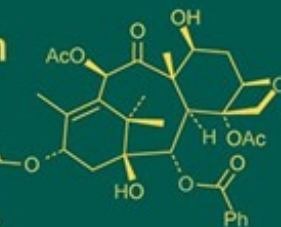
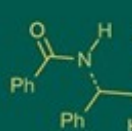
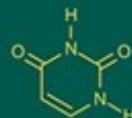
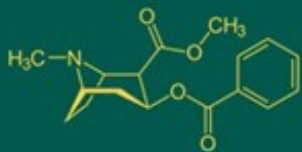


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Periodical dry matter, nutrient uptake and yield at harvest of maize affected by application of pre and post emergence herbicides

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ABSTRACT

Maize crop is dominating industrial crop in Maharashtra however; the productivity of maize is less due to abiotic and biotic reasons. One of the factors affects the productivity is weed. Weed control always remains challenging in maize. The combination study of pre and post emergence herbicide is meagre. A field experiment entitled "Effect of Pre and Post Emergence Application of Herbicides in Kharif Maize (*Zea mays* L.)" was carried out during kharif season of 2025 at AICRP on Maize Research Farm, ZARS, Kolhapur with an objective of finding the suitable pre-emergence and post-emergence herbicides and its economy through various weed treatments. The field experiment was laid out in Randomized Block Design with twelve treatments and three replications. The maximum periodical dry matter accumulation, nutrient uptake and yield of maize recorded in weed free treatment but was on par with the application of atrazine @ 500 g a.i. ha⁻¹ (PE) fb topramezone @ 25 g a.i. ha⁻¹ (PoE) at 25 DAS and application of pyroxasulfone @ 127 g a.i. ha⁻¹ (PE) fb topramezone @ 25 g a.i. ha⁻¹ (PoE) at 25 DAS. Therefore, application of atrazine @ 500 g a.i. ha⁻¹ (PE) fb topramezone @ 25 g a.i. ha⁻¹ (PoE) at 25 DAS and application of pyroxasulfone @ 127 g a.i. ha⁻¹ (PE) fb topramezone @ 25 g a.i. ha⁻¹ (PoE) at 25 DAS can be recommended for achieving higher dry matter accumulation, nutrient uptake and yield of kharif maize.

Keywords: Dry matter, Nutrient uptake, Yield, Maize, Herbicides

Introduction

Maize (*Zea mays* L.) is widely recognized for its high yield potential and is often referred to as the "Queen of Cereals" and the "Miracle Crop." It ranks as the third most important cereal crop globally as well as in India, following rice and wheat (Murdia *et al.*, 2016) [1]. Maize is now cultivated worldwide and serves multiple purposes. It is extensively utilized for human consumption, livestock feed, and as a raw material in various industrial applications, including the production of starch, oil, syrups, and fermentation-based products such as bio-fuels. Furthermore, maize is characterized by a high level of genetic diversity, which contributes to its adaptability across diverse agro-climatic conditions. By considering versatile use of maize, its importance has further increased and ultimately increases the responsibility to enhance the productivity of maize. The various factors affect directly on the productivity. Effective protection of maize from weeds, pests, and diseases is crucial to prevent significant yield losses and to maintain crop quality. Among these factors, weed management is particularly critical, as weeds pose a serious threat to maize, especially during the early stages of growth. Yield reductions due to weed infestation can range from 28% to 93%, depending on the type, intensity, and duration of weed competition. The most sensitive period for crop-weed competition in maize occurs between 1 and 8 weeks after sowing, making timely weed control essential to achieve optimum yields (Sharma *et al.*, 1998) [2].

