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YIELD, NUTRIENT UPTAKE AND ECONOMICS OF ZERO TILL MAIZE (*ZEA MAYS* L.) AS INFLUENCED BY NUTRIENT MANAGEMENT PRACTICES IN NORTH COASTAL ZONE OF A.P

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ABSTRACT

A field experiment was conducted during *rabi,* 2014-15 at Agricultural College Farm, Naira, Srikakulam (A.P) on sandy loam soils to assess the performance of maize under zero till conditions. The experiment was laid out in split plot design, consisting of three nitrogen levels (S_1: NPK @ 120-60-60 kg ha^{-1}, S_2: NPK @ 180-60-60 kg ha^{-1}, S_3: NPK @ 240-60-60 kg ha^{-1}) and seven micronutrient management practices (supplied through foliar application at 20 & 40 DAS *viz*., F_1: Zn @ 0.2%, F_2: B @ 0.2%, F_3:Zn and B @ 0.2% , F_4 : Mn @ 0.2%, F_5 : Mn and B @ 0.2% , F_6 : micronutrient mixture (Fe, Mn, Zn, Cu, Mo and B) @ 0.2% and F_7 : vermiwash), each replicated thrice. Application of 240 kg N ha^{-1} significantly increased yield attributes and yield. Among the micronutrient management practices, the highest yield structure and yield were noted with foliar feeding of micronutrient mixture. Among interaction effects, application of 240 kg N ha^{-1} and supplemented with foliar application of micronutrient mixture recorded the highest kernel yield (8165 kg ha^{-1}) however it was on a par with same micronutrient management practice at 180 kg N ha^{-1}. With regard to uptake of nutrients by kernel and stover, significantly higher values for N, and micro nutrients were registered with application N @ 240 kg ha^{-1} and supplemented with foliar feeding of micronutrient mixture. Maximum net returns (Rs. 86773 ha^{-1}) and B: C ratio (2.1) were also obtained with the same treatment combination, which was however, on a par with 180 kg N ha^{-1} and supplemented with foliar feeding of micronutrient mixture.

KEY WORDS: Economics, Micronutrients, Nitrogen levels, Nutrient uptake, Kernel yield, Zero till maize

INTRODUCTION

Maize (*Zea mays* L.) is a miracle crop emerging as the third most important cereal crop in the world after wheat and rice. Potentiality of maize for its growth and development can be fully exploited by adopting suitable agronomic practices such as maintenance of optimum crop stand, adoption of proper nutrient and weed management strategy etc. and among them nutrient management holds the key. As greengram and blackgram have been suffering from yellow vein mosaic and Cuscuta problems from the past decade in North Coastal A.P and in the absence of immediate solution to these problems, rice-pulse sequence is gradually being replaced by rice-zero till maize. Due to higher productivity and remunirativeness, the acreage of maize has shown an increasing trend and emerged as a potential alternative to rice fallow pulse. Low fertility is one of the reasons for low productivity of maize and hence, sustainable yield levels could be achieved only by application of appropriate combination of fertilizers. In zero tillage technology, fertilizer application is challenging and therefore to derive potential benefits from maize, a high nutrient feeder, there is every need to improve input use efficiency through timely foliar supplementation with micronutrients besides adequate supply of fertilizers through topdressing. Hence, there is every need to evaluate the best nutrient management package to realize higher productivity of zero till maize.

