International Journal of Agricultural Sciences
Volume 12 | Issue 1 | January, 2016 | 134-138 ■ e ISSN-0976-5670
DOI:10.15740/HAS/IJAS/12.1/134-138
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A CASE STUDY

On farm demonstration of zero tillage maize in farmers fields of Anantapuram district of Andhra Pradesh

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Abstract : On farm demonstrations were conducted in farmers fields to popularize zero tillage maize technology among farmers under supervision of DAATT Centre (Extension unit of Acharya N.G. Ranga Agricultural University, Andhra Pradesh), Anantapuram for four years during *Rabi*, 2011-12, 2012-13, 2013-14 and 2014-15. The comparison was made between zero tillage maize and farmers practice (traditional maize cultivation) with an objective to obtain higher maize productivity and net returns in farmers fields under zero tilled conditions. Results revealed that higher cob length of 17.4 cm was recorded with zero tillage maize compared to farmers practice (15.5 cm). Higher grain weight per plant of 129 g was recorded with zero tillage maize compared to farmers practice (115 g). There were more number of grains per cob (421) in zero tillage maize as compared to 385 grains per cob in farmers practice. Higher 100 grain weight of 26.2 g was recorded with zero tillage maize compared to farmers practice (23.6 g). In zero tillage maize cob length, grain weight / plant, number of grains/cob and 100 grain weight were increased by 12.3, 12.2, 9.4 and 11.0 per cent, respectively over farmers practice. Zero tillage maize recorded higher grain yield (6250 kg ha^{-1}) and stover yield (7750 kg ha^{-1}) which was 11.4 and 6.9 per cent, respectively higher over farmers practice (5610 kg ha^{-1} grain yield and 7250 kg ha^{-1} stover yield). Gross returns (Rs. 93,750/-) and net returns (Rs. 78,000/-) per hectare were more with zero tillage maize compared to farmers practice (Rs. 84,150/- gross returns and Rs. 62,500/-net returns). Simultaneously cost benefit ratio was higher with zero tillage maize (1:5.9) compared to farmers practice (1:3.9) because of lower cost of cultivation and improved yield with zero tillage maize. In zero tillage maize cost of cultivation was reduced by 27.3 per cent whereas, gross returns and net returns were improved by 11.4 and 24.8 per cent, respectively over farmers practice.

Key Words : : On farm demonstration, Zero tillage maize, Farmers fields

View Point Article : Kumari, C. Radha and Sudheer, John M. (2016). On farm demonstration of zero tillage maize in farmers fields of Anantapuram district of Andhra Pradesh. *Internat. J. agric. Sci.*, **12** (1) : 134-138.

Article History : Received : 15.09.2015**; Accepted :** 26.12.2015

INTRODUCTION

Andhra Pradesh is the non-traditional maize growing state but, the climate of the state is very favourable for the maize crop and hence maize can be grown in any season in the state. Maize crop has been cultivated in Andhra Pradesh since 1999. Since then acreage over a decade period from 1999 to 2009 had increased from 3.60 lakh acres to 5.30 lakh acres in *Kharif*, 0.92 lakh acres to 3.58 lakh acres in *Rabi*. Maize is occupying more acreage under non-traditional season as well as non-traditional areas that indicates that maize is emerging

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as one of the potential driver for crop diversification in the state. Moreover, winter maize is more assured crop with higher productivity potential compared to monsoon season. Therefore, areas where winter rice crop suffers due to water scarcity, the maize has emerged as potential alternative like Guntur, Krishna and west Godavari districts. This shift is due to no-till maize in rice-maize system and cultivation of single cross hybrids. The productivity of the crop varied between 2205 kg per ha to 4581 kg per ha depending on the availability of moisture and favourable conditions during *Kharif*. In *Rabi crop*, maize crop cultivated under irrigated conditions produced yield ranging between 2996 kg per ha to 4930 kg per ha.

