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Evaluating the effect of herbicide combinations and sequential applications for broad-spectrum weed control in wheat

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ABSTRACT

Wheat is India's second-largest staple food crop grown in different agro climatic zones in which weeds are known to pose a severe challenge to wheat production. Weed infestation is a major constraint reducing wheat productivity globally. A field experiment was carried out during the rabi seasons of 2021-22 and 2022-23 on loamy sand soil at the AICRP-Weed Management farm, Anand Agricultural University, Anand (Gujarat). The study aimed to evaluate the effect of herbicide combination and sequential application for broad-spectrum weed control in wheat (Triticum aestivum L.). Twelve treatments were evaluated in a randomized block design with three replications. Results indicated that application of pendimethalin 30% EC 500 g a.i./ha PE fb clodinafop propargyl 15% WP 60 g a.i./ha PoE,clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE, hand weeding at 20 and 40 DAS and sulfosulfuron 75% + metsulfuron methyl 5% WG (PM) 30 + 2 g a.i./ha PoE provided significantly lower density and dry biomass of weeds, a higher number of effective tillers, test weight, lower weed index, higher gross return, and benefit-cost ratio as compared to other treatments. Further, application of metribuzin 42% + clodinafop propargyl 12% WG (PM) at both the rate i.e. 140 + 40 or 210 + 60 g a.i./ha PoE provided effective control of weeds with higher weed control efficiency but due to phytotoxic effect on the crop which leads to reduce the grain yield of wheat.

Keywords: *Weed density, weed control efficiency, premix, weed index, yield, B:C*

Introduction

Wheat (*Triticum aestivum* L.), a vital *rabi* crop in India, ranks second only to rice in importance. Predominantly grown in the fertile northern and northwestern regions, it has been a dietary staple for centuries, making India one of the largest global producers and consumers. Wheat is crucial for human health as it contains a multitude of dietary components and nutrients. The major wheat-growing states in India are Uttar Pradesh, Madhya Pradesh, Punjab, Haryana, Bihar, Rajasthan and Gujarat. The average productivity of wheat in India was to the tune of 3537 kg/ha (Anon., 2023). Weeds pose a substantial threat to agricultural production, impacting both crop yields and biodiversity. Effective weed management is crucial in wheat fields to ensure sustainable agriculture and maximize resource efficiency. Weed infestations compete with wheat for sunlight, space, nutrients, and moisture, significantly impacting crop growth and productivity.

Weeds, often more harmful than pests and diseases in agriculture, impede achieving the full potential yield of wheat by competing for resources. Despite their significant impact, weed infestations often go unnoticed and lack adequate attention from farmers. In wheat, yield losses due to weeds can range from 10% to 82%, influenced by weed species, infestation severity, and climatic conditions (Parita and Rana, 2021).

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Brar and Walia (2008) reported a 30-80% reduction in wheat grain production due to intense competition from grassy weeds like *Phalaris minor*. Weeds can be controlled in wheat by using a different method throughout the crop growth but early, up to 30-40 days window that is thought to be crucial for weed management. Using multiple herbicide mechanisms of action (MOAs) or new herbicide molecules, whether premixed, tank-mixed, or applied sequentially, is essential for efficient weed control in wheat, reducing application costs and environmental impact. Combinations of herbicides are preferable because they require lower dosages and leave less residue in the soil, which breaks down more quickly. This improves the safety of the next crop and is a smart strategy for controlling both monocot and dicot weeds in wheat fields. It also enhances the effectiveness of the herbicide, increases its action on the target weed species, and reduces toxicity to the crops.

Materials & Methods

A field experiment was conducted during the 2021-22 and 2022-23 rabi seasons on loamy sand soil at the AICRP-Weed Management farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat). The wheat variety 'GW 451' was sown on November 30th and November 21st using a seeding rate of 120 kg/ha, with rows spaced 22.5 cm apart, manually in previously opened furrows with the help of a *kudali*. Twelve treatments: T_1: Pendimethalin 30% EC 500 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE, T_2 : Flumioxazin 50% SC 125 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE, T_3: Pyroxasulfone 85% WG 127.5 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE, T_4: Pendimethalin 30% EC 500 g a.i./ha PE *fb* sulfosulfuron 75% WP 30 g a.i./ha PoE, T_5 : Pendimethalin 30% EC + metribuzin

