Economic value of neonicotinoid seed treatment to New Zealand

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Background

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Executive Summary

This report estimates the value of neonicotinoid (neonic) seed treatment to the New Zealand economy.

The economic impact of neonic seed treatment

Approximately 800,000 hectares of arable grain, forage brassica and pasture grass seeds are planted each year, of which BERL estimates 62 percent are planted with neonic treated seeds. The total weighted value added output that neonic treated seeds provide over bare/untreated seeds without the use of alternative forms of insect pest control is $738 per hectare.

BERL estimates that the annual direct value added (GDP) that neonic treated seeds provide over bare/untreated seeds without the use of alternative forms of insect pest control is $368 million. When the impacts of indirect value added from suppliers to the producers and increased household expenditure by those working directly and indirectly in the industry are also added, the total GDP impact is just under $1.2 billion.

In terms of employment generated as a result of neonic seed treatment use when no alternatives are available, BERL estimates that approximately 5,300 total additional FTEs are created on an annual basis.

Drawing on information from the comprehensive The Humbold Forum for Food and Agriculture e.v (HFFA) working paper on *The value of Neonicotinoid seed treatment in the European Union,* BERL estimates that the impact of neonic seed treatment use where alternative crop protection measures are available is likely to reduce value added by a third.

The table below summarises the economic impacts of neonic seed treatment use in New Zealand, with and without the availability of alternative crop protection measures.

Table: Summary of annual economic impacts of neonic seed treatment

	Direct GDP ($ Million)	With Indirect Impacts ($ Million)	With Total Impacts ($ Million)
Value added (GDP, $m)			
No alternatives available	$367.5	$864.3	$1,153.2
Alternatives available	$245.0	$576.2	$768.8
Employment (FTEs)			
No alternatives available	2,244	4,349	5,325
Alternatives available	1,496	2,899	3,550

The likely economic impact if neonic seed treatment were banned

Industry experts advise that if neonic seed treatments were banned in New Zealand, in the short-medium term, most growers will revert to using existing alternative measures of crop protection such as ‘old fashioned’ organophosphates.

However, in 2012 and 2013 the New Zealand Environmental Protection Agency reviewed organophosphates in New Zealand and in 2013 made the decision to cease approving many organophosphates in a staged approach from 2016 onwards due to their high levels of toxicity to the environment, animals and humans.

With the reduced availability of organophosphate treatments, which could be a reasonably efficient and widely used alternative to neonic seed treatment, we can surmise that the overall value-added lost if neonic seed treatment was removed would not be as large as if all current crop protection measures (including organophosphates that are going to be phased out) were available.

BERL therefore estimates that the total annual GDP lost by the removal of neonic seed treatments in New Zealand in the short-medium term is likely to be between $800 million and $1.2 billion. Similarly we expect between 3,600 FTEs and 5,300 FTEs fewer FTEs to be created each year.

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1 Introduction

Agcarm, the industry association for companies that make and sell crop protection products, commissioned BERL to undertake an assessment of the economic value of neonicotinoid (neonic) seed treatment to the New Zealand economy.

Neonics are a group of modern insecticides, with a similar chemical makeup to nicotine, that help protect crops and pasture against attack from insects. Neonics are used globally and have been used in New Zealand since the early 1990s.

1.1 Objectives

In early 2013 the European Commission (EC) announced that from 31 December 2013 it would impose use restrictions on three neonic compounds (clothianidin, imidacloprid and thiamethoxam) for applications (seed treatment, granular, foliar) in cereals and bee-attractive crops.

Following this EC announcement, a number of groups have discussed the environmental and economic impacts of neonic seed treatment. The objective of this study is to provide a credible estimate of the impact of neonic seed treatment to the New Zealand economy to help inform such discussions.

This report:

1. Provides a **background** to neonic seed treatment usage in New Zealand
2. Outlines **current usage and impacts** of neonic seed treatment in New Zealand
3. Models the **economic impact of neonic** use to the New Zealand economy

1.2 Scope of this report

This report looks at the economic contribution of neonic seed treatments to New Zealand. It is not a cost benefit analysis and is limited to the economic contribution of neonic seed treatments.

While outside the scope of this report, information obtained from key individual industry players as part of this study highlighted several salient points about the relationship between neonic seed treatments and the bee population in New Zealand. These points include:

- Most neonics have high intrinsic toxicity to bees, but used as seed treatment they represent a very low risk to bees.
- There has been no unexplained bee colony losses in New Zealand linked with proper use of neonic seed treatments.
- There is a risk to bees from dust exposure when sowing neonic treated seeds. Correct stewardship mitigates this risk of neonic dust exposure to bees.
- Most of the criticisms of neonic seed treatment are based around its toxicity to bees and unproved linkages with bee health problems. It is also worth noting that the managed global, and New Zealand, bee population is increasing.

1.3 Methodology

There is little publicly available information about the use and impact of neonic seed treatment in New Zealand. BERL has surveyed industry as a base to estimate the economic impact of neonic seed treatment.

1.3.1 Data availability

Given the lack of publicly available information, BERL surveyed main industry players to determine the extent of use and the assessed percentage penetration of the market by neonic seed treatment in New Zealand. The numbers obtained from this survey have been cross-referenced to industry data on the total areas and production of the relevant crops and pastures in New Zealand.

