MAIZE GRAIN RESEARCH 2023

PIONEER®
BRAND · PRODUCTS

CONTENTS

INTRODUCTION

Welcome to the Pioneer Maize Grain Research update for 2023.

For many years we've produced Maize Grain Hybrid Performance Information which provides comprehensive hybrid yield data enabling growers to make informed decisions on which hybrid to plant. However, our research programme covers so much more than just hybrid evaluation. Each year we aim to deliver more value to growers by conducting a range of agronomic and environmental research. In this publication, we've summarised some of our latest research which includes maize field establishment, tillage systems and we also present a technical update on fall armyworm.

An IMPACT™ small plot planter at Gordonton, Waikato. IMPACT is the acronym for "intensively managed product advancement and characterisation trials".

Long term breeding delivers higher yields

The annual rate of increase in maize grain yield in New Zealand is estimated to have been over 180 kg/ha/year over almost 60 years (Figure 1). Crop management and genetic improvement have both made significant contributions to yield increases.

A newly introduced Pioneer hybrid will usually have considerable yield advantage over older hybrids. To maximise returns, grain growers should look to introduce suitable new hybrids regularly. Desired harvest timing, soil type, cultivation methods and agronomic traits such as early growth, drought tolerance, stalk and root strength, disease resistances and grain quality are all important considerations to include in the hybrid selection process.

The most reliable way to select superior hybrids is to consider trial yield and grain quality data gathered over several seasons from a wide range of locations within a growing region. Individual on-farm trial results should not be used to select a hybrid because in isolation, they are not a reliable predictor of future hybrid performance. Hybrids should be planted and harvested at the same time. Trial data should be statistically analysed to determine if there is a real yield difference between the hybrids being compared.

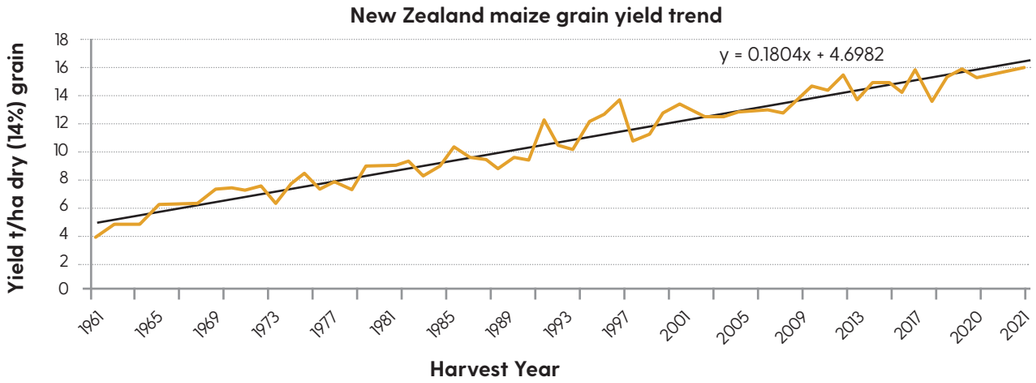
This publication provides a summary of the investment made to evaluate the yield performance of Pioneer® and other brands of maize grain hybrids in five defined growing regions; 1) Northland and South Auckland 2) Waikato 3) Bay of Plenty 4) Gisborne and northern Hawke's Bay 5) Lower North Island and South Island.

Summarised hybrid comparison data published in this book has been collected from field trials conducted over one or more growing seasons up to and including the 2022 harvest. The most recent regional Hybrid Performance Information (HPI) can be found at pioneer.nz.

Sometimes we publish comparisons between hybrids which were not trialled during the most recent growing season. There are two main reasons why this happens. Firstly, where two commercial hybrids have been extensively trialled and a statistically significant difference has been achieved, there is no need to continue trialling these hybrids. Secondly, not all competitor hybrids have trial seed available every season. In addition, because trial results are published prior to the spring sales season, we occasionally publish comparisons which include recently retired competitor hybrids.

It is impossible to publish every possible hybrid comparison. When determining which competitor hybrid comparisons to publish we:

- **only publish comparisons where the P value is less than 0.10 which means there is a greater than 90% probability the reported yield difference is real and not just due to chance. This includes trials where the result is commercially acceptable (CA) (see opposite page). Consequently, comparisons involving new hybrids may take several seasons to generate sufficient data to publish.**
- **don't compare hybrids based on Comparative Relative Maturity (CRM) ratings because there is no industry standard. This means hybrids from different companies can have the same CRM rating but take varying amounts of time to reach grain harvest maturity.**
- **only include comparisons where the grain harvest moisture difference is +/- 2%. This is an objective measure and a more robust way to compare the relative maturity of grain hybrids. We also always publish the actual harvest moisture difference so growers can consider this as a measure hybrid maturity along with grain yield in their hybrid decision making process.**



Source: New Zealand Year Book (1961 to 1996) and Pioneer® brand products New Zealand Research Programme (1997 to 2020).

Interpreting the hybrid comparison t-test

The table below presents a summary of the possible t-test outcomes.

P value	Confidence level	Scientific designation	Level of significance	Yield advantage	Interpretation
<0.001	>99.9%	★★★	Very highly significant	YES	**Hybrid superiority for yield <u>can be claimed</u>.** Can confidently plant the winning hybrid providing no key agronomic traits are limiting. Check the trait ratings for any considerations.
<0.01	>99.0%	★★	Highly significant	YES	
<0.05	>95.0%	★	Significant	YES	
<0.10	>90.0%	CA	Commercially acceptable	YES	Not a significant result, but may be regarded as a commercially acceptable basis for a decision.
>0.10	<90.0%	NS	Not significant	NO	**Hybrid superiority for yield <u>cannot be claimed</u>.** Ignore the yield comparison and refer primarily to important trait ratings to select between the hybrids.

The more stars (★) present for the comparison, the more confident we can be that the measured average yield difference is due to an actual genetic yield difference between the two hybrids rather than just chance.

Where a result is commercially acceptable **(CA)**, the P value is <0.10 indicating the result is suitable for making a hybrid decision based on yield. Always remember to include key agronomic traits in your hybrid selection process

Where a result is not significant **(NS)**, we cannot conclude there is a yield difference between the hybrids. There are two principle explanations;

1. Where the yields are very similar and the comparison has been made over a large number of locations, no significance may indicate there is little measurable difference between the two hybrids or;
2. Where there appears to be a large yield difference, no significance likely indicates there are too few trial locations, or there have been inconsistent or fluctuating results. It is therefore not possible to indicate that the difference is real.

In both instances above, growers should use regionally important hybrid trait ratings to select which hybrid to plant.