In India, maize is predominantly cultivated during the *kharif* season. Chemical weed control is widely regarded as an effective, practical, and economical alternative or supplement to manual weeding. Compared to hand weeding, it is more flexible, requires less labour, and is generally more cost-efficient (Sutton *et al.*, 2002) [3]. However, excessive or improper use of herbicides can lead to serious issues like development of weed resistance, contamination of groundwater and environmental pollution (Abdin *et al.*, 2000) [4]. Weed control can be effectively achieved through both cultural and chemical methods in which yield increased from 77 to 96.7% compared to untreated weedy conditions (Khan *et al.*, 1998) [5]. The manual weeding is highly labour-intensive, time-consuming, expensive and is often not carried out at the most critical stages of crop-weed competition. In addition, the increasing scarcity of labour has made it difficult and uneconomical to rely solely on traditional weed control practices. As a result, farmers are increasingly adopting herbicides, as they provide timely and efficient weed control while significantly reducing the overall cost of weed man

agement under different conditions (Oerke *et al.*, 2005). Several post-emergence herbicides are commonly used to manage weeds that emerge later in the crop cycle.

Chemical weed management is widely recognized as an efficient, practical, and cost-effective alternative, as well as a complement, to manual weeding. Compared with traditional hand weeding, chemical methods offer greater operational flexibility, reduced labour requirements, and improved economic viability (Sutton *et al.*, 2002) [3]. However, indiscriminate or excessive use of herbicides may lead to resistant weed populations, groundwater contamination, and environmental degradation, all of which raise serious concerns for human health (Abdin *et al.*, 2000) [4]. Achieving effective weed control and maximizing crop productivity depends on the careful selection of herbicides based on the dominant weed flora, timely application according to crop growth stages, recommended dosages and application techniques (Mani *et al.*, 1968) [6].

Maize productivity is significantly constrained by biotic factors, particularly nutrient deficiencies and severe weed infestations. More than 90 weed species are known to compete with maize, leading to intense crop-weed competition and substantial yield losses. The crop is highly sensitive to weed interference, with yield reductions of up to 70% reported under heavy infestation. However, the adoption of modern weed management practices can enhance maize yield by as much as 30% (Kumar *et al.*, 2017) [7]. These can be achieved by post-emergence herbicides. Considering these factors, the present study was undertaken to evaluate the effective pre and post emergence herbicides in maize and its economics to enhance the crop performance.

Materials and methods

Experimental Site & Location: The field experiment was carried out during Kharif-2025 at AICRP on Maize Research Farm, Zonal Agricultural Research Station (ZARS), Shenda Park, Kolhapur. The Kolhapur comes under the Sub-montane Zone of Maharashtra and situated at an elevation of 548 m above the mean sea level. The experimental site was located at latitude of 16.67°N and a longitude of 74.24°E. During the experimental period, the total rainfall received was 961.9 mm in 72 rainy days. The highest rainy days was observed from 25 to 27th meteorological week. The average relative humidity was 93.7 per cent in morning and 82.6 per cent in evening. The minimum temperature varied from 20.3°C to 22.7°C and maximum temperature was in the range of 25.5°C to 29.8°C. The high rainfall received during 24th and 33rd meteorological weeks. The highest evaporation was recorded 2.8 mm day⁻¹ and lowest being 0.9 mm day⁻¹ on 29th and 30th meteorological weeks respectively. Over the entire pleasant climate was observed during crop period that benefitted to the maize crop in entire life cycle.

Experimental Soil: The soil of the experimental site was sandy clay loam in texture with neutral reaction (pH 7.0), moderate electrical conductivity of 0.15 dSm⁻¹, low available nitrogen (194.37 kg ha⁻¹), medium available phosphorus (21.77 kg ha⁻¹), medium available potassium (277.83 kg ha⁻¹) and low organic carbon (0.47%).

Experimental Details: The used pre and post emergence herbicides were in label claim. The activities of each pre and post emergence herbicides were varied according to their doses and types of weed fauna i.e. grassy, broad leaf weeds (BLW) and sedges. The uniform application of pre and post emergence herbicides were undertaken by using knapsack sprayer and as per the schedule (25 days after sowing of maize crop) given in Table 1. The detailed information of pre and post emergence herbicides is depicted in Table 2. The experiment was designed in randomized block design with twelve treatments that replicated thrice. The following treatments were included in this experiment.