MATERIALS & METHODS

Field experiment was carried out on wetland block of Agricultural College Farm, Naira, Andhra Pradesh during *rabi*, 2014-15. The soil of the experimental site was sandy loam in texture with a pH of 7.3 and EC of 0.15 dSm^{-1}, low in organic carbon (0.3%) and available nitrogen (257.5 kg ha^{-1}), medium in available phosphorus (22 kg ha^{-1}) and potassium (312.5 kg ha^{-1}). The experiment was laid out in split- plot design with three replications. Healthy and bold seeds of maize hybrid DHM- 117 were dibbled into the soil @ one seed hill^{-1} at a spacing of 60 x 25 cm at a seed rate of 20 kg ha^{-1} on 29th November, 2014. The plot size was 4.8 m × 5 m. The crop received all the recommended package of practices as and when required except nutrient management treatments. The experiment comprised of 21 treatment combinations with three nitrogen levels; NPK @ 120-60-60 kg ha^{-1} (S_1), NPK @ 180-60-60 kg ha^{-1} (S_2), NPK @ 240-60-60 kg ha^{-1} (S_3) allotted to main plots and seven micronutrient management practices (supplied through foliar feeding twice at 20 & 40 DAS) *viz.,* Zn @ 0.2% (F_1), B @ 0.2% (F_2), Zn + B @ 0.2%, (F_3), Mn @ 0.2% (F_4), Mn + B @ 0.2% (F_5), micronutrient mixture (Fe, Mn, Zn, Cu, Mo and B) @ 0.2% (F_6) and vermiwash (F_7) allotted to subplots. Nitrogen was applied as per treatments by hill placement in four equal splits *i.e.* basal, 30-35 DAS, 50-55 DAS and 65-70 DAS through urea. Entire phosphorous was applied at the time of sowing through SSP and potassium was applied in two splits *i.e.,* half as basal dose and remaining half at tasseling through MOP. Zn, Mn and B were applied in the form of $ZnSO_4$, $MnSO_4$ and $Na_2 B_4O_7$ respectively. The crop was grown on residual soil moisture up to 30 days after sowing and thereafter three light (4 cm depth) irrigations were given at critical stages. The crop was harvested on 27th March, 2015 at maturity when the cobs dried and the entire plants turned yellow.

Biometric observations were recorded on no. of cobs plant^{-1}, no. of kernels cob^{-1}, test weight, kernel yield, stover yield. The plant and kernel samples were collected at harvest and analyzed for N and micronutrient uptake by adopting standard methods. The experimental data were statistically analysed by using Fisher´s method of analysis of variance as outlined by Panse and Sukhatme. Critical Difference (CD) was calculated wherever F-test was found significant. The level of significance used in F- test was five percent.

RESULTS & DISCUSSION

Effect of Nitrogen Levels on Yield attributes and yield

Number of cobs plant^{-1} did not alter significantly due to added levels of nitrogen however, significant increase in number of kernels cob^{-1} and test weight were observed with the highest (240 kg ha^{-1}) level of nitrogen supplied (S_3) while, the lowest values were associated with the lowest (120 kg ha-1) nitrogen level (S_1). Significantly higher kernel as well as stover yield were obtained with S_3 while, it was minimum with the lowest dose of nitrogen (S_1). A gradual and progressive increase in kernel yield (from 5589 to 7297 kg ha^{-1}) was observed with increase in N dose from 120 to 240 kg ha^{-1}. Incremental dose of nitrogen increased the kernel yield of maize to the tune of 18.7 % and 30.6 % with application of 180 (S_2) and 240 kg ha^{-1} (S_3) respectively over the lowest level of nitrogen (120 kg ha^{-1}) supplied. Increased availability of nitrogen at the eco-rhizosphere of maize due to incremental dose of N might have enabled zero till maize to produce significantly higher yield attributes. The highest kernel and stover yield with increased levels of nitrogen supplied was the result of better kernel filling due to increased photosynthetic activity owing to larger leaf area and higher dry matter production. These results were in corroboration with the findings of earlier researchers (Malla Reddy and Padmaja, 2014).

Nutrient uptake

Significantly higher values for uptake of N by kernel and stover were registered with S_3 while, minimum values were observed with S_1. As regards the uptake of Zn, Fe, Cu, Mn, B and Mo by kernel and stover, the highest values were associated with S_3, which were however, comparable with S_2 in case of Mn uptake by kernel. Uptake of nutrients by kernel and stover was the outcome of increased concentration of these nutrients in the plant parts (kernel and stover). In the present investigation, application of higher levels of nitrogen produced more number of kernels cob^{-1}, higher kernel weight and higher yield that resulted in higher uptake of nutrients by kernel and stover. These results were in corroboration with the findings of earlier researchers (Malla Reddy and Padmaja, 2014).

Economics

The highest gross returns, net returns and B: C ratio was recorded with S_3 (240 kg ha^{-1}) while, the lowest values were recorded with S_1 (N @ 120 kg ha^{-1}).