In other comparisons, yield differences may appear to be relatively small but still achieve significance – this happens in cases where yield data quality is high, and the number of trial locations is large.

A t-test analysis of statistical significance is carried out on all Pioneer hybrid comparisons and we take great care to base our product yield statements and recommendations on the outcome.

NEW

PIONEER® BRAND P8240

HIGHER YIELDS FOR SOUTHERN GROWERS.

CRM 82

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P8240 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
Lower North Island & South Island						
P8240	P8000	14	-0.40	2,429	★★★	-2.91
P8240	P8333	13	-0.16	993	★	-1.99
P8240	P8500	15	-0.29	597	NS	1.18
P8240	P8666	17	0.25	106	NS	1.34
P8240	P8711	8	0.66	-1,498	CA	0.31
P8240	P8805	13	-0.03	242	NS	0.52
P8240	P8000	14	-0.40	2,429	★★★	-2.91

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	90
Medium yield environments	100
High yield environments	115

PIONEER® BRAND P8666

HIGH PERFORMANCE HYBRID WITH STRONG AGRONOMIC PROPERTIES.

CRM 86

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P8666 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
Lower North Island						
P8666	PAC007 (Booster)	20	0.74	1,428	★★	-9.44
P8666	P8000	36	-0.61	2,204	★★★	-2.69
P8666	P8240	17	-0.25	-106	NS	-1.34
P8666	P8333	35	-0.34	680	★★★	-2.35
P8666	P8500	54	-0.24	75	NS	-0.31
P8666	P8711	11	0.75	-1,799	★★	-1.65
P8666	P8805	48	-0.18	71	NS	0.39
P8666	P9127	37	0.59	-1,299	★★★	1.36
P8666	P9400	17	0.60	20	NS	-1.35
P8666	Titus	14	0.91	3,614	★★★	-8.89
Waikato						
P8666	P8000	15	-0.20	1,701	★★	-2.22
P8666	P8500	20	-0.15	375	NS	1.06
P8666	P8711	9	0.16	-1,790	★★	-0.61
P8666	P8805	15	-0.04	339	NS	1.89
P8666	P9127	29	0.22	-991	★★★	2.23
P8666	P9400	21	-0.08	-1,062	★★★	-2.60
Gisborne & Hawke's Bay						
P8666	P8805	8	0.00	1,731	★	1.00

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	85
Medium yield environments	95
High yield environments	105

NEW

PIONEER® BRAND P8711

DEFENSIVE WINNER WITH GAME-CHANGING YIELDS.

CRM 87

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P8711 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
National						
P8711	P8333	14	-0.72	2,128	★★★	-2.35
P8711	P8500	21	-1.04	2,002	★★★	0.82
P8711	P8666	25	-0.58	1,693	★★★	1.11
P8711	P8805	24	-1.01	1,485	★★★	0.44
P8711	P9127	28	-0.67	317	NS	2.44
P8711	P9400	25	-0.38	259	NS	-2.43
Waikato						
P8711	P8333	5	0.06	1,172	NS	-1.67
P8711	P8500	7	-0.26	1,338	★	1.05
P8711	P8666	9	-0.16	1,790	★★	0.61
P8711	P8805	6	-0.20	929	CA	1.08
P8711	P9127	13	-0.55	497	NS	2.29
P8711	P9400	10	-0.23	-17	NS	-3.25
Lower North Island & South Island						
P8711	P8333	8	-0.94	2,688	★★	-2.61
P8711	P8500	11	-1.39	2,760	★★★	1.31
P8711	P8666	11	-0.75	1,799	★★	1.65
P8711	P8805	15	-1.16	1,532	★★★	0.53
P8711	P9127	10	-0.99	282	NS	2.67
P8711	P9400	10	-0.59	532	NS	-2.27

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	90
Medium yield environments	100
High yield environments	115

PIONEER® BRAND P9400

TRUSTY AND RELIABLE. DELIVERS YEAR AFTER YEAR.

CRM 94

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P9400 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
Northland						
P9400	P0021	98	1.32	-791	★★★	0.46
P9400	P8805	10	-0.36	225	NS	1.81
P9400	P9127	18	0.06	-370	NS	2.90
P9400	P9721	85	0.39	-486	★★★	2.42
P9400	P9978	7	1.03	-791	NS	1.81
Waikato						
P9400	P0021	172	1.09	-439	★★★	1.09
P9400	P8666	21	0.08	1,062	★★★	0.08
P9400	P8711	10	0.23	17	NS	0.23
P9400	P8805	63	-0.11	821	★★★	-0.11
P9400	P9127	66	0.24	-56	NS	0.24
P9400	P9721	178	0.70	-297	★★	0.70
P9400	P9978	27	1.84	-1,952	★★★	1.84
P9400	PAC249	21	0.65	1,465	★★	0.65
Gisborne & Hawke's Bay						
P9400	P0021	73	1.01	-953	★★★	1.37
P9400	P8666	8	-0.56	410	NS	2.42
P9400	P8805	26	-0.30	551	★	2.01
P9400	P9127	26	0.33	-384	NS	3.33
P9400	P9721	72	0.54	-973	★★★	3.03
P9400	P9978	14	1.41	-2,657	★★★	3.07
Lower North Island						
P9400	P8711	10	0.59	-532	NS	2.27
P9400	P8805	134	-0.49	47	NS	1.93
P9400	P9127	76	0.00	-680	★★★	3.50
P9400	P9721	272	0.40	-834	★★★	3.43
P9400	P9978	18	2.78	-1,826	★★★	4.75
P9400	PAC249	60	0.77	74	NS	4.11

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	85
Medium yield environments	95
High yield environments	105

THE HERO FOR FAST DRYDOWN AND TIMELY HARVEST.

