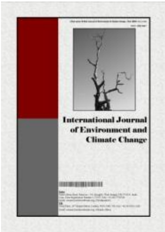

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Effect of Cotton Stalks Residues to Check Fertility Level of Soil, Yield and Energetics of Sweet Corn

K. Bhargavi Reddy [a*#], M. Malla Reddy [a≡], B. Padmaja [bφ] and T. Srijaya [c†]

[a] *Department of Agronomy, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, India.*
[b] *AICRP on Weed Management, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, India.*
[c] *AICRP on STCR, Agricultural Research Institute, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, India.*

Authors' contributions

This work was carried out in collaboration among all authors. Author KBR designed the study and performed the statistical analysis. Authors MMR and BP managed the analysis of study and manuscript correction. Author TS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment on Impact of incorporation of shredded cotton stalks to influence soil fertility status along with production of succeeding sweet corn was organized at college farm, Rajendranagar, Hyderabad in the midst of rabi 2020-21. The demonstration was proportioned in Randomized Block Design (factorial) and replicated thrice. Treatments contain two 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 (Recommended Dose of Fertilizer). Incorporation of cotton stalks did not significantly influenced the grain and fodder yield. Grain and Fodder yield was significantly higher in 125% RDF which was on par with 150% RDF. Incorporation of cotton stalks @ 5 t ha^{-1} (Residue management) before sowing of the succeeding sweet corn did not influence the energy ratio, energy productivity, productivity day^{-1}. 125% RDF recorded higher energy ratio, energy productivity, while higher productivity day^{-1} was observed in 150% RDF.

 # M.Sc. Scholar;
≡ Professor;
φ Principal Scientist (Agronomy);
† Senior Scientist (SSAC);
**Corresponding author: E-mail: katkuribhargavi1904@gmail.com;*

Keywords: Cob yield; energy productivity; energy ratio; fodder yield; productivity per day.

1. INTRODUCTION

Maize (*Zea mays*) is one of the major cereal crops with wide adaptability to diverse agro-climatic conditions. Globally, during the 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} [1]. In India, during 2018-19, it was cultured in an area of 9.18 Mha, producing 27.23 Mt and average capacity is 2965 kg ha^{-1} [2]. 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} [2]. 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, covered an region 12.58 M ha producing 37.0 M bales with an average kapas productivity of 500 kg ha^{-1} during the year 2017-18 [3]. Cotton residues are natural resort with immense merit to farmers and can be diversified as animal feed, composting, thatching and fuel for manufacture. The cotton stalk are rich in nutrients having C, H, N, K, P, Ca and Mg [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 requires major quantity of soil supplements, and it does great with collective types of fertilizer put on at independent rhythm round the extend prime.

2. MATERIALS AND METHODS

Field trials were conducted at College farm, PJTSAU, Rajendranagar, Hyderabad, Telangana state in the course of *rabi*, 2020-2021. The field is design in Randomized block design with factorial concept and replicated thrice. Experimental soil consistency was sandy clay loam and slightly alkaline (7.78 pH), low in OC (0.34 %) low in available nitrogen (201 $kgha^{-1}$), very low in available P_2O_5 (28 $kgha^{-1}$) and high in available K_2O (370 $kgha^{-1}$) with electrical conductivity of 0.368 dSm^{-1}. 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 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}, 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, 1/3rd N at 40 DAS and remaining 1/3rd N at 60 DAS. Energy from inputs and outputs were calculated by converting the physical units of inputs and outputs into respective energy units by using appropriate energy equivalents as given by Mittal and Dhawan, Devasenapathy et al*.*, Alipour et al*.*, and Yadav et al*.* and ratio is worked out. The crop yield obtained was divided by the input energy to get the energy productivity. It was expressed as kg MJ^{-1}. The grain yield obtained was divided by the crop duration to get the productivity day^{-1}. It was expressed as kg ha^{-1} day^{-1}. The duration of the crop from sowing to harvest was calculated and expressed as days.

$$\text{Energy ratio} = \frac{\text{Output energy (MJ)}}{\text{Input energy (MJ)}}$$

$$\text{Energy productivity} = \frac{\text{Crop yield (kg)}}{\text{Input energy (MJ)}}$$

$$\text{Productivity day} - 1 = \frac{\text{Grain yield (kg)}}{\text{Crop duration (days)}}$$

All the data were subjected to analysis of variance (ANOVA) as per the standard procedures. The comparison of treatment of means was made by critical difference (CD) at P=0.05.

3. RESULTS AND DISCUSSION

3.1 Yield

There was no significant effect of cotton stalks incorporation in green cob yield and fodder yield over residue removal. Sprunger et al. [5] 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 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 and fodder yield was produced with the application of 150% RDF, which was on par with 125% RDF. Whereas lower green cob and fodder yield was obtained with no fertilizer application. Enhanced cob yield at higher NPK levels might be due to the lower competition for nutrients which leads to more canopy of plant contributing higher photosynthetic activity to accumulate more biomass. These findings are in agreement with Sharanabasappa and Basavanneppa [6]. However, there was no significant interaction effect between residue management and fertility levels for green cob yield and fodder yield in sweet corn.