70% WP (TM) 500 + 140 g a.i./ha PE, T_6 : Clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE, T_7 : Sulfosulfuron 75% + metsulfuron methyl 5% WG (PM) 30 + 2 g a.i./ha PoE, T_8 : Mesosulfuron methyl 3% + iodosulfuron methyl sodium 0.6% WDG (PM) 12 + 2.4 g a.i./ha PoE, T_9 : Metribuzin 42% + clodinafop propargyl 12% WG (PM) 140 + 40 g a.i./ha PoE, T_{10} : Metribuzin 42% + clodinafop propargyl 12% WG (PM) 210 + 60 g a.i./ha PoE, T_{11}: Hand weeding at 20 & 40 DAS and T_{12}: Un-weeded check, were evaluated in a randomized block design with three replications having net plot size 2.4 x 4.0 m.Pre-emergence herbicides were applied the day after the first irrigation, while post-emergence herbicides were applied at 30 DAS using a knapsack sprayer equipped with a flat fan nozzle with using a spray volume of 500 liters of water/ha. At the maturity of the crop, border lines were harvested first and were removed from the experimental area. Then the net plot area was harvested separately. Data on weed density and dry biomass were recorded at 25, 50 DAS, and at harvest for each treatment using a randomly selected 0.25 m^2 quadrat in each net plot area and converted into m^2area. Weed density and weed dry biomass data were subjected to square root transformation $(\sqrt{x+1})$ before statistical analysis to achieve homogeneity of variances.

Results and Discussion

Weed flora

The experimental field was thoroughly infested with a mixed population of both monocots and dicots. During the investigations, twelve weed species were identified in the experimental area, with the monocots being *Eleusine indica* L., *Dactyloctenium aegyptium*(L.) P. Beauv., *Digitaria sanguinalis*(L.) Scop., *Commelina benghalensis, Eragrostis major, Setaria tomentosa(Roxb.)* Kunth, *Asphodelus tenuifolius* L., and *Phalaris minor*Retz., and the dicots including *Digera arvensis*Frosk, *Chenopodium album* L., *Chenopodium murale* L. and *Melilotus indica* L. as dicot weeds.

Effect on weeds

Application of pendimethalin 30% EC 500 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE recorded a significantly lower density of total weed while pendimethalin 30% EC + metribuzin 70% WP (TM) 500 + 140 g a.i./ha PE recorded significantly lower dry biomass of total weed at 25 followed by pendimethalin 30% EC 500 g a.i./ha PE *fb* sulfosulfuron 75% WP 30 g a.i./ha PoE. At 50 DAS, application of metribuzin 42% + clodinafop propargyl 12% WG (PM) 140 + 40 g a.i./ha PoE recorded lower density of total weed while hand weeding at 20 and 40 DAS recorded lower dry biomass of weed at 50 DAS followed by clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE and pendimethalin 30% EC 500 g a.i./ha PE *fb* sulfosulfuron 75% WP 30 g a.i./ha PoE. Similarly, Singh *et al*. (2005) and Kumar *et al*. (2006) observed that the application of sulfosulfiiron and metribuzin was most effective against broad-leaf weeds. Application of metribuzin 42% + clodinafop propargyl 12% WG (PM) 140 + 40 g a.i./ha PoE recorded significantly lower density and dry biomass of total weed at harvest but it was at par with clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE and flumioxazin 50% SC 125 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE. Sharma *et al.* (2018) also observed that ready-mix herbicide clodinafop + metsulfuron 60 + 4 g a.i./ha proved to be the most effective, showing the highest reduction in both density and dry biomass of weed throughout both years of the study.

Weed Control Efficiency

At 25 DAS, hand weeding at 20 and 40 DAS achieved complete weed control efficiency of total weeds, while application of pyroxasulfone 85% WG 127.5 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE reported the lowest WCE of total weeds among the pre-emergence herbicidal treatments. At 50 DAS, application of metribuzin 42% + clodinafop propargyl 12% WG (PM) 210 + 60 g a.i./ha PoE attained the highest WCE followed by hand weeding at 20 and 40 DAS, metribuzin 42% + clodinafop propargyl 12% WG (PM) 140 + 40 g a.i./ha PoE, flumioxazin 50% SC 125 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE and clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE.

