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Studies on weed management in maize (*Zea mays* L.) through pre and post-emergent weedicides

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Abstract
A field experiment was conducted on effect of weed management in maize (*Zea mays* L) through pre and post-emergent herbicides at Main Agricultural Research Station, UAS, Raichur during *kharif*, 2024 in *vertisol*. The experiment was laid out in a randomized complete block design with three replications and thirteen treatments. The results of the experiment revelaled that among the herbicidal treatments, application of pyroxasulfone 85% WG @ 255 g *a.i.* ha^{-1} as PE *fb* tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE had resulted in lower density and dry matter of all categories of weeds, higher weed control efficiency, higher grain yield and lower weed index, which was statistically on par with application of pyroxasulfone 85% WG @ 170 g *a.i.* ha^{-1} as PE *fb* tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE and pyroxasulfone 85% WG @ 127.5 g *a.i.* ha^{-1} as PE *fb* tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE. However, Weedy check recorded significantly higher weed density, weed dry weight and weed index. Hence, pyroxasulfone 85% WG @ 127.5 g *a.i.* ha^{-1} as PE *fb* tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE could be used as an effective weed management practice in maize.

Keywords: Maize, weedicide, Pre-emergent, post- emergent, weed density, weed dry matter yield and weed control efficiency

1. Introduction
Maize, the Indian and American word for corn literally means that "sustains life". It is the third most important cereal crop grown in India in terms of both area and production after rice and wheat, providing nutrition for humans, animals and serving as a basic raw material for the production of starch, oil, protein, alcoholic beverages, food sweeteners and more recently, the fuel. The green plant made into silage has been used with much success in the dairy and beef industries. After harvest of the grain, the dried leaves and upper part including the flowers are still used today to provide relatively good forage for animals owned by many small farmers in developing countries. In developed countries more than 60 per cent of the production is used in compounded feeds for poultry, pigs and ruminant animals (Anon., 1992) [1].

Though the crop has high production potential, the weed menace is a major constraint in its production, especially during *kharif*. Maize is most sensitive to weed competition during its early growth period. The growth of maize plants in the first week is usually slow, during this period weeds establish rapidly and become competitive. Presence of weeds reduces the photosynthetic efficiency, dry matter production and distribution to economical parts and there by reduces sink capacity of crop resulting in poor grain yield. In India, the presences of weeds reduce the maize yield which ranges from 27 to 60 per cent depending upon the growth and persistence of weeds in maize fields (Singh *et al.*, 2015) [14]. The mechanical removal of weeds is very difficult due to labour scarcity on large scale. Now a day's timely use of weedicides to remove weeds is good option. Hence sequential application of pre and post-emergent herbicides and cultural methods is one such strategy to improve the yields on large scale.

2. Material and Methods
A field experiment was laid out in Randomized Complete Block Design with thirteen treatments comprising of ten herbicidal treatments along with hand weeding, weed free and weedy check, which were replicated in thrice during *kharif*, 2024 at Main Agricultural research station, UAS,

Raichur, which is situated at latitude of 16° 12' N and 77° 20' E longitude with an altitude of 389 meters above the mean sea level (MSL). The soil of the experimental site was medium black soil classified under the order vertisols with low organic carbon (0.41%) and available nitrigen (232.15 kg ha-1) medium in available P2O5 (23.33 kg ha-1) and available K2O (378.80 kg ha-1). The Maize (NK-6240) seeds were sown with a spacing of 60 cm × 20 cm. The crop was fertilized with recommended dose of fertilizers (150:75:37.5 kg N:P:K ha-1, respectively). Weed density was recorded by placing a quadrant 0.5 m × 0.5 m (0.25 m2) at random places in each plot and weeds were counted and later converted to m2. The weed density and dry weight of weeds data at harvest was subjected to transformation √(x+0.50). The observations on yield parameters were taken at harvest and yield was expressed as kilograms per hectare.
The weed control efficiency was calculated by using the formula given by Lal (1990) [9].

$$\text{WCE (\%)} = \frac{W_c - W_t}{W_c} \times 100$$

Where, Wc = Dry weight of weeds in weedy check (g m-2)
Wt = Dry weight of weeds in respective treatment plot (g m-2)