Areas of land in different crops and pastures, and the volume of production from each are published by a number of bodies in New Zealand. The numbers obtained from different sources do not always coincide. In recent years BERL has been retained by two separate organisations to collate and cross-check data from industry sources and to use this to create an estimate of the economic impacts of two major parts of the primary industry, namely arable production and pasture. Details of these projects are outlined below:

Economic impact assessment of arable production, Kel Sanderson, Kelly Dustow and Hugh Dixon, BERL. The Arable Food Industry Council, August 2012. This work cross-referred information from Statistics NZ, the Foundation for Arable Research (FAR), the New Zealand Feed Manufacturing Association, AsureQuality, and the Arable Industry Marketing Initiative (AIMI) at Lincoln.

Economic analysis of the value of pasture to the New Zealand economy, Kel Sanderson and Michael Webster, BERL. Pasture Renewal Charitable Trust. September 2009. This work was completed in consultation with a steering group from Ministry of Agriculture and Forestry.

The areas planted and the volumes of production used in the assessments made in this report are those found and published in the above reports.

1.3.2 Approach

To provide an estimate of the economic value of neonic seed treatment to the New Zealand economy, we model the impacts of the ‘hypothetical’ complete removal of the neonic seed treatments currently in use (seed treatments with the active ingredients: Clothianidin; Imidacloprid; and Thiamethoxam) in New Zealand for arable grains, forage brassicas and pasture grasses.

To achieve this BERL collected information on the impact of the use of both neonic seed treatment and bare/untreated seed treatment (without use of alternative insect treatments) on growers’ gross margins. The difference between the two provides us with the marginal economic impact (value-added) of neonic seed treatment over bare/untreated seeds (with no other form of insect control).

Using information obtained about the impacts of neonic seed treatment use at the grower level, we modelled the impact of a ‘hypothetical’ removal of neonic seed treatment in New Zealand with no alternative insect control measures available.

Drawing on international literature, we then estimate the impact of a hypothetical removal of neonic seed treatment in New Zealand with alternative insect control measures available.

2 Background

Neonics are a group of modern insecticides, with similar chemical qualities to nicotine, which protect crops and pasture against attack from a range of important insects. Most neonics are water-soluble and break down slowly in the environment. They are taken up by the plant and provide systemic protection against insects from within as the plant grows, typically for up to 6 weeks.

Neonic seed treatment is regarded as more efficient and effective compared to alternative methods, such as organophosphate and synthetic pyrethroids, at providing insect control for plants to growers for reasons including:[1]

- Higher yield: The Humbold Forum for Food and Agriculture e.v (HFFA) working paper on *The value of Neonicotinoid seed treatment in the European Union* suggests that the loss of neonics will result in higher production prices and lower yields.
- Minimal additional application cost: Beyond the cost of buying neonic treated seed and the cost of sowing the seed, additional insect control costs, such as foliar and/or granular sprays, are not required.
- Lower environmental toxicity: Neonic treated seeds have relatively low eco-toxicity and levels compared to the main alternatives.
- Lower environmental loading: Neonic treated seeds are applied at very low rates of active ingredient per hectare compared to organophosphates (g/ha cf kg/ha).
- Lower levels of insecticide use: The residual activity of neonics can result in a reduced number of applications of foliar applications of synthetic pyrethroids.
- Targeted treatment: Seed treatment is a very targeted crop protection application method. Only the object needing protection is treated compared to granular (in row) or foliar applications (where the whole field is treated).

2.1 Treatment of plants against insects in New Zealand

Neonics are one of many types of crop protection measures used on crops and pasture in New Zealand. Alternative forms of crop protection include organophosphate, carbamates and synthetic pyrethroids. This section provides a brief outline of the neonic seed treatment use in New Zealand and the alternatives available to control crops and pastures from insect attack.

2.1.1 Neonic seed treatment in New Zealand

Neonic seed treatments have been used in New Zealand since the early 1990s to protect crops and pastures against insects. Growers typically use neonic treated seeds as a form of insurance against crop attack and failure. The use of neonic treated seeds has increased in recent years for a variety of reasons including greater marketing about the impact of neonic seed treatment on yield and growers wanting greater levels of 'insurance' for their crop and pasture investment, particularly with the shift in sowing of some crops from spring to autumn, which carries greater risk.

The majority of neonic treated seeds in New Zealand have one of the following active ingredients:

[1] AGCARM, *Fact Sheet On Neonicotinoids*, June 2013

- Thiamethoxam: used for maize and forage brassicas. Protects against aphids, Argentine stem Weevil and springtails.
- Imidacloprid: used for cereals, forage brassicas, grass seed, maize/sweetcorn, potatoes and winter squash/pumpkins. Protects against Argentine stem Weevil, black beetle, grass grub, aphids, nysius and springtails.
- Clothianidin: used for cereals, maize/sweetcorn, forage brassicas and grass seed. Protects against Argentine stem Weevil, black beetle, springtails, grass grub, greasy cutworm and aphids.

2.1.2 Alternatives to neonic seed treatment in New Zealand

The main alternatives available to New Zealand growers include organophosphates, carbamates and synthetic pyrethroids. Industry experts note that in a few instances, some growers use an alternative method (e.g., organophosphate granule), as well as neonic seed treatment to provide extra 'insurance' against insect attack (grass grub).

