present investigation was carried out in an experimental area of research farm of Guru Kashi University, Talwandi Sabo (Bathinda) during Kharif and Rabi season in the year 2018-20. Talwandi Sabo is located at 29^o 57'N latitude and 75^o 7'E longitude and altitude of 213 meters above the sea levels. This tract is characterized by semi humid climate, where both winters and summers are extreme.

The experiment was laid out in randomized block design with three replications. The crop residue of previous harvested crop was incorporated in the same plot before sowing of next crop in Rice Wheat, Cotton-Wheat and Guar-Wheat cropping system. Total number of plots was 36 and the plot size was 6 m x 4 m.

The experimental data analyzed using Analysis of Variance technique in randomized block design. The LSD at 0.05 per cent of probability were calculated for testing the significance of difference between any two means where, 'F' test was significant.

Results and Discussion

Growth parameters of wheat

Plant height

At harvesting stage, the maximum plant height of wheat crop was obtained with treatment T₉ (103.25 cm) followed by treatment T₁₁ (101.98 cm) and T₁₀ (100.35 cm) which was statistically at par in 2018-19.

During 2019-20, at harvesting stage of wheat crop maximum plant height was obtained with treatment T₉ (114.01 cm) which was significantly better than other treatments. The minimum plant height was recorded with treatment T₈ (97.26 cm). The present results

are similar to the findings of Meelu *et al.*, (1994) reported that incorporation of rice residue 5.0 t ha⁻¹ with recommended dose of fertilizer had increased the height, number of tillers and yield attributes of wheat.

Table.1 Treatment details

Treatments	Kharif 2018/2019	Rabi 2018-19/2019-20
T ₁	Wheat straw to rice	Rice straw to wheat
T ₂	Wheat straw to rice	No Rice straw to wheat
T ₃	No wheat straw to rice	Rice straw to wheat
T ₄	No wheat straw to rice	No Rice straw to wheat
T ₅	Wheat straw to cotton	Cotton straw to wheat
T ₆	Wheat straw to cotton	No Cotton straw to wheat
T ₇	No wheat straw to cotton	Cotton straw to wheat
T ₈	No wheat straw to cotton	No Cotton straw to wheat
T ₉	Wheat straw to guar	Guar straw to wheat
T ₁₀	Wheat straw to guar	No Guar straw to wheat
T ₁₁	No wheat straw to guar	Guar straw to wheat
T ₁₂	No wheat straw to guar	No Guar straw to wheat

Table.2 Effect of crop residue incorporation on plant height and number of effective tillers m⁻² of wheat

Treatment	Plant height (cm)		Number of effective tillers m ⁻²	
	2018-19	2019-20	2018-19	2019-20
T ₁	98.95	107.25	274.34	280.45
T ₂	97.23	104.45	259.16	265.45
T ₃	98.31	106.36	268.48	275.46
T ₄	94.13	103.87	252.64	259.86
T ₅	97.29	101.78	249.36	257.46
T ₆	94.18	100.25	243.68	250.48
T ₇	95.17	101.02	247.32	253.65
T ₈	90.39	97.26	239.78	245.98
T ₉	103.25	114.01	321.25	334
T ₁₀	100.35	109.98	287.36	298.25
T ₁₁	101.98	112.26	301.27	331.25
T ₁₂	99.52	109.02	278.65	290
LSD (p=0.05)	2.9137	1.27	3.1	3.1

Table.3 Effect of crop residue incorporation on spike length, number of grain spike⁻¹, grain yield and straw yield of wheat

Treatment	Spike length (cm)		Number of grain spike-1		Grain yield (q ha ⁻¹)		Straw yield (q ha ⁻¹)	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
T ₁	11.35	14.58	44.50	58.86	53.25	55.98	76.68	82.29
T ₂	10.29	13.28	39.79	52.14	51.61	53.46	73.80	78.59
T ₃	10.98	13.98	44.42	58.09	52.46	54.86	74.49	79.55
T ₄	10.31	13.02	40.93	53.75	50.08	52.14	71.11	76.12
T ₅	11.00	12.96	42.82	49.26	50.59	51.84	71.33	74.65
T ₆	10.16	12.24	40.48	47.56	44.65	46.15	62.96	66.92
T ₇	11.29	12.46	42.23	48.10	50.34	51.74	70.47	74.51
T ₈	9.98	11.78	40.77	46.32	44.84	45.82	62.78	69.65
T ₉	12.20	17.78	46.67	68.36	66.48	69.45	98.39	104.18
T ₁₀	10.21	15.98	39.29	59.12	50.77	58.86	74.64	88.88
T ₁₁	11.48	16.42	43.93	64.28	62.38	65.36	91.07	97.39
T ₁₂	10.17	14.92	40.53	59.42	49.56	56.18	71.87	83.15
LSD(p=0.05)	0.61	0.52	0.79	1.48	1.79	2.17	3.64	2.40

