Chemical Use

PF Olsen Group Scheme FSC RA-FM/COC-000190

During 2004/05, PF Olsen Limited developed a monitoring system that captures active ingredient by area for the chemicals used within the managed estate.

Since then, PF Olsen have fine-tuned the monitoring system to deal with the complexities of different chemical concentrations of similar chemical products to get an accurate active ingredient used by affected area. The records system also enables separation of data for FSC (aggregated and certificate-specific) and non-FSC forests.

In 2004/05 the information collected represented only part of the estate and less than a full year. In 2005/06, the data covered total herbicide usage, and saw the introduction of fertilisers. In 2006/07 the addition of vertebrate pesticides used in the control of animal pests such as possums and wallabies was implemented, and in 2013/14 the categories were further separated out to include surfactants and insecticides.

The comparable areas treated in **all** forests (both FSC certificates and non-FSC forests) since 2004/05 (in hectares) are tabulated below:

Period	Fertiliser	Fungicide	Herbicide	Insecticide	Pesticide	Surfactant	Total Area (ha)
2004/05			6,266.8				**6,267**
2005/06	513.0	6,302.0	7,686.2				**14,501**
2006/07	211.3	5,282.8	21,510.7		1,563.0		**28,568**
2007/08	437.2	7,772.5	6,822.8				**15,033**
2008/09	437.2	7,772.5	6,822.8		2,947.2		**17,980**
2009/10	290.0	6,751.5	10,703.9		4,161.2		**21,907**
2010/11	2,936.0	2,977.0	9,937.0		919.0		**16,769**
2011/12	4,760.7	2,676.1	16,097.7		7,986.3		**31,521**
2012/13	1,930.0	7,541.0	25,491.0		5,731.0		**40,693**
2013/14	1,851.7	6,007.5	10,720.6	3.3	95.1	8,953.5	**27,632**
2014/15	2,979.4	3,616.6	14,048.6		1,532.0	10,067.0	**32,244**
2015/16	1,553.4	8,101.9	7,494.4		6,162.0	16,662.1	**39,974**
2016/17		10,059.3	9,695.4		877.2	12,284.0	**32,916**
2017/18	269.7	16,887.2	12,099.5	3,513.3		21,330.6	**54,100**

In 2011/12 the areas treated by herbicides climbed significantly as client planting goals were reassessed in the light of the Emissions Trading Scheme encouraging both more replanting of old heavily weed infested cutovers as well as new afforestation, over and above the standard replanting programmes. Most of that boost in area was treated during that year and in 2012/13. Subsequent years have seen planting and replanting rates dropping back in response to low ETS prices and a continuation in conversions to pastoral use. Due to the warm wet conditions prevalent

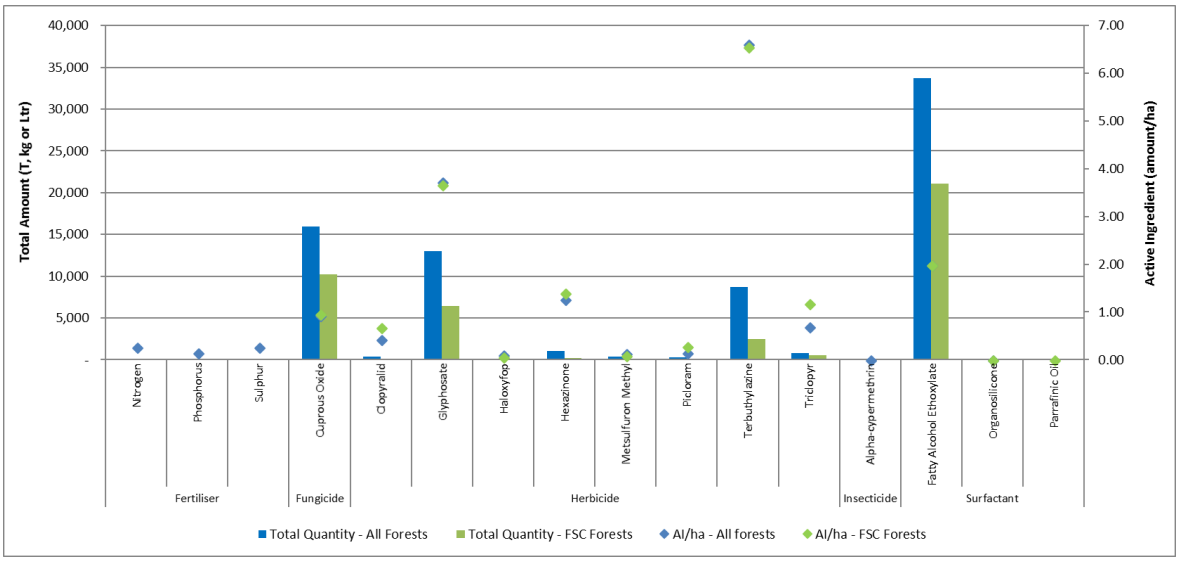
for most of the 2017/18 year, there was an increase in the use of fungicides and surfactants to try to minimise the effects from Dothistroma.