Alternatives available to neonic seed treatment are often more toxic. The New Zealand Environmental Protection Agency (EPA) notes that organophosphates are harmful to the environment, have high levels of toxicity to animals and can contribute to long term adverse health effects in humans.[2]

In 2012 the EPA reviewed a number of organophosphates. As a result of this review, in 2013 the EPA made the decision to cease approving many organophosphates in a staged approach from 2016 onwards due to their high levels of toxicity to the environment, animals and humans.

[2] http://www.epa.govt.nz/search-databases/HSNO%20Application%20Register%20Documents/APP201045_APP201045_Decision_FINAL.pdf

3 Current usage and impacts

This section outlines the impact of neonic seed treatment relative to bare/untreated seeds in New Zealand for arable grains, forage brassicas and pasture grasses. For each of these crop types we

- Outline the overall hectares of planted per annum and the corresponding value of the yield of these crops; and
- Discuss the impact of neonic treated seed compared to bare/untreated seeds (without the use of alternative forms of crop protection) and apply these impacts to national yield levels.

3.1 Arable grains

Arable grains in New Zealand

To obtain information on the overall hectares of arable grains sown per annum, total tonnes ex-farm and the associated value of tonnes ex-farm we draw on previous comprehensive work that BERL undertook in 2012 on the *Economic impact assessment of arable production.* This report provided a robust estimate of arable crop production in 2011. Table 3.1 summarises key relevant information about arable grains in 2011 from the *Economic impact assessment of arable production* report.

Table 3.1: Arable grains planted, harvested and value, 2011

Arable Grain type	Hectares planted	Tonnes of dry matter harvested	Value crop harvested ($m)
Maize	76,000	1,497,000	$346.1
Wheat	55,000	411,000	$146.9
Oats	6,000	25,000	$10.1
Barley	66,000	419,000	$135.6
Other cereal grains	2,000	17,000	$6.7
Total	205,000	2,369,000	$645.4

Source: BERL

Arable grains – treated and untreated seeds

BERL collected detailed information on neonic seed treatment usage and the associated impacts of this use relative to bare/untreated seeds for arable grains with no alternative form of crop protection used. This information was obtained for a variety of arable grain crops through interviews with industry experts, seed treatment brochures and studies undertaken comparing the yield of treated and untreated seeds.

Information collected showed that for arable crops overall, neonic treated seeds:

- Are 32 percent more expensive than untreated seeds
- Have an average crop establishment failure rate of 11 percent compared to 20 percent for untreated seeds
- Yield 11 percent more dry matter per hectare compared to untreated seeds

Using the information collected, along with other information, such as the failure of crop establishment and the resulting cost of replanting, BERL applied information about neonic seed treatment use and associated impacts to arable grain hectares sown and associated yield values in 2011. This was done at a detailed level for wheat, barley, oats, maize and other cereal grains. The use and impacts of neonic treated seeds and bare seeds for arable grains is summarised in the table below.

Table 3.2: Arable grain - Neonic seed treatment use and impacts, 2011

		Maize		Wheat		Oats	
	Unit	Treated	Untreated	Treated	Untreated	Treated	Untreated
Hectares planted	ha	68,700	7,600	32,900	21,900	3,700	2,400
Seed cost - total hectares planted	$m	$34.2	$2.9	$16.4	$8.3	$1.8	$0.9
Percentage of crops failing to establish	%	11%	20%	11%	20%	11%	20%
Hectares failed to establish	ha	7,200	1,500	3,500	4,300	400	500
Cost of replanting a hectare that has failed to establish	$/ha	$1,774.80		$1,774.80		$1,774.80	
Cost of replanting total hectares failed to establish	$m	$12.8	$2.6	$6.1	$7.6	$0.7	$0.8
Tonnes Harvested	tonnes	1,360,800	136,200	256,800	154,200	15,500	9,300
Value of tonnes harvested	$m	$314.6	$31.5	$91.8	$55.1	$6.3	$3.8
Gross margin - total hectares planted	$m	$267.6	$26.0	$69.3	$39.3	$3.8	$2.0
Neonic seed treatment value added total hectares planted	$m	$33.8		$10.4		$0.8	
Neonic seed treatment value add per hectare planted	$/ha	$492.30		$314.80		$209.50	

		Barley		Other cereal grain		Total	
	Unit	Treated	Untreated	Treated	Untreated	Treated	Untreated
Hectares planted	ha	39,400	26,300	1,000	700	145,600	58,900
Seed cost - total hectares planted	$m	$19.6	$9.9	$0.5	$0.3	$72.6	$22.2
Percentage of crops failing to establish	%	11%	20%	11%	20%	11%	20%
Hectares failed to establish	ha	4,100	5,100	100	100	15,300	11,500
Cost of replanting a hectare that has failed to establish	$/ha	$1,774.80		$1,774.80		$1,774.80	
Cost of replanting total hectares failed to establish	$m	$7.3	$9.1	$0.2	$0.2	$27.1	$20.4
Tonnes Harvested	tonnes	261,500	157,100	10,600	6,400	1,905,100	463,100
Value of tonnes harvested	$m	$84.7	$50.9	$4.2	$2.5	$501.6	$143.8
Gross margin - total hectares planted	$m	$57.8	$31.9	$3.5	$2.0	$401.9	$101.2
Neonic seed treatment value added total hectares planted	$m	$9.9		$0.5		$55.3	
Neonic seed treatment value add per hectare planted	$/ha	$251.20		$442.00		$379.50	

Source: BERL, various

This table shows that 146,000 hectares of arable grains planted in 2011 were planted with neonic treated seed while 59,000 hectares were planted with bare/untreated seed. The overall gross margin, the difference between the value harvested and the costs, for total hectares of arable grain seeds planted was $402 million for seeds treated with neonics and $101 for bare/untreated seeds. On a per hectare basis, all arable grain seeds treated with neonics generated value added of $379 per hectare over bare/untreated seeds.