Table 1. Treatment details of the experiment

Treatment No.	Treatment details
T ₁	Weedy check
T ₂	Weed free check
T ₃	Application atrazine @ 500 g a.i. ha ⁻¹ (PE) <i>fb</i> hand weeding at 25 DAS
T ₄	Application of pyroxasulfone @ 127 g a.i. ha ⁻¹ (PE) <i>fb</i> hand weeding at 25 DAS
T ₅	Application of atrazine @ 500 g a.i. ha ⁻¹ (PE) <i>fb</i> halo-sulfuron methyl @ 67 g a.i. ha ⁻¹ (PoE) at 25 DAS
T ₆	Application of atrazine @ 500 g a.i. ha ⁻¹ (PE) <i>fb</i> tembotrione @ 120 g a.i. ha ⁻¹ (PoE) at 25 DAS
T ₇	Application of atrazine @ 500 g a.i. ha ⁻¹ (PE) <i>fb</i> topamezone @ 25 g a.i. ha ⁻¹ (PoE) at 25 DAS
T ₈	Application of atrazine @ 500 g a.i. ha ⁻¹ (PE) <i>fb</i> mesotrion + atrazine (Ready mix) @ 300 g a.i. ha ⁻¹ at 25 DAS
T ₉	Application of pyroxasulfone @ 127 g a.i. ha ⁻¹ (PE) <i>fb</i> halosulfuron methyl @ 67 g a.i. ha ⁻¹ (PoE) at 25 DAS
T ₁₀	Application of pyroxasulfone @ 127 g a.i. ha ⁻¹ (PE) <i>fb</i> tembotrion @ 120 g a.i. ha ⁻¹ (PoE) at 25 DAS
T ₁₁	Application of pyroxasulfone @ 127 g a.i. ha ⁻¹ (PE) <i>fb</i> topamezone @ 25 g a.i. ha ⁻¹ (PoE) at 25 DAS
T ₁₂	Application of pyroxasulfone @ 127 g a.i. ha ⁻¹ (PE) <i>fb</i> mesotrion + atrazine (Ready mix) @ 300 g a.i. ha ⁻¹ at 25 DAS

fb= followed by, (PE)= Pre-emergence, (PoE)= Post-emergence, DAS= Days after sowing

The maize hybrid 'Phule Maharshi' (QMH-1025) developed by AICRP on maize, Kolhapur affiliated to Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S) was sown by dibbling at spacing of 60 x 20 cm within 4.8 m x 3.6 m and 3.6 m x 3.4 m as gross and net plot sizes respectively. The features of Phule Maharshi is tabulated in Table 3.

Table 2. Details of the herbicides used

Sr. No	Name of Herbicide	Nature	Used in crops	Weed control	Recommended dose
1.	Pyroxasulfone (Zidua, Momiji)	Pre emergence	Wheat, Corn, Soybean	Grass, BLW	100 g a.i./ha
2.	Atrazine (Atrax, Atrata)	Pre & Post emergence	Corn, Sorghum, Sugarcane	Grassy weeds, BLW	1.0-1.25 kg/ha
3.	Halosulfuron Methyl (Sempra)	Post emergence	Corn, Sugarcane, Rice	Sedges	90-95 gm/ha
4.	Tembotrione (Laudis)	Post emergence	Corn, Sugarcane	Grassy weeds	115 ml/200 lit. water

(continued on next page)

Sr. No	Name of Herbicide	Nature	Used in crops	Weed control	Recommended dose
5.	Topramezone (Tinjari)	Post emergence	Corn, Sugarcane	BLW	75-100 ml/ha
6.	Mesotrion + atrazine (Cal xtra)	Post emergence	Corn, Sugarcane	Grass, BLW	3500 ml/ha