CRM 97

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P9721 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
Northland						
P9721	P0021	93	0.66	-277	★	-2.03
P9721	P0362	34	1.29	-940	★★★	-1.71
P9721	P9400	85	-0.39	486	★★★	-2.42
P9721	P9978	7	1.36	-1,063	NS	0.41
Waikato						
P9721	PAC295 (N39-Q1)	48	0.32	1,290	★★★	0.99
P9721	Obelix	18	-0.38	1,492	★★	0.40
P9721	P0021	174	0.55	0	NS	-1.94
P9721	P0362	49	2.18	-466	★★	-2.29
P9721	P9400	178	-0.70	297	★★	-3.31
P9721	P9978	23	1.17	-1,117	★★★	0.66
P9721	PAC249	18	0.01	2,094	★★★	-1.62
P9721	PAC314	8	0.55	1,175	CA	-5.13
Gisborne & Hawke's Bay						
P9721	P0021	79	0.42	97	NS	-1.44
P9721	P0200	14	1.01	-563	NS	-2.10
P9721	P0362	38	2.02	-144	NS	-1.69
P9721	P9400	72	-0.54	973	★★★	-3.03
P9721	P9978	21	1.09	-1,289	★★★	0.69
Lower North Island						
P9721	PAC295 (N39-Q1)	58	0.57	390	★	0.61
P9721	Obelix	13	-0.79	1,986	★★★	-1.96
P9721	P0021	231	0.98	-32	NS	-1.75
P9721	P0362	55	2.84	-370	★	-0.73
P9721	P9400	272	-0.40	834	★★★	-3.43
P9721	P9978	30	1.99	-940	★★★	1.21
P9721	PAC249	67	0.36	915	★★★	-0.16

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	88
Medium yield environments	96
High yield environments	102

VERY PRODUCTIVE. VERY STABLE. VERY DEFENSIVE.

CRM 99

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P9978 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
Northland						
P9978	P0021	24	-0.41	151	NS	-3.12
P9978	P0362	25	0.75	173	NS	-3.13
Waikato						
P9978	PAC295 (N39-Q1)	22	-0.83	2,547	★★★	0.40
P9978	P0021	44	-0.55	1,239	★★★	-2.45
P9978	P0362	49	1.01	303	NS	-2.35
P9978	P9400	27	-1.84	1,952	★★★	-5.54
P9978	P9721	23	-1.17	1,117	★★	-0.66
P9978	PAC314	15	-0.49	1,145	CA	-5.42
Gisborne & Hawke's Bay						
P9978	P0021	29	-0.37	1,190	★★★	-2.24
P9978	P0362	24	0.78	1,130	★★	-2.69
P9978	P0640	26	1.09	581	★	0.32
P9978	P9400	14	-1.41	2,657	★★	-3.07
P9978	P9721	21	-1.09	1,289	★★★	-0.69
Lower North Island						
P9978	PAC200 (Afinity)	13	-1.08	1,371	★★	-1.99
P9978	PAC295 (N39-Q1)	20	-1.01	2,218	★★★	0.07
P9978	P0021	51	-0.88	923	★★★	-2.22
P9978	P0362	44	0.95	181	NS	-1.68
P9978	P0547	47	-0.45	566	★★	-2.57
P9978	P9400	18	-2.78	1,826	★★★	-4.75
P9978	P9721	30	-1.99	940	★★★	-1.21
P9978	PAC249	22	-1.32	2,515	★★★	-2.14
P9978	PAC314	16	-0.99	1,464	★★★	-3.96

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	85
Medium yield environments	95
High yield environments	110

HARD TO BEAT CONSISTENCY.

CRM 100

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P0021 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
Northland						
P0021	P0362	44	0.88	-269	NS	0.45
P0021	P9400	98	-1.32	791	★★★	-0.46
P0021	P9721	93	-0.66	277	★	2.03
P0021	P9978	24	0.41	-151	NS	3.12
Waikato						
P0021	PAC295 (N39-Q1)	74	-0.32	710	★★★	2.54
P0021	P0362	71	1.70	-677	★★★	0.40
P0021	P9400	172	-1.09	439	★★★	-1.63
P0021	P9721	174	-0.55	0	NS	1.94
P0021	P9978	44	0.55	-1,239	★★★	2.45
P0021	PAC249	17	-0.20	1,957	★★★	0.21
Bay of Plenty						
P0021	P0200	9	0.49	-1,733	★★	-1,733
P0021	P0362	15	0.98	-583	NS	-583
P0021	P9721	11	-0.50	1,397	★	1,397
P0021	P9978	9	0.15	-1,342	CA	-1,342
Gisborne & Hawke's Bay						
P0021	P0200	22	0.43	-657	★	-0.28
P0021	P0362	46	1.33	-307	CA	-0.24
P0021	P9721	79	-0.42	-97	NS	1.44
P0021	P9978	29	0.37	-1,190	★★★	2.24
Lower North Island						
P0021	PAC295 (N39-Q1)	88	-0.25	331	★★	2.42
P0021	P0200	35	0.67	-173	NS	0.80
P0021	P0362	92	1.83	-625	★★★	0.60
P0021	P0547	189	0.46	-474	★★★	-0.16
P0021	P9400	203	-1.46	785	★★★	-1.52
P0021	P9721	231	-0.98	32	NS	1.75
P0021	P9978	51	0.88	-923	★★★	2.22
P0021	PAC249	36	-0.48	588	★	2.60

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	85
Medium yield environments	95
High yield environments	100

NEW

PRESENTS PERFORMANCE AND RELIABILITY.

CRM 102

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P0200 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
Northland						
P0200	P0021	23	-0.82	56	NS	-0.95
P0200	P0362	24	0.26	32	NS	-0.75
P0200	P9978	24	-0.52	-89	NS	2.37
Waikato						
P0200	Afinity	15	-0.48	673	★★★	0.17
P0200	PAC295 (N39-Q1)	21	-0.94	2,266	★★★	0.14
P0200	P0021	41	-1.08	728	★★★	-1.08
P0200	P0362	41	0.58	-81	NS	-0.68
P0200	P9721	15	-1.62	440	★	1.08
P0200	P9978	41	-0.47	-349	CA	1.11
P0200	PAC314	18	-0.67	1,089	★	-4.21
Bay of Plenty						
P0200	PAC200 (Afinity)	8	-0.70	1,712	★	3.17
P0200	P0021	9	-0.49	1,733	★★	0.15
P0200	P0640	7	-0.09	665	★	5.24
P0200	P0891	7	0.84	1,810	★	-5.11
P0200	P9978	8	-0.22	105	NS	3.24
Gisborne & Hawke's Bay						
P0200	P0021	22	-0.43	657	★	0.28
P0200	P0362	19	0.63	653	CA	0.30
Lower North Island						
P0200	PAC295 (N39-Q1)	19	-1.13	1,327	★★★	0.24
P0200	P0021	35	-0.67	173	NS	-0.80
P0200	P0547	32	-0.60	30	NS	-1.18
P0200	P9978	34	-0.06	-758	★★★	1.45

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	85
Medium yield environments	95
High yield environments	105

ROBUST HYBRID WITH YIELD STABILITY AND "EYE APPEAL."