3.2 Forage brassicas

Forage Brassicas in New Zealand

Estimating the average number of hectares of forage brassicas per annum and the associated yield provided to farmers, both in terms of milk solids and sheep and beef output, is not as straightforward. Unlike most crops, such as arable grains and pasture grasses, there is little detailed information available about forage brassica crops and their associated yield value at a national level. BERL therefore drew on a variety of reliable sources to estimate the number of hectares of forage brassicas planted per annum and the associated yield value.

While there is limited information about how many hectares are planted in rape, kale, turnips, swedes and turnips per annum in New Zealand, there is general consensus that approximately 300,000 hectares are sown in forage brassicas in total per annum in New Zealand.[3] Of this, BERL estimates, based on information gathered from industry experts cross-referenced against publicly available information[4], that the average dry matter yield per hectare from forage brassicas is about 11 tonnes.

Having identified the number of hectares planted in forage brassicas and the associated yield per hectare, we then identified the proportion of forage brassicas harvested that are used for dairy cattle farming and the proportion used for sheep and beef farming. Drawing on 2012 Agricultural Census data showing supplementary feed by farm type cross referenced against other data sources, BERL believes that approximately 30 percent of forage brassica yield is used for dairy cattle farming and 70 percent is used for sheep and beef farming. This information allowed us to estimate the value of yield of forage brassicas used in dairy cattle farming and sheep and beef farming.

To estimate the value of forage brassicas used in dairy cattle farming, BERL estimated the value of the dry matter harvested in terms of milk solids by drawing on a range of robust data sources. The broad approach undertaken is outlined below:

- Using the DairyNZ publication *'DairyNZ Facts and Figures for New Zealand Dairy Farmers (Version 2 September 2012)'* we conservatively estimate the average metabolisable energy from forage brassicas to be 11 ME MJ per kilogramme of dry matter.
- This information, along with the average milk solids produced by a cow per day of 1.3 kilogrammes derived from DairyNZ Dairy Herd Milk Statistics, enabled us to identify that the milking requirements for a jersey x friesian at 11.0 MJ ME per kilogramme of dry matter is 14.5 kilogrammes of milk solids per day.
- We then multiplied the average milking requirements for dry matter per cow per day by the average dry matter yield estimate for forage brassicas (11 tonnes per hectare) to identify the number of cow days of feed generated by a hectare of forage brassicas.
- To identify the level of milk solids these cows produced per hectare, we multiplied the number of cow days of feed generated by a hectare of forage brassicas by the average amount of milk solids produced by a cow per day (1.3 kilogrammes of milk solids per day).
- To obtain the value of milk solids per hectare of forage brassica yield, we multiplied the level of milk solids produced per hectare by the historical 4 year rolling average price for a kilogramme of milk solids ($7.22).
- Finally, having identified the value of milk solids per hectare of forage brassica yield we were able to estimate the overall value of milk solids generated from forage brassicas by multiplying the per hectare value of milk solids generated from forage brassicas by the proportion of overall forage brassica hectares sown for dairy cattle farming (30 percent).

Table 3.3 summarises the key information used in deriving this estimate.

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[3] See for example http://maxa.maf.govt.nz/sff/about-projects/search/06-033/final-report.htm; http://www.lincoln.ac.nz/PageFiles/7642/Forage%20Brassica%20Crops%20for%20Pastoral%20Systems.pdf; http://www.plantandfood.co.nz/growingfutures/case-studies/feeding-livestock-through-the-year

[4] For example, PGG Wrightson (2012) Seeds, *Brassica Options 2011*

Table 3.3: Forage Brassicas planted for dairy use and associated yield value, 2009

Variable	Unit	Level
Hectares for Dairy use	ha	90,000
Dry matter yield per hectare	t/dm	11
Average milk solids produced by a cow per day	kg	1.3
Daily milking requirements of a J x F at 11.0 MJ ME/kg DM	kg/DM/cow /day	14.5
Cow feeding days produced by a hectare of forage brassicas	days	761
Milk solids produced per hectare	kg	990
Fonterra 4 year rolling average price for a kg of milk solids	$/kg	$7.22
Value of milk solids produced per hectare	$/ha	$7,145.05
Value of milk solids produced for all hectares used for dairy	$m	$643.1

Source: BERL, various

To estimate the value of output of forage brassicas used in sheep and beef cattle farming, BERL drew on previous work it undertook for the *Economic analysis of the value of pasture to the New Zealand economy* report that estimated the existing farm gate value per kg of dry matter by drawing on Beef and Lamb NZ data and AgResearch model data at a regional and farm type level. BERL aggregated this detailed information to a national level to generate the existing farm gate value per kg of dry matter from pasture grasses of $0.058 per kg of dry matter. While the value generated is for pasture grasses, given the lack of information available for forage brassicas, BERL has assumed that the value per kg of dry matter from pasture grasses and forage brassicas are the same.