3.2 Energetics

Crop cultivation requires application of both animate (bullock, human power) and inanimate (tractors, tillers etc.) forms of energy at different stages. Data on energetic viz., energy ratio, energy productivity and productivity day-1 as influenced by residue management and fertility levels were calculated, analyzed and presented in Table 2.

3.3 Energy Ratio

Energy ratio was obtained by calculating energy consumption called as input energy and output energy for all the treatments by converting the physical inputs and outputs into respective energy units by using appropriate energy equivalents and ratio is worked out. Between residue management, there was no significant difference in energy ratio however, higher energy ratio was obtained with residue removal and lowest was obtained with residue incorporation. Lowest energy was due to more usage of input energy and less output energy. Among the fertility levels higher energy ratio was obtained with 125% RDF and was on par with 150% and 100% RDF.

Table 1. 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)				
RM1 : Cotton stalks Incorporation	79166	25.0	28.5	46.7
RM2 : 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)				
F1 : Control (No fertilizers)	63333	17.9	23.0	43.8
F2 : 75% RDF	79108	24.1	27.5	46.6
F3 : 100% RDF	79166	25.2	28.9	46.7
F4 : 125% RDF	87035	28.4	31.3	47.6
F5 : 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 x F)				
SEm ±	4235	1.2	0.6	1.5
CD (P = 0.05)	NS	NS	NS	NS

Table 2. Energetics of sweet corn as influenced by incorporation of cotton stalks and fertility levels

Treatment	Energy Ratio (MJ)	Energy productivity (kg/MJ)	Productivity day^{-1} (kg ha^{-1} day^{-1})
Residue Management (RM)			
RM1 : Cotton stalks incorporation	7.8	0.44	39.5
RM2 : No Incorporation	8.0	0.46	8.4
SEm ±	0.2	0.01	1.0
CD (P = 0.05)	NS	NS	NS
Fertility Levels (F)			
F1 : Control (No fertilizers)	7.1	0.41	24.8
F2 : 75% RDF	7.9	0.44	38.0
F3 : 100% RDF	8.1	0.46	41.0
F4 : 125% RDF	8.4	0.48	44.5
F5 : 150% RDF	8.3	0.47	45.9
SEm ±	0.1	0.01	1.2
CD (P = 0.05)	0.3	0.03	4.3
Interaction (RM x F)			
SEm ±	0.4	0.02	2.3
CD (P = 0.05)	NS	NS	NS

Table 3. Energy conversion factors used in the field experiment

Input	Equivalent energy (MJ)	Reference
Human labour (Man)	1.96 MJ h^{-1}	Mittal and Dhawan, [8]
Women	1.57 MJ h^{-1}	Mittal and Dhawan, [8]
Farm machinery (Tractor)	64.80 MJ h^{-1}	Devasenapathy et al., [9]
Diesel	56.31 MJ lt^{-1}	Devasenapathy et al., [9]
Sweet corn seed	15.1 MJ kg^{-1}	Singh and Mittal. [10]
Nitrogen	60.60 MJ kg^{-1}	Devasenapathy et al., [9]
Phosphorus	11.10 MJ kg^{-1}	Devasenapathy et al., [9]
Potassium	6.70 MJ kg^{-1}	Devasenapathy et al., [9]
Cotton stalk	16.01 MJ kg^{-1}	Singh and Mittal. [10]
Shredder	18.59 MJ kg^{-1} hr^{-1}	Singh and Mittal. [10]
Water	0.63 MJ 1000 lt^{-1}	Alipour et al., [11]
	Output energy	
Kernel	14.7 MJ kg^{-}	Devasenapathy et al., [9]
Fodder	18 MJ kg^{-1}	Devasenapathy et al., [9]

3.4 Energy Productivity

Energy productivity obtained by dividing crop yield obtained with input energy. Between residue management, there is no significant difference in energy productivity. Higher energy productivity was obtained with 125% RDF and lowest for no fertilizer. Davari et al. [7] also found that the energy output of rice was not affected significantly by residue incorporation.

3.5 Productivity Day^{-1}

There is no significant difference in productivity day^{-1} between the residue management. Higher productivity day-1 was obtained with 150% RDF and lowest for no fertilizer. 150% RDF was on par with 125% RDF. However, there was no significant interaction effect between fertility levels and residue incorporation at on yield, economics and energetics.

4. CONCLUSION

From this study it can be concluded that Energy ratio, Energy productivity (kg MJ^{-1}) and productivity day^{-1} (kg ha^{-1} day^{-1}) were not significantly influenced by incorporation of cotton stalks. Application of 125% RDF recorded higher

Energy ratio, Energy productivity (kg MJ^{-1}) and was on par with 150% RDF. However, higher productivity day^{-1} (kg ha^{-1} day^{-1}) was observed with 150% RDF which was on par with 125% RDF.

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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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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