Effect of Micronutrient Management Practices on Yield attributes and yield

As regards yield attributes like number of cobs plant^{-1}, no. of kernels cob^{-1} and test weight, foliar application of micronutrient mixture @ 0.2% (F_6) registered significantly higher values, which was however on par with application of Mn and B @ 0.2 % (F_5) in case number of cobs plant^{-1} and test weight. The highest kernel yield (7470 kg ha^{-1}) was found with F_6 and the lowest (5718 kg ha^{-1}) was observed with F_1. Significantly higher stover yield of maize (15386 kg ha^{-1}) was registered with F_6 which was however, comparable with F_5. Stover yield was minimum with F_1 (Zn @ 0.2%) which was however, on par with F_4 (Mn @ 0.2%) and F_7 (vermiwash). The clear cut superiority of F_6 (micronutrient mixture @ 0.2% twice) over rest of the micronutrient management practices in enhancing yield of maize could be ascribed to balanced nutrition to maize including bulk of the micronutrients (six) supplied through foliar feeding. These results were in corroboration with the findings of earlier researchers (Malla Reddy and Padmaja, 2014).

Nutrient uptake

Maximum values for uptake of N by kernel and stover were observed with F_6, which was however comparable with F_5 in case of N uptake by kernel. Application of micronutrient mixture (F_6) recorded maximum uptake of all the micronutrients which was however, comparable with F_5 in case of Fe by kernel, F_4 in case of Mn by kernel, which again found on par with F_3 and F_4 in case of Mn and Cu by stover. Supplementation of micronutrient mixture (F_6) through foliar feeding in the presence of sufficient quantities of macro nutrient elements during the peak physiological requirements of maize might have helped formation of a congenial nutriophysiology to produce huge kernel yield. Higher uptake of nutrients by kernel and stover due to foliar application of a combination of micronutrients was widely documented by a number of earlier workers. Similar findings were observed with Reddi Ramu and Reddy (2007).

Economics

Maximum gross returns, net returns and B: C ratios were realized with foliar application of micronutrient mixture @ 0.2% (F_6) while, the lowest gross returns, net returns and B: C ratio were noticed with F_1 (Zn @ 0.2 %) which was however, comparable with F_4 (Mn @ 0.2%).

Interaction Effect of Nitrogen and Micronutrients on Yield attributes and yield

The interaction effect between nitrogen levels and micronutrient management practices was found absent in case of no. of cobs plant^{-1} and test weight. Regarding number of kernels cob^{-1}, higher values were observed when the highest level of nitrogen (S_3) was supplemented with micronutrient mixture @ 0.2 % (F_6), and found significantly superior over rest of the combinations while, it was minimum with the lowest level of nitrogen and supplemented with F_1 (Zn @ 0.2 %) which was however, comparable with F_2, F_3, F_4 and F_7 at the same level of N and F_4 at S_2 (N @ 180 kg ha^{-1}).

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TABLE 1: Yield attributes, yield and economics of zero till maize as influenced by different N levels and micronutrients

Treatments	No. of cobs plant^{-1}	No. of kernels cob^{-1}	Test weight (g)	Kernel yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Gross Returns (Rs. ha^{-1})	Net Returns (Rs. ha^{-1})	B:C ratio
Nitrogen Levels (Soil application: kg ha^{-1})								
S_1: 120	1.2	487.1	22.2	5589	12301	87185	47172	1.2
S_2: 180	1.2	510.5	23.7	6635	14292	103353	62600	1.5
S_3: 240	1.2	537.5	24.4	7297	16521	114067	72573	1.8
S.Em ±	0.1	3.8	0.2	122.8	113.5	1793.9	1793.3	0.04
CD (P=0.05)	NS	14.8	NS	481.9	445.7	7042.9	7042.9	0.2
CV (%)	18.3	3.4	3.2	8.7	3.6	8.1	13.5	13.2
Micronutrient management practices (Foliar feeding @ 0.2% at 20, 40 DAS)								
F_1: Zn	1.0	489.5	22.9	5718	13620	89716	49204	1.2
F_2: B	1.0	504.9	23.2	6428	14298	100350	59583	1.5
F_3: Zn+ B	1.1	517.0	23.5	6713	14553	104615	63234	1.5
F_4: Mn	1.0	490.6	23.0	5991	13634	93693	52925	1.3
F_5: Mn+ B	1.4	522.3	23.9	6972	14997	108594	66957	1.6
F_6: Micronutrient mixture	1.7	559.1	24.4	7470	15386	116005	75746	1.9
F_7: Vermiwash	1.1	498.3	23.1	6256	14112	97773	57824	1.4
S.Em ±	0.1	4.0	0.3	146.2	172.1	2118.5	2118.5	0.05
CD (P=0.05)	0.3	11.5	0.9	419.3	493.5	6075.9	6075.8	0.1
CV (%)	29.6	2.4	3.2	6.7	3.6	6.3	10.5	10.3
INTERACTION								
S.Em ±	0.2	7.5	0.5	264.6	298.3	3841.7	3841.7	0.09
CD (P=0.05)	NS	23.5	NS	819.2	901.3	11904.4	11904.4	0.3

