



International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

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www.agronomyjournals.com

2025; 8(1): 891-893

Received: 17-11-2024

Accepted: 20-12-2024

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Effect of different weed control methods on growth and yield attributes of maize (*Zea mays* L.)

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DOI: <https://doi.org/10.33545/2618060X.2025.v8.i1h.2482>

Abstract

A field experiment was conducted in the agriculture farm of The Neotia University during the *kharif* season to study the effect of different weed control methods on growth and yield attributes of maize. Maize variety Gaurav- 65 was shown in randomized block design with 3 replications and seven treatments i.e., Paddy straw mulching, Live much (cowpea), Pre emergence (PE) Atrazine, Post- emergence (PoE) (Topramezone + Atrazine), PE Atrazine with 1 Hand Weeding (HW) at 40 DAS, HW at 20 and 40 DAS, Weedy check and data was recorded at 20, 40, 60 and at harvest (90 DAS). The statistical data analysis revealed that Atrazine with 1 HW at 40 DAS among all other treatments denoting effectiveness combine treatment.

Keywords: *Kharif* maize, atrazine, hand weeding, tank mix herbicide, crop growth

Introduction

Maize or corn (*Zea mays* L.) is an important annual cereal crop of the world belonging to family Poaceae. It is known as the "queen of cereals" because of its highest genetic yield potential among the cereals. According to the 3rd advance estimates for 2023-24 by the Government of India, the Maize crop is estimated at 356.73 lakh tonnes, compared to 380.85 lakh tonnes in 2022-23. The major Maize-consuming states in India are Karnataka, Andhra Pradesh, Punjab, Gujarat, Haryana, Telangana, Tamil Nadu, Bihar, and West Bengal. Growing demand from the poultry sector, which consumes more than half of the domestic production and increasing urbanization, leading to higher demand for processed foods like corn flakes and bakery products. The expanding organized dairy sector, which requires more fine cereals or Maize-based concentrates and rising international prices due to the diversion of Maize grain towards biofuel production (ANGARU,2023). Weed control is a vital part of maize (*Zea mays* L.) cultivation and production, especially in regions like West Bengal, where maize has gained prominence as a profitable crop for both food and feed purposes. In recent years, maize cultivation in West Bengal has expanded so much that it is even supplanting traditional summer crops such as Boro rice, contributing to both local food security and the livestock feed industry by the initiative of the state government. With its growing demand in the poultry and food processing sectors, the West Bengal Livestock Development Department has begun purchasing maize directly from farmers for poultry feed production. This initiative has encouraged farmers to cultivate maize in regions with scant rainfall and less fertile soil. However, suitable and effective weed control remains a critical factor for maximizing yield potential in the region, as weeds compete directly with maize for essential resources, including sunlight, water, and nutrients. There are many control methods available in the market but no single treatment is effective based on their sole performance. To address this, there is a study on different treatments and their combination to find out efficiency and yield of maize.

Materials and Methods

The present investigation was carried out during the *kharif* season of 2023 at the Research Farm, Institute of Agricultural Sciences, The Neotia University, Sarisha. Hybrid maize var. Gaurav- 65 was taken as trial crop with a spacing arrange of (60×25) cm row × plant. The experiment was laid out in a Randomised block design and replicated three times. In this way, there were seven treatments. i.e., T1- Paddy straw mulch (4 t ha⁻¹), T2- Live much (cowpea), T3- PE Atrazine 1

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a.i. kg ha⁻¹, T4- PoE Topramezone 0.04 a.i. kg ha⁻¹ + Atrazine 0.25 a.i. kg ha⁻¹, T5- PE Atrazine 1 a.i. kg ha⁻¹ + 1 HWat 40 DAS, T6- HWat 20 and 40 DAS, T7- Weedy check. The crop was fertilized at a recommended dose of 120 kg, 60 kg and 40 kg ha⁻¹ was applied through urea, DAP, MOP respectively. 50% N was given as a basal dose remaining half dose of nitrogen in the form of urea was top dressed in two equal splits, once at knee high and tasselling stage. For this purpose, periodical observation was taken at 20, 40, 60 DAS and at harvest (90DAS) on crop growth characters (i.e., plant height, leaf area index, dry matter accumulation, crop growth rate), weed (i.e., Weed control efficiency and weed index) and yield attributes (final plant stand, cob length, cob girth, cob weight, cob plant⁻¹, grain weight cob⁻¹ and 1000 grain weight, yield (grain yield, straw yield and biological yield), harvest index (%), economics (B:C ratio).

