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Effect of incorporation of cotton stalks and fertility levels on growth of succeeding sweet corn

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Abstract
A field experiment on effect of incorporation of cotton stalk on soil fertility status and yield of succeeding sweet corn was conducted at Professor Jayashankar Telangana State Agriculture University, Rajendranagar, Hyderabad during *rabi* 2020-21. The experiment was laid out in randomized complete block design with factorial concept and replicated thrice. The treatments comprise of two residue management *viz.* cotton stalks incorporation and no incorporation and five levels of fertility levels *viz.* control, 75% RDF, 100% RDF, 125% RDF and 150% RDF. There was no significant impact of residue incorporation on growth characters over the residue removal. 150% RDF resulted in significant increase in growth parameters like plant height, number of leaves plant^{-1}, LAI, SPAD meter reading, dry matter production but at par with 125% RDF. It would be therefore, advisable to apply 125% RDF (250:75:62.5 kg NPK ha^{-1}) to sweet corn.

Keywords: Cotton residues, nitrogen, phosphorus, potassium, sweet corn

Introduction
Maize (*Zea mays*) is one of the major cereal crops with wide adaptability to diverse agro-climatic conditions. During 2018-19 about 1147.6 Mt of maize was produced by over 170 countries from an area of 193.7 M ha with average productivity of 5.92 t ha^{-1} (FAOSTAT, 2020) [8]. Correspondingly in India, it was cultivated over an area of 9.18 M ha with an annual production of 27.23 Mt and average productivity of 2965 kg ha^{-1} (Agricultural Statistics at Glance, 2019) [6]. Sweet corn (*Zea mays saccharata* L.) is one of the commercially used types of maize. It is an exhaustive crop, harvested at milky stage and requires fertile soils for optimum production. 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 fiber crop of India. In India, it covered an area of 12.58 M ha producing 37.0 M bales with an average kapas productivity of 500 kg ha^{-1} during the year 2017-18 (Agriculture at a Glance, 2017-18) [7]. Cotton residues are natural resources 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 stalk are rich in nutrients having 51.0, 4.9, 1.0, 0.61, 0.08, 0.43 and 0.12 per cent C, H, N, K, P, Ca and Mg (Anil *et al*., 2004) [4]. Farmers are adopting irrigated dry (ID) crops such as sweet corn, sesame, vegetables, water melon and green gram after removal of *kharif* sown cotton depending upon water availability and soil type. Most of the farmers are burning the cotton stalks for easy land preparation and sowing of ID crops. Proper incorporation of cotton stalks into soils enable the farmers to reduce quantity of fertilizers application to succeeding crops. Optimum fertilization is considered to be one of the most important pre-requisite. 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. Keeping the above points in view, the present work is planned.

Materials and Method: Field experiment was conducted during *rabi*, 2020-2021 at College farm, Professor Jayashankar Telangana State Agriculture University, Rajendranagar, Hyderabad, Telangana state. 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 in texture and slightly alkaline in reaction (7.78 pH), low in organic carbon (0.34%) and low in available nitrogen (201 kg/ha), low in available P_2O_5 (28 kg/ha) and high in available K_2O (370 kg/ha) with electrical conductivity of 0.368 dS/m. Treatments included were RM_1 - cotton stalks incorporated; RM_2 – No incorporation; F_1- Control (no fertilizer); F2- 75% RDF (150:45:37.5 NPK kg ha^{-1}); F_3- 100% RDF (200:60:50 NPK kg ha^{-1}); F_4-

125% RDF (250:75:62.5 NPK kg ha^{-1}); F_5- 150% RDF (300:90:75 NPK kg ha^{-1}). The cotton stalks which are collected from preceding crop are shredded (made into small pieces) with cotton shredder. The cotton stalks are incorporated @ 14.5 kg per plot. The seeds (sugar 75) were dibbled @ 1 seed hill^{-1} at a depth of 4-5 cm in conventionally tilled soil to get desired plant population, followed by a irrigation to ensure proper and uniform germination. The gross and net plot sizes were 9.6 x 3.0 m^2 and 8.4 x 2.6 m^2 respectively. The nitrogen fertilizer @ 150, 200, 250, 300 N kg ha^{-1} in form of urea; phosphorus fertilizer @ 45, 60, 75, 90 P_2O_5 kg ha^{-1} in form of SSP and 37.5, 50, 62.5, 75 K_2O kg ha^{-1} in form of muriate of potash were calculated and weighed as treatments. Entire phosphorus and potash were applied as basal. Nitrogen was applied as per schedule i.e., 1/3rd N at 20 DAS, 1/3rd N at 40 DAS and remaining 1/3rd N at 60 DAS.