Rice-relay pulse crop sequence is an important crop sequence covering three lakh hectares in Andhra Pradesh. Due to problems of yellow vein mosaic in green gram and blackgram rice-pulse sequence was replaced by rice zero till maize sequence. In the conventional rice-maize cropping system, due to efficient land preparation after rice, the problem of rejuvenation of rice stubble was not encountered and initial weed problem is solved by pre emergence application of atrazine. In rice relay pulse crop sequence, the broadcast of presoaked seeds in rice crop 10 days prior to harvest in standing crop, three times high seed rate, ephemeral crop growth nature prevented rejuvenation of rice stubbles and initial weed growth without any weed control measure. But these problems are encountered in present rice- zero till maize due to sowing of maize crop after rice harvest, wide spacing, erect and slow early growth nature of crop. These problems of rejuvenation of rice stubbles and initial weed growth can be controlled by herbicide application. Among herbicide treatments, use of paraquat as pre-emergence application for controlling rejuvenation of rice stubbles in zero-till maize was superior to pre-emergence application of atrazine and no-herbicide treatment. On the other hand pre-emergence application of atrazine was more effective in controlling first flush of weeds than paraquat and no-herbicide treatment (Mukundam *et al*., 2011). Herbicide treatments, consequent to termination of rice stubble and weed competition, promoted plant growth, dry matter production, nutrient uptake, yield structure and yield of maize and consequently productivity and economics of the system as compared to no-herbicide treatment. Rice-zero till maize irrespective of the herbicide supplementation gave higher rice equivalent yield, net returns and benefit of cost when compared to existing rice-pulse sequence (Mukundam *et al*., 2011).

Under conventional tillage for planting maize under heavy textured soil of rice ecologies needs 25-30 per cent higher energy for field preparation that not only limits the farm profitability but also delays planting of maize which in turn leads to lower productivity. Generally rice is harvested during second fortnight of November in case of zero tillage under rice-maize rotation the farmers can plant maize in time but if maize is planted after repeated conventional tillage, the planting gets delayed for ploughing and farmers have to wait for optimum soil moisture. Further the no till maize in rice fallow demonstrated a potential benefit of saving on cost of production changing from Rs. 3800-5500 ha^{-1} (DMR Technical Bulletin, 2009). Cultivation of maize gained momentum during *Rabi* season especially under zero tillage in rice fallows in Andhra Pradesh. This technique aids in overcoming planting difficulties in rice fallow, reduces weeds and improves fertilizers and water use efficiency, saves energy and finally reduce cost of cultivation (DMR Technical Bulletin, 2009).

Hence, considering the above points, on farm demonstrations were conducted in farmers fields to popularize zero tillage maize technology among farmers under supervision of DAATT Centre (Extension unit of Acharya N.G. Ranga Agricultural University, Andhra Pradesh), Anantapuram for four years during *Rabi*, 2011-12, 2012-13, 2013-14 and 2014-15. The comparison was made between zero tillage maize and farmers practice (traditional maize cultivation) with an objective to obtain higher maize productivity and net returns in farmers fields under zero tilled conditions.

MATERIAL AND METHODS

Twelve on-farm demonstrations were conducted in rice fallows under no till conditions to popularize benefits of zero tillage maize technology on yield components, yield and economics of maize in three villages of Anantapuram district with an area of 9.6 hectares during *Rabi* season over a period of 4 years from 2011-12, 2012-13, 2013-14 and 2014 -15 (Table A). The treatments consisted of T_1: Zero tillage maize T_2: Farmers practice (Traditional maize cultivation). Plot size for each treatment of on-farm demonstration was 4000 m^2. In each year of on-farm demonstration soil samples were collected from farmer's fields and analyzed at Krishi Vigyan Kendra, Reddipalli (Anantapuram district). The soil analysis revealed that pH varied from 6.1 to 8.3, EC

Table A : Details of on-farm demonstrations

Sr. No.	Year	No. of villages	No. of locations	Area (ha)
1.	2011-12	3	3	2.4
2.	2012-13	3	3	2.4
3.	2013-14	3	3	2.4
4.	2014-15	3	3	2.4
	Total	12	12	9.6

ranged from 0.05 to 0.49 dS m^{-1}, organic carbon was 0.05 to 0.38 per cent, available nitrogen was low in all the samples, available phosphorus was medium to high (36.2 to 67.2 kg ha^{-1}) and available potassium was low to medium (71 to 285 kg ha^{-1}). The *Kharif* season rice was sown with puddling during 3rd week of July and harvested during 1st week of January.

