Potatoes in Practice 2009

POTATO COUNCIL

Thursday 13th August
9.30am to 4.30pm
Balruddery Farm
Invergowrie,
Dundee DD2 5LJ

scri living technology

SAC

CSC Crop Protection

Supported by POTATO Review

Field Trials & Demonstrations, Seminars and Exhibitors Guide

Trials and Demonstration Results Summary

This summary has been produced to ensure visitors that attended the event are able to find out further information on the trials and demonstrations that took place at the 2009 Potatoes in Practice Event.

SCRI, SAC, CSC and the Potato Council hosted the 2009 'Potatoes in Practice' event in Dundee, supported by Potato Review magazine. This is the largest annual potato knowledge transfer event in Britain, with 650 visitors in 2009.

The event is a unique opportunity for farmers, advisors and others to view government and industry-supported research and new developments at a single site.

How to use this summary

In order to maintain consistency, we followed the same layout as the Event Summary for 2008 – with the 2009 Summary being in PDF format, and available from the organiser's websites.

If you have any questions regarding a specific trial or demonstration, please contact the relevant person responsible for it.

Date for your Diary

Potatoes in Practice 2010 will be held on **Thursday 12th August 2010**, and will take place again at: Balruddery Farm, near Dundee. For more details, www.potato.org.uk/pip

Principal organisers

Scottish Crop Research Institute (SCRI): Sharon Neilson (Outreach & Events Manager), Sarah Collier (Information Services Manager), Euan Caldwell (Farm Manager) and Dr Finlay Dale (Research Scientist)
Scottish Agricultural College (SAC): Dr. Stuart Wale (Head of Crop Services)
Potato Council: Mark Prentice (Head of Seed & Export), Sophie Lock (Seed & Export Executive)
CSC Crop Protection: Colin Rennie (Agronomist), Jim Rennie (Technical Director)

Trial Results

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1- SCRI (Scottish Crop Research Institute)

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The application of new developments in potato breeding at SCRI

Genetics and breeding of potatoes at SCRI uses the latest methods of gene discovery to find the genes required for the genetic improvement of the potato; and then uses efficient breeding methods to transfer these genes into potatoes that can be used as parents in the breeding of new cultivars in a number of breeding programmes. Desirable genes are sought in the wide range of germplasm held at SCRI, including accessions of the wild and cultivated potatoes of Latin America in the Commonwealth Potato Collection (CPC), and long-day-adapted *Phureja* potatoes derived from the CPC.

The breeding of cultivars is commercially funded and success requires producing new cultivars with the qualities demanded by processors and supermarkets. We have developed a potato breeding strategy at SCRI which avoids the ineffective practice of intense early-generation visual selection between seedlings in a glasshouse and spaced plants at a seed site. Emphasis is placed on progeny tests (seedling tests for disease and pest resistance and visual assessment of tubers; and tuber tests for fry colour and further visual assessment) being used to discard whole progenies before starting conventional within-progeny selection, then placing selection pressure within the superior families.

However, potato breeding is now entering a new phase that promises much. Molecular markers have been developed for selection of several important disease resistance and quality traits in potato. We are now starting to deploy such markers within breeding programmes here at SCRI. This is coupled to research at SCRI and others in a world-wide consortium Potato Genome Sequencing Consortium (PGSC), aiming to elucidate the entire potato DNA sequence will greatly facilitate gene isolation and allow molecular geneticists to use candidate gene approaches for trait gene discovery. This in turn will have radical effects on potato breeding. At Potatoes in Practice 2009 examples of the application of molecular markers to potato breeding programmes were discussed, with over 200 potential new varieties being assessed within two commercial breeding programmes in 2009 for resistance to *Globodera rostochiensis* and *G. pallida* using both conventional tests and also molecular markers to identify the presence or absence of resistance genes. This research offers a rapid test for resistance to both *G. rostochiensis* and using other markers for some *G. pallida* resistance and will ‘roll out’ to other breeding programmes based at SCRI/MRS and also to other traits to aid rapid selection.

RESISTANT				SUSCEPTIBLE		
	Average Cyst No.	Marker present			Average Cyst No.	Marker present
M.Piper	0	Yes		CLONE 140	16	Yes
CLONE 2	0	Yes		CLONE 142	42	No
CLONE 3	0	Yes		CLONE 143	51	No
CLONE 4	0	Yes		CLONE 144	57	No
CLONE 5	0	Yes		CLONE 145	60	No
CLONE 6	0	Yes		CLONE 146	60	No
CLONE 7	1	Yes		CLONE 147	64	Yes
CLONE 8	1	Yes		CLONE 148	64	No
CLONE 9	0	Yes		CLONE 149	65	No
CLONE 10	0	Yes		CLONE 150	72	No
CLONE 11	3	Yes		Desiree	70	No

Genes for Breeding: Where do they come from?