CRM 103

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P0362 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
Northland						
P0362	P0021	44	-0.88	269	NS	-0.45
P0362	P0200	24	-0.26	-32	NS	0.75
P0362	P0640	56	0.20	-410	★	2.42
P0362	P0891	14	0.57	738	★	-2.49
P0362	P9978	25	-0.75	-173	NS	3.13
Waikato						
P0362	PAC200 (Afinity)	24	-0.83	829	★★	1.54
P0362	PAC295 (N39-Q1)	21	-1.29	2,635	★★★	1.34
P0362	P0021	71	-1.70	677	★★★	-0.40
P0362	P0200	41	-0.58	81	NS	0.68
P0362	P0640	82	0.39	-1,065	★★★	2.48
P0362	P0891	40	0.11	-552	★	-3.32
P0362	P9978	49	-1.01	-303	NS	2.35
P0362	PAC314	15	-1.22	1,397	★★★	-3.39
P0362	PAC400 (Plenitude)	21	-0.14	851	★	1.25
Bay of Plenty						
P0362	PAC200 (Afinity)	13	-1.13	654	NS	1.92
P0362	P0021	15	-0.98	583	NS	-0.83
P0362	P0200	7	-0.52	-393	NS	-0.56
P0362	P0640	36	-0.12	10	NS	1.77
P0362	P0891	38	0.12	546	CA	-3.84
P0362	P9978	14	-0.47	-50	NS	2.18
Gisborne & Hawke's Bay						
P0362	P0021	46	-1.33	307	CA	0.24
P0362	P0200	19	-0.63	-653	CA	-0.30
P0362	P0547	32	-1.01	258	NS	0.03
P0362	P0640	47	0.40	-471	★	2.81
P0362	P0891	33	0.48	321	CA	-3.16
P0362	P9978	24	-0.78	-1,130	★★	2.69

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	85
Medium yield environments	95
High yield environments	105

LEAF DISEASE CHAMPION DELIVERING YIELD STABILITY.

CRM 106

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P0640 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
Northland						
P0640	P0021	48	-1.34	463	★	-3.01
P0640	P0200	24	-0.38	364	NS	-2.43
P0640	P0362	56	-0.20	410	★	-2.42
P0640	P0891	52	0.24	610	★★	-5.68
P0640	P0900	16	0.77	750	★★★	-1.02
P0640	P0937	30	0.56	-377	CA	-0.80
P0640	PAC314	9	-0.86	830	CA	-2.20
Waikato						
P0640	P0021	114	-1.54	1,144	★★★	-3.10
P0640	P0200	35	-1.20	903	★★	-2.21
P0640	P0362	82	-0.39	1,065	★★★	-2.48
P0640	P0891	170	0.41	314	★★	-5.15
P0640	P0900	43	1.06	208	NS	-1.56
P0640	P0937	74	0.92	-302	NS	-0.62
P0640	PAC314	8	-1.66	1,449	★	-5.87
P0640	PAC432	35	1.01	1,049	★★★	0.52
P0640	PAC400 (Plenitude)	36	0.21	1,669	★★★	-1.49
Bay of Plenty						
P0640	P0021	28	-0.63	753	★★	-3.27
P0640	P0200	7	0.09	-665	★	-5.24
P0640	P0362	36	0.12	-10	NS	-1.77
P0640	P0891	123	0.43	325	★★	-6.23
P0640	P0900	27	0.85	-583	★	-1.34
P0640	P0937	61	0.68	-636	★★	-0.21
P0640	PAC400 (Plenitude)	11	-0.56	1,922	★★★	-2.32
Gisborne & Hawke's Bay						
P0640	P0021	75	-1.31	499	★★	-2.60
P0640	P0200	21	-0.96	248	NS	-2.55
P0640	P0362	47	-0.40	471	★	-2.81
P0640	P0891	88	0.39	315	★	-5.96
P0640	P0900	27	1.10	-242	NS	-1.93
P0640	P0937	36	0.78	-1,036	★★★	-0.41
P0640	P1253	81	1.19	-408	★	-5.51
P0640	P9978	26	-1.09	-581	★	-0.32

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	85
Medium yield environments	95
High yield environments	100

HARD TO FAULT, STABLE, ALL-ROUND HYBRID.

PIONEER® P0900

Optimum AQUAmax

CRM 109

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P0900 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
Northland						
P0900	P0640	16	-0.77	-750	★★★	1.02
P0900	P0891	16	-0.69	502	★	-4.40
P0900	P0937	16	-0.44	-638	★★	-0.01
Waikato						
P0900	P0640	43	-1.06	-208	NS	1.56
P0900	P0891	49	-0.50	544	CA	-3.47
P0900	P0937	52	-0.17	-428	CA	1.10
P0900	P1096	14	0.88	138	NS	1.01
Bay of Plenty						
P0900	P0640	27	-0.85	583	★	1.34
P0900	P0891	39	-0.25	979	★★	-5.22
P0900	P0937	40	-0.18	-164	NS	0.82
Gisborne & Hawke's Bay						
P0900	P0640	27	-1.10	242	NS	1.93
P0900	P0891	27	-0.80	245	NS	-4.57
P0900	P0937	27	-0.33	-762	★★	1.63
P0900	P1096	9	0.19	-108	NS	0.04
P0900	P1253	28	-0.25	276	NS	-4.13

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	80
Medium yield environments	90
High yield environments	110

SOLID HYBRID WITH NEXT GENERATION GRAIN YIELD.

PIONEER® P0937

CRM 109

Feature hybrid	Comparison hybrid	Number of trials	Harvest moisture difference (%)[1]	Yield advantage to P0937 (kg/ha)[2]	Yield statistical significance[3]	Test weight difference (kg/hl)[2]
National						
P0937	P0362	119	-0.86	1,306	★★★	-1.90
P0937	P0640	207	-0.80	552	★★★	0.45
P0937	P0891	208	-0.52	1,187	★★★	-5.36
P0937	P0900	136	0.24	430	★★	-1.00
P0937	P1096	40	0.57	350	NS	-0.26
P0937	P1253	197	-0.11	877	★★★	-5.06
P0937	PAC430	27	-0.34	731	★	-2.95
P0937	PAC432	55	-0.17	795	★★	-0.34
Northland						
P0937	P0362	18	-0.52	1,355	★★	-1.26
P0937	P0640	30	-0.56	377	CA	0.80
P0937	P0891	24	-0.46	1,387	★★★	-4.33
P0937	P0900	16	0.44	638	★★	0.01
P0937	P1253	24	-0.17	1,244	★★★	-4.69
Waikato						
P0937	P0362	34	-1.00	1,691	★★★	-1.94
P0937	P0640	74	-0.92	302	NS	0.62
P0937	P0891	74	-0.67	945	★★★	-4.68
P0937	P0900	52	0.17	428	CA	-1.10
P0937	P1253	71	-0.15	585	★★	-4.44
Bay of Plenty						
P0937	P0362	35	-0.65	948	★★	-2.01
P0937	P0640	61	-0.68	636	★★	0.21
P0937	P0891	70	-0.30	1,215	★★★	-6.32
P0937	P0900	40	0.18	164	NS	-0.82
P0937	P1253	62	-0.20	974	★★★	-5.86
Gisborne & Hawke's Bay						
P0937	P0362	22	-0.79	1,588	★★★	-1.90
P0937	P0640	36	-0.78	1,036	★★★	0.41
P0937	P0891	39	-0.66	1,491	★★★	-5.58
P0937	P0900	27	0.33	762	★★	-1.63
P0937	P1253	39	0.13	1,015	★★★	-5.14

