# Effect of Weed Management on Growth and Yield of Maize Grown Under Different Tillage Systems

**Abstract**

A field trial was carried out in the *kharif* of 2022 and 2023 at Hisar, Haryana to evaluate the impact of different tillage practices and weed management strategies on growth and the productivity of *kharif* maize (*Zea mays* L.). The study included three tillage treatments: conventional flat planting, ridge planting and sowing by pneumatic planter. It also tested nine weed control methods. The experiment followed a split-plot design with three replications, with tillage methods assigned to the main plots and weed management practices to the subplots. 'NMH 589' was the maize variety used. At 30 DAS, ridge planting showed the maximum plant height and LAI with both pneumatic planter and conventional flat planting methods. Among the weed management practices, the combination of pre-emergence followed by one hand weeding was most effective, resulting in the higher plant height and LAI at 30 DAS. Significantly maximum grain yield was recorded in ridge planting methods with pyraxosulfone 127.5 g $ha^{-1}$ as PRE *fb* hand weeding at 30 DAS during both *kharif* season.

**Keywords:** *kharif* maize, plant height, atrazine, grain yield and LAI

## INTRODUCTION

Maize, commonly known as corn, is a staple cereal grain that has been fundamental to human agriculture for thousands of years. Originating in southern Mexico, it was first domesticated by indigenous peoples over 7,000 years ago. Since then, maize has become one of the most widely grown crops in the world, playing a crucial role in global food systems. Maize (*Zea mays* L.), a miracle crop, also known as “Queen of Cereals” is considered to be the world's third most significant cereal crop, after rice and wheat respectively. This is mostly attributable to the increased demand from the poultry or livestock sector (37%) as well as other purposes coupled with the assured market price (Kumar *et al.,* 2023a). India has an area of 11.2 mha maize area with production of 37.7 Mt and average productivity of 3.35 t $ha^{-1}$. In Haryana, maize is grown on approx. 5000 ha, with productivity of 3.69 t $ha^{-1}$ and total production of 0.018 Mt (Anonymous, 2024).

Different tillage methods provide varying advantages and challenges in managing weeds in maize cultivation. Conventional tillage, while effective at controlling weeds, can result in soil erosion and degradation over time. Ridge sowing, on the other hand, offers better

weed suppression but often requires more labor and resources. Pneumatic planters are commonly used in reduced-tillage systems, which help preserve soil structure and moisture while still managing weed growth. By combining these tillage approaches with comprehensive weed control strategies, farmers can improve both the productivity and sustainability of maize farming (Veeresh *et al.,* 2016). Weed depletes around 30-40% of applied nutrients from the soil. This is in addition to the indirect losses caused by weed infestation, which includes competition for growth resources, harbouring of other crop pests, and interference with management practises (Gharde *et al*., 2018). Some of the grassy and broad-leaf weeds found in maize field are *Cyperus rotundus, Cynodon dactylon, Commelina benghalensis, Cyanotis oxillaris, Denebra arabica, Tridax procumbens, Lagasca mollis, Euphorbia hirta, Euphorbia geniculata, Digera arvensis, Phyllanthus niruri, Celosia argentea* and *Acalyfa indica*. These are among the deadly weeds of the world which infest the maize field and thus, increase the cost of production as hand weeding is not effective against these weeds (Kumar *et al.,* 2023b).

Tillage and the management of weeds are two essential aspects that are among the many diverse factors that have a significant influence on the growth and yield of maize. Tillage is the mechanical manipulation of surface soil to provide a favourable environment for the germination and proper development of seeds in addition to the suppression of native weeds. Tillage affects the vertical distribution of weed seeds within soil profile. Therefore, appropriate tillage operations are desired for better crop yields and as a result of which the total production increases (Memon *et al*., 2012).

## MATERIAL AND METHODS

The present study was carried out over two consecutive *kharif* seasons (2022-2023) at the research farm of the Agronomy farm at Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana. The experiment was laid out using a split-plot design, consisting of 27 treatment combinations comprising three crop establishment techniques, viz. $T_1$; Conventional flat planting, $T_2$; Ridge planting and $T_3$; Sowing by pneumatic planter in main plot and nine weed management treatments are $W_1$; Atrazine 1000 g $ha^{-1}$ PRE *fb* hand weeding at 25 DAS, $W_2$; Pendimethalin 1000 g $ha^{-1}$ PRE *fb* hand weeding at 25 DAS, $W_3$; Pyraxosulfone 1000 g $ha^{-1}$ PRE *fb* hand weeding at 25 DAS, $W_4$; Pyroxasulfone + atrazine (TM) 127.5 + 750 g $ha^{-1}$ PRE, $W_5$; Tembotrione + atrazine (TM) 120 + 750 g $ha^{-1}$ at 15 DAS, $W_6$; Topramezone + atrazine (TM) 25.2 + 750 g $ha^{-1}$ at 15 DAS, $W_7$; Mesotrione + atrazine (TM) 850 g $ha^{-1}$ at 15