Using this information, BERL multiplied the value per kilogramme of dry matter by average dry matter yield per hectare from forage brassicas (11 tonnes) to get the value of dry matter per hectare. This was then multiplied by the overall hectares sown for sheep and beef farming (70 percent) to obtain the total existing farm gate value.

Table 3.4 summarises the key information used in deriving this estimate.

Table 3.4: Forage Brassicas planted for sheep and beef use and associated yield value, 2009

Variable	Unit	Level
Hectares for Sheep and Beef use	ha	210,000
Existing farm gate value per kg of dry matter	$/kg	$0.06
Farm gate gate value per hectare	$/ha	$638.00
Farm gate value for all hectares used for sheep and beef	$m	$134.0

Source: BERL, various

Forage Brassicas – treated and untreated seeds

BERL collected a wide range of information on neonic seed treatment use for forage brassica crops and the associated impacts in terms of yield relative to untreated/bare seeds with no alternative form of crop protection used. This information was obtained for a variety of forage brassica crops through interviews with industry experts, seed treatment brochures and studies undertaken comparing the yield of seeds treated with neonics with untreated seeds.

Information collected showed that for forage brassicas, neonic treated seeds:

- Are 30 percent more expensive than untreated seeds

- Have an estimated crop establishment failure rate of 19 percent compared to 43 percent for untreated seeds. A simple average from the limited number of available trials gives a crop establishment failure rate of 22 percent for neonic treated seeds and 53 percent for untreated seeds. However, taking account of most of the failures (excluding outliers), the average crop establishment rate is closer to 19 percent for neonic treated seeds and 43 percent for untreated seeds. We have used these crop establishment failure rates in our analysis.
- Yield 13 percent more dry matter per hectare compared to untreated seeds.

BERL took an average of information collected on treated and untreated forage brassica seeds by crop type and applied these to estimates of overall levels of forage brassicas sown and associated outputs. This information was then combined with other information, such as the failure of forage brassica crop establishment and the resulting in the cost of replanting and lost output, to build a comprehensive picture of the impact of neonic seed treatment for forage brassicas relative to bare/untreated seeds.

To calculate the cost of replanting a hectare of forage brassicas that failed to establish along with associated lost value of output, we combined the cost of replanting a hectare in turnips, a lower value yielding forage brassica crop, of $220 with an estimate of the value of output lost per hectare as a result of establishment failure. Based on information obtained via interviews, BERL estimates that establishment failure of forage brassicas reduces annual output/production by a third:

- For forage brassicas used in dairy farming, we estimate the lost value of milk solids per hectare due to establishment failure to be $2,382 (a third of the annual value of milk solids produced per hectare from forage brassicas planted).
- For forage brassicas used in sheep and beef farming, we estimate the lost existing farm gate value per hectare to be $213 (a third of the annual existing farm gate value output per hectare from forage brassicas planted).

Table 3.5 summarises the impacts of neonic treated seeds and bare/untreated seeds on forage brassicas planted.

Table 3.5: Forage Brassicas - Neonic seed treatment use and impacts

		Dairy		Sheep & Beef		Total	
	Unit	Treated	Untreated	Treated	Untreated	Treated	Untreated
Hectares planted	ha	72,000	18,000	168,000	42,000	240,000	60,000
Seed cost - total hectares planted	$m	$9.5	$1.8	$22.3	$4.2	$31.8	$6.0
Percentage of crops failing to establish	%	19%	43%	19%	43%	19%	43%
Hectares failed to establish	ha	13,700	7,700	31,900	18,100	45,600	25,800
Cost of replanting a hectare that has failed to establish + lost value of output	$/ha	$2,601.70		$432.70			
Cost of replanting total hectares failed to establish + lost value of output	$m	$6.9	$3.4	$23.5	$12.4	$30.4	$15.9
Dairy output	$m	$539.4	$103.7	-	-	$539.4	$103.7
Sheep and Beef output	$m	-	-	$112.4	$21.6	$112.4	$21.6
Gross margin - total hectares planted	$m	$522.9	$98.5	$66.6	$5.0	$589.5	$103.4
Gross margin - per hectare planted	$/ha	$7,262.50	$5,469.60	$396.60	$118.80	$2,456.40	$1,724.00
Neonic seed treatment value added - total hectares planted	$m	$129.1		$46.7		$175.8	
Neonic seed treatment value added - per hectare planted	$/ha	$1,792.90		$277.80		$732.40	

Source: BERL, various

Table 3.5 shows that 80 percent of forage brassicas planted per annum are treated with neonic treated seeds. The total gross margin per hectare planted of forage brassicas is $2,456 for crops treated with neonic seed compared with $1,724 for crops with bare/untreated seed. Value added by neonic treated seeds per hectare over bare/untreated seeds is $732.

3.3 Pasture grasses

Pasture grasses in New Zealand

BERL drew on previous work it completed for the Pasture Renewal Charitable Trust in 2009 on the *Economic analysis of the value of pasture to the New Zealand economy* for an estimate of the overall hectares of pasture grasses sown for dairy cattle farming and sheep and beef farming.

