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Research Communication

Residual effect of shredded cotton (*Gossypium* species) stalks and fertility levels on productivity, quality parameters and economics of sweet corn (*Zea mays*)

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ABSTRACT

A field experiment was carried out during the winter (*rabi)* season of 2020–21 on sandy clay loam soil of College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, to study the effect of incorporation of cotton (*Gossypium* sp.) stalk on soil-fertility status and yield of succeeding sweet corn (*Zea mays* L.). The treatments comprised 2 levels of residue management, viz. shredded cotton stalks incorporation and no incorporation, and 5 fertility levels, viz. control, 75% Recommended dose of fertilizer (RDF), 100% RDF, 125% RDF and 150% RDF, making 10 treatment combinations. There was no significant impact of residue incorporation on yield and quality parameters of sweet corn over the residue removal but NPK uptake was enhanced with cotton-stalk incorporation. However, higher net returns and benefit : cost (B : C) ratio were obtained with residue removal plots. An application of 150% RDF (300 : 90 : 75 kg NPK/ha) resulted in the significant increase in yield and was at par with 125% RDF (250 : 75 : 62.5 kg NPK/ha). Quality parameter, viz. crude protein (11.6%), was higher with the application of 150% RDF, being at par with 125% RDF. The higher gross returns, net returns and B : C ratio were obtained with 150% RDF. It would be, therefore, advisable to apply 125% RDF (250 : 75 : 62.5 kg NPK/ha) to sweet corn. The interaction effect between residue management and fertility levels was non-significant for all the parameters of sweet corn.

Key words: Cotton residues, Economics, Nutrient Uptake, Productivity, Quality parameters, Sweet corn

Maize (*Zea mays*) is one of the major cereal crops with wider adaptability to diverse agro-climatic conditions. In India, during 2018–19, it was cultivated over an area of 9.18 million ha, with an annual production of 27.23 million tonnes and average productivity of 2,965 kg/ha (DOAC &FW, 2019). While in Telangana State, it was grown in 0.56 million ha with total production of 2.03 million tonnes and productivity of 3,658 kg/ha (DOAC&FW, 2019). Since sweet corn has a very short period of optimum harvest maturity, it can be harvested within 80 to 90 days after sowing. Cotton is an important fibre crop of India, it covered an area of 12.58 million ha, producing 37.0 million bales with an average productivity of 500 kg/ha (DOAC&FW, 2019). Cotton residue are natural resource with tremendous value to farmers and their use can be diversified as animal feed, composting, thatching for rural homes and fuel for domestic and industrial use. The cotton stalks are rich in nutrients, having 51.0, 4.9, 1.0, 0.61, 0.08, 0.43 and 0.12% C, H, N, K, P, Ca and Mg (Anil *et al*., 2014). Farmers are adopting irrigated dry crops such as sweet corn, sesame, vegetables, watermelon and greengram after removal of rainy (*kharif)* season sown cotton depending on water availability and soil type. Most of the farmers are burning the cotton stalks for easy land preparation and sowing of irrigated dry crops. Proper incorporation of cotton stalks into soils enables the farmers to reduce quantity of fertilizers application to succeeding crops. Optimum fertilization is considered to be one of the most important pre-requisites. Sweet corn uses a large amount of soil nutrients as it grows, and it does best with multiple types of fertilizer added at different times throughout the growing season. Current research was undertaken to properly manage the cotton stalks residue to protect the environment without reducing sweet corn production.

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Keeping the above point of view, the present work was planned to evaluate the effect of cotton stalks on yield of succeeding sweet corn, and to find out the optimum dose of NPK to sweet corn upon cotton stalks addition.

