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Yield, Quality, NPK Uptake and Monetary Returns of Fodder Maize (*Zea mays* L.) as Influenced by Wheat Residue Management and Fertilizer Levels

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A B S T R A C T

A field experiment was conducted at Farming System Research Centre, AICRP-IFS, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat on medium black soil to study the effect of wheat residue management and fertilizer levels on yield, quality, NPK uptake and monitory returns of fodder maize (*Zea mays* L.). Among different residue management treatments, harvesting through combine harvester and straw incorporation in soil + 5 kg madhyam + 25 kg N ha^{-1} recorded higher fodder yield, protein content, NPK uptake, net returns and BCR followed by harvesting through combine harvester and straw incorporation in soil + 5 kg *Trichoderma* + 25 kg N ha^{-1}. Among different fertilizer levels application of 100% RDF recorded significantly highest fodder yield, protein content, NPK uptake, net returns and BCR over rest of the treatments.

Introduction

Maize (*Zea mays* L.) also fondly called as a "king of fodder" due to its great importance in animal diet, as it can be grown throughout the year mainly due to its photo-thermo-insensitive character. Maize is cultivated in diverse production environments ranging from temperate hill zone to the semi-arid region (Singhal, 2003).

In Saurashtra region most of the area during rabi covered by wheat crop which generated huge amount of residues interferes with cultivation practices of next crop and also affect the quality and productivity of fodder maize if it is not properly managed. The quality and productivity of fodder maize can be enhanced considerably if proper fertilizer schedules are followed. So far no systemic study involving crop residue management and fertilizer levels in fodder maize has been conducted under Saurashtra conditions. Hence, the present study was conducted to work out appropriate crop residue management practices and fertilizer levels.

Materials and Methods

A field experiment was conducted at Farming System Research Centre, AICRP-IFS, Department of Agronomy, College of

Agriculture, Junagadh Agricultural University, Junagadh, on medium black soil during summer season of 2015 and 2016 to study the effect of wheat residue management and fertilizer levels on fodder maize (*Zea mays* L.) in medium black soils of Saurashtra. The experiment was laid out in Split Plot Design (SPD) with fifteen treatment combinations and three replications. Treatment comprised of five residue management practices (R_1) no residue incorporation (Manual harvesting), (R_2) harvesting through combine harvester and burning the straw, (R_3) harvesting through combine harvester and straw incorporation in soil, (R_4) harvesting through combine harvester and straw incorporation in soil +5 kg *T. viride* + 25 kg N ha^{-1} and (R_5) harvesting through combine harvester and straw incorporation in soil + 5 kg madhyam + 25 kg N ha^{-1} assigned to main plot and three fertilizer levels as a sub plot treatments *viz*., (F_1) control, (F_2) 50% RDF and (F_3) 100% RDF. Crude protein content of fodder was calculated by multiplying the nitrogen content with a factor 6.25 as proposed by Tsen and Martin (1971) and expressed in terms of per cent protein content. Estimation of nitrogen was done by micro Kjeldhal's method. Phosphorus content in the fodder was determined by Venedomolybdo phosphoric yellow colour method using spectrophotometer and potassium concentration in fodder by Flame photometer method employing the methods given by Jackson (1974).The net plot wise yield was recorded and subjected to statistical analysis Cochran and Cox (1957).

Results and Discussion

Effect of wheat residue management

The data depicted in Table 1 showed that harvesting through combine harvester and straw incorporation in soil + 5 kg madhyam + 25 kg N ha^{-1} (R_5) recorded significantly higher fodder yield (54057 kg ha^{-1}) but it was remained at par with R_4 (harvesting through combine harvester and straw incorporation in soil +5 kg *T. viride* + 25 kg N ha^{-1}). This might be due to, yield of crop is a function of several yield components which are dependent on complimentary interaction between vegetative and reproductive growth of crop. A significant increase in green fodder yield under these treatments because, straw incorporation with microbial inoculants leads to faster decomposition of straw, improved the status of soil organic matter, leading to higher uptake of available nutrients from soil and ultimately increased the growth and yield components. The results are in accordance with the results obtained by Singh and Yadav (2006) and Rajkhowa and Borah (2008).

Data presented in Table 1 indicated that significantly higher protein content (7.03%) were reported in treatment R_5 (harvesting through combine harvester and straw incorporation in soil + 5 kg madhyam + 25 kg N ha^{-1}) as compared to rest of the treatments except R_4 (harvesting through combine harvester and straw incorporation in soil +5 kg *T. viride* + 25 kg N ha^{-1}).