Results and Discussion

Plant height (cm): Incorporation of cotton stalks did not affect plant height significantly with the age of sweet corn (Table 1). Plant height exhibited statistically significant differences due to various fertilizer levels. The application of 150% RDF recorded significantly higher plant height, but it was on par with 125% RDF. Higher plant height might be due to the production of chlorophyll and proteins which resulted in increased cell division, cell elongation, structural and metabolic functions which accelerated vegetative growth and responsible for the significant improvement in plant height with elevated volumes of ‘N', ‘P' and ‘K'. These findings were in acquiescense with Akmal *et al.* (2010) [3], Mukhtar *et al.* (2011) [11] and Thorat *et al.* (2016) [16]. There was no interaction between residue management and fertility levels with respect to plant height.

Table 1: Plant height (cm) of sweet corn as influenced by incorporation of cotton stalks and fertility levels

Treatment	Plant height (cm)		
	30 DAS	60 DAS	Harvest
Residue Management (RM)			
RM_1 - Residue incorporation	33.4	168.7	237.0
RM_2 - Residue removal	32.9	164.0	230.7
SEm ±	0.8	3.2	2.0
CD (P=0.05)	NS	NS	NS
Fertility Levels (F)			
F1- Control	26.5	119.8	205.6
F2- 75% RDF	31.9	150.3	231.9
F3-100% RDF	33.7	179.6	237.7
F4- 125% RDF	35.8	186.0	244.6
F5- 150% RDF	37.6	195.9	249.5
SEm ±	1.2	5.1	3.1
CD (P=0.05)	3.2	13.0	9.3
Interaction (RM x F)			
SEm ±	1.7	7.2	4.4
CD (P=0.05)	NS	NS	NS

Number of leaves plant^{-1}: With regards to the number of leaves plant^{-1}, it remained non significant during 30, 60 DAS and at harvest between the residue management practices. There was no interaction effect of residue management and fertility levels on number of leaves plant^{-1}. Fertility levels had significant effect on number of leaves plant^{-1}. The results of Table 2 revealed that, the number of leaves plant^{-1} produced were higher in 150% RDF, which was statistically on par with 125% RDF, while lowest was recorded from no fertilizer application. The plants grow rapidly and produced more leaves as a result of proper seedling establishment, which resulted in improved uptake of nutrients and water at a faster pace. Increased absorption rate, cell division, and metabolic activities in the plant may result in a higher number of functioning leaves when fertilizer levels are higher. These results are in agreement with Woldesenbet *et al.* (2016) [17], Rajesh and Jitendra. (2014) [13], Paul *et al.* (2019) [12].

Table 2: Number of leaves plant^{-1} of sweet corn as influenced by incorporation of cotton stalks and different fertility levels

Treatment	Number of leaves plant^{-1}		
	30 DAS	60 DAS	Harvest
Residue Management (RM)			
RM_1: Residue incorporation	8.7	12.3	13.4
RM_2: Residue removal	8.6	12.1	13.1
SEm ±	0.1	0.1	0.1
CD (P = 0.05)	NS	NS	NS
Fertility Levels (F)			
F_1: Control	7.5	9.1	10.8
F_2: 75% RDF	8.6	12.5	13.3
F_3: 100% RDF	8.8	12.8	13.7
F_4: 125% RDF	9.0	13.1	14.0
F_5: 150% RDF	9.3	13.6	14.4
SEm ±	0.15	0.2	0.21
CD (P = 0.05)	0.39	0.52	0.54
Interaction (RM x F)			
SEm ±	0.2	0.3	0.3
CD (P = 0.05)	NS	NS	NS

Leaf Area Index: According to results shown in Table 3, LAI remained non significant between the residue management practices during 30, 60 DAS and at harvest. LAI was significantly influenced by the fertility levels. The increasing levels of fertility from 0% to 150% RDF progressively improved the LAI of sweet corn from 30 and 60 DAS. Maximum LAI was observed with 150% RDF followed by 100% RDF. With increase in NPK levels, the leaf area index increased up to 60 DAS respectively and later on declined at harvest due to senescence of older leaves. However, 150% RDF had shown higher LAI which was at par with 125% RDF. The boost in leaf area index was due to a significant increase in leaf primordia, a high rate of cell division, cell expansion, greater amounts of cellular protoplasm as well as increased amounts of proteins all of which contributed to increase in leaf area with higher fertilizer levels. The similar findings were reported by Tajul *et al.* (2013) [15], Gul *et al.* (2015) [9] and Achenef and Patil (2020) [2]. There was no interaction effect of residue management practices and fertility levels on LAI.