Parenthesis indicates commercial name of herbicide, BLW= Broad leaf weed

The sowing was done by dibbling two seeds per hill opened at 60 cm apart with the help of marker and 20 cm spacing at a depth of 4-5 cm to obtain uniform plant population. The seed rate @ 20 kg ha⁻¹ was used. The inorganic fertilizers were applied as recommended dose (120:60:40 NPK kg ha⁻¹) and nitrogen was divided in three equal splits in which first split of nitrogenous fertilizer and full dose of phosphatic and potassic fertilizers were applied at the time of sowing as basal dose. The second half of nitrogenous fertilizer i.e. urea was applied at 30 DAS and third at 45 DAS. The inorganic fertilizers were applied by using urea (46% N), single super phosphate (SSP 16% P₂O₅) and muriate of potash (MOP 60% K₂O) as the sources of nitrogen, phosphorus and potassium respectively. All recommended agro-nomic practices of maize cultivation were carried out. The results of the experiment were enumerated and given as below.

Table 3. Features of Phule *Maharshi*' (QMH-1025) hybrid

Sr. No.	Particulars	Features
1	Maturity period (days)	Medium to Mid-late maturity (90-100)
2	Parents	QMI-1403 x QMI-1401
3	Area of adaption	Across the state of Maharashtra
4	Special characters	- It is high yielding, orange yellow, semi-flint type - Multiple disease resistance including Maydis leaf blight <i>Fusarium</i> stalk rot and Banded leaf and sheath blight - semi spreading in growth, - medium bold size (25-30 g 100 seeds⁻¹)
5	Yield attributes	Grain Straw

Table 4. Methods adopted for digestion of plant samples

Sr. No	Properties	Method adopted
1.	Digestion of plant samples	Conc. H ₂ SO ₄ + H ₂ O ₂ (1:1) 30% (Parkinson and allen, 1975)
2.	Nitrogen	Micro -Kjeldhal (Anonymous, 1982)
3.	Phosphorous	Vanado-molybdophosphoric yellow colour method (Jakson, 1973)
4.	Potassium	Flame photometric method (Jakson, 1973)

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient conc. (\%)} \times \text{Yield (kg ha}^{-1}\text{)}}{100}$$

Statistical analysis

The experimental data obtained from the research trial was statistically analysed by using a standard procedure of "Analysis of Variance" which was given by Panse and Sukhatme (1975). The standard error of mean was worked out for each factor under study and their critical difference at 5% level of significance was calculated whenever the results were significant. Standard error of mean (S.E.m_±) was worked out for each factor and interaction.

Results and discussion

Periodical Dry Matter Accumulation Plant⁻¹(g) : The dry matter accumulation increases progressively until harvest. The periodic dry matter accumulation was calculated at 30, 60, 90 DAS and at harvest

Sr. No.	Particulars	Features
6	<i>Kharif</i>	75-80 q ha ⁻¹ 12-14 tonnes/ha
7	<i>Rabbi</i>	85-90 q ha ⁻¹ 13-15 tonnes/ha
8	Year of release	2017

Source : Borle *et al.*, (2018)

Observations recorded

Dry matter accumulation plant⁻¹ (g): Five plants were selected from border rows of each treated plot. The plants were uprooted and their roots were separated at collar at all observation day viz. 30, 60, 90, DAS and at harvest. The plant samples were chopped into pieces which were first sun dried and later on dried in the hot air oven at 55 ± 5 °C till constant weight was noticed of the samples. The total dry matter obtained was recorded as mean dry matter plant⁻¹ in gram (g).

Yield of Maize: Treatment wise total number of cobs from each net plot was harvested at maturity. Shelling of cob after that, grain weight was calculated from the net plot yield and expressed in q ha⁻¹. Similarly, the corn plants were cut plot wise close to the ground level after harvesting of cobs. The stover yield was calculated after weighing the cut-out portion of stalk from each net plot q ha⁻¹.

Nutrient Uptake: The plant samples so collected were cleaned and then dried in hot air oven at 65 ± 5 °C. Further, these samples were grinded to required fineness in wiley mill and stored in plastic bags/paper bag for further analysis. The powdered plant sample of half a gram was digested and thereafter the methods for analysis were carried out as given in Table 4.