Application of metribuzin 42% + clodinafop propargyl 12% WG (PM) 210 + 60 g a.i./ha PoE recorded maximum WCE followed by metribuzin 42% + clodinafop propargyl 12% WG (PM) 140 + 40 g a.i./ha PoE, clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE and flumioxazin 50% SC 125 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoEat harvest. Notably, it was also reported that all the treatments except treatment T_5, in general, gave greater than 79 percent weed control efficiency of total weeds at harvest. Sequential and premix applications of herbicides in wheat offer numerous benefits, including broad-spectrum weed control and reduced resistance by targeting weeds through multiple modes of action. Raj *et al.* (2020) and Sikeriya *et al.* (2023) obtained similar results in their study.

Effect on crops

Among the crop growth parameters, plant population (measured per meter row length) recorded at 15 DAS was found to be non-significant (Table 2). Plant height at different growth stages was significantly affected by treatments. At 30 DAS, the tallest plants were in the un-weeded check, while the shortest flumioxazin 50% SC 125 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE. At 60 DAS, hand weeding at 20 and 40 DAS resulted in the tallest plants while at harvest, the highest plant height was in pendimethalin 30% EC 500 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE and hand weeding at 20 and 40 DAS treatments. At 60 DAS and at harvest, the lowest plant height was observed with metribuzin 42% + clodinafop propargyl 12% WG (PM) 210 + 60 g a.i./ha PoE. The lowest plant height under said treatment might be due to the phytotoxic effect of metribuzin on wheat plant as reported by Sidhu *et al.* (2014) and Sharma *et al.* (2018). While increase in plant height under manual weeding might be due to hand weeding creating a weed-free environment for the crop, enhancing resource utilization, and promoting better plant growth and development, ultimately leading to increased crop height.

With respect to data on effective tillers per meter row length, application of clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE reported a higher number of effective tillers per meter row length compared to other treatments. These findings are dependable with the results of Kaur *et al*. (2015), they also observed a higher number of effective tillers per square meter in wheat when using a ready-mix of clodinafop and metsulfuron-methyl at 75 g a.i./ha with 0.2% surfactant.

Application of pendimethalin 30% EC 500 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE, clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE and sulfosulfuron 75% + metsulfuron methyl 5%

WG (PM) 30 + 2 g a.i./ha PoE remained at par with each other and recorded significantly higher test weight (36.3 g). Parallel results were also documented by Kumar *et al.* (2018) and Sharma *et al.* (2018).

Significantly the lowest harvest index was recorded under application of pendimethalin 30% EC + metribuzin 70% WP (TM) 500 + 140 g a.i./ha PE among all the treatments tried in the experiment. Application of pendimethalin 30% EC 500 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE recorded significantly higher grain and straw yield but it was at par with clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE, sulfosulfuron 75% + metsulfuron methyl 5% WG (PM) 30 + 2 g a.i./ha PoE, hand weeding at 20 and 40 DAS, pyroxasulfone 85% WG 127.5 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE, pendimethalin 30% EC 500 g a.i./ha PE *fb* sulfosulfuron 75% WP 30 g a.i./ha PoE and flumioxazin 50% SC 125 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE. Among herbicidal treatments, lower grain and stover yield was noticed under the application of metribuzin 42% + clodinafop propargyl 12% WG (PM) 140 + 40 g a.i./ha PoE due to phytotoxic effect on wheat (Table 3). Among all the treatments, significantly the lowest grain and stover yield was recorded under un-weeded check.These findings agree with those of Chaudhari *et al.* (2017)in case of clodinafop + metsulfuron methyl and Meena *et al.* (2019) in case of sulfosulfuron + metsulfuron methyl application.

Findings related to weed index indicated that application of clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE, hand weeding at 20 and 40 DAS and sulfosulfuron 75% + metsulfuron methyl 5% WG (PM) 30 + 2 g a.i./ha PoE recorded 0.77, 1.63, and 3.93% weed index, respectively. These results are consistent with the findings of Singh *et al.* (2018), Meena *et al.* (2019) and Raj *et al.* (2020).

Economics

The results concerning economics showed that maximum gross realization, net realization, and benefit-cost ratio of `1,16,343/ha,`74869/ha, and 2.81, respectively, were registered under sequential application of pendimethalin 30% EC 500 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE, which was closely followed by the application of clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE, sulfosulfuron 75% + metsulfuron methyl 5% WG (PM) 30 + 2 g a.i./ha PoE and hand weeding at 20 and 40 DAS.

Conclusion

On the basis of the results obtained in this study, it is concluded that application of either pendimethalin 30% EC 500 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE or clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE or sulfosulfuron 75% + metsulfuron methyl 5% WG (PM) 30 + 2 g a.i./ha PoE or hand weeding at 20 and 40 DAS in wheat provided significantly lower density and dry biomass of weeds, a higher number of effective tillers, test weight, lower weed index, higher gross return, and benefit-cost ratio.

