Zero Tillage Method of Maize Cultivation in Visakhapatnam District of North Coastal Zone of Andhra Pradesh

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Abstract— *Maize is a major predominant crop during the Rabi season in the Visakhapatnam district of Andhra Pradesh. Traditionally, farmers grow maize by ploughing fields after paddy harvest and sowing seeds behind the plough or by dibbling, which leads to loss of residual soil moisture and delayed sowing. To conserve this crucial moisture and enable timely sowing, the zero-tillage practice was introduced by the DAATTC, Visakhapatnam, in collaboration with the Department of Agriculture. This method involves sowing maize directly into unploughed fields using a manually operated 'Peg Marker,' eliminating the need for tillage. On-Farm Demonstrations (OFDs) were organized across 16 locations in the district during Rabi 2021-22 and Rabi 2022-23. Zero-tillage maize recorded a significant yield advantage, with an average increase of* ***9.4%*** *(6701 kg/ha vs. 6125 kg/ha in conventional tillage). Economically, the practice was highly beneficial, reducing the cost of cultivation by approximately* ***11.1%*** *(Rs. 3,500/ha) due to savings on tillage and irrigation. Combined with a* ***7-10 day earlier harvest*** *that fetched a premium market price (Rs. 14/kg vs. Rs. 12/kg), zero-tillage resulted in a* ***40.0% higher net income*** *(Rs. 64,401/ha vs. Rs. 42,000/ha) and a superior cost-benefit ratio (3.30 vs. 1.33). The study concludes that zero-tillage maize is a feasible, profitable, and moisture-conserving technology for rice fallows in the region.*

Keywords— Zero tillage, Maize, Peg Marker, On-Farm Demonstrations, Rice fallow, Economics, Residual moisture.

I. INTRODUCTION

Maize (*Zea mays* L.) is one of the most versatile cereals, with high genetic yield potential and adaptability to diverse agro-climatic conditions. In India, maize occupies an area of 9.4 million hectares with a production of 23.0 million tonnes (Anonymous, 2015). In Andhra Pradesh, it is a crucial Rabi season crop. In the North Coastal Zone, the Rice-Maize cropping sequence is rapidly replacing Rice-Pulses due to the latter's susceptibility to weeds, diseases, and low profitability.

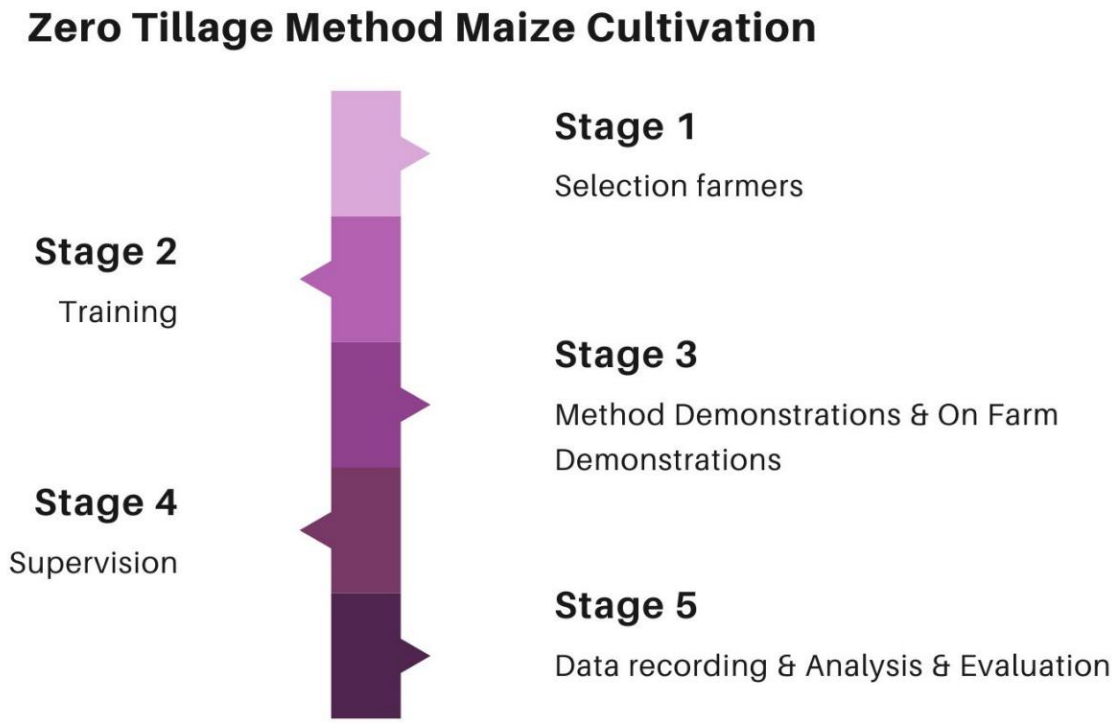
In Visakhapatnam district, maize is traditionally cultivated after Kharif paddy. Farmers plough the field after rice harvest, leading to rapid evaporation of valuable residual soil moisture. Sowing is subsequently delayed, extending the crop cycle into late April. This exposes the crop to terminal heat stress and hot winds, resulting in reduced grain filling, lower yields (4.5-5 t/ha), and depressed market prices due to late arrival. To address this technological gap, the DAATTC, Visakhapatnam, promoted zero-tillage maize cultivation as a strategy to conserve moisture, ensure timely sowing, and enhance farm profitability.