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With ever-increasing pressures on food production, breeders need to ensure that they are making the best use of all the resources at their disposal to improve the potato and keep its production sustainable. Where do these genetic resources come from and what can they offer the modern potato?

The ultimate origin of the cultivated potato has been located in S Peru using DNA techniques which revealed a strong affinity to wild species there. This display charted the movement of cultivated potato along the Andes since that first domestication event. Even in prehistory some of the wild species in the Andes were involved in introgressions as the potato adapted to new areas of South America after that initial domestication. More recently modern breeders have been making planned crosses and sampling the genetic riches found in the related wild species. For example, resistance to late blight has been introgressed into cultivated potato from a number of wild species in Mexico and Argentina. *S. demissum* was the first and most important of these, donating a series of R-genes to cultivated potato. Resistance to potato cyst nematode has also come from wild species, including *S. vernei* and *S. spegazzinii,* these from a different part of South America where this pest has applied selection pressure to natural populations. Virus resistance has been contributed by *S. chacoense* and *S. acaule*.

Today, new resistance to late blight is again required following its recent increase in virulence and this is being sought from a diversity of species of Mexican and Andean origin including *S.verrucosum, S.okadae* and *S.stoloniferum*,

For the future, research at SCRI is likely to be looking at the genetic resources for the new issues of resource use efficiency and sustainability.

2 - SAC

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How do variety resistance ratings help you with agronomy?

(in conjunction with PCL)

Introduction

Variety disease resistance ratings are determined for almost all varieties grown in GB through National List (NL) testing and the Potato Council funded Independent Variety Trials (IVT) programme.

The resistance ratings are published in the Potato Variety Database on the Potato Council website: http://www.potato.org.uk/varieties

Eight established or new varieties were planted to demonstrate their relative strengths and weaknesses. In the table below:
Susceptible varieties (rated 1, 2, 3) are shown in red
Moderately susceptible varieties (4, 5, 6) are shown in orange and
Resistant varieties (7, 8, 9) are shown in green.

Table 1 – Treatments

Variety	Estima	Gemson	Harmony	King Edward	Maris Peer	Maris Piper	Mozart	Nicola
Black dot	5	5		6		4	8	
Black scurf	6	4	6	6		6	4	
Dry rot (F. coeruleum)	3	3	5			3	5	3
Dry rot (F. sulphureum)	6	1	3			2	3	4
Late blight foliage*	4	4	3	3	4	4	5	2
Late blight tubers	5	2	3	4	4	5	5	3
Powdery scab	3	7	2	7	6	3	5	5
Silver scurf	4	6	3	3		4	6	
Skin spot	6	5	8	3		4	8	
Blackleg	2	8	3	4	4	5	6	5
Common scab	6	5	6	7	5	1	6	6
PCN Pallida (Pa 2/3, 1)	2	2	4	2	2	2	2	2
PCN Rostochiensis (Ro1)	2	1	4	2	2	9	8	9
PLRV	3	9	6	5	4	4		8
PVY	2	4	3	2	3	2		4

Results / Conclusions

Knowing the resistance ratings can help determine:

- Risk of disease in store and field
- Appropriate seed treatments and the best timing of application
- Appropriate soil treatments
- How important it is to test soil for disease contamination
- The need for insecticide use to reduce virus spread
- The need for nematicide use to control PCN
- How critical irrigation is
- Where damage should be particularly avoided to prevent disease ingress
- and more

Before a crop is planted the disease and pest resistance ratings should be considered in relation to the market a crop is being grown for, the quality parameters desired and evidence of specific pest and disease issues on a farm.

* Note that resistance ratings for foliage blight should be treated with caution as most major resistant genes can be overcome by the predominant blight strain in GB (A2-13) and resistance relies on minor gene (field or horizontal) resistance.

Best practice for soil pest control

Introduction

As part of the Success through Knowledge programme funded by the Scottish Government to transfer outcomes from the R&D they fund, SAC have carried out a series of best practice trials at PIP. In 2009 the focus was soil pests, wireworms and slugs. These are both potentially difficult pests to control. Whilst there are agronomic control measures available, on the other hand, commercial practice still relies on the use of agrochemicals. This replicated trial took place on a farm where an arable rotation has been long practiced and wireworm was not considered a problem. On the other hand slugs have been a persistent problem. The trial was planted with the slug and wireworm susceptible variety Maris Piper.

