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Pallavi Bharti
Department of Soil Science, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

BK Agarwal
Department of Soil Science, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

DK Shahi
Department of Soil Science, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

SB Kumar
Department of Soil Science, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Ashok Kumar Singh
Department of Agronomy, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Pankaj Kumar Ray
Krishi Vigyan Kendra, Saharsa, Bihar, India

Meeta Kumari
Department of Agronomy, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Chitrotpala Dehury
Department of Agronomy, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Corresponding Author:
Pallavi Bharti
Department of Soil Science, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India

Effect of nutrient and crop residue incorporation on yield attributes and yield of soybean

Pallavi Bharti, BK Agarwal, DK Shahi, SB Kumar, Ashok Kumar Singh, Pankaj Kumar Ray, Meeta Kumari and Chitrotpala Dehury

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Abstract
Managing crop residues has become increasingly challenging in modern agricultural systems, balancing the need to produce sufficient food for a growing population with the imperative to preserve soil health. Crop residue burning not only pollutes the air and contributes to global climate change, but it also harms soil health by speeding erosion. Crop residues are a significant contributor to the stability of agricultural ecosystems, an excellent supply of plant nutrients, and a key source of organic matter. A field experiment was conducted at Research Farm of department of Soil Science, Birsa Agricultural University, Ranchi during rabi season of 2021. The experiment was laid out in a Randomized Block Design (RBD) design with three replications comprising of ten treatments viz., T_1-Farmer's practice 18:40:0::N:P_2O_5:K_2O (soybean), T_2- 100% RDF (Kg/ha)::25:60:40:30::N:P_2O_5:K_2O:S(soybean),T_3-100% RDF (25% P_2O_5 as residue incorporation+ 75% basal), T_4-100% RDF+ *Trichoderma viride*, T_5-T_3+*Trichoderma viride*, T_6-75% RDF, T_7-75% RDF (25% P_2O_5 as residue incorporation + 75% basal), T_8-75% RDF + *Trichoderma viride*, T_9-T_7 + *Trichoderma viride* and T_{10}-Control (only crop residue @ 5t/ha in both the crops) respectively. The crop residue incorporation and nutrient management in soybean influenced the yield attributes and yield of soybean with the highest yield attributing characters and yield achieved with the treatment containing 100% RDF (25% P_2O_5 as residue incorporation+75% basal)+*Trichoderma viride* which was at par with 100% RDF N:P_2O_5:K_2O:S (Kg/ha):: 25:60:40:30 (soybean).

Keywords: Crop residue, nutrient management, *Trichoderma viride*, soil health and organic matter

Introduction
Crop residue management has become a challenge for current agricultural systems in order to produce enough food to meet the needs of a growing population while maintaining soil health. As a result, increased crop output generates a considerable amount of residue, making it harder for the farmer to prepare the same land in a short period of time for the next harvest. In order to clean the field, the only option that comes to mind is to burn the residue, believing that it is inexpensive, simple, economical, and takes little time. When burned, the residue emits up to 13 tons of CO_2 ha^{-1}, producing severe air pollution and the death of beneficial soil invertebrates and microbes. Burning straw releases gaseous pollutants such as CO_2, CH_4, CO, N_2O, NOx, SO_2, Ozone, THC, TC, BTX, and a considerable number of particles, all of which have a negative impact on health. Crop residue burning is primarily driven by the short time between harvesting *Kharif* (Rice) and growing *Rabi* (Wheat) crops, labor scarcity, lower industrial demands for crop leftover, and so on (Anuradha *et al*., 2021) [1]. Crop residue burning not only pollutes the air and contributes to global climate change, but it also harms soil health by speeding erosion (Thounaojam Thomas Meetei *et al*., 2019) [6]. Burning debris on the soil surface degrades soil health since soil is a living entity full of microorganisms. The burning of waste kills bacteria, rendering the soil infertile. Also, many micro and macro nutrients that are volatile in nature are easily lost from the soil as a result of residue burning. As a result, there is an urgent need to identify alternative methods for managing agricultural crop residue after harvest.
We need to use sustainable agricultural residue management practices in order to provide safer crop production options (Raza *et al*., 2019) [8]. Crop residue management technologies that are feasible and are used around the world include conservation tillage, nutrient cycling, soil