The nutrient uptake at harvest was calculated. For the stage of maize harvest, the nutrient uptake was calculated by "multiplying per cent content of nutrients (N, P and K) in plant sample with yield (grain + stover) of plant at harvest obtained on per hectare basis at maturity and divided it by 100"

is given in Table 5. At 30 DAS there was non-significant difference among various weed management treatments. However, the weed free check showed maximum dry matter accumulation at 60, 90 and harvest, (122.92 g, 208.1 g and 248.7 g respectively) and on par with application of atrazine @ 500 g a.i. ha⁻¹ (PE) *fb* topramezone @ 25 g a.i. ha⁻¹ (PoE) at 25 DAS (120.15 g, 205.3 g and 246.7 g) and application of pyroxasulfone @ 127 g a.i. ha⁻¹ (PE) *fb* topramezone @ 25 g a.i. ha⁻¹ (PoE) at 25 DAS (119.33 g, 202.2 g and 245.7 g respectively). The unchecked weed growth in resulted in the lowest dry matter accumulation at similar observed days of experiment in all growth stages. Effective suppression of weed competition through these herbicide treatments optimized resource availability for root and canopy development, directly driving maximum dry matter accumulation and final grain yield in maize (Koushal *et al.*, 2025). Uncontrolled weed growth created severe competition for essential resources, which negatively affected crop growth and minimized final dry matter accumu

lation. this reduction in biomass highlights how vulnerable the crop is to early weed pressure (Singh *et al.*, 2025) [8].

Yield (q ha^{-1}): It was observed from Table.6 that mean grain (74.73 q ha^{-1}) and stover yield (90.94 q ha^{-1}) during the experiment was highest in the weed-free check treatment. A result that did not much differ significantly from application of atrazine @ $500 \text{ g a.i. ha}^{-1}$ (PE) *fb* topramezone @ $25 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS (72.62 and 87.61 q ha^{-1} as grain and stover yield respectively) and application of pyroxasulfone @ $127 \text{ g a.i. ha}^{-1}$ (PE) *fb* topramezone @ $25 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS (70.76 and 85.60 q ha^{-1} as grain and stover yield respec-

tively). This outstanding performance is explained by a minimal weed presence, marked by the lowest weed count and dry matter weight, excellent weed control efficiency and a low weed index successfully secured vital resources exclusively for the maize crop. Together, these factors promoted superior vegetative growth and upgraded all major yield components, driving the final grain production to its maximum potential. The lowest grain and stover yield observed in weedy check (35.20 and 46.95 q ha^{-1} respectively). The experimental outcomes obtained in this study are in complete alignment with the literature reported by Nimanwad *et al.* (2022) [9], Bada *et al.* (2022) [10] and Shukla *et al.* (2024) [11].

Table 5. Dry matter accumulation plant^{-1} (g) of maize as affected by various treatments

Treatments	Dry matter accumulation plant^{-1} (g)			
	30 DAS	60 DAS	90 DAS	At Harvest
T ₁ : Weedy check	19.81	70.00	104.15	135.33
T ₂ : Weed free check	23.28	122.92	208.14	248.67
T ₃ : Application atrazine @ $500 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> hand weeding at 25 DAS	22.10	107.33	184.50	222.33
T ₄ : Application of pyroxasulfone @ $127 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> hand weeding at 25 DAS	21.05	104.67	183.67	221.00
T ₅ : Application of atrazine@ $500 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> halosulfuron methyl @ $67 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS	20.23	89.33	176.33	208.78
T ₆ : Application of atrazine @ $500 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> tembotrione @ $120 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS	21.60	84.00	168.33	205.00
T ₇ : Application of atrazine @ $500 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> topramezone @ $25 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS	22.79	120.15	205.26	246.67
T ₈ : Application of atrazine @ $500 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> mesotrion + atrazine (Ready mix) @ $300 \text{ g a.i. ha}^{-1}$ at 25 DAS	21.08	99.33	182.67	214.33
T ₉ : Application of pyroxasulfone @ $127 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> halosulfuron methyl @ $67 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS	20.23	85.67	171.44	207.33
T ₁₀ : Application of pyroxasulfone @ $127 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> tembotrion @ $120 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS	20.32	82.00	166.67	201.67
T ₁₁ : Application of pyroxasulfone @ $127 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> topramezone @ $25 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS	22.48	119.33	202.23	245.67
T ₁₂ : Application of pyroxasulfone @ $127 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> mesotrion + atrazine (Ready mix) @ $300 \text{ g a.i. ha}^{-1}$ at 25 DAS	20.59	93.43	180.95	210.38
S.Em±	0.77	3.46	5.85	7.83
C.D. ($P = 0.05$)	NS	10.16	17.16	23.95
General mean	21.30	98.18	177.86	213.93