To estimate the value of the output of pasture grasses sown for dairy cattle use, BERL first calculated the amount of milk solids produced by multiplying hectares re-planted by the average tonnes of milk solids produced per hectare of pasture grass. To obtain the total value of the milk solid produced, this value was then multiplied by Fonterra's historical 4 year rolling average price for a kilogramme of milk solids ($7.22). Table 3.5 summaries the key information used in the process.

Table 3.6: Pasture grasses re-planted for dairy use and associated yield value, 2009

Variable	Unit	Level
Hectares re-planted for Dairy use	ha	120,000
Milk solids per hectare	t/ha	1.15
Milk solids - total hectares planted	tonnes	138,000
Value of Milk solids total hectares planted	$m	$997.11

Source: BERL, various

In estimating the value of pasture grasses planted for sheep and beef cattle use, BERL drew on previous work it undertook for the *Economic analysis of the value of pasture to the New Zealand economy*. This work estimated the existing farm gate value per kilogramme of dry matter by drawing on Beef and Lamb NZ data and AgResearch model data at a regional and farm type level. BERL aggregated this detailed information to a national level to generate the existing farm gate value per hectare of $557.90. With this information, we were able to multiply the existing farm gate value per hectare by total hectares planted for sheep and beef use to obtain the total existing farm gate value. Table 3.6 summaries summarises the key information used in deriving this estimate.

Table 3.7: Pasture grasses planted for sheep and beef use and associated yield value, 2009

Variable	Unit	Level
Hectares re-planted annually for Sheep and Beef use	ha	180,000
Existing farm gate value	$/ha	$557.87
Total existing farm gate value total hectares planted	$m	$100.1

Source: BERL, various

Pasture grasses – treated and untreated seeds

BERL collected information on neonic seed treatment use for pasture grasses and the associated impacts of this use relative to bare untreated seeds. This information was obtained via interviews with industry experts, seed treatment brochures and studies undertaken comparing the yield of seeds treated with neonics with untreated seeds.

Information collected showed that for forage brassicas, neonic treated seeds:

- Are 35 percent more expensive than untreated seeds
- Have a crop establishment failure rate of 9 percent compared to 40 percent for untreated seeds. A simple average from the limited number of available trials gives a crop establishment failure rate for untreated seeds as high as 62 percent. However, taking account of most of the failures (excluding outliers), we believe the average crop establishment failure rate for untreated seeds is about 40 percent. We have therefore used a crop establishment failure rate for untreated seeds of 40 percent in our analysis.
- Yield and estimated 20 percent more dry matter per hectare compared to untreated seeds. In situations of heavy grass grub pressure, industry figures indicate that seed treatment provides an increase in yield of 25 percent. In a more moderate situation of grass grub pressure, it is reasonable to assume the yield increase from treated seed may average 20 percent.

Drawing on the information collected, including information about the failure of pasture grass crop establishment and resulting in the cost of replanting and lost output, BERL applied the impacts of neonic seed treatment and bare/untreated seeds to 2009 information about pasture grasses use in New Zealand.

To calculate the cost of replanting a hectare of pasture grasses that failed to establish along with associated lost value of output, we combined the cost of replanting a hectare of pasture grasses ($500) with an estimate of the value of output lost per hectare as a result of establishment failure. Based on information obtained via interviews, BERL estimates that establishment failure of pasture grasses reduces annual output/production by a third:

- For pasture grasses re-planted for dairy farming, we estimate the lost value of milk solids per hectare due to establishment failure to be $2,772 (a third of the annual value of milk solids produced per hectare from pasture grasses re-planted).
- For pasture used in sheep and beef farming, we estimate the lost existing farm gate value per hectare to be $186 (a third of the annual existing farm gate value output per hectare from pasture grasses re-planted).

Table 3.8 summarises the impacts of neonic treated seeds and bare/untreated seeds on pasture grasses planted.

Table 3.8: Pasture grasses - Neonic seed treatment use and impacts

		Dairy		Sheep & Beef		Total	
		Treated	Untreated	Treated	Untreated	Treated	Untreated
Hectares planted	ha	45,000	75,000	67,000	112,000	112,000	187,000
Seed cost - total hectares planted	$m	$10.0	$12.4	$14.9	$18.5	$24.9	$30.9
Percentage of crops failing to establish	%	9%	40%	9%	40%	9%	40%
Hectares failed to establish	ha	4,200	30,000	6,300	44,900	10,600	74,900
Cost of replanting a hectare that has failed to establish + lost value of output	$/ha	$3,272.50		$686.00			
Cost of replanting total hectares failed to establish + lost value of output	$m	$13.8	$98.1	$4.3	$30.8	$18.2	$128.9
Dairy output	$m	$417.4	$579.7	-	-	$417.4	$579.7
Sheep and Beef output	$m	-	-	$46.4	$53.7	$46.4	$53.7
Gross margin - total hectares planted	$m	$393.6	$469.3	$27.1	$4.4	$420.7	$473.7
Gross margin - per hectare planted	$/ha	$8,754.30	$6,263.60	$403.00	$39.50	$3,746.90	$2,531.70
Neonic seed treatment value added - total hectares planted	$m	$112.0		$24.5		$136.4	
Neonic seed treatment value added - per hectare planted	$/ha	$2,490.70		$363.50		$1,215.20	

Source: BERL, various

Table 3.8 shows that, a larger proportion of pasture grasses are sown with neonic treated seeds compared to bare/untreated seeds. The difference in gross margin per hectare sown between seeds treated with neonics and bare/untreated seeds is $1,215.