Results and Discussion

Effect on weeds

The analysis of Dry matter accumulation demonstrated that treatments involving HW(HW) at 20 and 40 days after sowing (DAS) and PE Atrazine (1 kg a.i. ha⁻¹) + 1 HW consistently exhibited the lowest weed dry weight across all growth stages compared to other treatments. Live mulch exhibited a substantially lower dry matter accumulation than paddy straw mulch. The other two herbicidal treatments resulted lower weed dry matter compare to weedy check plot. These outcomes matched up with the findings of Sreenivas and Satyanarayana (1996)^[5] and Iqbal *et al.*, (2020)^[4].

Among all the treatments, HW at 20 and 40 DAS recorded highest weed control efficiency (W.C.E.) and lowest weed index (W.I.) followed by PE Atrazine 1 kg a.i. ha⁻¹ + 1 HW at 40 DAS and Live mulch (cowpea) respectively. These findings established support from Pathak *et al.*, 2015. Lower weed control efficiency among the herbicides were associated with alone application PE Atrazine 1 kg a.i. ha⁻¹. It might be due to higher weed intensity and dry matter accumulation of weeds in this treatment. These outcomes support the conclusions made by Lakshmi and Luther (2017)^[6], Ehsas *et al.*, (2016)^[3] and Shingrup *et al.*, (2014)^[9].

On crop

HWat 20 and 40 DAS and PE Atrazine + 1 HW consistently showed higher growth on height across all time points compared to other treatments. Treatment like live mulch showed significantly higher height difference than paddy straw mulch. The treatment Weedy check consistently exhibits the lowest plant height across all time points, indicating the importance of

weed control for maximizing crop yield. Tahir *et al.*, (2009)^[10] and Akhtar *et al.*, (1998)^[11] unveiled same results. Treatments involving manual weed control (hand weeding) consistently outperform other treatments, emphasizing the significance of labour-intensive weed management practices.

During the entire crop growing cycle, HW at 20 and 40 DAS had given highest crop growth result ahead of PE Atrazine 1 kg a.i. ha⁻¹ + 1 HW at 40 DAS followed by Live mulch (cowpea). Herbicide applications, PE Atrazine 1 kg a.i. ha⁻¹, PoE Topramezone 0.04 kg a.i. ha⁻¹ + Atrazine 0.25 kg a.i. ha⁻¹ also contributed positively to crop growth, although the growth enhancement might be relatively lower compared to HW.

On yield

During the entire crop growing cycle, treatments such as HW at 20 and 40 DAS prior to PE atrazine 1 kg a.i. ha⁻¹ + 1 HW at 40 DAS consistently resulted in the highest values for cob length, cob girth, and cob plant⁻¹, indicating superior yield and quality compared to other treatments. Other than HW among other treatments Live mulch (cowpea), PE Atrazine 1 kg a.i. ha⁻¹ + 1 HW at 40 DAS showed noticeable differences on yield. Similar Abdullahi *et al.*, and Amare *et al.*, 2014^[12] who reported lower ear length in weedy checks and higher ear length in weed control treatments. Kawsar *et al.*, (2011) and El-Bially (1995) who revealed that HWand herbicide application plots all resulted to increase in maize yields.

The highest yield (grain yield, stover yield) was recorded at sequential application of manual HW at 20 DAS followed by 40 DAS (5.15 t ha⁻¹, 11.54 t ha⁻¹) had given statistically ahead of PE Atrazine 1 kg a.i. ha⁻¹ + 1 HW at 40 DAS (4.80 t ha⁻¹, 10.35 t ha⁻¹), Live mulch (cowpea) (4.28 t ha⁻¹, 8.83 t ha⁻¹).

Among herbicidal treatments PE Atrazine 1 kg a.i. ha⁻¹ + 1 HW at 40 DAS outperformed PoE Topramezone 0.04 kg a.i. ha⁻¹ + Atrazine 0.25 kg a.i. ha⁻¹ and alone application of PE Atrazine 1 kg a.i. ha⁻¹. Among mulching, Live mulch (cowpea) outperformed Paddy straw mulch (4 t ha⁻¹). These results are in accordance with Patel *et al.*, (2006)^[8] who claimed that in terms of yield characteristics, all weed control treatments outperformed weedy check by a wide margin. The efficiencies of various chemicals and other weed control practices in enhancing grain yield have previously been observed by Paradkar *et al.*, (1993)^[7] and Gill *et al.*, (1987). Herbicide treatments also contribute to yield enhancement, albeit to a lesser extent compared to HW methods. Mulching shows a positive effect on yield, but the impact is relatively lower compared to weed control treatments. Ahmad *et al.*, (1988)^[11] and Abdullahi *et al.*, (2016)^[12] have reported similar results obtained from various weed control techniques.

