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Influence of Incorporation of Shredded Cotton Stalks and Fertility Levels on Yield 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 levels of residue management *viz*., Shredded cotton stalks incorporation and no incorporation and five levels of fertility levels *viz* control, 75% RDF, 100% RDF, 125% RDF and 150% RDF. There is no significant impact of residue incorporation on yield attributes and yield over the residue removal. The application of 150% RDF (300:90:75 kg NPK ha^{-1}) resulted in significant increase in number of yield attributes and yield and was at par with 125% RDF (250:75:62.5 kg NPK ha^{-1}). It would be therefore, advisable to application of 125% RDF (250:75:62.5 kg NPK ha^{-1}) to sweet corn. Long term studies on incorporation of cotton stalks and nutrient supply in cropping system need to be evaluated to recommend farmers.

Keywords: Cob Yield, Cotton residues, Fodder yield, RDF % and Sweet Corn.

INTRODUCTION

Maize (*Zea mays*) is one of the major cereal crops with wide adaptability to diverse agro- climatic conditions. Globally, during period, 2018-19 about 1147.6 MT of maize is being produced by over 170 countries from the area of 193.7 Mha with average productivity of 5.92 t ha^{-1} (FAOSTAT, 2020). In India, during 2018-19, it was cultivated over an area of 9.18 Mha with an annual production of 27.23 Mt and average productivity of 2965 kg ha^{-1} (Agricultural Statistics at Glance, 2019). While in Telangana State, it was grown in 5.6 lakh ha with total production of 20.3 lakh tons and productivity of 3658 kg ha^{-1} (Agricultural Statistics at Glance, 2019). 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). 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 Kumar Dubey *et al*., 2004). 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 requires major quantity of soil supplements, and it does great with collective types of fertilizer put on at independent rhythm round the extend prime.

MATERIALS AND METHOD

Field experiment was conducted at College farm, Professor Jayashankar Telangana State Agriculture University, Rajendranagar, Hyderabad, Telangana state during *rabi*, 2020-2021. 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), very 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 - Without residue; F_1- Control (no fertilizer); F_2- 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 treatment. The seeds (sugar 75) were dibbled @ 1 seed $hill^{-1}$ at a depth of 4-5 cm in conventionally tilled soil. The gross and net plot sizes were 9.6 × 3.0 m^2 and 8.4 × 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

Yield attributes. The number of cobs $plant^{-1}$ was not significantly influenced by residue management and their interaction as well. Among fertility levels, higher no. of cobs $plant^{-1}$ was recorded with 150% RDF which was at par with all other treatments except no fertilizer. The lowest no of cobs $plant^{-1}$ was observed with control treatment. This may be due to maximum photosynthetic activity and carbohydrates use within plant that stimulated root growth and development as well as the uptake of other nutrients by Abbas *et al*. (2005); Bakht *et al*. (2007).

The cotton stalks incorporated plots proved to be non-significant in recording values of cob length and cob girth compared to residue removal plots. Application of 150% RDF (300:90:75 NPK kg ha^{-1}) registered highest cob length and cob girth compared to no fertilizer but was at par with 125% RDF and 100% RDF treatments. Similarly, a positive correlation between the level of nitrogen and length of cob was reported by Pokhrel *et al.* (2009); Ahmad *et al.* (2018). The probable reason for longer cob length at a higher level of N could be due to optimum utilization of solar light, higher assimilated production and its conversion to starches resulted in higher cob length. Increased photosynthates translocation to the sink leading to enhanced growth parameters might have resulted in the formation of healthy and longer cobs by Woldesenbet *et al.* (2016); Adhikari *et al.* (2021). There was no interaction effect of residue management and fertility levels on cob length. A similar result was obtained by Majid *et al*. (2017); Saleem *et al*. (2017). The increment of cob diameter could be due to sufficient availability of Nitrogen which is responsible for cell division and cell elongation (Shrestha *et al*., 2018). There was no interaction effect of residue management and fertility levels with respect to cob girth.

Number of kernel rows cob^{-1} of sweet corn was not influenced by either the residue management or fertility levels and their interaction. In contrast to our findings results obtained by Majid *et al*. (2017) who found the increase in kernel row cob^{-1} with the increase in N level.

Number of kernels $rows^{-1}$ of sweet corn did not differ significantly with residue management. 150% RDF registered highest number of kernels row^{-1} compared to no fertilizer but was at par with 125% RDF and 100% RDF which corresponds with the cob length. This result agreed with those reported by Sharifi and Namvar (2016), who recorded the maximum number of kernels row^{-1} by the application of 250 kg N ha^{-1} than lower doses. An increase in the number of kernels row^{-1} at higher NPK levels might be due to the lower competition for nutrients that allowing the plants to accumulate more biomass with a higher capacity to convert more photosynthesis into sink resulting in more kernels row^{-1} by Wasim *et al*. (2017). There was no interaction effect of residue management and fertility levels on number of kernels row^{-1}.