Objectives:

1. To demonstrate the feasibility and agronomic performance of zero-tillage maize cultivation in Visakhapatnam district through On-Farm Demonstrations (OFDs).
2. To compare the grain yield and yield attributes of zero-tillage maize with the conventional tillage method.
3. To analyze the economics of zero-tillage maize cultivation.

II. MATERIALS AND METHODS

The study was conducted by scientists from DAATTC, Visakhapatnam, in collaboration with the District Department of Agriculture. A total of 16 On-Farm Demonstrations (OFDs) were established across the district during the Rabi seasons of 2021-22 (9 locations) and 2022-23 (7 locations).



2.1 Technology Intervention: The Peg Marker:

The core technology demonstrated was a manually operated 'Peg Marker' (Fig. 1), fabricated from locally available wood. This simple tool creates six sowing holes simultaneously at a spacing of 20 cm within a row. It enables precise dibbling of seed and placement of basal fertilizer directly into the soil, minimizing fertilizer loss and ensuring uniform plant establishment without any field tillage.

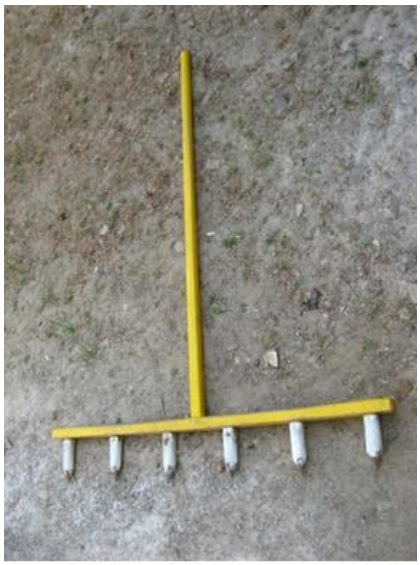


FIGURE 1: Peg Marker

FIGURE 2: Making holes in ideal moisture condition

FIGURE 3: Dibbling of Seed

FIGURE 4: Fertilizer application

FIGURE 5: Initial stage of Plant stand

FIGURE 6: Knee height stage

2.2 Salient Features of the Peg Marker & Zero-Tillage System:

- Eliminates cost of pre-sowing tillage operations.
- Enables sowing immediately after rice harvest, conserving residual soil moisture.
- Ensures uniform seed placement and optimal plant population.
- Reduces seed rate and eliminates thinning cost.
- Facilitates earlier crop maturity (by 7-10 days).

2.3 Agronomic Management:

In each demonstration, a paired comparison was made between the zero-tillage plot (using the Peg Marker) and the farmer's adjacent plot under conventional tillage (check). Maize was sown immediately after rice harvest in the zero-tillage plots. One seed was dibbled per hole. A pre-emergence application of Paraquat (10 ml/l) and Atrazine (5 g/l) was done to manage paddy stubbles and weeds. Recommended doses of fertilizers (N:P:K) were applied. Nitrogen was split-applied. The crop was maintained with three light irrigations and need-based plant protection measures.