[1]Positive harvest moisture differences indicate that the bolded Pioneer hybrid was drier at harvest, negative harvest moisture differences mean it was wetter. [2]Positive yield and / or test weight differences indicate the bolded Pioneer hybrid had higher yield and / or grain test weight. [3]For information on interpreting hybrid comparison data and statistical significance see page 3. Includes all data to the end of the 2022 harvest.

Recommended growing regions

Recommended established plant populations (000's/ha)

Challenging yield environments	85
Medium yield environments	95
High yield environments	110

USING CATCH CROPS FOR REDUCED NITRATE LEACHING IN MAIZE PRODUCTION SYSTEMS

Introduction

Maize is a high-yielding crop that requires a significant amount of nitrogen (N) to optimise production. Seasonal weather variability impacts crop yields and this makes it impossible to determine the ideal N application rate. Applying more N than required can increase the risk of N-leaching. In the event a grain crop is fertilised to achieve 16 t/ha and only achieves 10 t/ha, more than 70 kg N/ha is left over in the soil after harvest and could potentially be lost through leaching.

Managing N losses in maize cropping systems

Research by Pioneer® brand seeds indicates that on average greater than 90% of N-leaching losses in maize cropping systems occur after maize harvest. A catch crop is any crop that is grown with the primary objective of "mopping" up excess N in soils, which may otherwise be lost through leaching.

Nitrogen leaching reductions of more than 85% were observed when winter catch crops were established after maize.

Catch crops – timing methods and species

Maize grain harvest typically occurs in late autumn. Cold, wet conditions and high levels of crop residue often make it difficult to establish catch crops. For a catch crop to be effective, it should have a strong winter activity and be capable of scavenging leftover soil N.

A 3½ year Sustainable Food and Fibre Futures (SFFF) project funded by MPI, Pioneer® brand seeds and Foundation for Arable Research (FAR) was conducted between 2020 and 2022. The research evaluated a range of catch crop species and establishment methods combinations in replicated small plot trials in the Waikato. The species included perennial ryegrass, Italian ryegrasses and oats which were either interseeded at V5 maize development stage, broadcast at brown husk stage (25% maize leaf senescence), or drilled after maize grain harvest as a monoculture, or as a mix with plantain.

The 3-4 most consistent catch crop treatments were further tested in 15 on-farm sites across four North Island regions to demonstrate commercial feasibility.

Results

V5 interseeding

While inter-seeding at the V5 growth stage of maize (Figure 1) may be gaining popularity overseas, it proved to be the most inconsistent performer across the various trials in our project. Success was dependent on soil moisture, degree of shading and herbicide choice.

Figure 1: Inter-seeding catch crops into maize at the V5 maturity stage.

Pre-harvest aerial broadcasting at brown husk maturity stage.

Pre-harvest aerial broadcasting of annual or Italian ryegrass has been shown to be the most consistent performing option for establishing catch crops in maize grain systems.

Timing the broadcasting with rain or targeting early autumn, when the chances of rain are higher, will increase success.

Broadcasting requires higher seeding rates (+20%) than drilling. This is required to compensate for poor seed to soil contact or seed that becomes trapped within the maize canopy. Slug bait and bird repellent treated seed will also help improve establishment success.

Post harvest drilling

Post harvest drilling is suitable where the maize crop is harvested before soils are too wet and cold. Where residue volumes are light, direct drilling is advisable, otherwise, discing is a good option to incorporate the residue before drilling. Figure 2 illustrates the potential benefits of incorporating maize residue prior to drilling for a high yielding maize grain crop averaging 18–19 t/ha.

How effective are catch crops at reducing N-leaching?

Figure 3 illustrates the catch crop yields and N removal under two Waikato soil types. Interseeding catch crops at the V5 stage was considered the most inconsistent option whereas pre harvest broadcasting annual or Italian ryegrass at brown husk stage was the most consistent across seasons and environments. Post harvest drilling was only good if maize was harvested before soils were wet and cold.

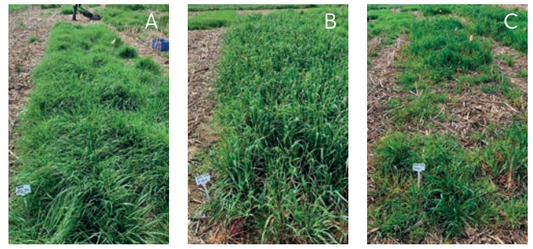


Figure 2. Catch crop plots after maize grain on an ash soil established by method of (A) broadcast Italian ryegrass at brown husk maturity sown in March 2021, (B) disc and drill oats and (C) direct drilled oats sown in May 2021.