A field experiment was carried out during the winter (*rabi*) season of 2020–21 at College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad at (17°19'18'' N, 78°24'3'' E and 550 m above mean sea-level). The experiment was laid out in randomized complete block design with factorial concept and replicated thrice. The soil of experimental site was sandy clay loam, slightly alkaline (7.78 *p*H), low in organic carbon (0.34 %), low in available nitrogen (201 kg/ha), very low in available P_2O_5 (28 kg/ha) and high in available K_2O (370 kg/ha), with an electrical conductivity of 0.368 dS/m. Treatments were: RM_1, cotton stalks incorporated, RM_1 without residue; RM_2, F_1, control (no fertilizer); F_2, 75% recommended dose of fertilizer (RDF) (150, 45 and 37.5 kg/ha of N, P and K); F_3, 100% RDF (200, 60 and 50 kg/ha of N, P and K); F_4, 125% RDF (250, 75 and 62.5 kg/ha of N, P and K); F_5, 150% RDF (300, 90 and 75 kg/ha of N, P and K). The cotton stalks collected from preceding crop were shredded (made into small pieces) with cotton shredder. The cotton stalks were incorporated @ 14.5 kg per treatment (cotton stalks have nutrient content of N 0.85%, P 0.08% and K 0.65%). The seeds (sugar 75) were sown at spacing of 60 cm x 30 cm, dibbled @ 1 seed/hill at a depth of 4-5 cm in conventionally tilled soil. Full dose of P and K was applied at the time of sowing through single super phosphate and muriate of potash respectively. The nitrogen was applied in 3 splits as per treatment requirement through urea - 1/3rd N at 20 days after sowing (DAS), 1/3rd N at 40 DAS and remaining N at 60 DAS. Nutrient supplied through cotton stalks need to be evaluated.

Incorporation of cotton stalks did not significantly influence the yield and yield attributes compared with the residue removal (Table 1). In the present study, cotton stalks (shredded) with wider C : N ratio (50.5 : 1) were used. At 45 DAS and at harvesting, the C : N ratio of the cotton was 37.1 : 1 and 31.5 : 1, respectively, when appended with 150% NPK. It was apparent that, the ratio got narrowed down with advancement of time but by the end of crop season, it was still wider (31.5 : 1). It was also observed that, there was a positive balance of NH_4^+ - N and NO_3^- - N pools in cotton stalks applied plots at the end of the crop season, indicating N-mineralization, but it might have not been in the magnitude to effect yield enhancement. Hence, it can be inferred that the yield advantage owing to incorporation of residues with wide C : N ratio may be realized on long-term application, as also reported by Ding *et al*. (2019). Among the fertility levels, an application of 150% RDF, resulted in the highest grain and fodder yields being at par with 125% RDF and significantly superior to the other levels. The lowest grain and fodder yields were recorded with no-fertilizer application (Table 1). Increased fertilizer application enhanced the photosynthesis and CO_2 fixation which could have promoted meristematic activities and physiological activities such as leaf expansion, root development and plant dry-matter accumulation that resulted

Table 1. Effect of incorporation of cotton stalks and fertility levels on yield and economics of sweet corn

Treatment	Cobs/ plant	Green cobs/ha	Green cob yield (t/ha)	Green fodder yield (t/ha)	Harvest Index (%)	Gross returns /ha	Net returns /ha	Benefit : cost ratio
Residue management (RM)								
RM_1	1	79,166	25	28.5	46.7	201,774	148,123	3.8
RM_2	1	79,122	24.7	28.4	46.5	201,360	150,709	4.0
SEm±	0.03	1,894	0.6	0.2	0.7	–	–	–
CD (P=0.05)	NS	NS	NS	NS	NS	–	–	–
Fertility levels (F)								
F_1	0.8	63,333	17.9	23	43.8	146,252	97,187	3.0
F_2	1	79,108	24.1	27.5	46.6	194,475	142,505	3.7
F_3	1	79,166	25.2	28.9	46.7	204,947	152,342	3.9
F_4	1.1	87,035	28.4	31.3	47.6	229,175	175,935	4.3
F_5	1.1	87,083	28.9	31.6	47.7	232,987	179,112	4.3
SEm±	0.05	2,995	0.9	0.4	1.1	–	–	–
CD (P=0.05)	0.14	8,899	2.6	1.2	NS	–	–	–
Interaction (RM × F)								
SEm±	0.1	4,235	1.2	0.6	1.5	–	–	–
CD (P=0.05)	NS	NS	NS	NS	NS	–	–	–

RM_1, Cotton stalks incorporation; RM_2, No incorporation; F_1, Control (No fertilizer); F_2, 75% Recommended dose of fertilizer (RDF); F_3, 100% RDF; F_4, 125% RDF; F_5, 150% RDF.

in increased values of all the growth and yield attributes owing to higher yields, as also reported by Achenef and Patil (2020). Harvest index was not significantly influenced by incorporation of cotton stalks and different fertility levels.