Residue management practices did not differed significantly in cob weight with and without husk. The increase in the NPK levels from 0% to 150% RDF significantly influenced the cob weight with husk. Application of 150% RDF recorded significantly heavier cobs over 75% RDF and no fertilizer application. While it was on par with 125% RDF. Greater availability of photosynthates, metabolites and nutrients to develop reproductive structures seems to have resulted in increased cob weight with these fertility levels by Khazaei *et al*. (2010). Optimum utilization of solar light, higher assimilates production and its conversion to starches resulted in higher kernel number and higher cob weight. Nitrogen being a major constituent of chlorophyll, amino acids and proteins. Phosphorus being the component of energy compounds, viz., ATP, NADP and Potassium serving as an activator or cofactor for various enzymes involved in photosynthesis and CO_2 fixation could have promoted meristematic activities and physiological activities such as leaf expansion, root development and plant dry matter accumulation. These culminate in efficient water, nutrient absorption and translocation to various sinks, resulting in the development of higher sink components such as cob length, cob girth, number of kernels cob^{-1}, cob weight with and without husk by Achenef and Patil (2020).

Test weight was not significantly influenced by residue management and fertility levels. Gursoy *et al*. (2010) also found that chopping and retaining the cotton stalks resulted in lower test weight than the collecting and removal of cotton stalks.

Similar to the growth parameters, yield attributes of sweet corn were also not influenced by residue addition. A review by Chalk *et al.* (2013) showed that the 15N recovery from crop residues ranged from 12.4 to 19.1% in the first season. Ding *et al*. (2019) also found that 16.9% of 15N-labeled maize residue was absorbed by succeeding wheat whereas 35.9% of 15N-labeled urea was absorbed which was attributed to relatively longer release process in the first season. Recovery of crop residues is heavily dependent on the residue quality, which is deemed to a primary controller of the decomposition rate (Zhang *et al*., 2008).

Yield. Incorporation of cotton stalks did not significantly influenced the number of cobs ha^{-1} over the residue removal. Number of cobs ha^{-1} were found to be increased with increased fertility levels from 0% RDF to150% RDF. The maximum number of cobs ha^{-1} were produced with the application of 150% RDF, which was on par with 125% RDF. Whereas lower number of cobs ha^{-1} were obtained with no fertilizer application. Higher amounts of 'N', 'P' and 'K' have a positive impact on physiological processes, plant metabolism, and growth, resulting in more cobs. However, there was no significant interaction effect between residue management and different fertility levels for number of cobs plant^{-1} in sweet corn. There was no significant effect of cotton stalks incorporation in green cob yield and fodder yield over residue removal. Gursoy *et al*. (2010) results of three years field experiment indicated that chopping and retaining the cotton stalks had no significant effect on grain yield of succeeding wheat. Davari *et al*. (2012) also reported that rice yields were unaffected by the residue incorporation in first year of study. Sprunger *et al*. (2019) compared the maize yields in a long-term residue management (10+ years) in Kenya and found that the residue with low C:N ratio (legumes) significantly enhanced the maize yields compared to maize stover with wider C:N ratio. The mineralizable carbon was enhanced by 57% in legume residue applied plots than that of maize stover. Hence, the authors opined that the mineralizable and processed pools of carbon are related to agronomic performance. In the present study, cotton stalks (shredded) with wider C:N ratio (50.5:1) were used. The succeeding sweet corn crop was harvested at 98th DAS. At 45 DAS and harvest, 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 was getting narrowed down with advancement of time but by the end of crop season, it was still wider (31.5:1). The corresponding C:N ratio of the soil were 12.1, 11.9 and 11.6 at initial, 45 DAS and harvest, respectively.

It can also be 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 the N-mineralization, but it might have not been in the magnitude to effect yield enhancement. It was also reflected in nutrient uptake of the crop. Hence, it can be inferred from the above discussion that the yield advantage due to incorporation of residues with wide C:N ratio may be realized on long-term application by Seyed *et al*. (2014), Almaz *et al*. (2017); Ding *et al*. (2019).

The green cob yield and fodder yield was found to be increased with increased fertility levels from 0% RDF to 150% RDF. The maximum green cob yield was produced with the application of 150% RDF, which was on par with 125% RDF. Whereas lower green cob yield was obtained with no fertilizer application. The nutrients augment the supply of carbohydrates to kernels, boosting growth parameters and yield components like cob length, cob girth and number of kernels cob^{-1} can have a direct impact on the production of green cob by Shrestha *et al*. (2018); Sharanabasappa and Basavanneppa (2019). However, there was no significant interaction effect between residue management and fertility levels for green cob yield in sweet corn.