Table 1 – Treatments

No.	Treatment description	Application Timing	Product Dose
1	Untreated control	-	-
2	Mocap 10G	Broadcast during final soil preparation immediately pre-planting	60 kg/ha
3	Slug control option 1 Decoy Wettex full dose early	Just before canopy closure Flowering Haulm destruction	7.5 kg/ha 3.75 kg/ha 3.75 kg/ha
4	Slug control option 2 Decoy Wettex half dose early	Just before canopy closure Flowering Haulm destruction	3.75 kg/ha 3.75 kg/ha 3.75 kg/ha
5	Slug control option 3 Decoy Wettex single full dose early	Just before canopy closure	7.5 kg/ha
6	Slug control option 4 Prego	Just before canopy closure Flowering Haulm destruction	7.0 kg/ha 3.5 kg/ha 3.5 kg/ha

Table 2 – Pesticide details

Treatment	Active ingredient	Product	Product dose
1	ethoprophos	Mocap 10G	10% w/w
2	methiocarb	Decoy Wettex	2% w/w
3	metaldehyde	Prego	5% w/w

Trial was planted on 21/22 May 2009. Haulm destruction was 3 & 7 September and harvest 5/6/7 October 2009.

Results / Conclusions

The spring was dry until early July. Thereafter until the end of August rainfall was above average. Slug activity started in mid-July and persisted until September. The first slug pellet applications were made on 10 July and subsequent applications on 21 August & 7 September. Moderate slug damage occurred in the trial and the percentage tubers showing slug damage was significantly reduced over the untreated control by the Decoy Wettex treatments (3 & 4). Given the slug pressure later in crop growth, a single full dose at canopy closure was insufficient to control slugs effectively. Mocap gave a small numerical but non-significant reduction in slug damage.

Wireworm damage was restricted at the site. Whilst the variability in damage between replicates was high and the differences non-significant, Mocap reduced damage to 0.5% tubers from 7.5% in the untreated control.

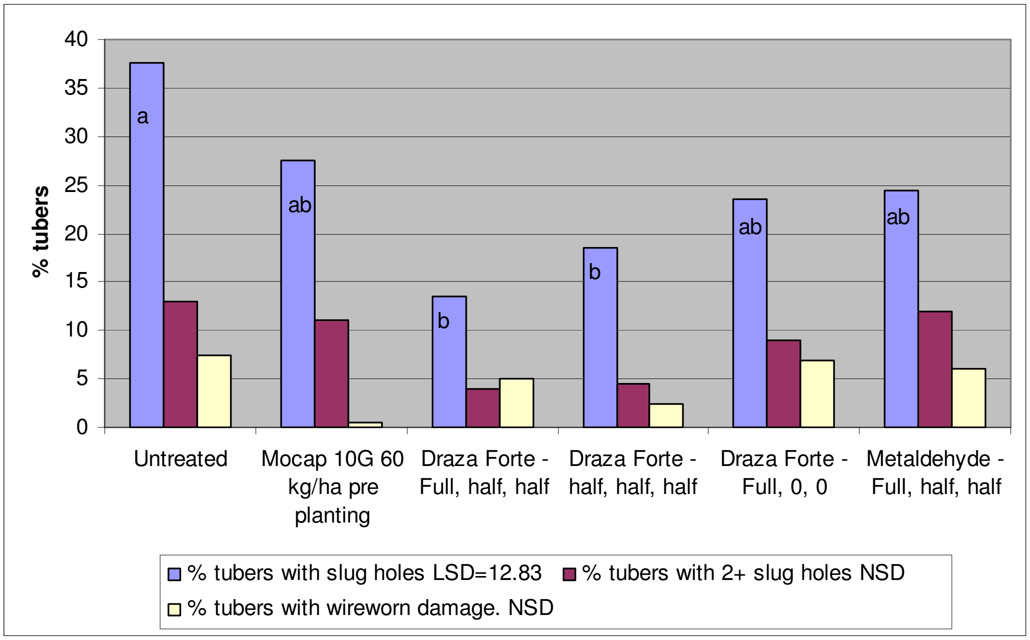


Figure 1. Slug and wireworm damage post-harvest

On slug susceptible varieties, timing and number of applications of pellets is important. Previous experience has shown that a dose before canopy closure can provide early control of slugs but this trial demonstrates that more than one application is necessary and subsequent applications should coincide with periods of slug activity.

