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Technical Report

Efficacy of a Range of Fallow Herbicide Treatments for Weed Control in a Bare Soil Trial, Pukekohe, New Zealand

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Summary

A field trial was conducted during summer 2026 in Pukekohe, New Zealand, to evaluate the efficacy of a range of herbicide treatments applied under bare soil (fallow) conditions. The trial site contained a diverse weed population; however, white clover was the dominant species across all plots and formed the primary driver of weed pressure and treatment response. Secondary species included hedge mustard, groundsel, redroot, and twin cress, although these occurred at comparatively low densities and did not materially influence overall weed trends.

Due to the dominance and uniform distribution of white clover, total weed counts were used as the primary measure of herbicide efficacy.

Across all assessments, herbicide treatments significantly reduced weed density and ground cover compared with the untreated control ($P = 0.0001$). Frontier (dimethenamid-P) consistently provided the highest and most stable level of control, maintaining 88.9–92.3% weed control efficiency (WCE) across all assessments. Goltix (metamitron) and Foresite (oxadiazon) provided stable moderate-to-high control, while Ethomate + BackRow Max showed strong initial suppression followed by gradual decline. Ethomate alone provided moderate but declining control, and Chloronion (chloridazon) performed poorly throughout the trial period.

Materials and Methods

Experimental site and design

The trial was conducted at the Plant and Food Research Farm, Pukekohe, New Zealand, on a uniform bare soil site established to represent fallow field conditions. The experiment was arranged as a randomised complete block design (RCBD) with four replicates per treatment. Eight herbicide treatments, including an untreated control, were evaluated (Table 1). Plots were arranged in blocks to reduce spatial variability.

Each plot was of uniform size (1.72m x 4m), ensuring consistent spray coverage and sampling area.

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Table 1. Herbicide treatment details

Treatment	Product Name	Active Ingredient	Rate/ha
1	UTC	-	-
2	Stomp	pendimethalin	0.5 L/ha
3	Ethomate	ethofumesate	2 L/ha
4	Foresite	oxadiazon	1 L/ha
5	Goltix	metamitron	3 L/ha
6	Frontier	dimethenamid-P	1 L/ha
7	Ethomate + Backrow Max	ethofumesate + paraffinic petroleum oil	2 L/ha & 0.4 L/ha
8	Chloronion	chloridazon	2 L/ha

Weed establishment and species composition

Weed emergence was dominated by white clover, which established uniformly across all plots and formed the primary weed population used for assessment. Minor species present included hedge mustard, groundsel, redroot, and twin cress but these occurred at low and inconsistent densities.

Given the dominance of white clover, total weed counts (all species combined) were used as the primary response variable to ensure consistency and robustness of treatment comparisons.

Herbicide application

A single herbicide application was made on the 9th of February 2026 using a CO_2-pressurised plot sprayer fitted with 11002 AITT J60 TeeJet nozzles spaced at 30 cm. The application volume was calibrated to 400 L/ha. Applications were made under suitable environmental conditions to ensure uniform coverage and minimise drift.

Assessments

Weed counts were conducted on 10 March, 19 March, and 25 March 2026 using a 1 m² quadrat per plot. Final assessment (3 April 2026) measured percentage weed ground cover per plot.
Weed control efficiency (WCE) was calculated using:

$$WCE(\%) = (WDc - WDt)/WDc \times 100$$

WCE = Weed control efficiency
WDc = Weed population of the untreated control
WDt = Weed population of the treated plot

Statistical analysis

Data was analysed using ANOVA in ARM. Treatment means were separated using Tukey's HSD test at the 5% significance level. Replicate effects were assessed, and model assumptions were examined. Coefficients of variation (CV) and standard deviations are presented for each assessment timing.

Results

Table 2: Total weed count and % ground cover for each treatment

Treatment	Total Weed Count 10 March 2026	Total Weed Count 19 March 2026	Total Weed Count 25 March 2026	% Ground Cover 3 April 2026
UTC	123.8 a	110.0 a	131.0 a	100.0 a
Stomp	38.0 bc	34.0 c	33.5 c	75.0 ab
Ethomate	52.5 bc	46.3 bc	60.5 bc	75.0 ab
Foresite	29.8 c	32.8 c	38.8 bc	55.0 b
Goltix	30.0 c	26.5 c	29.8 c	70.0 ab
Frontier	10.5 c	8.5 c	14.5 c	15.0 c
Ethomate + Backrow Max	25.3 c	28.0 c	37.5 c	53.8 b
Chloronion	94.0 ab	91.5 ab	107.0 ab	85.0 ab
Tukey's HSD P=.05 (% mean diff)	57.78 (114%)	48.12 (102%)	69.08 (122%)	35.54 (54%)
Standard Deviation	24.36	20.29	29.13	14.99
CV	48.27	42.99	51.49	22.67
Replicate F	0.802	0.524	2.051	1.784
Replicate Prob(F)	0.5069	0.6705	0.1374	0.1810
Treatment F	10.116	11.919	7.949	11.620
Treatment Prob(F)	0.0001	0.0001	0.0001	0.0001

Weed density response

Weed density in the untreated control remained consistently high across all three assessment dates, ranging from 110.0 to 131.0 weeds/m². This confirmed strong and uniform weed emergence dominated by white clover. All herbicide treatments significantly reduced weed density compared with the untreated control (P = 0.0001), with strong treatment separation maintained across all time points.

Frontier consistently provided the lowest weed density across all assessments (10.5, 8.5, and 14.5 weeds/m²), demonstrating both strong initial activity and sustained suppression of ongoing white clover emergence. Goltix and Foresite provided stable intermediate suppression, while Ethomate + BackRow Max showed a gradual increase in weed numbers over time, indicating reduced residual persistence. Ethomate alone provided consistently weaker suppression. Chloronion remained ineffective throughout.