Table 1: Density, dry biomass, and WCE of total weeds as influenced by different weed management practices (pooled data of two years)

Treatments	Density of total weeds (No./m^2)			Dry biomass of total weeds (g/m^2)			WCE of total weeds (%)		
	At 25 DAS	At 50 DAS	At harvest	At 25 DAS	At 50 DAS	At harvest	At 25 DAS	At 50 DAS	At harvest
T_1: Pendimethalin 30% EC 500 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE	6.10 (37.00)	5.15 (25.67)	4.01 (15.17)	2.48 (5.29)	4.80 (22.08)	7.90 (62.23)	91.72	90.55	87.62
T_2 : Flumioxazin 50% SC 125 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE	6.97 (49.33)	4.21 (17.33)	3.22 (9.67)	2.95 (7.96)	3.80 (13.55)	6.36 (40.14)	87.04	94.28	92.04
T_3: Pyroxasulfone 85% WG 127.5 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE	8.30 (68.33)	6.47 (41.67)	4.08 (15.67)	2.96 (7.99)	5.31 (27.41)	8.39 (69.52)	87.00	88.19	85.95
T_4 :Pendimethalin 30% EC 500 g a.i./ha PE *fb* sulfosulfuron 75% WP 30 g a.i./ha PoE	6.30 (39.33)	5.24 (26.67)	4.32 (18.00)	2.45 (5.04)	4.77 (22.20)	8.14 (67.33)	92.02	90.55	86.77
T_5: Pendimethalin 30% EC + metribuzin 70% WP (TM) 500 + 140 g a.i./ha PE	6.09 (36.67)	7.66 (61.67)	7.21 (53.33)	2.30 (4.34)	9.76 (97.37)	14.07 (201.24)	93.08	59.31	60.21
T_6: Clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE	15.77 (249.00)	5.36 (28.00)	3.55 (12.00)	7.14 (50.15)	4.15 (16.57)	5.99 (36.89)	-	92.78	92.81
T_7: Sulfosulfuron 75% + metsulfuron methyl 5% WG (PM) 30 + 2 g a.i./ha PoE	16.38 (268.50)	6.28 (38.67)	4.71 (22.67)	6.85 (46.37)	4.53 (19.81)	8.20 (71.48)	-	91.44	86.10
T_8: Mesosulfuron methyl 3% + iodosulfuron methyl sodium 0.6% WDG (PM) 12 + 2.4 g a.i./ha PoE	16.23 (263.67)	6.21 (38.00)	5.11 (25.67)	7.25 (51.79)	5.48 (29.45)	8.58 (74.79)	-	87.33	85.29
T_9: Metribuzin 42% + clodinafop propargyl 12% WG (PM) 140 + 40 g a.i./ha PoE	16.12 (259.33)	3.07 (10.33)	2.91 (8.50)	7.59 (56.96)	3.54 (12.14)	4.62 (22.45)	-	94.95	95.67
T_{10}: Metribuzin 42% + clodinafop propargyl 12% WG (PM) 210 + 60 g a.i./ha PoE	16.49 (272.00)	1.00 (0.00)	1.00 (0.00)	7.36 (53.33)	1.00 (0.00)	1.00 (0.00)	-	100.00	100.00
T_{11}: Hand weeding at 20 and 40 DAS	1.00 (0.00)	7.20 (52.00)	6.02 (35.67)	1.00 (0.00)	2.71 (6.41)	10.12 (102.65)	100.00	97.29	79.58

T_{12}: Un-weeded check	17.06 (290.33)	14.86 (223.00)	13.17 (174.67)	7.98 (62.88)	15.33 (234.93)	22.32 (498.58)	-	-	-
Lsd$_{(0.05)}$	1.12	2.53	1.66	0.54	1.84	2.11	-	-	-

*Figures in parentheses are means of original values. Data subjected to transformation $(\sqrt{x} + 1)$.