4 Economic impact

This section estimates the immediate economic impact of neonic use in New Zealand under two scenarios:

- Alternative forms of insect pest control are not available to growers; and
- Alternative forms of insect pest control are available to growers.

To estimate the economic impact of neonic seed treatment, the impact of the industry's value added or GDP component and employment is calculated using information from Section 3 of this report along with multiplier analysis.[5] The industry's output generates three impact effects:

- **Direct –** initial spending of the grower (i.e. operational expenditure);
- **Indirect –** the additional inter-industry spending generated by suppliers providing goods and services to the producers;
- **Induced –** the impact of additional household expenditure resulting from income generated from the direct and indirect impact.

The multiplier captures the impact upstream through the economy of neonic seed treatment of the output produced by the agriculture sector.

4.1 Economic Impact if alternatives forms of insect pest control are not available to growers

Under this scenario we draw on the direct impacts of neonic seed treatment relative to bare/untreated seed from Section 3 of this report.

4.1.1 Value added or Gross Domestic Product (GDP)

GDP is the total of value added to a product in the New Zealand economy. For neonic treated seeds, the direct value added per hectare from neonic treated is the difference in gross margin per hectare between neonic treated seeds and bare/untreated seeds. If neonic treated seeds were banned from use, the overall immediate direct impact on value add would be the value add of neonic seed treatment per hectare multiplied by the number currently planted with neonic treated seeds.

Table 4.1 draws on information from Section 3 to estimate the total direct value added from neonic seed treatment. Multipliers are then used to estimate the overall upstream impact on GDP.

[5] Multiplier analysis uses multipliers derived from inter-industry input-output tables at the territorial authority, regional level and for New Zealand. The input-output tables have been derived from the national input-output tables and other data by Butcher Partners, Canterbury – a recognised source for regional input-output tables and multipliers. Multipliers allow us to identify the direct, indirect and induced effects in value added (GDP) and Full Time Equivalent (FTE) employment.

Table 4.1: GDP and multipliers for neonic treated seeds with no alternative forms of insect control available

Crop type	Value added per hectare	Hectares currently planted with neonics	Direct GDP ($ Million)	With Indirect Impacts ($ Million)	With Total Impacts ($ Million)
Arable grains					
Maize	$492	68,700	$33.8	$79.5	$106.1
Wheat	$315	32,900	$10.4	$24.3	$32.5
Oats	$209	3,700	$0.8	$1.8	$2.4
Barley	$251	39,400	$9.9	$23.3	$31.1
Other cereal grain	$442	1,000	$0.5	$1.1	$1.4
Total	***$379***	***145,600***	***$55.3***	***$130.0***	***$173.4***
Forage Brassicas					
Dairy	$1,793	72,000	$129.1	$303.6	$405.1
Sheep & Beef	$278	168,000	$46.7	$109.8	$146.5
Total	***$732***	***240,000***	***$175.8***	***$413.4***	***$551.6***
Pasture Grasses					
Dairy	$2,491	45,000	$112.0	$263.4	$351.4
Sheep & Beef	$363	67,000	$24.5	$57.6	$76.8
Total	***$1,215***	***112,000***	***$136.4***	***$320.9***	***$428.2***
Total	**$738**	**497,900**	**$367.5**	**$864.3**	**$1,153.2**

This table shows that neonic treated seeds generate $367 million of value added to the New Zealand economy when alternative insect protection measures are not available. When the impacts of indirect value added from suppliers to the producers and increased household expenditure by those working directly and indirectly in the industry are also added, the total GDP impact is just under $1.2 billion.

4.1.2 Employment

A further impact is employment in the agriculture industry, and the indirect employment generated by neonic seed treatment, measured by Full-Time Equivalents (FTEs). We have not completed a survey of employment in the industry, so have used national coefficients from the relevant section of the overall agricultural industry to estimate the employment generated from neonic seed treatment with no alternatives available. These coefficients provide the employment generated from the estimated level of sales and GDP from the industry. These estimates are shown in the following table.

Table 4.2: Employment multipliers for neonic treated seeds with no alternative forms of insect pest control available

Crop type	Value added per hectare	Hectares currently planted with neonics	Employment (FTEs)	With Indirect Impacts (FTEs)	With Total Impacts (FTEs)
Arable grains					
Maize	$492	68,700	206.4	400.0	489.8
Wheat	$315	32,900	63.2	122.5	150.0
Oats	$209	3,700	4.7	9.1	11.1
Barley	$251	39,400	60.5	117.2	143.5
Other cereal grain	$442	1,000	2.8	5.3	6.5
Total	***$379***	***145,600***	***337.5***	***654.1***	***800.9***
Forage Brassicas					
Dairy	$1,793	72,000	788.3	1,527.6	1,870.7
Sheep & Beef	$278	168,000	285.0	552.4	676.4
Total	***$732***	***240,000***	***1,073.4***	***2,080.0***	***2,547.2***
Pasture Grasses					
Dairy	$2,491	45,000	683.8	1,325.1	1,622.7
Sheep & Beef	$363	67,000	149.4	289.6	354.6
Total	***$1,215***	***112,000***	***833.2***	***1,614.7***	***1,977.3***
Total	**$738**	**497,900**	**2,244.1**	**4,348.7**	**5,325.4**

Our analysis indicates that the neonic treated seeds lead to the direct employment of around 2,200 FTEs when alternative insect protection measures are not available. When we take account of the indirect employment generated, the total employment is estimated to be around 5,300 FTEs.

