Weeds Programme TECHNICAL NOTE

Date: 30 June 2016

Performance of alternative to current herbicide treatments at 30 months after trial implementation

Summary: In 2013, new and already shortlisted alternatives to terbuthylazine and hexazinone were trialled in-field across a range of weed and environmental gradients with the objective of establishing successful operational prescriptions for use by all industry that were acceptable to forest certification bodies such as the FSC. This brief technote is a summary of the measurements of these trials made in 2016 at 30 months after treatment initiation.

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Background

The designation of terbuthylazine and hexazinone as highly hazardous herbicides by the Forest Stewardship Council (FSC) in 2007 was the major driver for a programme of research initiated by forest owners in 2009. The aim of this programme was to identify alternative herbicides that could be used in planted radiata pine forests for weed control, particularly in the year of planting.

In 2013, new and already shortlisted alternatives to terbuthylazine and hexazinone were trialled in the field across a range of weed and environmental gradients with the objective of establishing successful operational prescriptions for use by all industry that were acceptable to forest certification bodies such as the FSC. Specifically, several herbicide mixes that either eliminated both the FSC designated highly hazardous active ingredients, or retained only one (terbuthylazine) were tested in seven field trials spread across New Zealand, from Rotorua to Dunedin (see Rolando et al., 2015). These treatments were benchmarked against the current industry standard treatment that uses terbuthylazine and hexazinone applied at ~7000g and 1750g respectively.

A comprehensive report on the performance of the alternative herbicide mixes tested across the seven field trials was completed in June 2015 (Rolando et al., 2015). However, at that time tree growth data up to only 18 months after treatment implementation had been collected and it was considered a premature evaluation of the performance of the trees in relation to the current operational standard. To maximise the outcomes from these field trials one final tree measurement was made at all trials in April 2016 – 2.5 years after treatment implementation. This brief technote is a summary of the measurements made in 2016. It is not a standalone assessment and should be evaluated together with the report produced in June 2015 which contains comprehensive details of treatments, sites and early growth responses (Rolando et al., 2015).

Key Results at 30 months

The measurements of tree size at 30 months and analyses there-of indicated that in general there were no significant changes in the trends that were observed at the assessment made at 18 months (Table 1 and Table 2):

- The current industry standard that uses terbuthylazine and hexazinone remained the most effective and low-cost treatment for first-year weed control.
- Terbuthylazine used in combination with mesotrione was the best alternative tested in the group of treatments that examined a potential replacement option for hexazinone in the current terbuthylazine/hexazinone mix. Tree growth losses at 30 months of, on average, 10% were associated with this mix across the spectrum of sites tested.
- Treatments that did not include either terbuthylazine or hexazinone generally needed to be targeted to specific types of weeds to be effective. Across all sites, growth losses in excess of 30% were associated with these treatments.
- An application of clopyralid, triclopyr and aminopyralid in the spring of the second-year after planting was effective against young and emerging scrub weeds, particularly broom and gorse. There is potential that aminopyralid could be used to replace picloram, if picloram becomes prohibited for use.

While general trends were observed, it must also be noted that performance of treatments as measured by tree growth varied by site. The forest manager should therefore examine treatment performance across different sites for a full evaluation of the efficacy of herbicide mixes (Table 1). Before considering any operational change in herbicide mixes the performance of any alternative treatments should be trialled on specific sites.

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Conclusions

The 2014 review of the FSC indicators and thresholds for placement of pesticides on the "highly hazardous" list saw both terbuthylazine and hexazinone removed from the list of FSC Highly Hazardous Pesticides (HHP) – very positive news for the planted forest industry. Certified forests will need to continue to meet the current criteria set by certification bodies in order to retain certification status. However, for weed control in New Zealand planted forests this outcome meant that the search for alternatives to terbuthylazine and hexazinone was no longer a priority. In this regard, the need for further work on herbicide mixes is low unless:

- new active ingredients become available on the New Zealand market,
- active ingredients get removed from the market, or
- active ingredients get listed on the FSC HHP list.

The seven field trials reported on here and in Rolando et al., 2015, have provided a comprehensive database of results that reflect the impact, efficacy and cost of available active herbicide ingredients for first year post-plant weed control in planted forests. This information will be useful for meeting the requirements of an ever-changing list of highly hazardous pesticides.

References

Rolando, C., Todoroki, C. and Watt, M. 2015. Minimising the environmental impact of forest weed management in New Zealand. Final report on field trials. Scion Report S0015. ISBN 978-0-478-11037. Scion, Rotorua, new Zealand, 57 p.