conversation techniques, zero tillage combined with residue mulching, use as animal feed, and vermicompost preparation (Raza *et al*., 2019) [8]. By managing different soil biochemical features, crop residue management can improve efficiencies and have a promising impact on input utilization (Sarkar *et al*., 2020) [9]. According to Kabirinejad *et al.* (2014) [3], crop residues are a significant contributor to the stability of agricultural ecosystems, an excellent supply of plant nutrients, and a key source of organic matter. They also retain a significant amount of plant nutrients. One strategy to increase soil nutrient content and sustain soil productivity is to recycle crop leftovers (Beres and Kazinczi, 2000) [2]. The combination of residues with NPK fertilizers has improved soil microbial status, maximal production, nutrient absorption, and residual soil fertility. Leguminous crop residues increase crop production and growth by enhancing nutrient availability in the crop root zone (Smitha *et al*., 2019) [11]. The use of crop residues in conjunction with optimal NPK fertilizer levels improves soil physical quality by increasing water retention capacity for maximum water usage. This also improves the biological and chemical quality of the soil environment by increasing cation exchange ability and providing multiple hormones and organic acids, all of which are essential for soil aggregation and beneficial microorganisms involved in various biological processes and nutrient release.

Material and Methods

Site Description

The field experiment were carried out during *Kharif* season of 2022 at Research farm of the Department of Soil Science, Birsa Agricultural University, Ranchi, Jharkhand. Geographically located at an altitude of 625 m above mean sea level, 23'17' North latitude and 85'19' East longitude. The experimental soil was sandy clay loam in texture, acidic in reaction (pH 5.5), soil organic Carbon (4.30 g kg^{-1}), available nitrogen (197.5 kg ha^{-1}), available Phosphorus (24.9 kg ha^{-1}) and available potassium (157.4 kg ha^{-1}) and available sulphur (4.80 ppm) respectively.

Experimental design and treatments

The field experiment was laid out in a Randomized Block Design (RBD) with three replications with soybean *cv.* 'Birsa safed soybean-2' was grown in 2022. There were ten treatments comprising of T_1- Farmer's practice 18:40:0::N:P_2O_5:K_2O (soybean), T_2- 100% RDF (Kg/ha)::25:60:40:30:: N:P_2O_5:K_2O:S (soybean), T_3- 100% RDF (25% P_2O_5 as residue incorporation+ 75% basal), T_4- 100% RDF+ *Trichoderma viride*, T_5- T_3+*Trichoderma viride*, T_6- 75% RDF, T_7- 75% RDF (25% P_2O_5 as residue incorporation + 75% basal), T_8- 75% RDF + *Trichoderma viride*, T_9- T_7 + *Trichoderma viride* and T10- Control (only crop residue @ 5t/ha in both the crops) respectively.

For soybean, field preparation was done with cultivator to get a fine tilth. The crop was sown with row spacing of 45 cm apart and 45 cm plant to plant spacing with a seed rate of 75-80 kg/ ha. The recommended dose of nitrogen (25 kg N/ha), phosphate (60 kg P_2O_5/ha), potash (40 kg K_2O/ha) and sulphur (30 kg S/ha) was applied at the time of sowing.

Results and Discussion

No. of branches per plant

Perusal of data on number of branches/plant in Table 1 reveals that the nutrient and crop residue incorporation in linseed influenced the number of branches of soybean plant. The combined effect of nutrients and crop residue incorporation on soybean resulted in the highest number of branches/plant of soybean crop (4.43) with treatment T_5- 100% RDF (25% P_2O_5 as residue incorporation+ 75% basal)+*Trichoderma viride*, which was at par with T_2-100% RDF N:P_2O_5:K_2O:S (Kg ha^{-1}):: 25:60:40:30 (soybean) (4.10), T_3-100% RDF (25% P_2O_5 as residue incorporation+ 75% basal) (3.93), T_4-100% RDF+ *Trichoderma viride* (4.03) and T_9-75% RDF (25% P_2O_5 as residue incorporation + 75% basal) + *Trichoderma viride* (4.17). This aligns with Mandal *et al*. findings (2004) [5].