This might be due to increased N content in fodder which might be the results of increased availability of nitrogen to plant. Higher nitrogen content is directly responsible for higher protein because it is a primary component of amino acid which constitutes the basis of protein (Soleymani *et al.,* 2016). In case of fiber content (Table 1) different residue management practices does not influence their significant effect.

Further data presented in Table 1 indicated that treatment R_5 (harvesting through combine harvester and straw incorporation in soil + 5 kg madhyam + 25 kg N ha^{-1}) registered significantly higher N, P and K uptake of 60.62, 12.68 and 59.55 kg ha^{-1} respectively,

which was remained on same line with harvesting through combine harvester and straw incorporation in soil +5 kg *T. viride* + 25 kg N ha^{-1} (R_4) this is because the nutrient uptake is a function of yield and nutrient concentration in plant.

Thus significant improvement in uptake of N, P and K might be attributed to their concentration in fodder and associated with higher fodder yield.

This might also attributed to decomposition of straw inoculated with microorganism may release soluble nutrients chelating compounds, which may improve nutrient uptake Kachroo and Dixit (2005), Yadav *et al.,* (2009) and Pandiaraj *et al.,* (2015).

Treatment R_5 (harvesting through combine harvester and straw incorporation in soil + 5 kg madhyam + 25 kg N ha^{-1}) recorded the highest net realization of ₹ 45029 ha^{-1} with BCR 3.27 followed by treatment R_4 (harvesting through combine harvester and straw incorporation in soil +5 kg *T. viride* + 25 kg N ha^{-1}) with net realization of ₹41855 ha^{-1} and BCR of 3.12.

Effect of fertilizer levels

Result revealed in (Table 1) showed that significantly highest fodder (53200 kg ha^{-1}) was recorded under treatment F_3 (100% RDF) over rest of the levels. This may probably attributed to NPK being part of the essential nutrients required for the promotion of the meristematic and physiological activities such root development, plant dry matter production leading to an efficient absorption and translocation of water and nutrients, interception of solar radiation and assimilation of carbon dioxide. These activities promote higher photosynthetic activities leading to the production of enough assimilates for subsequent translocation towards sink and hence the production of higher yield. These findings closely associated with those of Jalia *et al.,* (2008) and Maqsood and Shehzad (2013).

Application of 100% RDF (F_3) recorded significantly highest protein content (6.80%) over rest of the levels (Table 1). The probable reason behind that higher N content in fodder and subsequently higher N uptake by fodder that supports to enhance protein content under the effect. This could also be explained on the basis of increase in crude protein content was due to fact that P is an important structural component of DNA and RNA. The phosphate group in nucleic acid bridges the RNA or DNA. DNA is the carrier of genetic information and RNAs functions in protein synthesis these findings are in close agreement with the findings of Almodares *et al.,* (2009), Rashid and Iqbal (2012) and Kanduri *et al.,* (2016). In case of fiber content (Table 1) different fertilizer levels does not influence their significant effect.

It is evident from the data that (Table 1) application of 100% RDF (F_3) registered significantly highest N, P and K uptake by fodder of 58.24, 11.90 and 58.34 kg ha^{-1} respectively.

Thus, significant improvement in uptake of N, P and K might be attributed to their respective higher concentration in fodder and associated with higher fodder yield. This might also be attributed to better availability of nutrient in the soil under these treatments Paramasivan *et al.,* (2010), Rashid and Iqbal (2012) and Enjueke (2013).

Data presented in Table 1 indicated that, treatments F_3 (100% RDF) recorded maximum net realization of ₹ 43021 ha^{-1} along with BCR value 3.13. Minimum net realization (₹ 30836 ha^{-1}) with BCR (2.81) was recorded in treatment F_1 (control).