Farmers practice :

After harvesting of *Kharif* rice field was ploughed for 4 to 5 times to break hard pans and to bring soil to fine tilth suitable for sowing of succeeding maize crop. Recommended dose of 120, 60 and 40 kg/ha N, P, K was also applied. Entire dose of P and K along with one third dose of nitrogen was applied as basal placement at a depth of 5 cm and 5-7 cm away from crop rows while remaining two equal splits of nitrogen were top dressed at knee high and tasseling stage. The sources of N, P and K for all the crops were urea, single super phosphate and muriate of potash, respectively.

Zero tillage maize :

After harvesting of *Kharif* rice without ploughing field a light irrigation was given to facilitate good germination of maize. Atrazine + glyphosate @ 2.5 kg/ha and 2.5 l/ha, respectively were sprayed immediately after sowing as pre-emergence to arrest the regrowth of rice stubbles, kill the emerged weeds and control the unemerged weeds. Recommended dose of 120, 60 and 40 kg/ha N, P, K was also applied. Entire dose of P and K along with one third dose of nitrogen was applied as basal placement at a depth of 5 cm and 5-7 cm away from crop rows while remaining two equal splits of nitrogen were top dressed at knee high and tasseling stage. The sources of N, P and K for all the crops were urea, single super phosphate and muriate of potash, respectively.

In both treatments maize variety Kargil super 900M of 110 - 115 days duration was sown at a spacing of 60 cm x 20 cm during four years of demonstration. Maize seed was dibbled manually at a depth of 5 cm @ one seed/hill in the rice fallows. The seeds of maize were treated with imidachloprid @ 2ml and Mancozeb @ 3 g/kg seeds before sowing in both treatments. Irrigations were given whenever it was necessary during the crop growth. The crop was harvested at 125 days after sowing (DAS). At harvest ten plants were randomly selected from each treatment for recording growth parameters such as plant height (cm), cob length (cm), grain weight / plant (g), number of grains/cob and 100 grain weight (g). At harvest in each treatment grain and stover yield from the net plot (5 m x 5 m) was recorded. Both treatments received uniform plant protection and cultural management practices throughout the period of crop growth. Labour charges, cost of inputs were worked out to compute the cost of cultivation. Gross returns were calculated based on local market prices of maize and net returns by subtracting the total cost of cultivation from gross returns. Benefit: cost ratio was computed by dividing gross returns with cost of cultivation.

RESULTS AND DISCUSSION

The results of the on farm demonstrations on zero tillage maize in comparison with farmers practice are given Table 1.

Growth and yield attributes :

Higher cob length of 17.4 cm was recorded with zero tillage maize compared to farmers practice (15.5 cm). Higher grain weight per plant of 129 g was recorded with zero tillage maize compared to farmers practice (115 g). There were more number of grains per cob (421) in zero tillage maize as compared to 385 grains per cob in farmers practice. Higher 100 grain weight of 26.2 g was recorded with zero tillage maize compared to farmers practice (23.6 g).

Winter maize productivity grown under zero-tilled conditions after rice was higher on account of greater values of yield attributes (cob length, grain weight per

plant, number of grains per cob, 100 grain weight). This might be due to favourable and weed free conditions under zero till cultivation might have improved the yield attributes and also crop with optimum source-sink ratio facilitate proper partitioning of photosynthates and thus, resulted in better filling of grains. Minimizing the competition of weeds with main crop for resources *viz*., space, light, nutrients and moisture with application of effective herbicides is important aspect in cultivation of maize under zero till conditions. Paraquat spray on rice stubbles controlled rice stubble rejuvenation but was less effective in controlling first flush of weeds in zero-till sequential maize. Immediately after rice harvest, consequent to removal of apical dominance, the lower buds were stimulated and spray of paraquat on them appear to have instantly killed the emerging cells in the bud and inhibited their growth and rejuvenation. As paraquat was adsorbed by soil particles and was no consequence in control of first flush of weeds. Systemic nature of atrazine did not appear to have impact to suppress the rejuvenation of rice stubbles but could prevent first flush of weeds (Mukundam *et al*., 2011). In zero tillage maize cob length, grain weight / plant, number of grains/cob and 100 grain weight were increased by 12.3, 12.2, 9.4 and 11.0 per cent, respectively over farmers practice.