Weed index was calculated by using the formula given by Gill and Kumar (1992) [6].

$$\text{WI (\%)} = \frac{X - Y}{X} \times 100$$

Where, X = Total yield (kg ha-1) from the weed free plot or best treatment plot
Y = Total yield (kg ha-1) from the treatment for which weed index has to be calculated

Result and Discussion

The important weed flora found in the experimental plot during the period of experimentation was recorded. Among broad leaved weeds, sessile joyweed [*Alternanthera sessilis* (L.) DC.], asthma plant (*Euphorbia hirta* L.), carrot grass (*Parthenium hysterophorus* L.), devil's horsewhip (*Achyranthes aspera* L.), benghal dayflower (*Commelina benghalensis* L.) and madras leaf-flower (*Phyllanthus maderaspatensis* L.) were predominant. Among the grassy weeds, signal grass (Brachiaria eruciformis (Sm.) was noticed and among sedges, purple nutsedge (*Cyperus rotundus* L.) was observed.

Weed density (no. m-2)

At harvest the broad leaved weeds, grassy weeds, sedges and total weed density was significantly higher in weedy check (7.36, 3.67, 4.74 and 9.44 no. m-2, respectively), whereas lower total weed density was noticed in weed free check (0.71 no. m-2). Among the herbicide applied treatments, application of pyroxasulfone 85% WG @ 255 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE had resulted in significantly higher broad leaved weeds, grassy weeds, sedges and total weed density (3.13, 1.58, 3.48 and 4.84 no. m-2, respectively). However, it was statistically on par with application of pyroxasulfone 85% WG @ 170 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE (3.46, 1.68, 3.53 and 5.13 no. m-2, respectively) and application of pyroxasulfone 85% WG @ 127.5 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE (3.78, 1.94, 3.62 and 5.52 no. m-2, respectively).

Significantly higher broad leaved weeds, grassy weeds, sedges and total weed density in weedy check treatment at all the stages might be due to availability of ample space, nutrients, moisture and light that helped in better weed growth in the treatment combined with the exclusion of weed management methods in order to maintain it as control treatment for recording weed parameters. Whereas, lower total weed density was observed in weed free check at all the stages because of complete removal of weeds, whenever the weeds emerged thereby destroying all kinds of weeds from the treatment and providing better environment with rich sources for the best crop growth and yield. Application of pyroxasulfone and tembotrione herbicide decreased the total weed density by obstructing the weed growth through reduced photosynthetic rates, carotenoids formation, auxin and HPPD inhibition during the critical period of crop weed competition which in turn favoured the crop growth by maximum utilization of nutrients, available soil moisture, utilization of ground space and solar radiation by maize compared to weeds. These results are in close agreement with the findings of Odero *et al.* (2016) [10], Kumar *et al.* (2021) [8] and Begum *et al.* (2025) [4]. Similarly, Singh (2024) [15] observed that the application of pyroxasulfone at 0.127 a.i. kg ha-1 as a pre-emergent fb tembotrione at 0.12 a.i. kg ha-1 as a post-emergent was recommended for effective weed control throughout all stages of crop growth.

Dry weight (g m-2)

At harvest, significantly higher broad leaved weeds, grassy weeds, sedges and total dry weight of weeds was recorded in weedy check (6.11, 3.15, 4.35 and 8.07 g m-2, respectively) whereas, lower broad leaved weeds, grassy weeds, sedges and total dry weight of weeds was noticed in weed free check (0.71 g m-2). Among the herbicide treatments, application of pyroxasulfone 85% WG @ 255 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE had resulted in significantly lower broad leaved weeds, grassy weeds, sedges and total dry weight of weeds (2.41, 1.52, 3.27 and 4.23 g m-2, respectively), which was statistically on par with application pyroxasulfone 85% WG @ 170 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE (2.64, 1.64, 3.32 and 4.44 g m-2, respectively).
Significantly higher broad leaved weeds, grassy weeds, sedges and total dry weight of weeds at different stages was recorded from weedy check which might be attributed to the maximum total density of weeds that was because of absence of any weed management methods and also due to the better availability and utilization of light, space, nutrients and moisture that led to weed establishment thereby providing tough competition to the crop establishment. At all the stages, lower broad leaved weeds, grassy weeds, sedges and total dry weight of weeds was recorded in weed free check which was due to the minimum total density of weeds caused by consecutive hand weeding operations carried out in the treatment as it must be ensured with the weedless environment throughout the experiment.