Table 2: Growth and yield attributes of wheat as influenced by different weed management practices (pooled data of two years)

Treatments	Plant Population (per meter row length) at 15 DAS	Plant height (cm)			Effective tillers (per meter row length) at harvest	Test weight (g)
		At 30 DAS	At 60 DAS	At harvest		
T_1: Pendimethalin 30% EC 500 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE	56.0	36.4	78.1	90.9	113.7	36.3
T_2 : Flumioxazin 50% SC 125 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE	54.4	31.3	73.4	83.9	106.5	36.0
T_3: Pyroxasulfone 85% WG 127.5 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE	53.7	33.5	74.3	85.0	109.7	35.6
T_4 :Pendimethalin 30% EC 500 g a.i./ha PE *fb* sulfosulfuron 75% WP 30 g a.i./ha PoE	55.2	35.9	73.8	86.4	107.2	35.3
T_5: Pendimethalin 30% EC + metribuzin 70% WP (TM) 500 + 140 g a.i./ha PE	54.0	37.1	76.6	83.0	82.8	32.8
T_6: Clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE	58.3	37.4	77.7	88.2	114.2	36.3
T_7: Sulfosulfuron 75% + metsulfuron methyl 5% WG (PM) 30 + 2 g a.i./ha PoE	57.6	37.0	74.4	86.1	113.0	36.3
T_8: Mesosulfuron methyl 3% + iodosulfuron methyl sodium 0.6% WDG (PM) 12 + 2.4 g a.i./ha PoE	58.4	35.9	71.1	79.0	102.8	33.4
T_9: Metribuzin 42% + clodinafop propargyl 12% WG (PM) 140 + 40 g a.i./ha PoE	57.7	35.6	68.1	77.8	100.3	32.8
T_{10}: Metribuzin 42% + clodinafop propargyl 12% WG (PM) 210 + 60 g a.i./ha PoE	57.0	36.0	62.0	71.2	96.3	32.1
T_{11}: Hand weeding at 20 and 40 DAS	56.4	36.5	78.9	88.6	111.3	35.6
T_{12}: Un-weeded check	57.7	37.8	71.5	78.5	35.5	29.7
Lsd$_{(0.05)}$	NS	2.06	4.11	6.16	9.37	2.26

*Figures in parentheses are means of original values. Data subjected to transformation $(\sqrt{x} + 1)$.

Table 3: Yield and economics of wheat as influenced by different weed management practices (pooled data of two years)

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index (%)	Weed Index (%)	Gross realization (`/ha)	Net realization (`/ha)	B: C
T_1: Pendimethalin 30% EC 500 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE	5086	7317	41.0	-	116343	74869	2.81
T_2 : Flumioxazin 50% SC 125 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE	4381	6311	41.0	13.86	100252	56721	2.30
T_3: Pyroxasulfone 85% WG 127.5 g a.i./ha PE *fb* clodinafop propargyl 15% WP 60 g a.i./ha PoE	4649	6647	41.1	8.59	106274	60864	2.34
T_4 :Pendimethalin 30% EC 500 g a.i./ha PE *fb* sulfosulfuron 75% WP 30 g a.i./ha PoE	4608	6308	42.2	9.40	104775	62599	2.48
T_5: Pendimethalin 30% EC + metribuzin 70% WP (TM) 500 + 140 g a.i./ha PE	2650	5960	30.8	47.90	64911	24764	1.62
T_6: Clodinafop propargyl 15% + metsulfuron methyl 1% WP (PM) 60 + 4 g a.i./ha PoE	5047	7217	41.2	0.77	115374	74361	2.81
T_7: Sulfosulfuron 75% + metsulfuron methyl 5% WG (PM) 30 + 2 g a.i./ha PoE	4886	7131	40.6	3.93	111972	71281	2.75
T_8: Mesosulfuron methyl 3% + iodosulfuron methyl sodium 0.6% WDG (PM) 12 + 2.4 g a.i./ha PoE	4197	6291	40.0	17.48	96521	55910	2.38
T_9: Metribuzin 42% + clodinafop propargyl 12% WG (PM) 140 + 40 g a.i./ha PoE	3318	6177	34.9	34.76	78704	38746	1.97
T_{10}: Metribuzin 42% + clodinafop propargyl 12% WG (PM) 210 + 60 g a.i./ha PoE	3212	6011	34.7	36.85	76262	35759	1.88
T_{11}: Hand weeding at 20 and 40 DAS	5003	7163	41.1	1.63	114376	67895	2.46
T_{12}: Un-weeded check	1845	2967	38.4	63.72	42845	4994	1.13
Lsd$_{(0.05)}$	398	615	3.44	-		-	-

*Figures in parentheses are means of original values. Data subjected to transformation $(\sqrt{x} + 1)$.

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