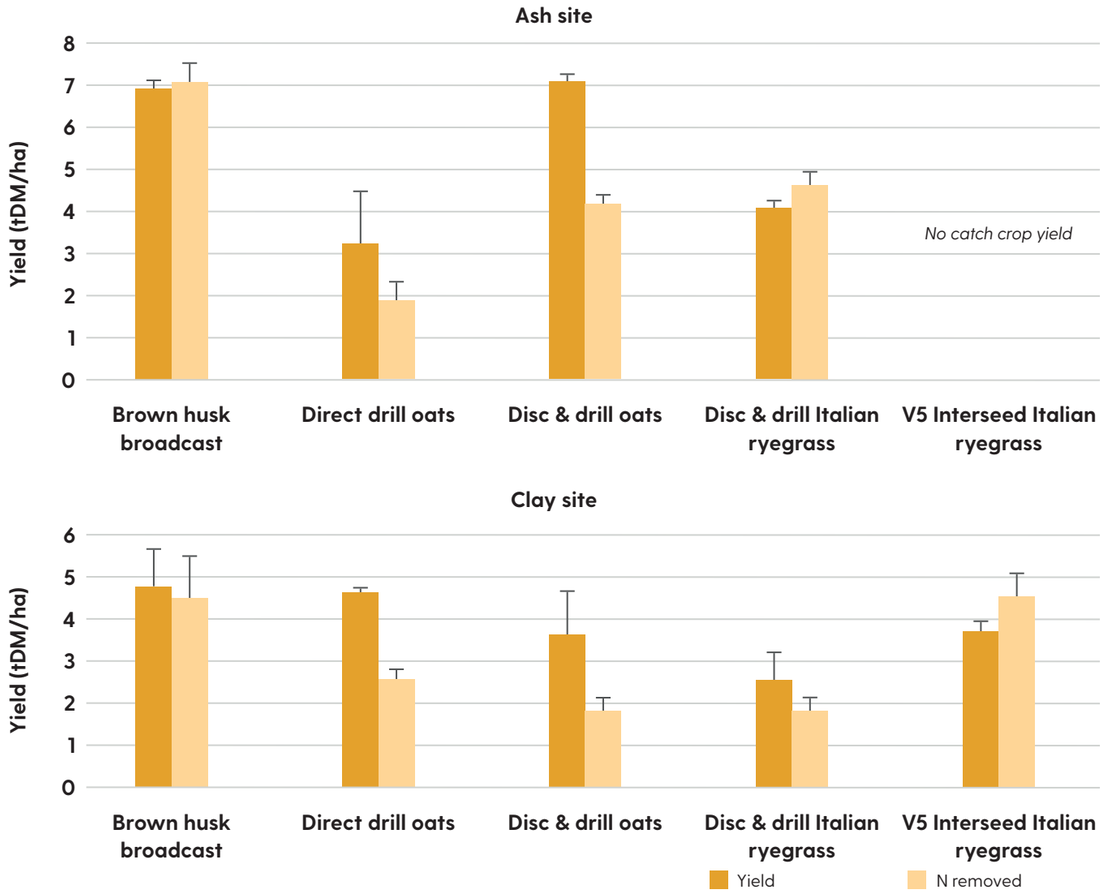


Figure 3. Total seasonal catch crop yield (t DM/ha) and N removed (kg N/ha) following maize grain harvest at an ash site (top) and clay site (bottom) in the Waikato.

Post harvest drilling

Given the impact of weather on maize crop yields, it is impossible for growers to apply the right amount of fertiliser N every season. This study shows growers can apply a fertiliser N rate to maximise yield for their environment and then use a winter catch crop to "mop" up excess soil N.

FALL ARMYWORM UPDATE

In the 2022-23 growing season, the Pioneer® brand products team worked alongside other industry partners in placing and monitoring pheromone traps to track the movement of fall armyworm (FAW) in New Zealand. This article provides a summary of what we know about this recently arrived insect pest.

Tillage systems

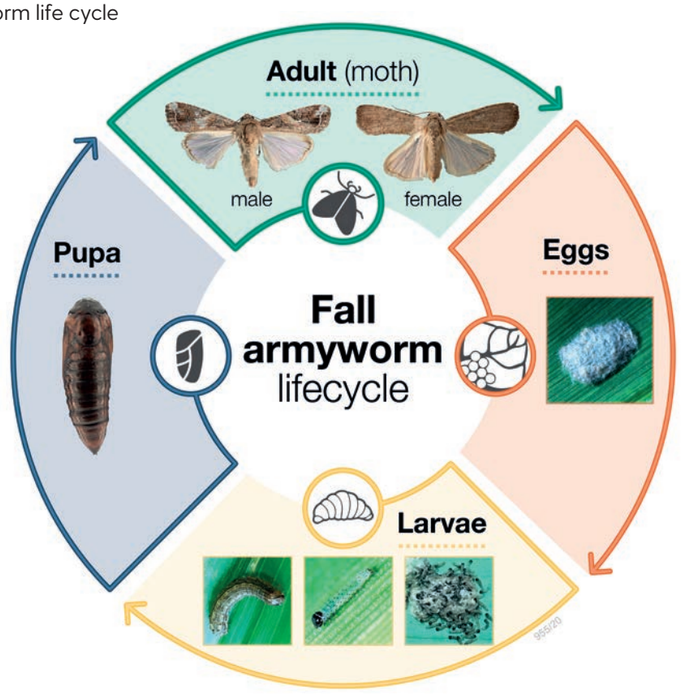
Fall armyworm (Spodoptera frugiperda) is a plant pest which is known to feed on over 350 plant species, but it prefers grasses and cereals including maize. Many of the places where FAW was first identified were close to the west coast of NZ and it is thought to have blown from Australia to NZ on storm fronts sometime in early 2022.

Life cycle

The pest has four life stages (Figure 1). Their life cycle is temperature dependent and can take between 24-55 days to progress from eggs to adult. Some life stages don't develop if temperatures fall below 7-10°C, which is the case in most of New Zealand during the maize off-season.

- Adults are 16-18 mm long with a wingspan of 38 mm. They have brown-grey forewings and cream-coloured hind wings. Adults have a strong ability to fly travelling as much as 100 km overnight and much larger distances on wind currents. They are nocturnal and most active in late summer and early autumn.
- Eggs are laid on lower leaf surfaces in masses of 150-200 covered in a protective layer of scales from the female abdomen. Each female moth lays 1,500 to 2,000 eggs (0.4 mm) and these hatch within 2-4 days.
- Larvae (caterpillars) change from green-brown to brown-black as they mature. Depending on temperature, they complete six growth stages in 14-22 days of hatching to reach maturity. Newly hatched larvae can lower themselves on a strand of silk and become windborne, contaminating plants nearby. Mature larvae crawl to adjacent crops. Once mature, larvae drop to the ground, where they pupate by constructing a loose cocoon.
- Pupae are reddish brown in colour, 4.5 mm in width and 14 to 18 mm in length. They remain the soil for 8 to 30 days depending on temperature.

Figure 1: Fall armyworm life cycle



Identifying fall armyworm

Older, larger caterpillars of FAW may be identified by:

- Inverted white 'Y' shape on the head between the eyes (Figure 2).
- Four large black spots in a square arrangement on top of the back end of the body (Figure 3).
- Four smaller dots in a trapeze arrangement on top of other segments (Figure 3).
- Light-coloured bands on the side with a dark-coloured band between them.

Figure 2: Fall armyworm caterpillar head (Photo courtesy of MPI)

Figure 3: Fall armyworm caterpillar

Control of FAW in maize

If uncontrolled, FAW can cause considerable damage to maize. Late planted crops or those which are infected at a young growth stage are more vulnerable.