Grain yield :

Zero tillage maize recorded higher grain yield (6250 kg ha^{-1}) and stover yield (7750 kg ha^{-1}) which was 11.4 and 6.9 per cent, respectively higher over farmers practice (5610 kg ha^{-1} grain yield and 7250 kg ha^{-1} stover yield). Higher cob length, grain weight / plant, number of grains/cob and 100 grain weight might be the reason behind the yield increase in zero tillage maize treatment. Zero till maize supplementation with paraquat and atrazine consequent to termination of the established and existing rice stubble rejuvenation and first flush of weeds and maintenance of early vigour and growth of the crop led to higher nutrient uptake resulting in improved growth, yield attributes and yield of maize as reported by Mukundam *et al*. (2011).

Economics :

Gross returns (Rs.93,750/-) and net returns (Rs. 78,000/-) per hectare were more with zero tillage maize compared to farmers practice (Rs. 84,150/- gross returns and Rs. 62,500/-net returns). This was due to higher grain yield with zero tillage maize. Higher gross returns of Rs.9,600/- per hectare was obtained with zero tillage maize due to higher grain yield compared to farmers practice. The cost of cultivation was comparatively high in farmers practice compared to zero tillage maize. Under conventional tillage for planting maize under heavy textured soil of rice ecologies needs 25-30 per cent higher energy for field preparation that not only limits the farm profitability but also delays planting of maize which in turn leads to lower productivity. Generally rice is harvested during second fortnight of November in case of zero tillage under rice-maize rotation the farmers can plant maize in time but if maize is planted after repeated conventional tillage, the planting gets delayed for ploughing and farmers have to wait for optimum soil moisture (DMR Technical Bulletin, 2009). This cost was reduced in zero tillage maize as there was no repeated plougings to break hard pans to bring soil to fine tilth. Further the no till maize in rice fallow demonstrated a potential benefit of saving on cost of

Table 1 : Yield attributes and yield of maize under zero till conditions (Mean of 4 years data)

Sr. No	Particulars	Zero tillage maize	Farmers practice	% increase or decrease over farmers practice
1.	Cob length (cm)	17.4	15.5	12.3
2.	Grain weight / plant (g)	129	115	12.2
3.	Number of grains/cob	421	385	9.4
4.	100 grain weight (g)	26.2	23.6	11.0
5.	Grain yield (kg/ha)	6250	5610	11.4
6.	Stover yield (kg/ha)	7750	7250	6.9
7.	Cost of cultivation (Rs./ha)	15750	21650	-27.3
8.	Gross returns (Rs./ha)	93750	84150	11.4
9.	Net returns (Rs./ha)	78000	62500	24.8
10.	C: B ratio	1:5.9	1:3.9	53.1

production changing from Rs. 3800-5500 ha^{-1} (DMR Technical Bulletin, 2009). Simultaneously cost benefit ratio was higher with zero tillage maize (1:5.9) compared to farmers practice (1:3.9) because of lower cost of cultivation and improved yield with zero tillage maize. In zero tillage maize cost of cultivation was reduced by 27.3 per cent whereas, gross returns and net returns were improved by 11.4 and 24.8 per cent, respectively over farmers practice. Rice - zero till maize irrespective of the herbicide supplementation gave higher rice equivalent yield, net returns and benefit cost when compared to existing rice-pulse sequence (Mukundam *et al*., 2011).

From the present study, it can be concluded that, maize can be successfully grown without any preparatory tillage under no-till situation with less cost of cultivation and higher profitability besides saving of tillage time and cost. Zero tillage maize was more productive and profitable compared to the traditional maize cultivation.

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