The tabular and graphical breakdown of the chemical usage over the year ending June 2018 is set out below. This includes not only the total quantities of active ingredient used but also the averaged application rate per hectare.

Active ingredient applied to treated areas within all forests (both FSC certificates and non-FSC) Y.E June 2018

Active Ingredient	Qty Total	Unit	Area (ha)	Qty/Ha	Application
Nitrogen	34.49	T	127.90	0.27	Fertiliser
Phosphorus	22.41	T	139.20	0.16	Fertiliser
Sulphur	0.71	T	2.60	0.27	Fertiliser
Cuprous Oxide	15,933.19	Kg	16,887.20	0.94	Fungicide
Clopyralid	365.64	Kg	842.10	0.43	Herbicide
Glyphosate	12,967.43	Kg	3,473.90	3.73	Herbicide
Haloxyfop	24.90	Kg	231.80	0.11	Herbicide
Hexazinone	1,016.46	Kg	800.20	1.27	Herbicide
Metsulfuron Methyl	375.17	Kg	2,722.40	0.14	Herbicide
Picloram	264.81	Kg	1,608.30	0.16	Herbicide
Terbuthylazine	8,716.25	Kg	1,316.60	6.62	Herbicide
Triclopyr	775.37	Kg	1,104.20	0.70	Herbicide
Alpha-cypermethrin	10.51	Ltr	3,513.30	0.00	Insecticide
Fatty Alcohol Ethoxylate	33,742.40	Ltr	16,887.20	2.00	Surfactant
Organosilicone	2.47	Kg	4,327.00	0.00	Surfactant
Parrafinic Oil	2.48	Kg	116.40	0.02	Surfactant

Active ingredient usage and rate/hectare treated Y.E June 2018



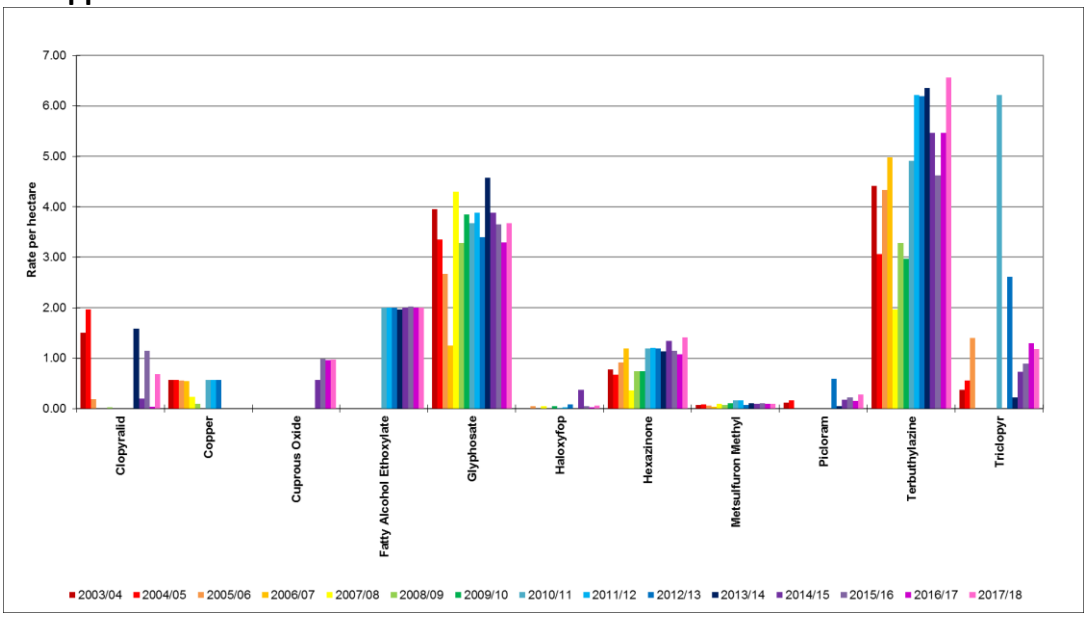
Active ingredient applied to FSC Group Scheme forests Y.E June 2018