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Table 1. Biomass index of trees across seven trials at 18 and 36 months expressed as a percentage of the operational standard at each site (7000 g terbuthylazine & 1750 g hexazinone). For more details see Rolando et al., 2015. ** Indicates a significant difference in tree size between the treatment and operational standard.

Description	Relative difference (%) to the Valzine treatment	
Kaingaroa	18 months	36 months
15 L Gardoprim & 0.75 L Callisto	-13.9^{ns}	-15.7^{ns}
3.8 L Versatill, 0.38 L Tordon and 2.5 L Gallant	-4.6^{ns}	5.3^{ns}
0.6 L Tordon PastureBoss and 1.0 L Callisto	5.4^{ns}	6.6^{ns}
15 L Gardoprim & 5 L Versatill	15.5^{ns}	12.9^{ns}
15 L Gardoprim & 0.6 L Tordon PastureBoss	22.3^{ns}	14.8^{ns}
15 L Gardoprim	32.2**	23.8^{ns}
Weeds	37.9**	26.5^{ns}
3.8 L Versatil and 1.0 L Callisto	25.3**	29.6**
15 L Gardoprim & 0.188 L Grazon	49.9**	48.2**
Whakawerawera	18 months	36 months
15 L Gardoprim & 5 L Versatill	33.1^{ns}	11.4^{ns}
3.8 L Versatill & 1.0 L Callisto	20.8^{ns}	21.1^{ns}
15 L Gardoprim & 0.75 L Callisto	21.6^{ns}	27.3^{ns}
0.6 L 437 & 1.0 L Callisto	36.8^{ns}	34.6^{ns}
3.8 L Versatill, 0.38 L Tordon & 2.5 L Gallant	33.5^{ns}	36.5^{ns}
15 L Gardoprim & 0.6 L Tordon PastureBoss	46.8**	45.1^{ns}
15 L Gardoprim	56.8**	51.2**
15 L Gardoprim & 0.188 L Grazon	65.8**	63.0**
Weedy	59.5**	80.5**
Mamaku	18 months	36 months
0.6 L 437 & 0.6 L Tordon Pastureboss	17.1^{ns}	-48.7 ^{ns}
15 L Gardoprim	24.9^{ns}	-33.1 ^{ns}
15 L Gardoprim & 0.188 L Grazon	40.9^{ns}	-19.4 ^{ns}
15 L Gardoprim & 0.75 L Callisto	-24.6^{ns}	-18.3 ^{ns}
15 L Gardoprim & 5 L Versatill	44.2^{ns}	-7.3 ^{ns}
3.8 L Versatill, 0.38 L Tordon and 2.5 L Gallant	24.3^{ns}	-3.3 ^{ns}
0.6 L 437 and 1.0 L Callisto	17.8^{ns}	-0.5 ^{ns}
15 L Gardoprim & 0.6 L Tordon PastureBoss	48.8^{ns}	9.2 ^{ns}
No treatment	32.7^{ns}	18.6 ^{ns}
Geraldine	18 months	36 months
15 L Gardoprim & 0.75 L Callisto	49.2**	33.93^{ns}
15 L Gardoprim & 1 L Tordon Max	59.0**	43.79^{ns}
0.6L 437 & 5 L Versatil	65.4**	43.87**
15 L Gardoprim	58.9**	46.34**
15 L Gardoprim & 5 L Versatill	52.5**	49.51**
3.8 L Versatill, 0.38 L Tordon XT & 2.5 L Gallant	62.8**	58.02**
0.6 L 437 & 0.75 L Callisto	72.6**	65.96**
0.6 L 437 & 0.6 L Tordon PastureBoss	81.5**	71.17**
Weedy	85.3**	83.32**

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Table 1. Continued.