Number of effective tillers m⁻²

A perusal of data in Table 1 reveals that during 2018-19 and 2019-20 the maximum numbers of effective tillers m⁻² of wheat crop were recorded in treatment T₉ (321.25 m⁻² and 334.00 m⁻² respectively), which were significantly superior to other treatments and minimum observation was 245.98 numbers of effective tillers m⁻² in treatment T₈. Similarly Verma and Pandey (2013) reported that the various rice residue and nutrient management systems significantly affect to growth and yield attributes.

Yield attributes of wheat

Spike length (cm)

Critical study data revealed that during 2018-19, the maximum length of spike was recorded in treatment T₉ (12.20 cm), which was significantly higher than other treatments and minimum length of spike was recorded in treatment T₈ (9.98 cm). In 2019-20, the

maximum length of spike of wheat crop was observed in treatment T₉ (17.78 cm), which were significantly superior to other treatments and minimum observation was 11.78 length of spike in treatment T₈. The findings are accordance with Sadeghi and Bahrani (2009) reported that increasing crop residue rates (0, 500 and 1000 kg ha⁻¹) increased the soil organic carbon as well as number of spike per plant, spike length, grains per spike, grains per plant and 1000-grain weight of wheat.

Number of grains spike⁻¹

The Data given in the Table 3 regarding number of grain spike⁻¹ revealed that during 2018-19, the maximum number of grain spike⁻¹ was recorded in treatment T₉ (46.67 grain spike⁻¹), which was significantly higher than other treatments. However, the minimum number of grain spike⁻¹ was recorded in treatment T₂ (39.79 grain spike⁻¹), which was statistically at par with treatment T₂. In 2019-20, the maximum number of grain spike⁻¹ of wheat crop was observed in treatment T₉

(68.36 grain spike⁻¹), which were significantly superior to other treatments and minimum observation was 46.32 number of grain spike⁻¹ was in treatment T₈. These findings are correlate with Nair *et al.*, (1979) observed that legumes namely soybean, cluster bean, pigeon pea, and groundnut grown as intercrop in maize had positive residual effect on the number of grain spike⁻¹, test weight and grain yield of succeeding wheat crop.

Productivity of wheat

Grain yield (q ha⁻¹)

A cursory glance over the data presented in Table 3 indicated that during 2018-19, the maximum grain yield was recorded in treatment T₉ (66.48 q ha⁻¹), which was significantly superior to other treatments. However, the minimum grain yield was recorded in treatment T₆ (44.65 q ha⁻¹), which was significantly lowest. In 2019-20, the maximum grain yield of wheat crop was observed in treatment T₉ (69.45 q ha⁻¹), which were significantly superior to other treatments. The minimum observation was 45.82 q ha⁻¹ grain yields in treatment T₈. These results collaborates the reports of Similarly Kumar *et al.*, (2005) revealed that deep incorporation of rice residue either by disc plough or by mould-board plough proved a better option for effective disposal of rice residue and recorded significantly higher grain yield as well as net returns of wheat.

Straw yield (q ha⁻¹)

From a perusal data of both the years (2018-19 and 2019-20) also it has been observed the significant influences of the treatments on straw yield. However, T₉ have been recorded with the highest straw yield (98.39 q ha⁻¹), which was significantly higher than other treatments. The minimum straw yield was recorded in treatment T₈ (62.78 q ha⁻¹), which

was significantly lowest during 2018-19. In 2019-20, the maximum straw yield of wheat crop was observed in treatment T₉ (104.18 q ha⁻¹), which were significantly superior to other treatments. The minimum observation was 66.92 q ha⁻¹ straw yields in treatment T₆. Our result correlate with Bakht *et al.*, (2009) reported that incorporation of crop residue significantly increased the grain and straw yields of wheat.

In conclusion the application of wheat and rice crop residue with recommended dose of fertilizers in wheat crop gives better results in term of crop growth and yield. Wheat crop grown after cotton stalk incorporation in soil is also beneficial over control treatment but not much better than guar and rice straw incorporation treatments. As a legume, guar stover incorporation in soil before wheat sown gave much better response in terms of grain yield and improvement in soil fertility.

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