Table.1 Effect of wheat residue management and fertilizer levels of yield, protein content, NPK uptake, net returns and BCR

Treatments	Fodder yield (kg ha^{-1})	Protein content (%)	Fiber content (%)	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})	Net returns ₹ ha^{-1}	B:C ratio
	Main plot (Crop residue management: R)							
R_1	39936	5.72	22.85	36.77	7.01	39.07	28673	2.49
R_2	37620	5.56	22.39	33.69	6.50	35.82	26567	2.43
R_3	45625	5.99	23.04	44.34	8.82	46.65	35900	2.86
R_4	51366	6.88	23.41	57.10	11.74	55.77	41855	3.12
R_5	54057	7.03	23.45	60.62	12.68	59.55	45029	3.27
S.Em±	1288	0.11	0.36	1.59	0.45	1.89	-	-
C. D. at 5%	3860	0.34	NS	5.08	1.34	5.67	-	-
C.V. (%)	12	7.61	6.58	15.46	16.31	16.95	-	-
	Sub plot (Fertilizer levels: F)							
F_1	39668	5.62	22.64	36.01	6.93	38.28	30836	2.81
F_2	44294	6.28	23.16	45.25	9.22	45.49	34552	2.86
F_3	53200	6.80	23.29	58.24	11.90	58.34	43021	3.13
S.Em±	534	0.08	0.21	0.99	0.26	0.86	-	-
C. D. at 5%	1526	0.24	NS	2.84	0.75	2.45	-	-
C.V. (%)	8	7.35	5.01	11.70	13.40	9.91	-	-
Interaction (R×F)	Sig.	NS	NS	Sig.	Sig.	Sig.	-	-

R_1: No residue incorporation (Manual harvesting); R_2:Harvesting through combine harvester and burning the straw; R_3:Harvesting through combine harvester and straw incorporation in soil; R_4: Harvesting through combine harvester and straw incorporation in soil +5 kg *T. viride* + 25 kg N ha^{-1}; R_5:harvesting through combine harvester and straw incorporation in soil + 5 kg madhyam + 25 kg N ha^{-1}

F_1: Control; F_2: 50% RDF; F_3: 100% RDF

Table.2 Interaction effect of wheat residue management and fertilizer levels on Fodder yield of maize

Fertilizer levels	Wheat residue management				
	R_1	R_2	R_3	R_4	R_5
F_1	35449	33625	39533	41827	47908
F_2	38771	36432	41415	52124	52728
F_3	45588	42803	55927	60147	61536
S.Em.±	1688				
C.D. at 5 %	4826				
C.V (%)	8				

Table.3 Interaction effect of wheat residue management and fertilizer levels on NPK uptake by fodder maize

Fertilizer levels	Wheat residue management				
	R_1	**R_2**	**R_3**	**R_4**	**R_5**
N uptake					
F_1	31.11	26.45	33.19	41.82	47.51
F_2	35.41	33.03	40.02	57.11	60.69
F_3	43.77	41.59	59.80	72.38	73.68
S.Em.±	3.14				
C.D. at 5 %	8.98				
CV (%)	11.70				
P uptake					
F_1	5.47	4.98	6.95	8.23	9.04
F_2	6.90	6.31	7.56	12.32	12.99
F_3	8.66	8.20	11.96	14.66	16.00
S.Em.±	0.83				
C.D. at 5 %	2.38				
CV (%)	15.40				
K uptake					
F_1	33.97	29.12	37.49	41.72	49.08
F_2	37.30	34.53	43.07	57.24	55.32
F_3	45.95	43.80	59.38	68.34	74.25
S.Em.±	2.71				
C.D. at 5 %	7.74				
CV (%)	9.91				

Interaction effect

The result presented in (Table: 2) revealed that treatment combination R_5N_3 (harvesting through combine harvester and straw incorporation in soil + 5 kg madhyam + 25 kg N ha^{-1} along with 100% RDF) registered higher fodder yield (61536 kg ha^{-1}) over rest of the treatment combinations but it was remained at par with R_4N_3 (harvesting

through combine harvester and straw incorporation in soil + 5 kg *T. viride* + 25 kg N ha^{-1} along with 100% RDF).

Data furnished in Table 3 showed that treatment combination R_5F_3 (harvesting through combine harvester and straw incorporation in soil + 5 kg madhyam + 25 kg N ha^{-1} + 100% RDF) recorded significantly higher N, P and K uptake of 73.68, 16.00 and 74.25 kg ha^{-1} respectively being at par with R_4F_3 (harvesting through combine harvester and straw incorporation in soil + 5 kg *T. viride* + 25 kg N ha^{-1} + 100% RDF).

It is inferred from the above result that improvement in yield, quality, nutrient uptake and monetary returns was observed in treatment R_5 (harvesting through combine harvester and straw incorporation in soil + 5 kg madhyam + 25 kg N ha^{-1}) and R_4 (harvesting through combine harvester and straw incorporation in soil + 5 kg *T. viride* + 25 kg N ha^{-1}). Nutrient supply through 100% RDF showed highest values for the same parameters.

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