Active Ingredient	Qty Total	Unit	Area (ha)	Qty/Ha	Application
Cuprous Oxide	10,234.32	Kg	10,557.3	0.97	Fungicide
Clopyralid	119.05	Kg	174.7	0.68	Herbicide
Glyphosate	6,404.20	Kg	1,746.1	3.67	Herbicide
Haloxyfop	2.29	Kg	36.5	0.06	Herbicide
Hexazinone	226.82	Kg	161.2	1.41	Herbicide
Metsulfuron Methyl	96.3,	Kg	1,036.0	0.09	Herbicide
Picloram	123.52	Kg	442.3	0.28	Herbicide
Terbuthylazine	2,495.49	Kg	380.3	6.56	Herbicide
Triclopyr	507.92	Kg	431.5	1.18	Herbicide
Fatty Alcohol Ethoxylate	21,122.40	Ltr	10,557.3	2.00	Surfactant
Organosilicone	0.88	Kg	1,697.2	0.00	Surfactant
Parrafinic Oil	0.80	Kg	91.0	0.01	Surfactant

Over the year, three main active ingredients (glyphosate, hexazinone and terbuthylazine) formed the basis of the forest re-establishment herbicide treatment programme. The unit rate of use of for glyphosate has not altered significantly around the mean figures of 3.5 kg/ha. However, for hexazinone there has been a moderate increase in use to 1.41 kg/ha (the average unit rate is 1.0 kg/ha), while terbuthylazine usage has significantly exceeded the average unit rate of 4.6 kg/ha respectively. While variation is primarily driven by weed competition and site variation, the warm and wet conditions that dominated 2017/18 have produced optimum growing conditions for weed species, which has resulted in the need for greater and more intensive weed control.

For the FSC Group Scheme specifically, results of active ingredient usage by treated area over the measurement periods, where comparisons are possible between chemicals, are as follows:

Chemicals applied to FSC GS forests Y.E June 2018



Some chemicals, in particular the mammalian pesticides sodium monofluroacetate and sodium cyanide have been used on occasion, as have the surfactants and the herbicide metsulfuron methyl (0.1kg/ha). The unit rates of application per hectare for these chemicals are too low to be represented in the graph above. No fertilisers were applied to FSC forests during the 2017/18 year.

Derogated Chemicals

Derogations are required for continued use of chemicals that are potentially hazardous as defined by FSC policies. Derogations are issued or renewed subject to controls when amongst other matters, other alternative methods are not socially, environmentally or economically satisfactory and there is a programme in place to reduce, minimise or find alternatives to the derogated chemicals.