Nutrient Uptake (kg ha^{-1}): The data pertaining to nitrogen, phosphorus, Potassium uptake by maize crop is presented in Table 7. The data revealed that the N, P, K uptake vary significantly due to different weed management treatments. However, the significantly highest total nitrogen uptake ($161.23 \text{ kg ha}^{-1}$), phosphorus uptake (82.23 kg ha^{-1}) and potassium uptake ($162.62 \text{ kg ha}^{-1}$) was recorded by treatment (T₂) which was statistically at par with application of atrazine @ $500 \text{ g a.i. ha}^{-1}$ (PE) *fb* topramezone @ $25 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS (T₇) and application of pyroxasulfone @ $127 \text{ g a.i. ha}^{-1}$ (PE) *fb* topramezone @ $25 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS (T₁₁) which recorded total N, P and K uptake to the tune of ($154.59 \text{ kg ha}^{-1}$ and $148.96 \text{ kg ha}^{-1}$), phosphorus (79.36 kg ha^{-1} and 75.73 kg ha^{-1}) and potassium ($154.83 \text{ kg ha}^{-1}$ and $149.83 \text{ kg ha}^{-1}$) respectively. The lowest uptake (68.29 , 32.14 and $70.42 \text{ N, P and K kg ha}^{-1}$ respectively) was recorded by treatment (T₁) i.e. weedy check.

Table 6. Grain and stover yield (q ha^{-1}) of maize as affected by various treatments

Treatments	Yield (q ha^{-1})	
	Grain yield	Stover yield
T ₁ : Weedy check	35.20	46.95

Treatments	Yield (q ha^{-1})	
	Grain yield	Stover yield
T ₂ : Weed free check	74.73	90.94
T ₃ : Application atrazine @ $500 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> hand weeding at 25 DAS	64.31	83.66
T ₄ : Application of pyroxasulfone @ $127 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> hand weeding at 25 DAS	63.83	80.45
T ₅ : Application of atrazine@ $500 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> halosulfuron methyl @ $67 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS	60.61	76.60
T ₆ : Application of atrazine @ $500 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> tembotrione @ $120 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS	58.73	74.94
T ₇ : Application of atrazine @ $500 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> topramezone @ $25 \text{ g a.i. ha}^{-1}$ (PoE) at 25 DAS	72.62	87.61
T ₈ : Application of atrazine @ $500 \text{ g a.i. ha}^{-1}$ (PE) <i>fb</i> mesotrion + atrazine (Ready mix) @ $300 \text{ g a.i. ha}^{-1}$ at 25 DAS	62.34	77.83

(continued on next page)

Treatments	Yield (q ha ⁻¹)	
	Grain yield	Stover yield
T ₉ : Application of pyroxasulfone @ 127 g a.i. ha ⁻¹ (PE) <i>fb</i> halosulfuron methyl @ 67 g a.i. ha ⁻¹ (PoE) at 25 DAS	59.65	75.44
T ₁₀ : Application of pyroxasulfone @ 127 g a.i. ha ⁻¹ (PE) <i>fb</i> tembotrion @ 120 g a.i. ha ⁻¹ (PoE) at 25 DAS	58.26	72.28
T ₁₁ : Application of pyroxasulfone @ 127 g a.i. ha ⁻¹ (PE) <i>fb</i> topramezone @ 25 g a.i. ha ⁻¹ (PoE) at 25 DAS	70.76	85.60
T ₁₂ : Application of pyroxasulfone @ 127 g a.i. ha ⁻¹ (PE) <i>fb</i> mesotrion + atrazine (Ready mix) @ 300 g a.i. ha ⁻¹ at 25 DAS	61.64	78.86
S.Em±	2.14	2.46