There is limited resistance to wireworm in current potato varieties and it is unlikely that variety selection will provide sufficient control. The targeted use of effective nematicides such as Mocap offers the best option for control. Judging when wireworm damage is a risk is not simple. Where grass has been part of the rotation in previous years the risk of wireworm is higher. Pheromone traps to catch adults in the year prior to potatoes and various pre-planting baits are available but these are not always consistent.

Seed rate and uniformity of planting trial

(in conjunction with Potato Council)

Introduction

PCL have recently published a set of new seed rate recommendations for five varieties. These were developed from an extensive series of Cambridge University Farm (CUF) trials over many years. The new recommendations have the added features of utilising information about the chronological age of seed and adjusting seed rate based on target yield and tuber size. At Potatoes in Practice comparisons were made between the seed rate recommended for Maris Piper and Estima from the new publications and a different spacing. For Maris Piper, the PCL recommendation was almost the same as that from the SAC seed rate programme. The alternative seed rate tested was 20% close spacing than recommended. With Estima there was a substantial disparity between the newly published seed rate and that from SAC and these were compared. The opportunity was also taken to evaluate the recommended seed rate (PCL) but instead of planting evenly, a proportion of the seed was planted as 'misses' or 'doubles'.

The trial had four replicates and a standard plot size of 4 drills. Tuber spacing was adjusted to ensure plot length was as similar as possible. The trial was planted using the SAC trial planter and all agronomy was standard for a ware crop.

Maris Piper: Recommended seed rate was based on a tuber count of 780/50kg. The bed width was 1.73m and expected yield was 50t/ha.
Estima: PCL recommended seed rate was based on a tuber count of 695/50kg. The bed width was 1.73m and expected yield was 50t/ha.

The trial was not irrigated.

Trial was planted on 21/22 May 2009. Haulm destruction was 3 & 7 September (Sulphuric acid) and harvest 5/6/7 October 2009.

Table 1 – Treatments

Maris Piper

No.	Seed rate	Spacing
1	Recommended (PCL/SAC)	43cm (15 tubers per drill giving a plot length of 6.45m)
2	20% closer spacing than recommended	36cm (18 tubers per drill giving a plot length of 6.48m)
3	Recommended but irregularly spaced	43cm (15 tubers per drill giving a plot length of 6.45m but spaced erratically)

Estima

No.	Seed rate	Spacing
1	Recommended (PCL)	42cm (15 tubers per drill giving a plot length of 6.3m)
2	Recommended (SAC)	34cm (19 tubers per drill giving a plot length of 6.46m)
3	Recommended (PCL) but irregularly spaced	42cm (15 tubers per drill giving a plot length of 6.3m but spaced erratically)

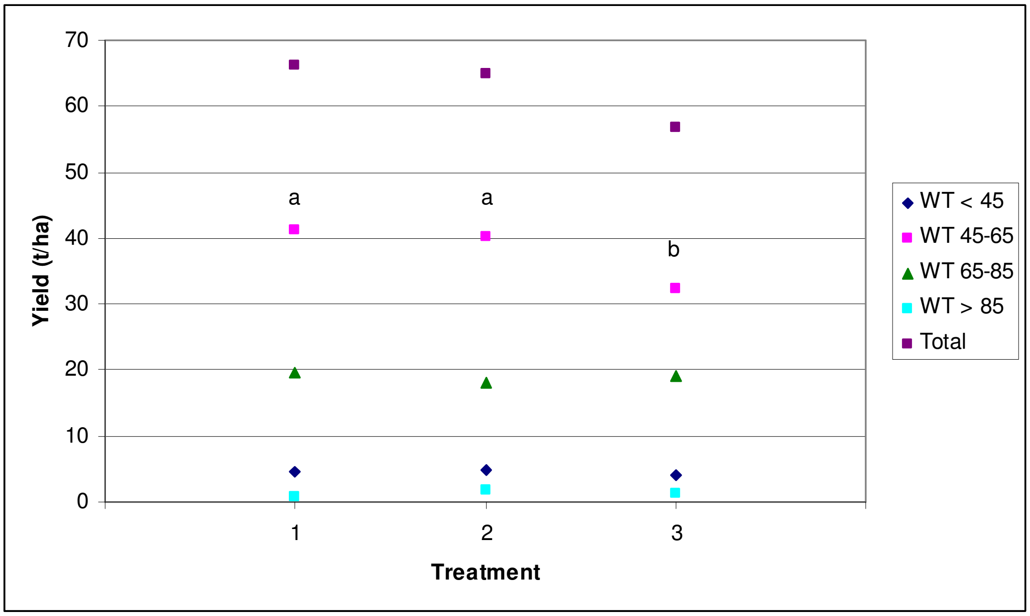
Spacing for treatment 3 with both varieties (1=single tuber, 2=double tuber, 3=miss)