DAS $W_8$; Weedy check and $W_9$; Weed free in subplot. Each treatment combination was replicated three times

The experimental site was sandy loam in texture and alkaline in nature. It had 0.37 % organic carbon (low), 114.2 kg/ha $KMnO_4$ oxidizable N (low), 13.6 kg/ha 0.5N $NaHCO_3$ extractable P (medium), 285.3 kg/ha 1N $NH_4OAc$ exchangeable K (high), 0.32 dS/m EC, 7.96 pH and 1.58 $Mgm^{-3}$ bulk density at the start of experiment. The maize variety 'NMH 589' was planted at a spacing of 60 x 20 cm on July 7 and July 22 in 2022 and 2023, respectively. The crops were fertilized with the recommended dose of 150:60:60:25 NPKZn (kg/ha). All phosphorus, potassium, and zinc fertilizers were applied as basal doses during the field preparation. Nitrogen was applied in three equal splits: 50% as basal doses, 25% when the plants reached knee height, and the remaining 25% at tasseling. The grain yield was recorded at 14% moisture content. Herbicide application followed a structured treatment plan: pre-emergence herbicides were applied two days after sowing (DAS), and post-emergence herbicides were sprayed between 15 and 20 DAS during both years. The herbicides were applied using a manually operated knapsack sprayer with a flat fan nozzle, distributing 500 liters of water per hectare. For comparison, weed-free plots were maintained by manual weeding throughout the growing season. Data analysis was performed using the OPSTAT software (Sheoran *et al.,* 1998), and treatment means were compared using the least significant difference (LSD) at a 95% confidence level. Graphs and figures were generated using Microsoft Excel.

## RESULTS AND DISCUSSION

### Growth Parameters

Crop establishment methods and weed management practices had a significant impact on maize growth, primarily through their influence on weed infestation. Growth parameters likes plant height and leaf area index (LAI) at 30 DAS show significant variation across the different crop establishment methods during both *kharif* season. Among different establishment methods, Significantly taller plant height and leaf area index was observed under ridge planting at 30 DAS, whereas minimum was recorded for conventional flat planting during both years (Table 1 & Fig 1). Kaur and Chinna (2019) also supported the findings of the current study, indicating that planting methods significantly influence plant height, dry matter accumulation and LAI. Maize grown on ridges produced taller plants and maximum dry weight compared to flat sowing. These findings are consistent with the results reported by Hassan *et al.* (2013).

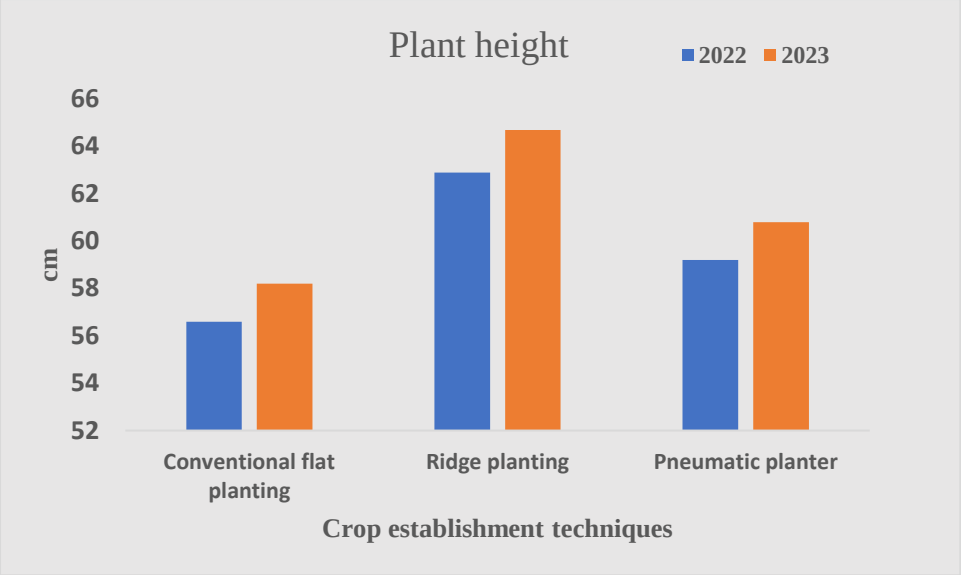


Fig 1. Effect of different crop establishment methods on plant height of maize at 30 DAS


Fig 2. Effect of different weed management practices on plant height of maize at 30 DAS

Among the various weed management strategies, the weed-free treatment recorded the highest plant height (64 & 65.8cm) and LAI (3.4 &3.5) at 30 DAS which was statically at par with pyraxosulfone, atrazine and pendimethalin as pre emergence followed by one hand weeding at 30 DAS during *kharif* season of 2022 & 2023, respectively (Table 1 & Fig 2). The superior performance can be attributed to the near-total weed control achieved by pyroxasulfone, followed by atrazine and pendimethalin which minimized crop-weed competition. With fewer weeds, the maize plants had better access to nutrients and moisture from the soil, leading to

enhanced photosynthesis and ultimately better growth. These findings are consistent with the results reported by Kumar *et al.* (2023a) and Shekhar *et al.* (2014).