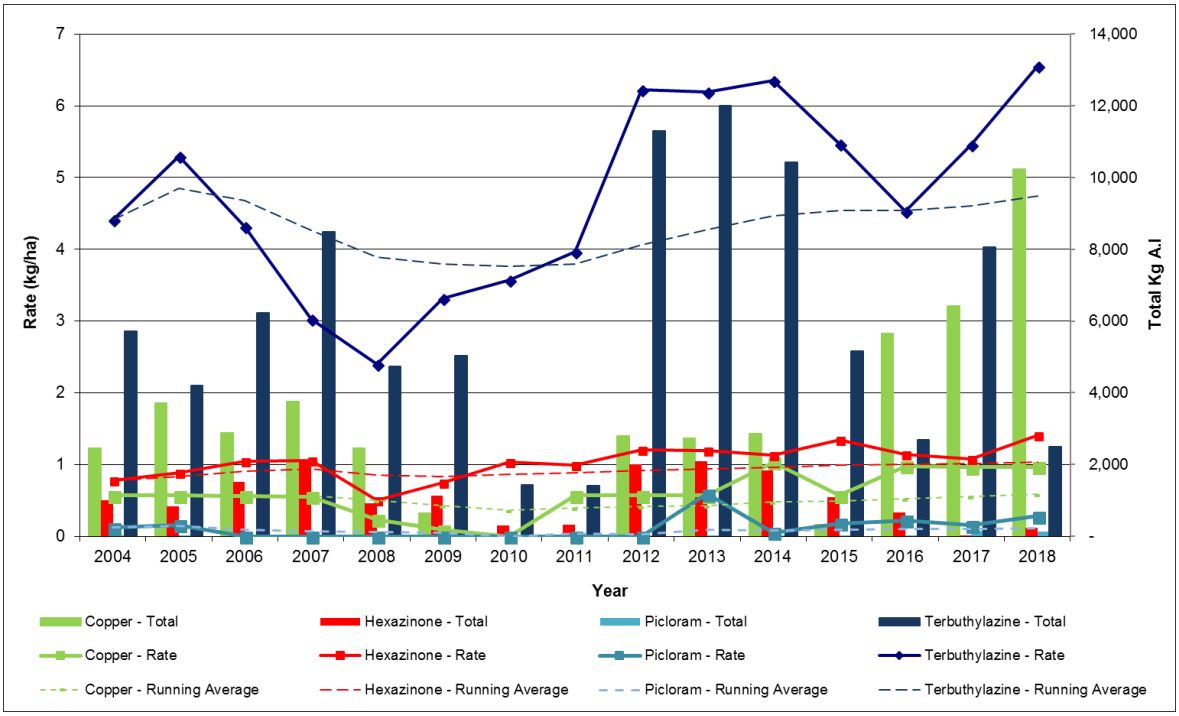
The Group Scheme had operated under derogations for the field use of hexazinone, terbuthylazine and 1080 up until the 2014/15 year. A new derogation (FSC-DER-30-001-Ext_2018_Sodium monofluoroacetateNZ) was issued in May 2013 for 1080 and the herbicide derogations FSC-DER-30-V1-1_EN_Hexazinone_NZ_220512 and FSC-DER-30-V1-1_EN_Terbuthylazine_NZ_220512 granted for the period through to 22nd May 2017. However, in 2015 FSC re-evaluated its list of Highly Hazardous chemicals, removing terbuthylazine and hexazinone from the category but adding picloram, copper products and some formulations of haloxyfop as well as all vertebrate pesticides.

Time series tracking is enabling a watch to be kept on the use of various chemicals. As illustrated below, before 2009 there was a progressive decrease in both total quantity and the rate of hexazinone and terbuthylazine applied, and an increase in the use of glyphosate as a substitute. But the finalising of the Emissions Trading Scheme legislation by the Government led to increases in planting, and areas that should have been planted in prior years were brought back into re-establishment programmes. This was reflected in a greatly increased total and unit rate increase in the use of terbuthylazine which continued through to 2015 via the releasing programme.

Time series data has been retained for the newly highly hazardous classed picloram and copper fungicide products. The results are plotted above. In general, except for terbuthylazine after the period of reestablishment of ETS delayed forests, the unit rates of application of all the chemicals has remained relatively stable.

With the addition of the new 'highly hazardous' chemicals a process of application for derogation was applied for. However, with a huge influx of derogation requests from all around the world, FSC have placed a stay of procedures while they assess the mechanisms for managing such a large worldwide demand. The derogation process will also have to cover all vertebrate pesticides such as pindone and cholecalciferol in addition to 1080 and sodium cyanide. These pesticides have been used from time to time in very small quantities for possum and rabbit or hare control.