Drill 1 - 1 2 0 1 1 1 0 2 1 1 1 1 2 0 1
Drill 2 - 1 1 1 2 0 1 1 1 2 0 1 0 2 1 1
Drill 3 - 1 0 2 1 1 0 2 1 1 1 2 0 1 1 1
Drill 4 - 1 2 0 1 1 1 0 2 1 1 1 1 2 0 1

Results / Conclusions

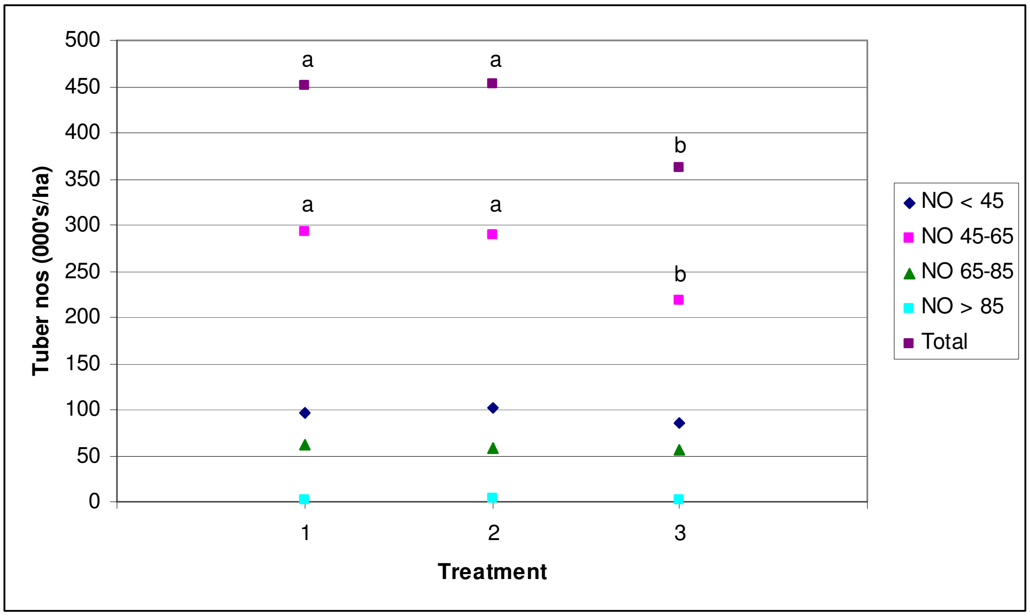
The spring was dry until early July. Thereafter until the end of August rainfall was above average. The higher than average incident radiation in 2009 coupled with adequate rainfall resulted in above average yields.

Maris Piper – Yield (total and grading fractions). CV% for total yield 6.98



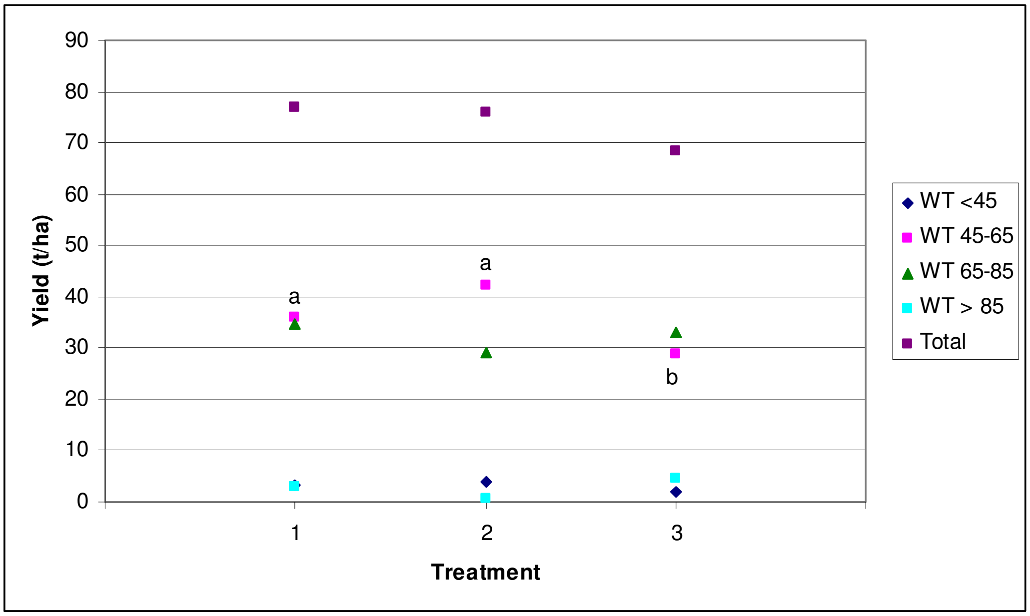
There were no significant differences in yield between treatments except for the 45-65mm fraction where the irregularly spaced treatment had significantly lower yield.