Ground cover response

Final ground cover measurements reflected cumulative weed pressure dominated by white clover. Frontier provided the lowest weed cover (15%), followed by Foresite (55%) and Ethomate + BackRow Max (53.8%). Goltix, Stomp, and Ethomate resulted in higher cover (approximately 70–75%), while Chloronion remained high (85%). These results closely matched WCE trends, confirming consistency across metrics.

Statistical summary

All weed count assessments and ground cover showed highly significant treatment effects (P = 0.0001). Coefficients of variation ranged from 42.99% to 51.49% for weed counts, reflecting natural spatial variability in white clover emergence. Ground cover showed lower variability (CV = 22.67%), indicating greater stability in later-stage area measurements.

Despite variability in early emergence, strong F-values across all assessments (7.949–11.919) confirmed robust treatment separation.

Table 3: Weed control efficiency for each treatment

Treatment	10 March 2026	19 March 2026	25 March 2026
Stomp	69.3%	69.1%	74.4%
Ethomate	57.6%	58%	53.8%
Foresite	76%	70.2%	70.4%
Goltix	75.8%	75.9%	77.3%
Frontier	91.5%	92.3%	88.9%
Ethomate + Backrow Max	79.6%	74.5%	71.4%
Chloronion	24%	16.8%	18.3%

Weed control efficiency (WCE)

Weed control efficiency closely aligned with weed density trends and provided a clear measure of treatment stability over time.

Frontier consistently achieved the highest WCE values (91.5%, 92.3%, 88.9%), confirming strong residual activity and suppressed later weed emergence. Goltix and Foresite maintained stable WCE values (approximately 70–77%), indicating consistent but moderate residual performance.

Ethomate + BackRow Max declined from 79.6% to 71.4%, indicating moderate early activity but reduced persistence. Ethomate alone remained lower throughout (57.6% to 53.8%), while Chloronion remained below 25% at all assessments.

Discussion

The dominance of white clover was the key driver of weed pressure in this trial and provided a uniform and reliable system for assessing herbicide performance. While minor species were present, their low density meant that treatment effects were primarily driven by control of white clover emergence.

The integration of ARM weed counts, WCE, and ground cover data provides a consistent and internally validated dataset. Treatments that performed well in early emergence assessments also maintained suppression in later assessments, while weaker treatments declined consistently across all metrics.

Frontier demonstrated the most consistent performance across all datasets. Its ability to maintain high WCE (>88%) across all assessments, combined with the lowest weed density and ground cover, shows strong residual activity and good control of later white clover emergence.

Goltix and Foresite provided stable, moderate performance across all metrics, suggesting reliable pre-emergent activity but reduced residual persistence compared with Frontier.

Ethomate + BackRow Max showed a clear decline across all measures, indicating moderate early activity but insufficient residual control under sustained emergence pressure. Ethomate alone provided consistently weaker control and limited residual performance.

Chloronion performed poorly across all datasets, confirming limited efficacy under dominant white clover pressure in fallow systems.

The moderate-to-high CV values observed in early weed counts reflect inherent spatial variability in clover emergence rather than treatment inconsistency, as evidenced by strong and consistent statistical separation across all assessments.

Conclusion

This trial demonstrated clear and statistically significant differences between herbicide treatments under fallow conditions dominated by white clover. Frontier provided the most consistent and effective control across all assessments, while Goltix and Foresite delivered stable moderate suppression. Ethomate + BackRow Max showed declining performance over time, Ethomate alone provided limited control, and Chloronion was ineffective.

The combined analysis of weed counts, WCE, and ground cover confirms that residual activity is the key determinant of long-term weed suppression in fallow systems with continuous white clover emergence.

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Appendix

Appendix i – Weather data

Date	February			March		
	Max (°C)	Min (°C)	Rainfall (mm)	Max (°C)	Min (°C)	Rainfall (mm)
1	-	-	-	26.8	12.1	2.9
2	-	-	-	21.7	6	0
3	-	-	-	19.9	8.1	0
4	-	-	-	21.9	8.2	0
5	-	-	-	24.6	9.1	0
6	-	-	-	24.2	9.4	0
7	-	-	-	24.8	11.3	0
8	-	-	-	25.2	12.5	0
9	26.3	15.2	0	26.8	11.7	0
10	28.4	16.5	0	24.6	14.3	0
11	29.2	16.2	0	18.9	13.9	0
12	27	19.2	1.3	24.2	16.2	0.6
13	25	19.8	23.2	28	17.4	8.3
14	21.1	16.1	0	22.6	12.3	0
15	22.1	14.6	0.4	23.1	10.7	0
16	24.3	12.2	1.3	23.9	10.2	0.1
17	25.1	14.1	0	24.9	11	0
18	25.1	14.2	1.4	26.2	12.7	0
19	24.1	14.6	0.4	27	10.3	0
20	24.4	13.9	0	26.3	11.7	0
21	24.2	10.1	0	28.1	13.5	0
22	24.2	12.2	0	27.9	15.2	0
23	26	11.3	0	26.2	11.7	0
24	26	14.9	0	22.8	14.6	0
25	27.5	14.1	0	20.1	15.6	32.6
26	27	14	0	20.2	15.9	60.7
27	26.9	15.1	0	27.9	15	0
28	24.8	15.5	0.3	25.4	12.8	0
29	-	-	-	25.1	15.9	12.5
30	-	-	-	22.7	15.6	1.4
31	-	-	-	20.6	12.2	0