Treatments	Yield (q ha ⁻¹)	
	Grain yield	Stover yield
C.D. (<i>P</i> = 0.05)	6.28	7.22
General mean	61.89	77.60

This trend can be explained by the dual benefits of reduced weed interference and maximized soil resource conservation. By combining integrated control tactics with soil organic inputs, weed management fosters a superior rhizosphere environment that facilitates efficient nutrient assimilation, optimizing photosynthetic source-to-sink allocation in the maize plant. The resulting increase in nitrogen content mirrors the parallel observations advanced by Kumar *et al.* (2012) [12], Kumar *et al.* (2017) [7], Shravan Kumar *et al.* (2017) [13], Shid *et al.* (2022) [14], Chaudhary *et al.* (2024) [15] and Lavanya *et al.* (2024) [16].

Table 7. Nutrient uptake (Kg ha⁻¹) by maize as affected by various treatments

Treatments	N uptake (kg ha ⁻¹)			P uptake (kg ha ⁻¹)			K uptake (kg ha ⁻¹)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T ₁	46.60	21.70	68.29	16.70	15.44	32.14	20.42	50.01	70.42
T ₂	108.49	52.74	161.23	43.72	39.10	82.83	53.80	108.82	162.62
T ₃	91.45	46.06	137.51	36.48	33.81	70.29	43.73	97.88	141.61
T ₄	89.85	43.76	133.61	35.89	32.51	68.40	42.76	93.32	136.09
T ₅	83.49	39.04	122.53	32.86	28.07	60.93	38.70	86.86	125.55
T ₆	78.59	37.37	116.62	30.37	26.71	57.08	36.21	84.15	120.36
T ₇	104.90	49.70	154.59	42.29	37.07	79.36	50.86	103.97	154.83
T ₈	87.53	40.17	127.70	34.42	30.48	64.90	41.03	89.50	130.53
T ₉	81.55	38.05	119.60	31.74	27.27	59.01	37.58	85.25	122.82
T ₁₀	78.42	34.84	112.62	29.24	25.40	54.03	34.95	80.47	115.43
T ₁₁	100.94	48.02	148.96	40.50	35.24	75.73	48.83	101.01	149.83
T ₁₂	85.52	40.74	126.26	34.04	30.09	64.12	40.06	89.94	130.00
S.Em±	3.33	2.04	4.86	1.25	15.44	2.23	2.45	3.12	4.20
C.D. (<i>P</i> = 0.05)	9.77	5.98	14.27	3.68	39.10	6.55	7.17	9.16	12.31
General mean	86.44	41.02	127.46	34.02	32.51	64.07	40.74	89.26	130.01

Conclusion

The application of atrazine @ 500 g a.i. ha⁻¹ (PE) *fb* topramezone @ 25 g a.i. ha⁻¹ (PoE) at 25 DAS and also application of pyroxasulfone @ 127 g a.i. ha⁻¹ (PE) *fb* topramezone @ 25 g a.i. ha⁻¹ (PoE) at 25 DAS resulted in the higher dry matter accumulation, yield and nutrient uptake of *kharif* maize. Therefore, application of atrazine @ 500 g a.i. ha⁻¹ (PE) *fb* topramezone @ 25 g a.i. ha⁻¹ (PoE) at 25 DAS and also application of pyroxasulfone @ 127 g a.i. ha⁻¹ (PE) *fb* topramezone @ 25 g a.i. ha⁻¹ (PoE) at 25 DAS can be recommended for achieving higher dry matter accumulation, yield and nutrient uptake of *kharif* maize.

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