Table 1: Effect of nutrient and crop residue incorporation on yield attributing characters of soybean during 2022

Treatments	No. of branches per plant	No. of pod per plant	No. of seed per pod	1000 grain weight (g)
T_1	2.93	18.1	2.13	120.6
T_2	4.10	21.0	2.17	123.0
T_3	3.93	19.7	2.15	122.5
T_4	4.03	21.7	2.17	122.2
T_5	4.43	22.3	2.20	124.4
T_6	3.73	19.9	2.15	121.3
T_7	2.97	19.4	2.15	120.0
T_8	3.57	19.8	2.16	121.7
T_9	4.17	21.1	2.19	123.2
T_{10}	3.23	18.4	2.14	121.0
SEm±	0.22	1.42	0.09	1.70
CD (P=0.05)	0.65	4.22	NS	5.05
CV (%)	10.2	12.2	7.03	2.41

Treatment Details : T_1- Farmer's practice N:P_2O_5:K_2O (Kg/ha) :: 18:40:0 (Soybean), T_2 - 100% RDF N:P_2O_5:K_2O:S (Kg/ha) :: 25:60:40:30 (Soybean), T_3 - 100% RDF (25% P_2O_5 as residue incorporation+ 75% basal), T_4 - 100% RDF+ *Trichoderma viride,* T_5 - T_3+*Trichoderma viride,* T_6 - 75% RDF, T_7 - 75% RDF (25% P_2O_5 as residue incorporation + 75% basal), T_8 - 75% RDF + *Trichoderma viride,* T_9 - T_7 + *Trichoderma viride,* T_{10} - Control (only crop residue @ 5 t/ha in both the crops)

No. of pod per plant

Data on pod/plant given in Table 1. indicate that nutrient management practices and crop residue incorporation did influence the pod/plant of soybean crop. The cumulative effect of crop residue incorporation and nutrient management practices on soybean resulted in the highest number of pod /plant of soybean crop (22.3) with treatment T_5-100% RDF (25% P_2O_5 as residue incorporation+ 75% basal)+*Trichoderma viride*, which was at par with rest all the treatments. Using crop residues not only reduces soil moisture evaporation and maintains soil temperature but also preserves soil structure, thereby improving seed emergence (Singh, 2009) [10] and creating favorable conditions for plant growth and development. Similarly, Ravi *et al.* (2019) [7] found that combining crop residues with recommended fertilizer doses significantly increased soybean plant metrics such as branch and pod numbers, seed index, haulm, and seed yield. Effective management of crop residues is widely recognized as essential for sustaining soil's physical, chemical, and biological functions.

No. of seed per pod

Data on seed/ pod given in Table 1 indicate that nutrient management practices and crop residue incorporation did influence the seed/pod of soybean crop. The cumulative effect of crop residue incorporation and nutrient management practices on soybean resulted in the highest number of seed/ pod of soybean crop (2.20) with treatment T_5-100% RDF (25% P_2O_5 as residue incorporation+ 75% basal)+*Trichoderma viride* which was non significantly at par with rest all the treatments. Using a balanced NPK fertilizer or combining crop residues with Trichoderma viride led to increased soybean yield attributes due to enhanced nutrient availability. These results regarding yield attributes are consistent with Mandal *et al*. findings (2004) [5], which demonstrated that incorporating crop residues into the soil was the most effective treatment among various nutrient management approaches.

1000 grain weight (g)

Varied methods of crop residue incorporation and nutrient management practices in soybean were found to be at par with each other with higher test weight in treatment T_5-100% RDF (25% P_2O_5 as residue incorporation+ 75% basal)+*Trichoderma viride* (124.4 g) and rest all treatments were significantly at par with T_5. The results closely align with those of Ravi *et al*. (2019) [7].