Derogated herbicide rates and quantities used - FSC GS forests only. Y.E June 2018



Research into Alternatives

In past years PF Olsen Ltd provided financial support to industry cooperative research programmes aiming to advance vegetation weed management efficacy and reduced chemical reliance including biological control. The aim was to develop a significant multifaceted strategy for long-term research into chemical use reduction and minimisation.

Key focus of this work was:

- Chemical safety characteristics
- Alternative FSC compliant formulations and treatment
- 'Best Practice' tools

A number of alternative FSC compliant active ingredients have been tested against the main forest establishment weeds resulting in a shortlist of alternatives with potential for further investigation that formed part of the first year's field trial testing as part of an Industry / Sustainable Farming Fund (SFF) three-year programme (project 12/038) started in 2012.

The project tested a range of chemicals in operational field trials based on the most promising options determined from the earlier research. Mixes includes those free from either terbuthylazine or hexazinone, mixes with some terbuthylazine and a baseline standard practice control of Valzine (a terbuthylazine-hexazinone mix).

The project, now completed, found that the industry standards using terbuthylazine and hexazinone remained the most effective, though there were some alternative actives offering efficacy under limited conditions and other that may yet have potential subject to further research.

The information has been published and may be accessed from the Sustainable farming fund website, Scion Research Website and NZ Forest Owners Association Website.

Details are held on the SFF website link below, with published reports listed in Appendix 1 below.

- http://maxa.maf.govt.nz/sff/about-projects/search/12-038/index.htm
- http://www.nzfoa.org.nz/images/certification/FSCChemicalsWeedManagementPamphlet_june2015.pdf
- http://www.nzfoa.org.nz/images/certification/FSC_Chemicals_FullReport_june2015.pdf

More recently research has been restructured and is funded by way of a national levy on all forest growers with research programmes directed through a Board.

Work has subsequently focussed on environmental fate aspects of herbicide use with the environmental fate of hexazinone and terbuthylazine tested in two of the soil groups most likely prone to leaching followed in 2015 by similar trials for copper fungicide, recognising the new "highly hazardous" classification attributed to that active ingredient.

In all cases, the trials reflected standard operational procedure and, in all cases, while there was an initial detectable spike in water in the hours immediately after application, rates degraded very quickly. The results concluded that health risks were very low as were the risk of impacts on aquatic fauna.
Specifically, for Copper, the report conclusions were:

- Copper was only detected for a few hours on the day of application;
- NZ drinking water standards (2,000 ug L-1) not exceeded;
- FSC standard (LC50 18.9 ug L-1 for 48 hours) – concentrations exceeded the level but for less than 2 hours; and
- ANZECC interim sediment quality guideline trigger values not exceeded.

Biological Control

PF Olsen is reviewing its biological control strategy to see if appropriate use of available agents is being made.

One agent, *Cleopus japonicus*, a recently released biocontrol for buddleia, appears to be spreading rapidly and having a significant impact upon that difficult weed.

Figure 1. *Cleopus japonicus* larvae on Buddleia

In conjunction with the industry cooperative efforts and Future Forests Research Ltd, a successful Sustainable Farming Fund bid in 2011 to investigate potential agents for the biological control of pampas has continued with Landcare Research Ltd.

This Sustainable Farming Fund project 11/049 sought to establish the possibility of finding safe vectors or agents for bio-control of this difficult weed. Initially a 3-year project, the programme was extended a year until June 2015 owing to a very slow start-up as the genetic match for NZ pampas could not be located in South America.

The completion of this initial project in 2015 greatly increased the knowledge about pampas and its ecology identifying concentrations of different genetic origin in different parts of NZ, the existence of 2 potentially different smut fungi and two delphacid leaf hoppers that are now being further researched as potential biocontrol agents.

A sideline to this research also revealed, a natural ubiquitous fungal pathogen, when mixed with well below label quantities of an organic herbicide or a synthetic herbicide have been found to potentially provide some possibilities for control as a spray application.

Details are held on the SFF website link below:

- http://maxa.maf.govt.nz/sff/about-projects/search/11-049/index.htm

Biocontrol release sites for broom, gorse, old man's beard and buddleia