TABLE 2. Uptake of nutrients by kernel and stover of zero till

Treatments	Uptake by kernel (g ha^{-1})							Uptake by stover (g ha^{-1})						
	N (kg ha^{-1})	Zn	Fe	Cu	Mn	B	Mo	N (kg ha^{-1})	Zn	Fe	Cu	Mn	B	Mo
Nitrogen Levels (Soil application: kg ha^{-1})														
S_1: 120	58.4	433.7	97.4	26.4	42.6	101.6	5.0	49.4	410.5	474.6	47.0	287.7	258.4	7.8
S_2: 180	61.0	524.0	124.9	34.3	47.2	129.4	6.2	62.0	467.9	575.9	50.0	358.1	326.2	9.8
S_3: 240	73.0	618.6	187.6	44.0	49.7	141.5	7.1	71.7	569.9	667.0	55.6	432.8	364.7	11.9
S.Em ±	2.8	2.7	1.8	0.4	0.7	1.4	0.04	0.9	8.0	18.6	0.5	15.6	10.9	0.2
CD (P=0.05)	11.3	10.7	7.2	1.4	2.79	5.5	0.2	3.4	31.5	73.2	2.1	41.1	26.5	0.6
CV (%)	20.6	2.4	6.2	4.8	7.02	5.1	3.5	6.5	7.6	14.9	4.8	13.3	9.8	7.3
Micronutrient management practices (Foliar feeding @ 0.2% at 20, 40 DAS)														
F_1: Zn	54.7	525.5	102.2	22.8	23.7	97.0	5.2	55.1	506.5	521.5	45.9	270.0	265.0	8.8
F_2: B	60.8	497.5	109.8	32.5	42.2	133.6	5.8	57.5	406.2	499.9	51.2	319.1	325.1	9.3
F_3: Zn+ B	68.6	558.2	144.1	35.9	47.4	132.7	6.5	61.1	517.5	579.5	52.9	374.7	328.0	10.4
F_4: Mn	60.5	464.2	108.7	30.3	58.6	102.5	5.3	58.9	466.3	515.2	51.8	372.4	284.6	8.7
F_5: Mn+ B	73.8	527.1	184.6	34.0	59.0	129.8	6.7	64.8	485.4	599.0	52.8	407.6	329.9	10.7
F_6:Micronutrient mixture	76.6	645.2	194.2	59.1	59.7	162.9	7.3	72.6	557.3	761.5	54.1	413.7	384.0	11.4
F_7: Vermiwash	54.1	460.4	112.3	29.6	34.9	110.7	5.7	57.4	440.0	531.2	47.4	359.2	298.4	9.3
S.Em ±	1.0	6.1	3.5	0.6	0.7	1.9	0.1	1.3	9.4	17.3	0.9	15.6	10.9	0.2
CD (P=0.05)	2.9	17.6	9.9	1.6	2.1	5.4	0.3	3.6	27.1	49.5	2.8	44.7	31.3	0.6
CV (%)	4.8	3.5	7.7	4.9	4.7	4.6	5.4	6.2	5.9	9.1	5.9	13.0	10.4	6.3
INTERACTION														
S.Em ±	3.3	10.2	5.9	1.0	1.4	3.3	0.2	2.2	17.1	33.4	1.7	27.1	18.8	0.4
CD (P=0.05)	12.2	30.1	17.5	2.9	4.3	10.2	0.5	6.7	53.1	NS	5.0	NS	56.4	1.1

As regards kernel yield, significantly higher values were obtained with the highest level of nitrogen tried (240 kg ha^{-1}) and supplemented with micro nutrient mixture (F_6) which was however, found parity with F_5 (Mn and B @ 0.2 %), F_3 (Zn and B @ 0.2%) at the same level of nitrogen and F_6 at 180 kg N ha^{-1} (S_2). Kernel yield was minimum with foliar application of Zn alone (F_1) at the lowest level of nitrogen supplied (120 kg ha^{-1}). The highest stover yield was obtained with S_3 at F_6. Stover yield was minimum with S_1 at F_4 which was however, on a par with F_2 and F_5 at the same level of nitrogen. The synergism between the highest level of nitrogen supplied to maize crop and supplemented with foliar feeding of a mixture of micronutrients was very much reflected in this study. Either additive or synergistic interaction effect at higher level of nitrogen when supplemented with foliar feeding of micronutrients is quite common in crops like maize having elevated yield potential. Similar views were also expressed by Malla Reddy and Padmaja (2013) and Usha kiran and Joy Dawson (2013) which are in conformity with the present results.