Maris Piper – Tuber numbers (total and grading fractions). CV% for total tuber numbers 5.17



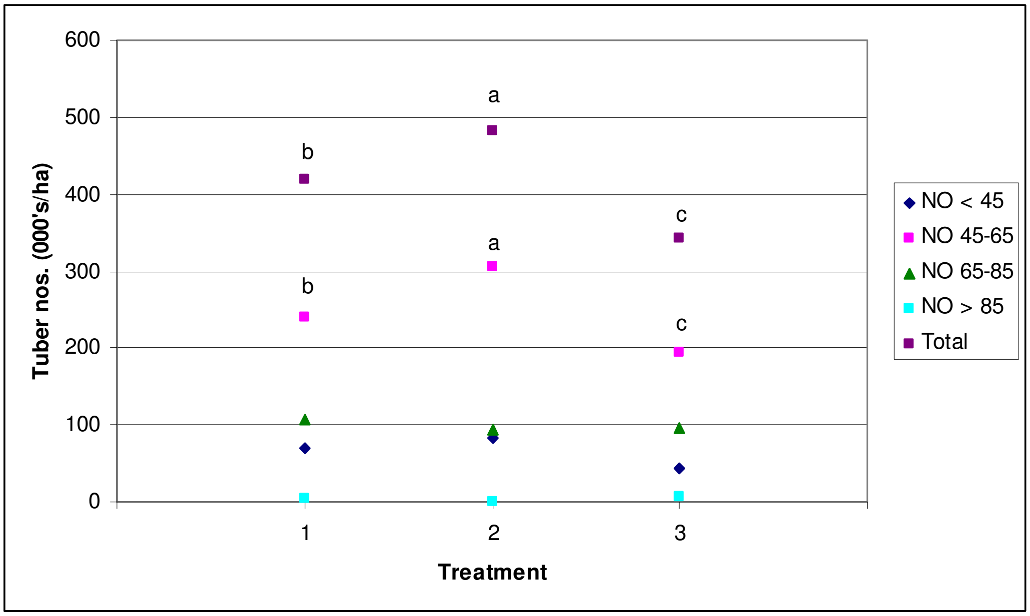
There were no significant differences between the two seed rates. However, the irregular spaced treatment resulted in fewer total tuber numbers. This difference arose almost entirely from a significant difference in the 45-65mm band.

Estima – Yield (total and grading fractions). CV% for total yield 5.58



There were no significant differences between the three treatments for any size fraction or total yield except the 45-65mm fraction where the irregularly spaced treatment had significantly less weight.

Estima – Tuber numbers (total and grading fractions). CV% for total tuber numbers 6.66



The SAC recommended seed rate (2) resulted in significantly greater tuber numbers than the other two treatments. The irregularly spaced treatment (3) produced significantly fewer tubers than regularly spaced treatments especially in the 45-65mm fraction.

Nitrogen fertiliser trial

(in conjunction with the Potato Council)

The aim of this trial was to determine the optimum N rate for ware crop production for a crop of Harmony and to compare with recommended nitrogen rates from Scottish and RB209 recommendations. This is a repeat trial of the nitrogen fertiliser trial at PiP in 2008.

Table 1 – Treatments

Treatment	N applied (kg/ha)
0 N	0
0.5 N	80
0.75 N	120
1.0 N	160
1.25 N	200

N = Normal dose recommended from 2009 Scottish recommendations

Trial was planted on 14/15 May 2009. Haulm destruction was 3 & 7 September and harvest 5/6/7 October 2009.

