

Effect of Herbicides on Weed Control and Yield of Daincha Seed Crop

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Abstract

Field experiments were conducted during 2023-24 and 2024-25 in daincha seed crop at Anbil Dharmalingam Agricultural College and Research Institute, Trichy. The treatments consisted of T₁- Pre- emergence application of pretilachlor 50% EC @ 1.5 lit/ha, T₂- Pre- emergence application of metolachlor @ 2.0 lit/ha, T₃- Pre emergence application of pendimethalin 30% EC @ 1.0 kg a.i/ha, T₄- Pre emergence application of atrazine 50% wp @ 2.0 kg/ha, T₅- Pre emergence application of butachlor 50% EC at 2.5 lit/ha, T₆- Pre emergence application of quizalafop ethyl 5% EC at 1.0 lit/ha, T₇- Pre emergence application of sodium acefluorofen and cladinafop proparygyl @ 1.0 lit/ha, T₈- Pre- emergence application of halosulfuron methyl at 90 g/ha and T₉- Unweeded check. The experiment was conducted in randomized block design with three replications. The results revealed that pre- emergence application of pendimethalin 30% EC @ 1.0 kg a.i/ha recorded the highest yield parameters and highest seed yield of 293 kg and WCE of 75%.

Key words: *Sesbania spp.*, Herbicides, Pendimethalin, Weed control efficiency, Seed yield

Daincha (*Sesbania spp.*) is an important leguminous crop widely utilized as a green manure owing to its rapid biomass accumulation and nitrogen-fixing ability, which enhance soil fertility and structure in subsequent crops [1]. In green manure systems, crop periods are short and weeds usually do not compete intensely with the crop, thus formal weed management is often neglected. However, when daincha is cultivated as a seed crop, the extended growth period exposes plants to prolonged competition from a diverse weed flora, resulting in reduced growth, compromised yield attributes, and lower seed yield [2]. Under such conditions, effective weed management becomes essential to ensure profitability and seed quality [3].

Weed competition is a major biotic constraint in leguminous crops, where unsuppressed weed growth can significantly reduce yield potential. Chemical weed control through selective herbicides provides a practical alternative to manual weeding, particularly under conditions of labor scarcity and increased production costs [4]. Studies in other legume systems have emphasized the value of herbicidal strategies for effective weed suppression. For instance, Mosjidis and Wehtje [5] reported that pre-emergence applications of pendimethalin and imazethapyr, when applied alone, were selective in sunnhemp, although their combined use adversely affected dry matter production, underscoring the importance of herbicide selectivity and crop safety. Similarly, in sunnhemp, pre-emergence application of pendimethalin at 1.0 kg a.i. ha⁻¹ followed by one hand weeding at 30 DAS significantly improved germination, crop growth, dry matter production, and weed control efficiency compared with untreated plots [6].

Recent weed management research in other grain legumes further highlights the continuing relevance of pre- and post-emergence herbicidal approaches. In chickpea, pendimethalin in combination with imazethapyr significantly

suppressed weed growth and was comparable to weed-free conditions, demonstrating high weed control efficacy and yield potential [7]. Additionally, a 2025 review on weed control in blackgram and cowpea has documented that pre-emergence pendimethalin, alone and in combination with other selective herbicides, effectively reduces weed density and enhances crop productivity, often outperforming manual weed control under specific conditions, while integrated approaches combining cultural and chemical methods can further optimize outcomes [8]. Despite advances in herbicide-based weed control for many legumes, research on weed management specifically in daincha seed production remains limited. The unique growth habit, extended reproductive phase, and weed competitive dynamics of daincha necessitate species-specific evaluation of herbicide efficacy, crop safety, and yield responses [9]. Moreover, the interaction between weed control efficiency, yield attributes, and economic returns under different herbicide regimes also needs careful assessment to formulate practical recommendations for farmers [10].

Therefore, this investigation was undertaken to evaluate the effect of different pre- and post-emergence herbicides on weed dynamics, weed control efficiency, yield attributes, and seed yield of daincha seed crop, with the objective of identifying suitable herbicide treatments that maximize productivity while minimizing weed-induced yield loss under field conditions.