The quality of sweet corn in terms of crude protein and TSS % was analysed. The quality parameters were not significantly influenced by residue management (Table 2). Almaz *et al*. (2017) from Malaysia also reported that, incorporation of maize residue was ineffective in increasing grain quality of succeeding maize crop (protein, brix sugar and oil content). Davari *et al*. (2012) also found that, residue incorporation did not show significant effect on protein yield of rice and wheat in the first year of study. Among fertility levels higher crude protein content was obtained with 150% RDF due to better physiological and biochemical activity of sweet corn under adequate and balanced nutrient supply of 'N' might have enhanced the protein content of kernel as also reported by Oktem *et al.* (2014). There is no significant improvement in TSS %, the TSS value will increase as a result of the decrease in the amount of water with maturation as reported by Abrar *et al*. (2018). The NPK uptake by sweet corn revealed that, in cotton stalk incorporated plots there was significant increase in nitrogen uptake, 22.2, 11.1 and 11.6%, phosphorus uptake, 66.6, 7.4 and 30.3% and potassium uptake, 20.6, 4.6 and 22.7% compared to residue removal at 30, 60 DAS and at harvesting (Table 2). The possible reason of higher P uptake with crop-residue incorporation might be owing to release of native P as a result of acids. Organic acids are highly efficient in reducing P adsorption by eliminating soil adsorption sites and increase the labile phosphorus concentration in soil solution which directly enhanced the crop P uptake during crop growing season, as also reported by Kumawat *et al.* (2018). Among the fertility levels, the maximum NPK uptake was recorded with 150% RDF. Increase in NPK uptake by kernel and fodder may be owing to better root establishment which resulted in better translocation of absorb nutrients from soil and its translocation to plant and seed which may cause higher plant growth, grain and straw yields and ultimately increased the uptake. Our results confirm the findings of Patel *et al.* (2018).

Between residue incorporated plots, gross returns remained similar. However, higher net returns and benefit : cost (B : C) ratio were obtained with no residue incorporation. The higher gross returns, net returns and B : C ratio were realized with application of 150% RDF which was statistically at par with 125% RDF (Table 1). The lowest economic returns were recorded with no fertilizer. Better nutrient use efficiency resulting in increased green cob yield and green fodder yield, fetching higher net returns at increased NPK levels as also reported by Manea *et al*. (2015).

It can be concluded from the study that incorporation of cotton stalks did not influence the yield of succeeding sweet corn. Long-term studies on incorporation of cotton

Table 2. Nutrient uptake and quality parameters of sweet corn as influenced by incorporation of cotton stalks and fertility levels

Treatment	Nutrient uptake (kg/ha)									Quality parameters	
	Nitrogen			Phosphorus			Potassium				
	30 DAS	60 DAS	Harvesting	30 DAS	60 DAS	Harvesting	30 DAS	60 DAS	Harvesting	TSS in kernels (%)	Crude protein (%)
Residue management (RM)											
RM_1	3.3	127.5	228	0.5	24.6	35.2	3.5	47.5	56.6	15.3	10.3
RM_2	2.7	114.8	204	0.3	22.9	27.0	2.9	45.4	46.1	15.2	10.1
SEm±	0.2	2.7	5.5	0.02	0.4	1.7	0.2	0.4	1.7	0.19	0.2
CD (P=0.05)	0.5	8	16.3	0.05	1.3	5.2	0.5	1.3	5.1	NS	NS
Fertility Levels (F)											
F_1	1.3	84.6	127.9	0.2	13	17.7	1.7	28.4	33.1	15.5	7.3
F_2	2.7	117.6	202.1	0.3	22.8	25.7	2.6	39.2	47.1	15.9	8.7
F_3	3	123.9	231.3	0.4	24.0	33.6	3.3	46.6	55.6	16.1	9.8
F_4	3.5	137.0	247.8	0.5	28.4	36.2	3.7	55.9	59.0	16.3	10.8
F_5	4.3	142.7	271.6	0.6	30.6	42.4	4.5	62.1	69.0	16.5	11.4
SEm±	0.3	4.3	8.7	0.03	0.7	2.7	0.3	0.7	2.7	0.29	0.28
CD (P=0.05)	0.8	12.7	25.8	0.1	2	8.1	0.8	2.1	8.1	NS	0.83
Interaction (RM × F)											
SEm±	0.4	6.1	12.3	0.04	1	3.9	0.4	1	3.8	0.41	0.4
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

RM_1, Cotton stalks incorporation; RM_2, No incorporation; F_1, Control (No fertilizer); F_2, 75% Recommended dose of fertilizer (RDF); F_3, 100% RDF; F_4, 125% RDF; F_5, 150% RDF.

stalks needed to be evaluated. Sweet corn responded significantly up to 150% RDF with higher productivity and economics returns. However, 125% RDF was found to be optimum.

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