Weed control efficiency (%)

Significantly higher broad leaved weeds, grassy weeds, sedges and total weed control efficiency on total weeds at harvest was observed in application of pyroxasulfone 85% WG @ 255 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE (85.48, 80.85, 44.43 and 73.08%, respectively), pyroxasulfone 85% WG @ 170 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE (82.25, 76.72, 42.86 and 70.19%, respectively) and pyroxasulfone 85% WG @ 127.5 g a.i. ha-1 as

PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE (79.45, 72.38, 39.66 and 67.05%, respectively) due to lower weed dry weight.

The higher broad leaved weeds, grassy weeds, sedges and total weed control efficiency on total weeds was observed in the weed free check, primarily due to the complete removal of weeds through regular hand weeding. In contrast, the weedy check showed the lowest weed control efficiency, as the absence of any weed management practices resulted in significantly higher dry weight of total weeds.

Significantly higher total weed control efficiency was observed with the application of pyroxasulfone and tembotrione herbicides. Pyroxasulfone inhibited the biosynthesis of very long chain fatty acids, disrupting cell division and elongation in emerging weed seedlings. However, tembotrione induced bleaching effect in grassy weeds by interfering with carotenoid biosynthesis, which is essential for chlorophyll production. Thus both herbicidal effect impaired photosynthesis, reduces weed dry weight, and ultimately enhanced weed control efficiency. Similar result of weed control efficiency was reported by Parveen *et al.* (2017) [11] and Singh (2024) [15] who reported that, combined application of pyroxasulfone at 0.127 a.i. kg ha-1 as pre-emergent and tembotrion at 0.12 a.i. kg ha-1 as post-emergent had resulted in significantly higher weed control efficiency of both monocot and dicot weeds in maize.

Grain yield (kg ha-1)

Significantly higher grain yield (5811 kg ha-1) was observed in weed free check as compared to weedy check (2381 kg ha-1). Among the herbicide treatments, application of pyroxasulfone 85% WG @ 255 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE had recorded significantly higher grain yield (5345 kg ha-1). This treatment was statistically on par with application of pyroxasulfone 85% WG @ 170 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE (5227 kg ha-1), pyroxasulfone 85% WG @ 127.5 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE (5212 kg ha-1) and atrazine 50% WP @ 1000 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i as POE (4917 kg ha-1).

The considerable variation in grain yield may be attributed to differences in growth attributes such as leaf area, number of leaves, and photosynthetic rate. In addition, soil related factors, particularly nutrient availability during the crops reproductive phase might have significantly influenced the nutrient uptake, especially under varying weed densities and soil moisture conditions. Furthermore, yield determining traits such as cob length and girth, number of grain rows per cob, number of grains per cob, cob weight and grain weight likely contribute to the observed variation in grain yield. Similar results were also noticed in the earlier investigations of Arunkumar (2018) [2], Dey (2020) [5] in maize, Baban (2022) [3] in sweet corn, Harisha *et al.* (2023) [7] and Sairam *et al.* (2023) [12] in maize. Begum *et al.* (2025) [4] reported that combined application of pyroxasulfone 85% WG 0.1275 a.i. kg ha-1 as PE fb tembotrione 34.4% SC 0.12 a.i. kg ha-1 as POE at 20 DAS had achieved higher grain yield and stover yield in maize.

Weed index (%)

The lower weed index was recorded in weed free check (0.00%), whereas higher weed index was observed in weedy check (65.31%). Among the herbicide treatments, application of pyroxasulfone 85% WG @ 255 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE had recorded significantly lower weed index (8.02%) which was statistically on par with the application of pyroxasulfone 85% WG @ 170 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE (10.05%) and pyroxasulfone 85% WG @ 127.5 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE had shown 10.31% weed index.