SPAD chlorophyll readings: SPAD readings indicate chlorophyll content in the crop. Higher chlorophyll content is the indication of higher photosynthetic efficiency of plants. SPAD were recorded at 75 DAS. However the SPAD readings were not significantly different with residue management (Table 4). Among the different fertility levels the SPAD chlorophyll reading was significantly higher with 150% RDF which was at on par with 125% RDF. The lower values were observed in no fertilizer plots. As available N increases, more leaf chlorophyll is produced and the plant displays increasingly greener leaves. These observations were in line with Bullock and Anderson (1998) [5] and Tajul *et al.* (2013) [15].

Dry matter production (kg ha^{-1}): It is revealed from the Table 5, dry matter production of sweet corn with the cotton stalks incorporation @ 5 t ha^{-1} (RM_1) shown that there is no significant increase in dry matter production compared to residue removal (RM_2) with the age of sweet corn. Dry matter production increased significantly with increase in NPK levels at 30, 60 DAS and harvest. Among the different fertility levels the dry matter production was significantly higher with 150% RDF at 30, 60 DAS and at harvest. However the lowest dry matter production was obtained with no fertilizer application. Higher fertility levels are associated with a higher plant height and photosynthetic activity, which strengthens the source-sink relationship and facilitates for higher dry matter. These findings were in conformity with Manea *et al*. (2015) [10], Shalini Kumari (2017) [14] and Abhishek and Basavanneppa (2020). There was no interaction effect of residue management and fertility levels on dry matter production.

Table 3: Leaf area index of sweet corn as influenced by incorporation of cotton stalks and fertility levels

Treatment	Leaf area index		
	30 DAS	**60 DAS**	**Harvest**
Residue Management (RM)			
RM_1: Residue incorporation	0.52	5.14	4.92
RM_2: Residue removal	0.40	4.84	4.54
S.Em ±	0.01	0.10	0.13
CD (P = 0.05)	NS	NS	NS
Fertility Levels (F)			
F_1: Control	0.24	3.10	2.89
F_2: 75% RDF	0.40	4.96	4.70
F_3: 100% RDF	0.47	5.32	4.99
F_4: 125% RDF	0.59	5.71	5.47
F_5: 150% RDF	0.63	5.86	5.62
SEm ±	0.01	0.16	0.20
CD (P = 0.05)	0.04	0.40	0.50
Interaction (RM x F)			
SEm ±	0.02	0.23	0.29
CD (P = 0.05)	NS	NS	NS

Table 4: SPAD chlorophyll meter readings of sweet corn as influenced by incorporation of cotton stalks and fertility levels

Treatment	SPAD at 75 DAS
Residue Management (RM)	
RM_1: Residue incorporation	54.0
RM_2: Residue removal	53.9
SEm ±	0.9
CD (P = 0.05)	NS
Fertility Levels (F)	
F_1: Control	43.8
F_2: 75% RDF	52.6
F_3: 100% RDF	54.7
F_4: 125% RDF	57.4
F_5: 150% RDF	61.2
SEm ±	1.4
CD (P = 0.05)	4.3
Interaction (RM x F)	
SEm ±	2.0
CD (P = 0.05)	NS

Table 5: Dry matter production (kg ha^{-1}) of sweet corn as influenced by incorporation of cotton stalks and different fertility levels

Treatment	Dry matter production (kg ha^{-1})		
	30 DAS	**60 DAS**	**Harvest**
Residue Management (RM)			
RM_1 - Residue incorporation	269	7909	16617
RM_2 - Residue removal	264	7872	16579
SEm ±	9.3	121.0	223.1
CD (P=0.05)	NS	NS	NS
Fertility Levels (F)			
F1- Control	210	6728	12872
F2- 75% RDF	250	7807	16411
F3-100% RDF	275	7980	17467
F4- 125% RDF	287	8363	17725
F5- 150% RDF	323	8574	18516
SEm ±	14.7	191.2	352.7
CD (P=0.05)	43.8	568.3	848.1
Interaction (RM x F)			
SEm ±	20.9	270.5	498.9
CD (P=0.05)	NS	NS	NS

Conclusion

The salient findings of the investigation are summarized: The use of cotton stalks did not show significant effect on growth parameters compared to residue removal. However higher values are recorded in cotton incorporated plots did not shown negative influence on growth of sweet corn, as cotton stalks have high CN ratios, incorporation of cotton stalks results in temporarily immobilization, reducing its productivity. Proper fertilizer management practices can reduce N immobilization. Placement of N fertilizer below the surface soil layer that is enriched with carbon after incorporation of crop residue, application of N fertilizer at a higher rate than the recommended rate, as starter dose with residue incorporation increased growth parameters. Among the fertility levels 150% RDF (300:90:75 kg NPK ha^{-1}) recorded higher growth parameters compared to 100% RDF. But 150% RDF (F5) was at par with 125% RDF (F4). It would be therefore, advisable to application of 125% RDF (250:75:62.5 kg NPK ha^{-1}) to sweet corn.

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