**Yield**

Among the different crop establishment practices, highest grain yield (3533 and 4361 kg $ha^{-1}$) was recorded under ridge planting. In contrast, conventional tillage resulted in significantly lower yields (table.1). The higher grain yield in ridge planting can be attributed to earlier planting, enhanced crop growth, and better yield attributes. Singh and Vashist (2015) observed that ridge sowing resulted in a 13.2% increase in grain yield compared to flat sowing. This finding is consistent with earlier study by Kumar and Chawla (2015), which also reported higher yields associated with ridge planting methods. In terms of weed management, the combination of pyraxosulfone 127.5 g $ha^{-1}$ as PRE with one hand weeding at 30 days after sowing (DAS) produced the highest grain yield of 3730 and 4574 kg $ha^{-1}$ of yield during 2022 and 2023 respectively which was statistically at par with atrazine and pendimethalin as pre with hand weeding at 30 DAS. It was further observed that tembotrione + atrazine (TM) 120 + 750 g $ha^{-1}$ at 12-15 DAS ($W_5$) provided 52 to 57 % higher grain yield as compared to weedy check and this treatment was statically at par with $W_3$. Other weed management strategies, including the use of pyraxosulfone 127.5 g $ha^{-1}$ as pre-emergence spray, resulted in significantly lower yields. Dutta (2016) also found that combining atrazine (2.0 kg/ha) with one hand weeding at 30 DAS produced higher baby corn yields than using atrazine alone as a pre-emergence treatment. Weedy check plots, where weeds were left uncontrolled, suffered a 43% reduction in grain yield compared to the atrazine + hand weeding treatment.

**CONCLUSION**

The results of the study showed that *kharif* maize thrived better under Ridge planting, which facilitated improved crop establishment, stronger seedling vigor, and overall superior growth. In terms of weed management, the integrated approach of applying a pre-emergence pyraxosulfone 127.5 g $ha^{-1}$ followed by a hand weeding at 30 days after sowing (DAS) provided excellent weed control throughout the critical weed competition period. This method resulted in significantly better growth and development of maize compared to both the sole application of pre-emergence herbicide and the weedy control treatment.

Table 1. LAI and yield of maize as influenced by various crop establishment methods and weed management treatments

| | | | 2022 | | 2023 | |
|---|---|---|---|---|---|---|
| | | | LAI at 30 DAS | Grain yield (kg ha$^{-1}$) | LAI at 30 DAS | Grain yield (kg ha$^{-1}$) |
| | **Crop establishment methods** | | | | | |
| **$T_1$** | Conventional flat planting | | 2.64 | 3060 | 2.75 | 3817 |
| **$T_2$** | Ridge planting | | 3.24 | 3533 | 3.35 | 4361 |
| **$T_3$** | Sowing by pneumatic planter | | 2.77 | 3148 | 2.86 | 3961 |
| | SE(m) | | 0.07 | 40 | 0.07 | 38 |
| | C.D at 5% | | 0.29 | 162 | 0.29 | 151 |
| | **Weed management treatments** | | | | | |
| | **Treatments** | **Dose (gha$^{-1}$)** | | | | |
| **$W_1$** | Atrazine *fb* hand weeding | 1000 | 3.24 | 3708 | 3.33 | 4550 |
| **$W_2$** | Pendimethalin *fb* hand weeding | 1000 | 3.27 | 3694 | 3.34 | 4535 |
| **$W_3$** | Pyraxosulfone *fb* hand weeding | 127.5 | 3.31 | 3730 | 3.42 | 4574 |
| **$W_4$** | Pyroxasulfone + atrazine (TM) | 127.5 + 750 | 3.13 | 2763 | 3.18 | 3528 |
| **$W_5$** | Tembotrione + atrazine (TM) | 120+ 750 | 2.66 | 3640 | 2.79 | 4477 |
| **$W_6$** | Topramezone + atrazine (TM) | 25.2+ 750 | 2.43 | 3014 | 2.58 | 3800 |
| **$W_7$** | Mesotrione + atrazine (RM) | 875 | 2.52 | 3311 | 2.64 | 4168 |
| **$W_8$** | Weedy check | - | 1.99 | 1570 | 2.04 | 2141 |
| **$W_9$** | Weed free | - | 3.40 | 3795 | 3.52 | 4643 |
| | SE(m) | | 0.06 | 36 | 0.07 | 40 |
| | C.D at 5% | | 0.18 | 103 | 0.19 | 114 |

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