The difference in the weed index ranging from 0 to 65.31 per cent due to different treatments was caused by significant variation in the grain yield due to different methods employed for weed management. Similar results were also noticed by Dey (2020) [5], Shrikanth (2023) [13], Singh (2024) [15], Baban (2022) [3]. Begum *et al.* (2025) [4] also observed significantly lower weed index in the treatment wherein pyroxasulfone 85% WG 0.1275 a.i. kg ha-1 as PE fb tembotrione 34.4% SC 0.12 a.i. kg ha-1 as POE at 20 DAS was applied as pre and post-emergent herbicide.

Table 1: Density of weeds (no. m-2) at harvest of maize as influenced by different weed management practices

Treatment	Density of weeds (no. m^{-2})			
	Broad leaved weeds	Grassy weeds	Sedges	Total weeds
T_1: Pyroxasulfone 85% WG @ 85 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	6.98(48.33)^{ab}	3.29(3.29)^{b}	4.38(18.67)^{ab}	8.82(77.63)^{b}
T_2: Pyroxasulfone 85% WG @ 127.5 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	6.26(38.67)^{bc}	2.85(7.67)^{cd}	4.10(16.33)^{bcd}	7.95(62.67)^{cd}
T_3: Pyroxasulfone 85% WG @ 170 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	6.01(35.67)^{cd}	2.79(7.33)^{cd}	4.06(16.00)^{bcd}	7.71(59.00)^{de}
T_4: Pyroxasulfone 85% WG @ 255 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	5.72(32.33)^{cde}	2.60(6.33)^{de}	3.98(15.33)^{bcde}	7.37(54.00)^{ef}
T_5: Atrazine 50% WP @ 1000 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	6.54(42.33)^{abc}	3.02(8.67)^{bc}	4.26(17.67)^{abc}	8.31(68.67)^{bc}
T_6: Pyroxasulfone 85% WG @ 85 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	4.98(24.67)^{ef}	2.27(4.67)^{ef}	3.72(13.33)^{cde}	6.56(42.67)^{g}
T_7: Pyroxasulfone 85% WG @ 127.5 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	3.78(14.00)^{gh}	1.94(3.33)^{fgh}	3.62(12.67)^{de}	5.52(30.00)^{hi}
T_8: Pyroxasulfone 85% WG @ 170 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	3.46(11.67)^{h}	1.68(2.33)^{gh}	3.53(12.00)^{de}	5.13(26.00)^{ij}
T_9: Pyroxasulfone 85% WG @ 255 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	3.13(9.33)^{h}	1.58(2.00)^{h}	3.48(11.67)^{e}	4.84(23.00)^{j}
T_{10}: Atrazine 50% WP @ 1000 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	4.33(18.33)^{fg}	2.04(3.67)^{fg}	3.67(13.33)^{de}	5.98(35.33)^{h}
T_{11}: Hand weeding @ 20 DAS *fb* Intercultivation at 35 - 40 DAS	5.36(28.33)^{de}	2.41(5.33)^{e}	3.93(15.00)^{bcde}	7.01(48.67)^{fg}

T_{12}: Weed free check	0.71(0.00)^{i}	0.71(0.00)^{i}	0.71(0.00)^{f}	0.71(0.00)^{k}
T_{13}: Weedy check	7.36(53.67)^{a}	3.67(13.00)^{a}	4.74(22.00)^{a}	9.44(88.67)^{a}
S.Em. ±	0.27	0.12	0.17	0.18
C.D. at 5%	0.81	0.35	0.50	0.53

Note: Means followed by same alphabet (s) within a column are not differed significantly by DMRT (P=0.05)
IC = Intercultivation SC = Suspension concentrate WG = Wettable granual a.i.= Active ingredient DAS = Days after sowing fb = followed by HW = Hand weeding *Figures in parentheses indicate original values Original data subjected to square root transformation : √(x+0.50)

Table 2: Dry weight of (g m-2) at harvest of maize as influenced by different weed management practices