Results / Conclusions

The response to nitrogen was consistent in trials across both years (2008 and 2009) even though two different varieties were studied (Saxon in 2008, Harmony in 2009).

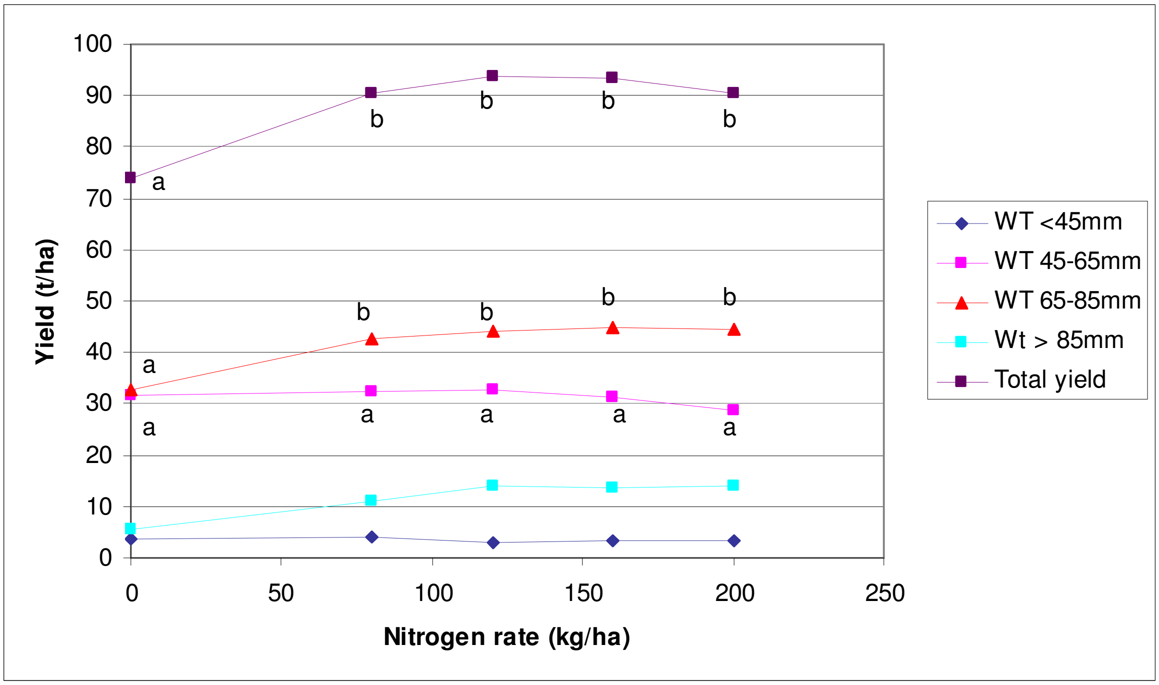


Figure 1. Total yield of tubers and in grading fractions in 2009. Variety Harmony

The total yield was significantly increased with the addition of N; however, there was no significant difference in yield between the different application rates of N. The yield in the 65-85mm fraction was also significantly increased with the addition of N; again, there was no significant difference in yield between amounts of N applied. Overall, in the 2009 trial, 0.5N (80kg/ha) was the optimum N rate. The yield of the 0 N treatment was extremely high reflecting a season of above average incident radiation combined with adequate rainfall. The trial was not irrigated.