While there is no NZ data, information from Australia suggests the following thresholds of economic damage which could justify crop spraying (Table 1).

Crop	Threshold
Maize at the vegetative stage	Greater than three larvae per plant and/or 50% of the plants showing signs of fresh feeding.
Maize whorl stage	Greater than 20% of the plants at the whorl stage with one or more larvae and/or more than 75% of plants showing signs of feeding damage.

Table 1: Thresholds of economic damage (Plant Health Australia)

The insecticide Sparta® is now on label for both aerial and ground applications for the control of fall armyworm in maize and sweetcorn crops. Growers should avoid the use of broad-spectrum insecticides that are ineffective on fall armyworm and potentially harmful to beneficial insects such as parasitic wasp Cotesia sp. which was often reported in FAW caterpillars last season.

What should I do if I think I have FAW?

As it has become apparent that fall armyworm is unlikely to be eradicated in New Zealand, Biosecurity NZ's fall armyworm response has ended which means growers are no longer required to notify MPI if they find FAW in their crops.

To help with the long-term management of FAW, growers should continue to check their crops. If you suspect you have FAW, contact your local Pioneer or merchant representative to determine the best management options.

FACTORS IMPACTING MAIZE FIELD ESTABLISHMENT IN NEW ZEALAND

Introduction

The aim of this field study was to quantify maize establishment under commercial growing conditions and to determine key factors influencing field establishment of maize in NZ.

Method

The study was conducted in spring 2021 and 2022 (n=156) and included commercial Pioneer® brand maize silage and grain crops from Northland to Canterbury. Pioneer field representatives estimated the actual planted and established populations using the methods described below:

Actual planted population per hectare

An even, flat (where possible) part of the paddock with no obvious gaps between plants was selected within the headland. Plants were counted in a 5.3 m section of a single row. This was repeated in different areas of the paddock to obtain three replicates.

Established population per hectare

A random starting point was selected outside the crop headland. Plants were counted in a 5.3 m section of a single row. This was repeated in different areas of the paddock until there were ten replicates.

Other information collected in this study included soil type, prior crop (or fallow), planting date, crop establishment method (conventional cultivation, strip till or no-till/direct drill), hybrid, amount of trash on the ground and seed bed preparation.

The assessment criteria for seed bed preparation are shown in Table 1.

Table 1: Assessment criteria for seed bed preparation.

Seed bed preparation	Description
Excellent	Small crumb size which is friable in hand, no clods or previous crop residue, no cracks
Acceptable	Medium crumb size which has minimal impact on emergence, small number of clods, low level or previous crop residue, small cracks
Poor	Large crumb size severely impacting crop emergence, lots of clods or previous crop residue, big cracks

Establishment percentage was calculated by dividing the established population by the planted population. Collected data was statistically analysed to determine trends.

Results

Maize establishment ranged from 76-100%. The median establishment percentage was 97% in both growing seasons. Maize that was planted using no-till or direct drill (n=4) had a lower establishment percentage than crops which were established using strip till (n=12) or conventional cultivation (n=140) (Table 2).

Table 2: Impact of crop establishment method on maize establishment.

Method of crop establishment	Establishment (%)*
Conventional cultivation	97[a]
Strip till	98[a]
No-till/direct drill	91[b]

*Means with different superscripts are statistically significant (P<0.05).

Crops which were established into excellent (n=98) or acceptable (n=50) seed beds, had a higher average establishment percentage than crops which were established into poor (n=8) seed beds (Table 3).

Table 3: Impact of seed bed preparation on maize establishment.

Method of crop establishment	Establishment (%)*
Excellent	97[a]
Acceptable	97[a]
Poor	91[b]

*Means with different superscripts are statistically significant (P<0.01).

Some paddocks were fallow over the winter prior to planting and there were a range of previous crops (annual ryegrass, perennial ryegrass, winter crop). The field study included a total of 24 different Pioneer® brand maize hybrids planted for silage and grain. Previous crop (including fallow) and hybrid had no impact on maize establishment.

Conclusions

Pioneer® brand maize seed is extensively tested for germination and cold vigour throughout the production process. The results of this survey show that field establishment is typically in the 90-100% range with only five paddocks (3%) having a field emergence less than 90%.

The two factors which resulted in the biggest impact on emergence and field establishment were the method of crop establishment or tillage type and the quality of seed bed preparation.

No-till or direct drill paddocks tend to be cooler, wetter and there is a higher incidence of slugs and snails than for conventionally cultivated paddocks. These factors can negatively impact seedling emergence and establishment.

Seed bed preparation impacts seed to soil contact and insect and weed pressure. This survey showed that there was no difference in the field establishment of high quality maize seed planted into excellent or acceptable seed beds. Poor seed bed preparation with large clods or cracks and/or a large amount of residue resulted in lower field establishment.

The current recommendations to plant 5% more seeds than the desired final plant population appears to be adequate for crops being established into well prepared seed beds using conventional cultivation or strip till. Where the seed bed preparation is poor, or the crop is being established via direct drill or no-till, growers should consider increasing the seeding rate.

THE IMPACT OF TILLAGE SYSTEMS ON MAIZE GROWTH AND THE ENVIRONMENT

Introduction

Tillage is the physical manipulation of soil to create a favourable environment for uniform seedling emergence and growth.

Tillage also helps aerate, warm and dry the soil, incorporate plant residues and fertilisers, control weeds, insects and disease organisms, improve nutrient availability by enhancing mineralisation and improve physical soil condition, e.g., reduce compaction. While the plough or disc continue to be the most popular equipment in crop production, a range of other tillage systems and variants exists.

Reduced tillage systems have a potential to reduce soil susceptibility to wind and water erosion and mitigate climate change through carbon sequestration. Besides the environmental benefits, increased soil carbon also results in improved soil fertility, water holding capacity and microbial activity and low bulk density.

Research conducted by Pioneer® brand seeds, Foundation for Arable Research, Plant and Food Research and other partners working on a Sustainable Farming Fund project concluded that in New Zealand, 89%, 9% and 2% of the maize is grown under conventional, strip and no-till systems respectively.

Since spring 2018, the Pioneer Research Team has been conducting a long-term tillage trial at the Rukuhia Research Station in the Waikato. This is a challenging maize growing environment with an ash soil. The trial involves growing maize silage under three tillage practices. The maize is then followed by an annual ryegrass option after harvesting in autumn. The research aims to help us better understand how these tillage practices influence crop growth, soil physical, chemical and biological conditions.