Harvest index was not significantly influenced by residue management and fertility levels. In contrast to our results, Sharifi and Namvar (2016) found the maximum harvest index with the application of 225 kg N ha^{-1}. Similarly, Wajid *et al*. (2007) also found the increase in harvest index with increasing fertilizer dose of NPK levels. There was no interaction effect between residue management and fertility levels for harvest index in sweet corn.

Table 1: Yield attributes of sweet corn as influenced by incorporation of cotton stalks andfertility levels.

Treatment	No. of cobs plant^{-1}	Cob length (cm)	Cob girth (cm)	No of kernel rows	No of kernels row^{-1}
Residue Management (RM)					
RM1 : Cotton stalks incorporation	1.0	19.5	16.6	17.7	37.7
RM2 : No Incorporation	1.0	19.6	16.6	16.9	39.3
SEm ±	0.03	0.5	0.5	0.5	1.0
CD (P=0.05)	NS	NS	NS	NS	NS
Fertility Levels (F)					
F1 : Control (No fertilizers)	0.8	18.0	15.7	16.3	32.3
F2 : 75% RDF	1.0	19.2	16.3	17.3	38.0
F3 : 100% RDF	1.0	19.5	16.5	17.3	39.0
F4 : 125% RDF	1.1	20.5	16.9	17.7	40.0
F5 : 150% RDF	1.1	21.0	17.8	18.0	41.5
SEm ±	0.05	0.6	0.45	0.8	1.1
CD (P=0.05)	0.14	1.5	1.34	NS	3.0
Interaction (RM x F)					
SEm ±	0.1	1.1	1.0	1.2	2.2
CD (P=0.05)	NS	NS	NS	NS	NS

Table 2: Cob weight with and without husk and test weight of sweet corn asinfluenced by incorporation of cotton stalks and different fertility levels.

Treatment	Cob weight with husk (g cob^{-1})	Cob weight without husk (g cob^{-1})	Test weight (g)
Residue Management (RM)			
RM_1 : Cotton stalks incorporation	314	219	27.6
RM_2 : No incorporation	312	218	27.3
SEm ±	1.4	1.5	1.0
CD (P = 0.05)	NS	NS	NS
Fertility Levels (F)			
F_1 : Control (No fertilizers)	283	186	27.0
F_2 : 75% RDF	304	209	27.3
F_3 : 100% RDF	319	229	27.5
F_4 : 125% RDF	327	231	27.7
F_5 : 150% RDF	332	238	27.8
SEm ±	2.4	2.6	1.4
CD (P = 0.05)	7.2	7.7	NS
Interaction (RM × F)			
SEm ±	5.4	5.6	2.0
CD (P = 0.05)	NS	NS	NS

Table 3: Yield of sweet corn as influenced by incorporation of cotton stalks and fertility levels.

Treatment	Yield			
	Green cobs (No. ha^{-1})	Green cob yield (t ha^{-1})	Green fodder yield (t ha^{-1})	Harvest Index (%)
Residue Management (RM)				
RM_1 : Cotton stalks Incorporation	79166	25.0	28.5	46.7
RM_2 : No Incorporation	79122	24.7	28.4	46.5
SEm ±	1894	0.6	0.2	0.7
CD (P = 0.05)	NS	NS	NS	NS
Fertility Levels (F)				
F_1 : Control (No fertilizers)	63333	17.9	23.0	43.8
F_2 : 75% RDF	79108	24.1	27.5	46.6
F_3 : 100% RDF	79166	25.2	28.9	46.7
F_4 : 125% RDF	87035	28.4	31.3	47.6
F_5 : 150% RDF	87083	28.9	31.6	47.7
SEm ±	2995	0.9	0.4	1.1
CD (P = 0.05)	8899	2.6	1.2	NS
Interaction (RM × F)				
SEm ±	4235	1.2	0.6	1.5
CD (P = 0.05)	NS	NS	NS	NS

CONCLUSION

Cotton incorporated plots did not shown negative influence on yields even though, 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. Application of N fertilizer at a higher rate than the recommended rate, as starter dose with residue incorporation increases yields. Among the fertility levels 150% RDF recorded higher yield and on par with 125% RDF. It would be therefore, advisable to application of 125% RDF to sweet corn.

FUTURE SCOPE

Based on research work done, it can be used as reliable work for further reference. Studies on the use of consortia of decomposers for faster decomposition of cotton stalks. Machinery for efficient shredding and incorporation of cotton stalks need to be evaluated.

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Conflict of Interest. None.

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