MATERIALS AND METHODS

The two-year field experiments conducted during the summer seasons of 2024 and 2025 were designed to evaluate the efficacy of different pre- and post-emergence herbicides on weed management, growth, and seed yield of daincha under field conditions. The study was laid out in a randomized block

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design with three replications, comprising nine treatments that included pre-emergence application of pretilachlor 50% EC @ 1.5 L ha⁻¹, metolachlor @ 2.0 L ha⁻¹, pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹, atrazine 50% WP @ 2.0 kg ha⁻¹, and butachlor 50% EC @ 2.5 L ha⁻¹, along with post-emergence application of quizalafop-ethyl 5% EC @ 1.0 L ha⁻¹, sodium acefluorfen + clodinafop-propargyl @ 1.0 L ha⁻¹, and halosulfuron methyl @ 90 g ha⁻¹, besides an unweeded control. Pre-emergence herbicides were applied within 2-3 days after sowing, while post-emergence herbicides were applied at appropriate crop and weed growth stages using a knapsack sprayer fitted with a flat-fan nozzle to ensure uniform spray coverage. Standard agronomic practices were followed uniformly across all treatments, and observations on plant height, number of branches, yield attributes, seed yield, weed control efficiency, and weed index were recorded following recommended procedures. The data were statistically analyzed using analysis of variance suitable for a randomized block design, and

treatment means were compared using critical difference at the 5% level of significance to assess the consistency and reliability of treatment effects across both years.

RESULTS AND DISCUSSION

Pre-emergence application of pendimethalin 30% EC @ 1kg a.i/ha recorded significantly the highest plant height in the first year. The same trend was noticed in the second year. The same treatment recorded the highest number of branches per plant in both the years. No of pods per plant and number of seeds per pod were highest in the pre-emergence application of pendimethalin 30% EC@ 1.0kg a.i/ha. Thousand seed weight was not affected by the herbicides treatment. Pre-emergence application of pendimethalin 30% EC @ 1.0kg a.i/ha recorded the highest seed yield of 293 kg/ha [11-12]. The weed control efficiency was highest (75%) with pre-emergence application of pendimethalin 30% EC @ 1.0kg a.i/ha.

Table1 Effect of herbicide treatments on plant height and yield attributes of daincha seed crop

Treatments	Plant Height		No. of branches per plant		No. of pods/ plant	
	2024	2025	2024	2025	2024	2025
T ₁	218.0	177.0	11.6	20.0	31.3	65.7
T ₂	205.0	190.0	13.3	25.0	19.0	62.7
T ₃	225.0	275.0	16.6	33.0	38.4	85.7
T ₄	210.0	182.0	14.7	20.7	25.0	54.7
T ₅	208.0	185.0	13.5	22.3	26.0	41.7
T ₆	214.0	250.0	15.6	25.0	28.0	62.3
T ₇	200.0	216.0	12.6	28.7	30.0	55.3
T ₈	205.0	255.0	15.2	24.3	32.6	62.0
T ₉	175.0	240.0	10.8	20.7	28.4	50.0
SEd	3.4	10.3	4.2	4.58	4.5	4.07
CD(p=0.05)	7.2	21.8	9.1	9.71	9.5	8.55

Effect of herbicide treatments on plant height and yield attributes of daincha seed crop

The data presented in (Table 1) illustrate the influence of different herbicide treatments on plant height, number of branches per plant, and number of pods per plant of daincha during the 2024 and 2025 cropping seasons. The results clearly indicate that herbicide treatments significantly affected growth and yield-attributing characters, with noticeable variations among treatments and between years.

Plant height

Plant height varied significantly among treatments in both years, as evidenced by the critical difference (CD) values at the 5% level. During 2024, plant height ranged from 175.0 cm (T₉) to 225.0 cm (T₃), indicating a clear superiority of T₃ over other treatments. A similar trend was observed in 2025, where plant height increased markedly across most treatments, with T₃ recording the maximum height (275.0 cm) followed by T₈ (255.0 cm) and T₆ (250.0 cm). The lowest plant height in 2025 was observed under T₁ (177.0 cm). The enhanced plant height under T₃, T₆, and T₈ may be attributed to effective weed suppression, which reduced competition for nutrients, moisture, light, and space, thereby promoting better vegetative growth. The comparatively lower plant height recorded under T₉ in 2024 suggests inadequate weed control or possible crop stress under that treatment. These results are in accordance with previous studies [13-14]. The overall increase in plant height during 2025 compared to 2024 across most treatments may be due to favorable climatic conditions or cumulative improvement in soil environment.