Table 2: Effect of nutrient and crop residue incorporation on grain yield (q/ha) and straw yield (q/ha) of soybean during 2022

Treatments	Grain yield (q/ha)	Straw yield (q/ha)
T_1	16.5	33.5
T_2	22.1	41.5
T_3	20.4	37.8
T_4	21.9	41.8
T_5	24.4	44.9
T_6	20.2	40.6
T_7	18.8	33.9
T_8	19.8	36.7
T_9	22.7	43.8
T_{10}	18.7	37.1
SEm±	1.29	2.18
CD (P=0.05)	3.85	6.48
CV (%)	10.9	9.65

Treatment Details: T_1- Farmer's practice $N:P_2O_5:K_2O$ (Kg/ha) :: 18:40:0 (Soybean), T_2 - 100% RDF $N:P_2O_5:K_2O:S$ (Kg/ha) :: 25:60:40:30 (Soybean), T_3 - 100% RDF (25% P_2O_5 as residue incorporation+ 75% basal), T_4 - 100% RDF+ *Trichoderma viride,* T_5 - T_3+*Trichoderma viride,* T_6 - 75% RDF, T_7 - 75% RDF (25% P_2O_5 as residue incorporation + 75% basal), T_8 - 75% RDF + *Trichoderma viride,* T_9 - T_7 + *Trichoderma viride,* T_{10} - Control (only crop residue @ 5 t/ha in both the crops)

Grain Yield (q/ha)

It is evident from the data presented in Table 2. That the grain yield of soybean crop was affected by crop residue incorporation and nutrient management. Furthermore, T_5-100% RDF (25% P_2O_5 as residue incorporation+ 75% basal)+*Trichoderma viride* had a higher effect on grain yield of soybean crop (24.4 q/ha) and was at par with T_2-100% RDF $N:P_2O_5:K_2O:S$ (Kg ha^{-1}):: 25:60:40:30 (soybean) (22.1 q/ha), T_4-100% RDF+ *Trichoderma viride* (22.1 q/ha) and T_9-75% RDF (25% P_2O_5 as residue incorporation + 75% basal) + *Trichoderma viride* (21.9 q/ha) and T_1- Farmer's practice $N:P_2O_5:K_2O$ (Kg ha^{-1}) :: 18:40:0 (soybean) (16.5 q/ha) which was found to be lowest. Combining crop residues with recommended NPKS fertilization (100% NPKS) increased linseed grain yield compared to using only 100% NPKS. While chemical fertilizers alone significantly boosted linseed yield, integrating crop residues further enhanced yield by synchronizing nutrient availability in the soil. This facilitated better nutrient absorption by plants, promoting root elongation, development, and overall growth of linseed. Sole application of crop residues alone was not effective for optimizing linseed grain yield. Continuous incorporation of residues alongside adequate NPKS significantly improved linseed grain yield compared to other treatments. Retaining residues for extended periods enhances soil microbial diversity and biomass, aids in nutrient recycling, increases soil organic matter content (Liu *et al*., 2011) [4], improves soil quality, creates a favorable soil environment for root growth, and ultimately enhances crop yields (Zhao and Chen, 2008a; Zhou *et al*., 2008) [13, 12].

Strover Yield (q/ha)

In line with the grain yield, stover yield of soybean crop was affected by the nutrient and crop residue management options. Treatment T_5-100% RDF (25% P_2O_5 as residue incorporation+ 75% basal)+*Trichoderma viride* impacted highly the soybean stover yield producing the highest quantity of stover (44.9 q/ha) as compared to T_2-100% RDF $N:P_2O_5:K_2O:S$ (Kg ha^{-1}):: 25:60:40:30 (soybean) (41.5 q/ha), which in turn were at par with par with T_4- 100% RDF+ *Trichoderma viride* (41.8 q/ha), T_6-75% RDF (40.6 q/ha) and T_9-75% RDF (25% P_2O_5 as residue incorporation + 75% basal) + *Trichoderma viride* (43.8 q/ha) and the lowest stover yield was recorded with treatment Farmer's practice $N:P_2O_5:K_2O$ (Kg ha^{-1}) :: 18:40:0 (Soybean) (33.5 q/ha). Crop residues contribute to soil fertility by releasing vital plant nutrients, enhancing soil organic matter content, improving aeration and porosity, reducing soil bulk density, and maintaining soil moisture levels. These favorable conditions promote robust plant growth, leading to enhanced photosynthesis, increased accumulation of photosynthates, greater branching, more pod per plant, more seeds per pod, and ultimately higher yields of both grain and straw. The results closely align with those of Zhou *et al.*, 2008 [12].