Nutrient uptake

Maximum uptake of N by kernel and stover was noticed with S_3 at F_6 and which was however, found parity with F_5 at S_3 in case of N uptake by kernel. The interaction effect was also found significant for micronutrients uptake except for of Fe and Mn by stover. The highest values for uptake of Zn, Cu, B and Mo by kernel and stover were recorded with S_3 at F_6 which was however, on a par with F_6 at S_2 in the case of Zn by kernel. F_3 and F_4 at S_3 registered maximum Cu uptake by stover. Irrespective of the nitrogen level, foliar feeding of F_4, F_5 and F_6 were found significantly superior to rest of the treatment combinations in the uptake of Mn. Significantly higher values for uptake of micronutrients (Zn, Fe, Cu, Mn, B and Mo) by kernel and stover were recorded in treatments which received the micronutrient mixture (F_6) as foliar spray at the highest level of nitrogen tried (S_3). Significantly higher uptake of individual micronutrients by kernel and stover were observed in the treatments where that particular nutrient was supplied as foliar feeding either alone or in combination with other micronutrients. Supplementation of micronutrients through foliar feeding directly involves in various physiological processes and accumulates in higher concentrations in the plant parts (kernel or stover). The results clearly revealed that foliar application of micronutrient mixture, consisting of different micro nutrient elements could only avert the possible hidden hunger besides playing a synergistic role in the mineral nutrition of zero till maize to scale up the production potential. Similar findings were also reported by Usha Kiran and Joy Dawson (2013) and Azhar Ghaffari *et al*. (2011).

Economics

The highest gross and net returns were obtained with S_3 (240 kg N ha^{-1}) at F_6 (micronutrient mixture @ 0.2%) which was however, on par with F_5 (Mn and B @ 0.2 %) at the same level of N and S_2 (N @ 180 kg ha^{-1}) at F_6. While, the lowest values were recorded with S_1 at F_1. The B: C ratio was maximum with S_3 at F_6 which was however, found parity with S_2 at F_6. While, it was the lowest with S_1 (120 kg N ha^{-1}) at F_1 (Zn @ 0.2 %).

Thus it can be concluded that gradual response was observed with the application of 240 kg N ha^{-1} to zero till maize. Foliar feeding of micronutrient mixture was found encouraging and economical. With regard to interaction effect, application of 240 kg N ha^{-1}, and supplemented with micronutrient mixture together is essential for realizing the highest kernel yield and maximum uptake of nutrients by kernel and stover, which was however, comparable with S_2 at F_6 in case of kernel yield. . The B: C ratio was highest (2.1) with S_3 at F_6 which was however, found on par with S_2 at F_6 (2.0) indicating that there was a realization of Rs. 2/- per every Re.1/- invested in maize cultivation under zero till cultivation in North Coastal zone of A.P.

REFERENCES

Azhar Ghaffari, Asghar Ali, Muhammad Tahir, Muhammad Waseem, Muhammad Ayub, Asif Iqbal and Atta Ullah Mohsin. 2011. Influence of integrated nutrients on growth, yield and quality of maize (*Zea mays* L.). American Journal of Plant Sciences. 2: 63 – 69.

Malla Reddy and Padmaja. 2014. Productivity and water use efficiency of no-till winter (rabi) maize (*Zea mays* L.) as influenced by drip fertigation. Indian Journal of Agronomy. 59 (1): 96-100.

Panse V.G. and Sukhatme P V. 1978. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi, pp. 361.

Reddi Ramu Y and Reddy D S. 2007. Effect of micronutrient management on growth, yield, quality and economics of hybrid maize. Crop Research 33 (1, 2 &3): 46-49.

Usha Kiran K and Joy Dawson. 2013. Influence of nutrient sources on growth and yield of maize (*Zea mays* L.) CV. DMH 123. Society for Science Development in Agriculture and Technology. 8: 203-204.