Tillage systems

The three tillage practices being tested are:

Conventional tillage – a three pass system using a standard disc followed by a power harrow and a precision seeding planter to plant the maize seed.

No-till (or direct drill) – a one pass system whereby a maize planter cuts a narrow slot of only sufficient width and depth and places the maize seed in the slot (Figure 1).

Strip tillage – a two pass system that combines no-till and full tillage by incorporating crop residues in a narrow zone, injecting fertiliser into the strip, while keeping residues between tilled strips undisturbed. The planter places maize seed directly into the strips. Strips can be created in autumn or in spring, but timing of stripping will depend on rotation, slope and soil type.

Figure 1: Maize establishment under a no-till system

Results

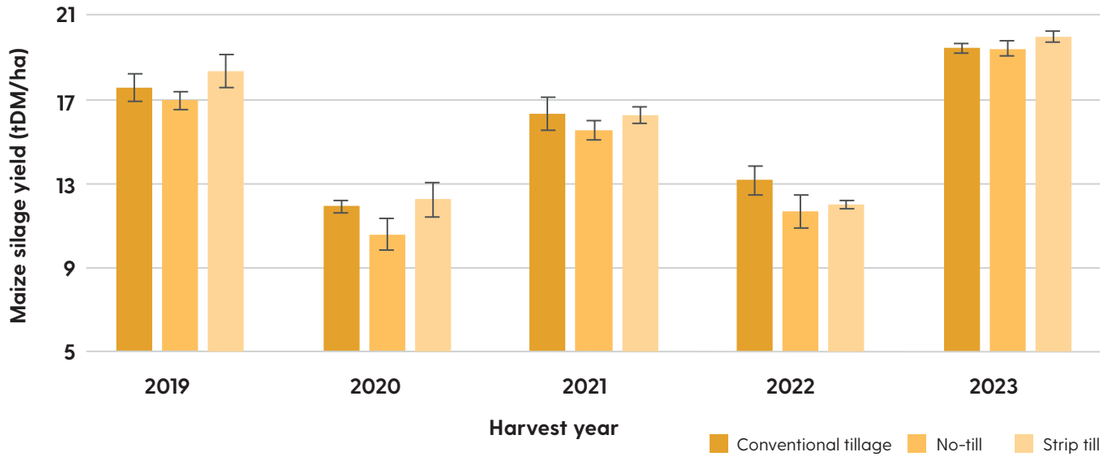
Below is a five-year summary of the key observations from our research:

Crop establishment and yields

On average, 95% plant establishment was achieved with strip till and conventional till, compared to 88% for no-till. Good seed to soil contact is critical to achieving high and uniform emergence. Our general observation has been that while appropriate soil conditions (e.g., moisture) are important for all planting systems, the impact of less favourable conditions has been greatest for no-till. Spring soil temperatures were lower in no-till than strip and conventional tillage, resulting in slower and less uniform emergence. This can be largely attributed to surface residue within the seed furrow and lack of tillage to aerate, warm and dry the soil.

Yield performance was more influenced by the season than the tillage system (Figure 2). This corroborates overseas research which indicates that tillage method success is influenced by the environment. Deciding on a tillage system should therefore be based on its suitability to the environment, and not yield.

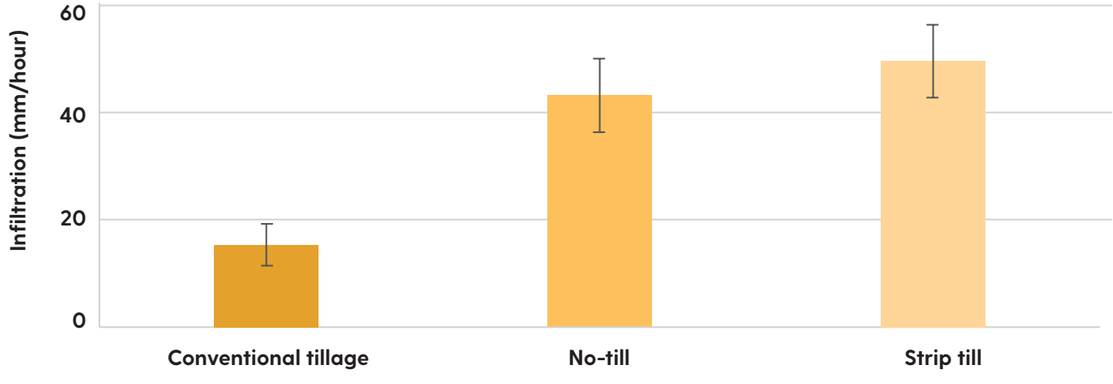
Figure 2: Maize silage drymatter yield at Rukuhia Research Station (2019-2023)



Water Infiltration

Water infiltration (measured in October 2022) was significantly greater under no-till and strip till than conventional tillage. Greater infiltration helps reduce soil water evaporation and surface runoff. Greater infiltration rates help soil absorb more water during heavy rain events, resulting in greater storage. This can have significant advantages during hot and dry summers.

Figure 3: Water infiltration rates between three tillage practices at Rukuhia Research Station



Organic matter (OM)

While soil OM levels measured at Year 5 are not statistically different, there has been a trend towards greater soil OM loss under conventional than reduced or no-till. Tilling the soil elevates soil temperature and aeration, increasing microbial activity which enhances mineralisation.

Summary

The best tillage option is the one capable of providing the best physical environment to achieve uniform plant emergence and growth. It should also provide the soil physical, chemical, and biological attributes necessary to achieve both environmental and crop yield benefits.

Both no-till and strip till showed a general trend towards better soil physical and biological conditions compared to conventional tillage. Despite the soil health benefits, under wet, compacted or heavy soil conditions, no-till will likely result in higher nitrous oxide losses.

Tillage helps to control weeds and buries crop residues which can harbour slugs and other pests and diseases. When shifting to reduced till an increase in chemical weed and slug control costs may need to be accounted for.

In high residue situations typical of no-till maize systems, more seed may be required to compensate for potentially lower seedling emergence and establishment.

Based on our Waikato trial, strip tillage appears to provide a balance between the environmental benefits of no-till and the positive attributes of conventional tillage.

THANK YOU TO THE 2021-2022 GRAIN TRIAL CO-OPERATORS

The results of the extensive research programme in this publication are only made possible with the willing assistance and co-operation of both farmers and contractors. Our special thanks go to all those involved with planting and harvesting grain trials across New Zealand.

Northland

Ambler, Paul & Susannah
Bamforth, Paul
Bells Produce
Greig, Phillip
Higham, Noel & Janet
Judd, Sidney & Janet
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