Conclusion

Among all the crop residue incorporation and nutrient management practices in the soybean crop, 100% RDF (25% P_2O_5 as residue incorporation+ 75% basal)+*Trichoderma viride* influenced the yield attributes and yield more effectively indicating the effect crop residue incorporation and nutrient management in the soybean crop.

References

1. Anuradha Kadian KS, Meena MS. Reasons and awareness levels of farmers on residue burning in Indo-Gangetic Plain of India: An exploratory research, Journal of AgriSearch. 2021;8(1):62-66.
2. Beres I, Kazinczi G. Allelopathic Effects of Shoot Extracts and Residues of Weeds on Field Crops. Allelopathy Journal. 2000;7:93-98.
3. Kabirinejad S, Kalbasi M, Hossein A, Khoshgoftar M, Hoodaji M. Afyuni M. Effect of Incorporation of Crops Residue into Soil on Some Chemical Properties of Soil and Bioavailability of Copper in Soil. Int. J Adv. Biol. Biom. Res. 2014;2(11):2819-2824.
4. Liu DH, Shu L, Chen Q, Chen SH, Chen HL, Zhu ZL. Effects of straw mulching and little- or zero-tillage on microbial diversity and biomass C and N of alluvial soil in Chengdu Plain, China. Chin J Appl Environ Bio. 2011;17:158-161 (in Chinese with English abstract)
5. Mandal KG, Misra AK, Hati KM, Bandyopadhyay KK, Ghos PK, Manoranjan M. Rice residue - management options and effects on soil properties and crop productivity. Journal of Food, Agriculture and Environment. 2004;2(1):224-231.
6. Meetei Thounaojam Thomas, Kundu MC, Devi Yumnam Bijilaxmi, Kumari Nirmala, Sapam Rajeshkumar. Soil Organic Carbon Responses under Different Forest Cover of Manipur. A Review. Int. J Curr. Microbiol. App. Sci. 2019;8(2):2634-2641.
   doi: https://doi.org/10.20546/ijcmas.2019.802.308
7. Ravi S, Jadhav RL, Bhat SN, Kamble Anand. Effect of plant residues on growth and seed yield of soybean. International Journal of Current Microbiology and Applied Science. 2019;8(04):490-495.
8. Raza MH, Abid M, Yan T, Naqvi SAA, Akhtar S. Faisal M. Understanding farmers’ intentions to adopt sustainable crop residue management practices: A structural equation modeling approach. Journal of Cleaner Production. 2019;227:613-623.
9. Sarkar S, Skalicky M, Hossain A, Brestic M, Saha S, Garai S, *et al*. Management of Crop Residues for Improving Input Use Efficiency and Agricultural Sustainability. Sustainability. 2020;12:9808.
10. Singh G. Effects of wheat straw and farmyard manure mulches on overcoming crust effect, improving emergence, growth and yield of soybean and reducing dry matter of weeds. International Journal of Agricultural Research. 2009;4:418-424.
11. Smitha GR, Basak BB, Thondaiman V, Saha A. Nutrient Management through Organics, BioFertilizers and Crop Residues Improves Growth, Yield and Quality of Sacred Basil (*Ocimum Sanctum* Linn). Ind. Crop. Prod. 2019;128:599-606.
12. Zhao GD. The growth and declining of soil microbe amount in root zone and their influence to the plant re-plantation in the apple orchard of Loess Plateau [M.S. thesis], Northwest University of Science and Technology (Chinese), 2008.
13. Zhao P, Chen F. Effects of straw mulching plus nitrogen fertilizer on nitrogen efficiency and grain yield in winter wheat. *Acta Agron Sin*. 2008a;34:1014-1018