Number of branches per plant

The number of branches per plant, a crucial yield-determining character, was significantly influenced by herbicide treatments in both years. In 2024, the number of branches ranged from 10.8 (T₉) to 16.6 (T₃), with T₃ recording the highest branching. In 2025, branching increased substantially, ranging from 20.0 (T₁) to 33.0 (T₃). Among the treatments, T₃ consistently produced the highest number of branches per plant during both seasons, followed by T₇ (28.7) and T₆ (25.0) in 2025. Increased branching under these treatments could be associated with reduced weed pressure during the critical growth stages, allowing better assimilation of photosynthates and enhanced lateral growth. Treatments such as T₁ and T₉, which recorded fewer branches, may have experienced higher weed competition, restricting plant vigor [15-16].

Number of pods per plant

The number of pods per plant showed significant variation among treatments, confirming the strong influence of herbicide management on reproductive growth. In 2024, pods per plant ranged from 19.0 (T₂) to 38.4 (T₃), whereas in 2025, a substantial increase was recorded, with values ranging from 41.7 (T₅) to 85.7 (T₃). Treatment T₃ recorded the highest number of pods per plant in both years, followed by T₁ and T₆ in 2025. The superior pod production under T₃ can be attributed to improved vegetative growth, higher branching, and enhanced photosynthetic efficiency resulting from effective weed control. In contrast, treatments such as T₅ and T₉ recorded comparatively fewer pods, possibly due to residual weed

competition or suboptimal herbicide efficacy affecting reproductive development [17-18].

Overall performance of treatments

Across both years, T₃ emerged as the most effective treatment, consistently producing significantly higher plant height, number of branches, and number of pods per plant. Treatments T₆ and T₈ also performed well, particularly in 2025, indicating their suitability for improving growth and yield attributes of daincha seed crop. The consistent improvement in all parameters during 2025 highlights the importance of season-

specific environmental interactions with herbicide treatments. The statistically significant differences, supported by SEd and CD values, confirm that the observed variations among treatments were not due to random chance. Overall, the findings demonstrate that appropriate herbicide management plays a crucial role in enhancing crop growth and yield attributes by minimizing weed competition during critical growth stages [19-20]. Application of Pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ consistently outperformed other treatments, emphasizing the importance of efficient weed control for improved vegetative and reproductive development of the crop.

Table 2 Effect of weed control treatments on yield attributes, weed control efficiency (WCE) and weed index

Treatments	Number of seeds / pods		Thousand seed weight (g)		Seed yield (kg/ha)		Weed control efficiency (%)		Weed index	
	2024	2025	2024	2025	2024	2025	2024	2025	2024	2025
T ₁	29.5	24.7	19.2	20.2	173.0	223	60	55	20	18
T ₂	26.4	26.0	19.4	20.1	202.0	300	68	63	12	13
T ₃	39.6	32.0	20.7	20.4	293.0	360	75	72	-	-
T ₄	28.5	27.3	20.6	20.3	220.0	265	59	54	26	24
T ₅	21.9	27.7	19.3	20.5	235.0	337	64	62	19	18
T ₆	24.0	26.7	19.2	20.1	197.0	345	58	56	31	28
T ₇	28.9	27.3	19.6	20.2	180.0	270	67	63	37	35
T ₈	35.5	28.3	19.6	20.4	199.0	286	61	58	31	28
T ₉	25.3	20.0	19.4	19.9	120.0	191	-	-	55	60
SEd	8.2	1.07	-	-	3.8	18				
CD(p=0.05)	17.4	2.24	NS	NS	8.0	39				

Effect of weed control treatments on yield attributes, weed control efficiency and weed index

The data presented in (Table 2) reveal the effect of different weed control treatments on yield attributes, seed yield, weed control efficiency (WCE), and weed index of daincha seed crop during the 2024 and 2025 seasons. The results clearly demonstrate that weed management practices had a pronounced influence on both crop productivity and weed suppression efficiency, with significant variation among treatments and across years.

Number of seeds per pod

The number of seeds per pod differed significantly among treatments in both years, as indicated by the CD (p = 0.05) values. During 2024, the number of seeds per pod ranged from 21.9 (T₅) to 39.6 (T₃), while in 2025 it ranged from 20.0 (T₉) to 32.0 (T₃). Treatment T₃ recorded the highest number of seeds per pod in both years, indicating superior reproductive development under this weed control strategy. The enhanced seed set under T₃ can be attributed to effective weed suppression, which minimized competition for nutrients, moisture, and light during the flowering and pod development stages. Treatments such as T₅ and T₉ recorded lower values, likely due to increased weed interference during critical reproductive phases, resulting in reduced assimilate partitioning towards seed formation [21].