4.2 Economic impact to New Zealand if alternative forms of insect pest control are available to growers

The above economic impact assessment of neonic seed treatment to the New Zealand economy assumed that alternative forms of crop treatment would not be available to growers. In reality, and drawing on the experience of the European Union (EU), it is unlikely that the removal of neonic seed treatment would coincide with the removal of existing alternative forms of insect protection. It therefore makes sense to examine the economic impact if current alternative forms of crop treatment were available.

Collecting detailed cost and yield information on the impacts of alternative insect protection measures relative to neonic seed treatment was outside the scope of this project. We can however, draw on the comprehensive research published in 2013 by Humboldt Forum Food and Agriculture e.V. (HFFA) that looked at the impacts of a ban or suspension of neonic seed treatment in the EU to examine the likely economic impacts to farmers of the removal of neonic seed treatment had alternatives been available.

In the HFFA working paper, the short-term value-added of neonic seed treatment application is examined under five different scenarios. Of the five scenarios, scenarios one and five are relevant to this exercise:

- Scenario five examined the impacts of a neonic seed treatment ban for all key crops and EU member states but assuming all other crop protection tools and technologies are not available to farmers.

- Scenario one examined the impacts of a neonic seed treatment ban for all key crops and EU member states assuming all other crop protection tools and technologies remain available to farmers.

The short-term value added provided by neonics where alternative crop protection measures were available (scenario five) was $4.2 billion Euro while the short-term value added provided by neonics where alternatives were available was $2.8 billion Euro. This tells us that the availability of alternative crop protection measures is likely to reduce value added created where no alternatives are available by a third.

Applying the reduction in value added created to the impact of neonic seed treatment on GDP and employment outlined in Section 4.1 indicates that the total GDP impact of neonic seed treatment when alternative crop treatments are available is just under $800 million, while the total employment impacts is likely to be around 3,600 FTEs. Table 4.3 summarises the overall economic impact of neonic seed treatment in New Zealand with and without the availability of alternative crop protection measures.

Table 4.3: Summary of economic impacts of neonic seed treatment – with and without the availability of alternatives

	Direct GDP ($ Million)	With Indirect Impacts ($ Million)	With Total Impacts ($ Million)
Value added (GDP, $m)			
No alternatives available	$367.5	$864.3	$1,153.2
Alternatives available	$245.0	$576.2	$768.8
Employment (FTEs)			
No alternatives available	2,244	4,349	5,325
Alternatives available	1,496	2,899	3,550

4.3 Economic impact to New Zealand – applying the reality check

Industry experts state the removal of neonic seed treatment in New Zealand is likely to lead to the following scenarios or responses by growers:

- **Short-medium term:** Most growers will revert to using existing measures of crop protection, reverting to organophosphate or synthetic pyrethroids.
- **Long-term:** Growers are likely to research alternatives available and adopt the most economic/efficient form of crop protection control available to them. Growers, crop protection companies and industry bodies are also likely to investigate other crop protection options available.

4.3.1 Short-medium term impacts

We do however know that the availability of alternatives is likely to reduce in the short-term as the New Zealand Environmental Protection Agency made the decision in 2013 to cease approving many organophosphates in a staged approach from 2016 onwards due to their high levels of toxicity to the environment, animals and humans.

Industry experts interviewed as part of this project identified organophosphates as one of the most efficient alternatives to neonic seed treatment available to growers. Industry experts also noted the high levels of toxicity associated with organophosphates.

Organophosphates are widely used and could potentially be a reasonably efficient alternative to neonic seed treatment. However, reduced availability of organophosphates over the coming years, leads us to surmise that the overall value-added lost if neonic seed treatment were removed would not be as large if all current insect control measures (including all current organophosphates) were available.

The order of magnitude of the impact to the New Zealand economy of the removal of neonic seed treatment where all alternatives are available except the organophosphate that are to be removed is difficult to reliably estimate. To do this would require detailed analysis of the impacts of insect protection alternatives relative to neonic treated seeds.

BERL therefore estimates that the total GDP generated by neonic seed treatments in New Zealand in the short-medium term to be between $800 million and $1.2 billion. Similarly we expect the total FTEs generated in the short-medium term to be somewhere between 3,600 FTEs and 5,300 FTEs.

4.3.2 Long term impacts

Over the long term, BERL expects growers to research all insect pest control measures available and adopt the most economic/efficient control available. Furthermore, growers, crop protection companies and industry bodies are likely to investigate insect control measures beyond those current available. As a result, we expect the annual total impact of neonic seed treatment in the long term where alternatives are available to be around $800 million in GDP and 3,600 FTEs.

It is possible that with the introduction of new, alternative insect pest control measures, it is possible that the total GDP impact could be lower than $800 million.