Description	Relative difference (%) to the Valzine treatment	
Flagstaff	18 months	36 months
15 L Gardoprim & 5 L Versatill	-34.5^{ns}	-33.0^{ns}
15 L Gardoprim & 0.6 L Tordon PastureBoss	-14.3^{ns}	-21.0^{ns}
15 L Gardoprim & 0.75 L Callisto	-4.9^{ns}	-17.0^{ns}
15 L Gardoprim	7.00^{ns}	3.0^{ns}
3.8 L Versatill, 0.38 L Tordon XT and 2.5 L Gallant	23.6^{ns}	15.0^{ns}
15 L Gardoprim & 0.188 L Grazon	14.9^{ns}	17.0^{ns}
3.8 L Versatill & 0.75 L Callisto	30.0^{ns}	29.0^{ns}
3.8 L Versatil & 1.0 L Tordon Max	62.8**	53.0**
No treatment	88.1**	92.0**
Rai	18 months	36 months
15 L Gardoprim & 0.6 L Tordon PastureBoss	22.2^{ns}	24.0^{ns}
15 L Gardoprim & 0.188 L Grazon	37.0^{ns}	26.0^{ns}
15 L Gardoprim & 5 L Versatill	30.7^{ns}	29.0^{ns}
15 L Gardoprim & 0.75 L Callisto	31.7^{ns}	29.0^{ns}
3.8 L Versatill, 0.38 L Tordon XT & 2.5 L Gallant	45.7**	38.0^{ns}
15 L Gardoprim	41.8**	40.0^{ns}
3.8 L Versatil & 1.0 L Tordon Max	46.2**	46.0^{ns}
3.8 L Versatill & 1.0 L Callisto	49.4**	55.0**
Weedy	67.8**	71.0**
Okuku	18 months	36 months
15 L Gardoprim	-1.7^{ns}	9.1^{ns}
15 L Gardoprim & 5 L Versatill	-1.1^{ns}	13.6^{ns}
0.6 L 437 & 1 L Sequence	15.8^{ns}	16.5^{ns}
15 L Gardoprim & 1 L Tordon Max	4.8^{ns}	17.4^{ns}
15 L Gardoprim & 0.75 L Callisto	12.1^{ns}	26.6^{ns}
3.8 L Versatill, 0.38 L Tordon XT and 2.5 L Gallant	24.4^{ns}	31.3^{ns}
0.6 L 437 & 0.75 L Callisto	34.5^{ns}	39.5**
2 L Guardian and 0.75 L Callisto	74.7**	75.7**
No treatment	83.4**	85.3**

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Table 2. An update on guide to the performance of alternative treatments across seven sites based on measurements made at 30 months. The Relative Performance column is an average of tree size relative to that in the operational standard (expressed as a percentage) across all sites tested. It is recommended that readers refer to Table 1 and Rolando et al., 2015 get the full account of treatments, sites, weeds and performance across sites.

KEY: Recommended | Alternative – growth loss possible (see Table1) | Potential (needs more testing) | Not recommended

Treatment group	Active ingredients (g ha^{-1})	Recommendation			No of sites	Relative Performance across sites (%)[3]	
		Scrub[1]	HBL[2]	Grass		18 months	30 months
	1st year treatments						
Operational standard	7 500 g terbuthylazine and 1750 g hexazinone				7	100	100
Treatments that use terbuthylazine	7500 g terbuthylazine & 360 g mesotrione				7	90	91
	7500 g terbuthylazine & 1500 g clopyralid				7	80	89
	7500 g terbuthylazine,120 g triclopyr & 18 g aminopyralid[4]				5	75	86
	7500 g terbuthylazine & 30 g aminopyralid				2	68	69
	7500 g terbuthylazine &113 g triclopyr				5	58	73
Treatments that do not use terbuthylazine or hexazinone	1125 g clopyralid, 113 g triclopyr & 250 g haloxyfop				7	70	74
	1125 g clopyralid & 480 g mesotrione				4	69	65
	1125 g clopyralid & 30 g aminopyralid				2	46	51
	300 g indaziflam[5] & 480 g mesotrione				4	60	65
	300 g indaziflam[5], 113 g triclopyr & 17 g aminopyralid[4]				2	51	89
	300 g indaziflam[5] &1500 g clopyralid				1[6]	35	56
	300 g indaziflam[5] & 240 g ha^{-1} clethodim				1[6]	84	83
	120 g triclopyr, 18 g aminopyralid & 480 g mesotrione				1[6]	95	93
2nd year treatment							
Treatment that does not include picloram[7]	1500 g clopyralid, 150 g triclopyr & 22.5 g aminopyralid					Not tested	Not tested

[1] Scrub weeds includes broom and gorse as dominant weeds, but other perennial, woody species were included in this category.
[2] Herbaceous broadleaves (HBL) includes a wide spectrum of annuals.
[3] This is an average of performance across sites. Performance was variable and the reader should examine Table 1 and original report by Rolando et al., 2015. .
[4] Tordon PastureBoss is not registered for aerial application. This will need to be addressed with DOW AgroSciences should users want to apply this product.
[5] Indaziflam is an active ingredient not yet registered for use in New Zealand.
[6] Treatment only tested on one site, variation across environments not known.
[7] Picloram is on the FSC list of highly hazardous herbicides

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