Thousand seed weight

Thousand seed weight did not differ significantly among treatments in either year, as indicated by non-significant (NS) CD values. In 2024, thousand seed weight ranged from 19.2 g to 20.7 g, while in 2025 it ranged from 19.9 g to 20.5 g. The relative stability of this trait suggests that seed size is predominantly governed by genetic factors and less influenced by weed control practices. However, a marginal increase in thousand seed weight was observed during 2025 across most

treatments, possibly due to favorable environmental conditions and improved crop growth leading to better seed filling [22].

Seed yield

Seed yield was significantly influenced by weed control treatments in both years. During 2024, seed yield ranged from 120.0 kg ha⁻¹ (T₉) to 293.0 kg ha⁻¹ (T₃), whereas in 2025 yields increased substantially, ranging from 191.0 kg ha⁻¹ (T₉) to 360.0 kg ha⁻¹ (T₃). Among the treatments, T₃ consistently recorded the highest seed yield, followed by T₅ and T₆ in 2025. The superior performance of T₃ can be attributed to higher seeds per pod, effective weed control, and improved overall crop vigour, as reflected by its higher weed control efficiency (WCE). Conversely, the lowest seed yield recorded under T₉ indicates severe yield penalties due to unchecked weed growth and intense crop-weed competition. The general increase in seed yield during 2025 compared to 2024 suggests better seasonal conditions and possibly cumulative improvements in soil and crop stand [23-24].

Weed control efficiency (WCE)

Weed control efficiency varied considerably among treatments and between years. In 2024, weed control efficiency (WCE) ranged from 58% (T₆) to 75% (T₃), while in 2025 it ranged from 54% (T₄) to 72% (T₃). Treatment T₃ consistently achieved the highest weed control efficiency (WCE), indicating its superior ability to suppress weed growth throughout the crop period. Moderate WCE values were recorded under treatments T₂, T₅, and T₇, suggesting partial weed suppression [25]. The lower WCE observed in treatments such as T₄ and T₆ indicates less effective weed management, which may have resulted in reduced crop growth and yield attributes. The slight decline in weed control efficiency (WCE) during 2025 across most treatments could be attributed to higher weed pressure or favorable conditions for weed emergence during that season [26].

Weed index, which represents the percentage reduction in yield due to weed competition compared to the best-performing treatment, showed substantial variation among treatments. Treatments T₃ recorded a zero-weed index in both years, confirming it as the most effective weed control treatment with no yield penalty. The highest weed index values were observed under T₉ (55–60%), indicating severe yield losses due to poor weed control [27]. Treatments such as T₇, T₆, and T₈ also recorded relatively high weed index values, reflecting moderate to high yield reductions as a result of weed competition. The lower weed index values under T₂ and T₅ indicate better weed management efficiency and improved yield protection compared to other treatments [28]. Overall, the results clearly indicate that effective weed control significantly enhances yield attributes and seed yield of daincha. Among all treatments, T₃ proved to be the most effective, as evidenced by higher seeds per pod, maximum seed yield, highest weed control efficiency, and zero weed index during both years. Treatments with lower WCE consistently recorded higher weed index values and reduced seed yields, highlighting the strong negative impact of weeds on crop productivity. These findings emphasize the importance of adopting efficient weed management strategies to minimize yield losses and improve the economic performance of daincha seed crop.

The results of the two-year field study clearly demonstrated that weed management practices significantly influenced growth, yield attributes, seed yield, weed control efficiency, and weed index of daincha seed crop. Among the different treatments evaluated, pre-emergence application of pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ (T₃) consistently outperformed all other treatments during both the years of experimentation. This treatment recorded significantly higher plant height, number of branches per plant, number of pods per plant, and number of seeds per pod, indicating superior vegetative and reproductive growth due to effective weed suppression during critical crop growth stages. Although thousand seed weight remained unaffected by herbicide treatments, seed yield showed a marked response to weed control practices. The highest seed yield was obtained with pendimethalin application, which was closely associated with its highest weed control efficiency (75% and 72%) and zero weed index, reflecting minimal yield loss due to weed competition. Overall, pre-emergence application of pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ can be recommended as an effective and reliable weed management practice for enhancing growth, yield attributes, and seed yield of daincha under similar agro-ecological conditions.

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