Table 1: Effect of different weed control method on Weed control efficiency (%) and Weed index (%) Dry matter g m⁻² in kharif maize

Treatments	Weed control efficiency (%)				Weed index (%)	Dry matter g m ⁻²			
	20 DAS	40 DAS	60 DAS	At harvest (90 DAS)		20 DAS	40 DAS	60 DAS	At harvest (90 DAS)
T1- Paddy straw mulch (4 t ha ⁻¹)	35	38	40	42	40.19	1.08	12.72	18.74	26.84
T2- Live mulch (cowpea).	71	73	75	76	17.08	0.71	3.47	7.16	8.60
T3- Pre-emergence Atrazine 1 kg a.i. ha ⁻¹ .	53	52	55	57	30.67	0.86	7.63	11.26	13.59
T4- Post-emergence Topramezone 0.04 kg a.i. ha ⁻¹ + Atrazine 0.25 kg a.i. ha ⁻¹ .	60	63	66	68	24.67	0.77	3.72	8.77	10.93
T5- Pre-emergence Atrazine 1 kg a.i. ha ⁻¹ + 1 Hand Weeding at 40 DAS.	81	82	84	87	6.8	0.45	2.70	6.30	7.21
T6- Hand Weeding at 20 and 40 DAS.	87	88	90	93	0	0.06	0.07	0.12	0.03
T7- Weedy check (no weed control).	0	0	0	0	52.23	2.03	20.77	35.97	52.27
CD (p= 0.05)						0.08	1.01	2.59	4.62

Table 2: Effect of different weed control method on Plant height and Crop growth rate(C.G.R.) in *kharif* maize

Treatments	Plant height (cm)				C.G.R (g m ⁻² d ⁻¹)		
	20 DAS	40 DAS	60 DAS	At Harvest (90 DAS)	20- 40 DAS	41- 60 DAS	61- 90 DAS
T ₁ - Paddy straw mulch (4 t ha ⁻¹)	22.83	71.46	172.09	176.67	0.27	0.60	1.30
T ₂ - Live mulch (cowpea).	29.81	79.76	180.80	188.37	0.32	1.00	1.52
T ₃ - Pre-emergence Atrazine 1 kg a.i. ha ⁻¹ .	24.67	73.46	174.45	179.67	0.29	0.71	1.27
T ₄ - Post-emergence Topramezone 0.04 kg a.i. ha ⁻¹ + Atrazine 0.25 kg a.i. ha ⁻¹ .	28.16	76.67	176.67	183.75	0.30	0.91	1.37
T ₅ - Pre-emergence Atrazine 1 kg a.i. ha ⁻¹ + 1 Hand Weeding at 40 DAS.	31.75	82.89	182.81	191.75	0.34	1.09	1.54
T ₆ - Hand Weeding at 20 and 40 DAS.	33.07	84.00	184.39	194.46	0.37	1.18	1.62
T ₇ - Weedy check (no weed control).	19.33	65.50	162.67	168.87	0.22	0.46	0.87
CD (p= 0.05)	1.88	2.12	2.28	2.49	0.03	0.06	0.06

Table 3: Effect of different weed control method on cob parameters and yield in *kharif* maize

Treatments	Cob Length (cm)	Cob Girth (cm)	Cob Plant ⁻¹	Grain yield (t. ha ⁻¹)	Stover Yield (t. ha ⁻¹)
T ₁ - Paddy straw mulch (4 t ha ⁻¹)	13.84	10.05	1.60	3.08	6.89
T ₂ - Live mulch (cowpea).	15.89	11.99	1.77	4.28	8.83
T ₃ - Pre-emergence Atrazine 1 kg a.i. ha ⁻¹ .	14.72	10.57	1.65	3.57	8.04
T ₄ - Post-emergence Topramezone 0.04 kg a.i. ha ⁻¹ + Atrazine 0.25 kg a.i. ha ⁻¹ .	15.57	11.35	1.73	3.88	8.51
T ₅ - Pre-emergence Atrazine 1 kg a.i. ha ⁻¹ + 1 Hand Weeding at 40 DAS.	16.92	12.59	1.85	4.80	10.35
T ₆ - Hand Weeding at 20 and 40 DAS.	17.50	12.92	1.87	5.15	11.54
T ₇ - Weedy check (no weed control).	13.14	9.83	1.45	2.46	5.33
CD (p= 0.05)	0.58	0.90	0.08	0.27	0.56

Conclusion

After analysing all the statistical the conclusion here drawn that the data the weed control treatments effectively controlled weeds and significantly reduced their density and dry matter, application of HW at 20 and 40 DAS proved to be better in terms of growth and yield of hybrid maize, atrazine 1 kg a.i. ha⁻¹ followed by 1 HWat 40 DAS found to be the best management of weed control method for increasing the yield and net return of maize.

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