Treatment	Dry weight of (g m^{-2})			
	Broad leaved weeds	Grassy weeds	Sedges	Total weeds
T_1: Pyroxasulfone 85% WG @ 85 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	5.54(30.27)^{b}	2.96(8.27)^{ab}	3.79(13.88)^{b}	7.27(52.43)^{b}
T_2: Pyroxasulfone 85% WG @ 127.5 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	4.92(23.77)^{cd}	2.61(6.33)^{c}	3.57(12.24)^{bc}	6.54(42.34)^{cd}
T_3: Pyroxasulfone 85% WG @ 170 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	4.66(21.26)^{de}	2.56(6.08)^{c}	3.47(11.52)^{bc}	6.27(38.86)^{de}
T_4: Pyroxasulfone 85% WG @ 255 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	4.42(19.01)^{ef}	2.41(5.35)^{c}	3.43(11.28)^{bc}	6.01(35.64)^{e}
T_5: Atrazine 50% WP @ 1000 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	5.18(26.40)^{bc}	2.74(7.06)^{bc}	3.64(12.78)^{bc}	6.83(46.24)^{c}
T_6: Pyroxasulfone 85% WG @ 85 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	3.49(11.76)^{g}	1.87(3.02)^{de}	3.49(11.73)^{bc}	5.20(26.52)^{g}
T_7: Pyroxasulfone 85% WG @ 127.5 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	2.83(7.56)^{hi}	1.75(2.61)^{ef}	3.40(11.15)^{bc}	4.67(21.32)^{hi}
T_8: Pyroxasulfone 85% WG @ 170 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	2.64(6.53)^{ij}	1.64(2.20)^{ef}	3.32(10.56)^{bc}	4.44(19.29)^{ij}
T_9: Pyroxasulfone 85% WG @ 255 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	2.41(5.34)^{j}	1.52(1.81)^{f}	3.27(10.27)^{c}	4.23(17.42)^{j}
T_{10}: Atrazine 50% WP @ 1000 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	3.12(9.30)^{gh}	1.82(2.85)^{def}	3.49(11.91)^{bc}	4.95(24.05)^{gh}
T_{11}: Hand weeding @ 20 DAS *fb* Intercultivation at 35 - 40 DAS	4.13(16.55)^{f}	2.09(3.89)^{d}	3.38(10.94)^{bc}	5.65(31.38)^{f}
T_{12}: Weed free check	0.71(0.00)^{k}	0.71(0.00)^{g}	0.71(0.00)^{d}	0.71(0.00)^{k}
T_{13}: Weedy check	6.11(36.78)^{a}	3.15(9.45)^{a}	4.35(18.48)^{a}	8.07(64.70)^{a}
S.Em. ±	0.13	0.11	0.15	0.11
C.D. at 5%	0.38	0.31	0.44	0.33

Note: Means followed by same alphabet (s) within a column are not differed significantly by DMRT (P=0.05)
a.i.= Active ingredient DAS = Days after sowing fb = followed by HW = Hand weeding IC = Intercultivation SC = Suspension concentrate WG = Wettable granual *Figures in parentheses indicate original values Original data subjected to square root transformation : √(x+0.50)

Table 3: Weed control efficiency (%) of different weed management on weeds at harvest of maize