2.4 Data Collection and Analysis:

Observations on yield attributes (number of cobs/25 m², grain rows/cob, grains/row) and grain yield (kg/ha) were recorded from both demonstration and check plots. The cost of cultivation was meticulously documented for both methods. Simple mean comparisons were used to analyze yield and cost data across locations. Percentage change and cost-benefit ratios were calculated to assess economic performance.

III. RESULTS AND DISCUSSION

3.1 Yield Attributes and Grain Yield:

The performance of zero-tillage maize compared to conventional tillage is summarized in Table 1.

TABLE 1

MEAN DATA ON YIELD AND YIELD ATTRIBUTES OF ON-FARM DEMONSTRATIONS ON ZERO-TILLAGE MAIZE CONDUCTED DURING RABI 2021-22 AND RABI 2022-23

Sl. No.	Season	No. of Locations	Average No. of Cobs / 25 m²		No. of Grain Rows / Cob		No. of Grains / Row		Yield (kg/ha)		% Increase in Yield
			Demo	Check	Demo	Check	Demo	Check	Demo	Check	
1	Rabi 2021-22	9	168	155	19	15	43	37	6951	6394	8.70%
2	Rabi 2022-23	7	169	150	15	13	38	35	6452	5849	10.30%
Average		16	168.5	152.5	17	14	40.5	36	6701	6125	9.40%

Zero-tillage plots consistently showed superior yield attributes. The average number of cobs per 25 m² was higher (168.5 vs. 152.5), indicating better plant survival and tillering due to adequate moisture at sowing. Similarly, more grain rows per cob (17.0 vs. 14.0) and more grains per row (40.5 vs. 36.0) were recorded. These improvements in yield components culminated in a **9.4% higher average grain yield** (6701 kg/ha vs. 6125 kg/ha). This aligns with findings by Barbieri et al. (2008), who noted that kernels per cob are highly influential on final yield. The advantage is attributable to earlier sowing, which allowed the crop's critical growth phases to coincide with cooler temperatures and optimal sunshine, promoting better pollination and grain filling.

3.2 Economics of Cultivation:

The economic analysis revealed substantial benefits from adopting zero-tillage (Table 2).

TABLE 2

ECONOMICS OF ZERO-TILLAGE VS. CONVENTIONAL METHOD OF MAIZE CULTIVATION (AVERAGE OF RABI 2021-22 AND 2022-23)

Sl. No.	Particulars	Zero-Tillage (Demo)	Conventional (Check)	Difference
1	Grain Yield (kg/ha)	6701	6125	576
2	Gross Returns (Rs./ha)*	93,814	73,500	20,314
3	Cost of Cultivation (Rs./ha)	28,001	31,501	-3,500
4	Net Income (Rs./ha)	65,813	41,999	23,814
5	Cost : Benefit Ratio	3	1	2

Assumption: Zero-tillage maize, harvested early, fetched Rs. 14/kg; conventional maize fetched Rs. 12/kg.

The reduction in cost of cultivation (approx. 11.1%) was primarily due to savings on tillage operations and reduced irrigation requirements (conserved soil moisture). The synergistic effect of **higher yield (9.4%), lower cost (11.1%), and a premium price for early produce** resulted in a dramatic **40.0% increase in net income** and a much-improved cost-benefit ratio (3.35 vs. 1.33). This makes a compelling economic case for technology adoption.

IV. CONCLUSION

The on-farm demonstrations conclusively prove that zero-tillage maize cultivation using the Peg Marker is a highly viable and profitable technology for the rice fallows of Visakhapatnam district. It successfully conserves residual soil moisture, enabling timely sowing. This leads to better crop establishment, improved yield attributes, and a significant yield advantage of 9.4%. Economically, it is transformative, reducing production costs by 11.1% and boosting net income by 40.0% through a combination of higher yield and premium market prices from early harvest. This practice is a boon for farmers, enhancing both productivity and resource-use efficiency. Extensive promotion of this low-cost, high-impact technology is recommended for sustainable intensification of the Rice-Maize system in the region.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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