Treatment	Weed control efficiency (%)			
	Broad leaved weeds	Grassy weeds	Sedges	Total weeds
T_1: Pyroxasulfone 85% WG @ 85 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	17.70^{i}	12.49^{i}	24.89^{g}	18.96^{i}
T_2: Pyroxasulfone 85% WG @ 127.5 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	35.37^{gh}	33.02^{g}	33.77^{ef}	34.56^{gh}
T_3: Pyroxasulfone 85% WG @ 170 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	42.20^{fg}	35.66^{g}	37.66^{bcde}	39.94^{fg}
T_4: Pyroxasulfone 85% WG @ 255 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	48.31^{ef}	43.39^{f}	38.96^{bcde}	44.91^{ef}
T_5: Atrazine 50% WP @ 1000 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	28.22^{h}	25.29^{h}	30.84^{fg}	28.53^{h}
T_6: Pyroxasulfone 85% WG @ 85 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	68.03^{d}	68.04^{d}	36.53^{cdef}	59.01^{d}
T_7: Pyroxasulfone 85% WG @ 127.5 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	79.45^{bc}	72.38^{cd}	39.66^{bcde}	67.05^{bc}
T_8: Pyroxasulfone 85% WG @ 170 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	82.25^{bc}	76.72^{bc}	42.86^{bc}	70.19^{b}
T_9: Pyroxasulfone 85% WG @ 255 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	85.48^{b}	80.85^{b}	44.43^{b}	73.08^{b}
T_{10}: Atrazine 50% WP @ 1000 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	74.71^{cd}	69.84^{cd}	35.55^{def}	62.83^{cd}
T_{11}: Hand weeding @ 20 DAS *fb* Intercultivation at 35 - 40 DAS	55.00^{e}	58.84^{e}	40.80^{bcd}	51.50^{e}
T_{12}: Weed free check	100.00^{a}	100.00^{a}	100.00^{a}	100.00^{a}
T_{13}: Weedy check	0.00^{j}	0.00^{j}	0.00^{h}	0.00^{j}
S.Em. ±	2.52	2.50	2.10	2.38
C.D. at 5%	7.41	7.35	6.18	6.98

Note: Means followed by same alphabet (s) within a column are not differed significantly by DMRT (P=0.05)
a.i.= Active ingredient DAS = Days after sowing fb = followed by HW = Hand weeding IC = Intercultivation SC = Suspension concentrate WG = Wettable granual *Figures in parentheses indicate original values

Table 4: Grain yield and weed index as influenced by different weed management practices in maize

Treatment	Grain yield (kg ha^{-1})	Weed index (%)
T$_1$: Pyroxasulfone 85% WG @ 85 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	2381^{gh}	59.03^{b}
T$_2$: Pyroxasulfone 85% WG @ 127.5 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	3139^{ef}	45.98^{d}
T$_3$: Pyroxasulfone 85% WG @ 170 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	3473de	40.23^{e}
T$_4$: Pyroxasulfone 85% WG @ 255 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	3615de	37.79^{e}
T$_5$: Atrazine 50% WP @ 1000 g *a.i.* ha^{-1} as PE *fb* Intercultivation at 35 - 40 DAS	2836^{fg}	51.20^{c}
T$_6$: Pyroxasulfone 85% WG @ 85 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	4316^{c}	25.73^{g}
T$_7$: Pyroxasulfone 85% WG @ 127.5 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	5212^{ab}	10.31^{i}
T$_8$: Pyroxasulfone 85% WG @ 170 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	5227^{ab}	10.05^{i}
T$_9$: Pyroxasulfone 85% WG @ 255 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	5345^{ab}	8.02^{i}
T$_{10}$: Atrazine 50% WP @ 1000 g *a.i.* ha^{-1} as PE *fb* Tembotrione 34.4% SC @ 48 g *a.i.* ha^{-1} as POE	4917^{b}	15.38^{h}
T$_{11}$: Hand weeding @ 20 DAS *fb* Intercultivation at 35 - 40 DAS	3918^{cd}	32.58^{f}
T$_{12}$: Weed free check	5811^{a}	0.00^{j}
T$_{13}$: Weedy check	2016^{h}	65.31^{a}
S.Em. ±	201	1.65
C.D. at 5%	591	4.85

Note: Means followed by same alphabet (s) within a column are not differed significantly by DMRT (P=0.05)
a.i.= Active ingredient DAS = Days after sowing fb = followed by HW = Hand weeding IC = Intercultivation SC = Suspension concentrate WG = Wettable granual *Figures in parentheses indicate original values

Conclusion

Pre and post-emergent application of pyroxasulfone 85% WG @ 255 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE was found effective in controlling weeds by reducing their density and dry weight which resulted in higher weed control efficiency, grain yield and lower weed index. This treatment was statistically on par with application of pyroxasulfone 85% WG @ 170 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE and pyroxasulfone 85% WG @ 127.5 g a.i. ha-1 as PE fb tembotrione 34.4% SC @ 48 g a.i. ha-1 as POE. Thus appropriate combination of pre and post emergent weedicide help in reducing the weed density, weed dry matter weed index and improve the weed control efficiency and yield.

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