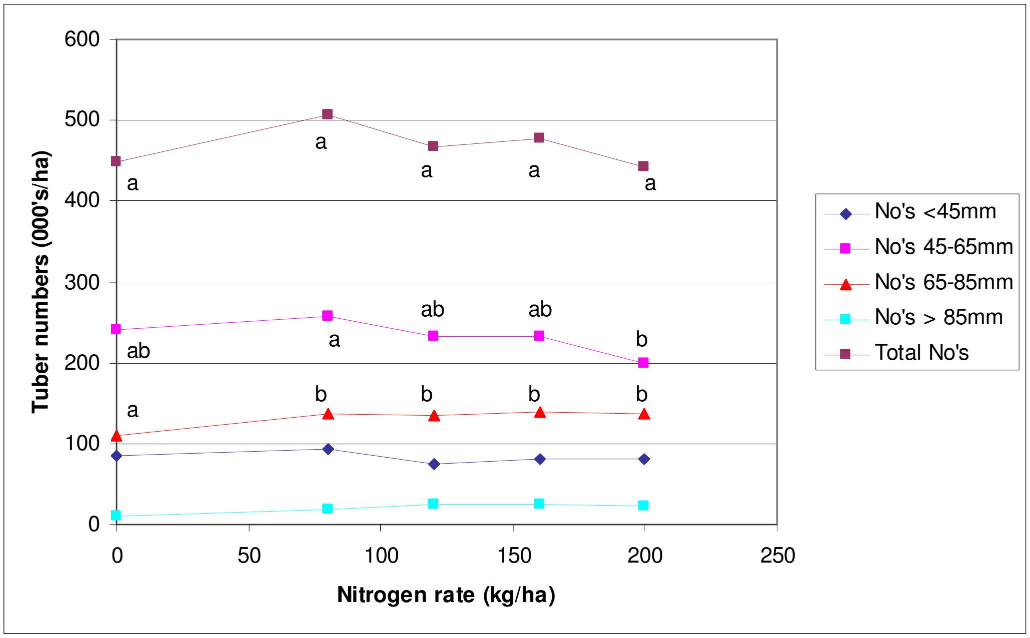


Figure 2. Total tuber numbers and in numbers in grading fractions in 2009

There were few significant differences between nitrogen treatments in tuber numbers. There was a significant increase in number of baker sized tubers (65-85mm) when comparing 0 N to all other N treatments. This increase appeared to relate to a fall in tuber numbers in the 45-65mm fraction.

The last two year's nitrogen trials have taken place in seasons with above average rainfall at some stage during the summer. There is clear evidence that in wetter seasons, nitrogen optima are less than currently recommended. However, the optimum N is an average for all seasons and for a dry season the optimum recommended for this situation (following a wheat crop) would be more appropriate. The results do confirm that excessive nitrogen, above that officially recommended, is not justified.

Reference

SAC (2009) Nitrogen recommendations for cereals, oilseed rape and potatoes. Technical Note TN625. ISBN 1 85482 864. October 2009. 8pp

3 - CSC Crop Protection

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Herbicide Trial

Introduction

Our trials over the last 4 years and commercial work show that the newer chemistry has a narrower weed spectrum and is more affected by season and soil type. Therefore weed control has become more difficult and requires more management to achieve the desired results.

Table 1 – Herbicide table (all pre-emergence)

Treatment	Active ingredient	Product	Product dose
1	Untreated		
2	Clomazone Metribuzin Carfentrazone-ethyl	Gamit Sencorex Shark	0.2 L/HA 0.5 KG/HA 0.33 L/HA
3	Clomazone Metribuzin Linuron Diquat Wetter	Gamit Sencorex Linuron Retro Activator 90	0.15 L/HA 0.5 KG/HA 1.2 L/HA 2.0 L/HA 0.3 L/HA
4	Prosulfocarb Metribuzin Diquat	Defy Sencorex Retro	4.0 L/HA 0.5 KG/HA 2.0 L/HA
5	Prosulfocarb Linuron Diquat	Defy Linuron Retro	4.0 L/HA 1.2 L/HA 2.0 L/HA
6	Pendimethalin Metribuzin Diquat Wetter	Stomp Sencorex Retro Activator 90	3.0 L/HA 0.5 KG/HA 2.0 L/HA 0.3 L/HA
7	Clomazone Linuron Diquat Wetter	Gamit Linuron Retro Activator 90	0.25 L/HA 1.0 L/HA 2.0 L/HA 0.3 L/HA
8	Clomazone Metribuzin Diquat Wetter	Gamit Sencorex Retro Activator 90	0.25 L/HA 0.5 KG/HA 2.0 L/HA 0.3 L/HA
9	Flufenacet + metribuzin Diquat wetter	Artist Retro Activator 90	2.5 KG/HA 2.0 L/HA 0.3 L/HA

Results / Conclusions

This year conditions were perfect at the time of application and all treatments would have been commercially acceptable. The untreated had a full spectrum of weeds and was way above crop canopy the crop leaves were also much paler in the untreated showing the nitrogen robbing effect that the weeds have on the crop thus reducing the yield of the crop. The best plot this year was plot 4 (Prosulfocarb, Metribuzin and Diquat) which was the cleanest over all with plot 2 (Clomazone, Metribuzin and Carfentrazone-ethyl) being the next best because of its poorer performance on annual meadow grass. The weakest treatment this year was plot 7 (Clomazone, Linuron and Diquat) performing poorly on annual meadow grass, common speedwell and prostrate knotweed.

Foliar Nutrition Trial

This year we choose to look at the some of the best treatments out of our previous year's work, in an effort to draw some long term conclusions about some of the best foliar nutrition products available to growers.

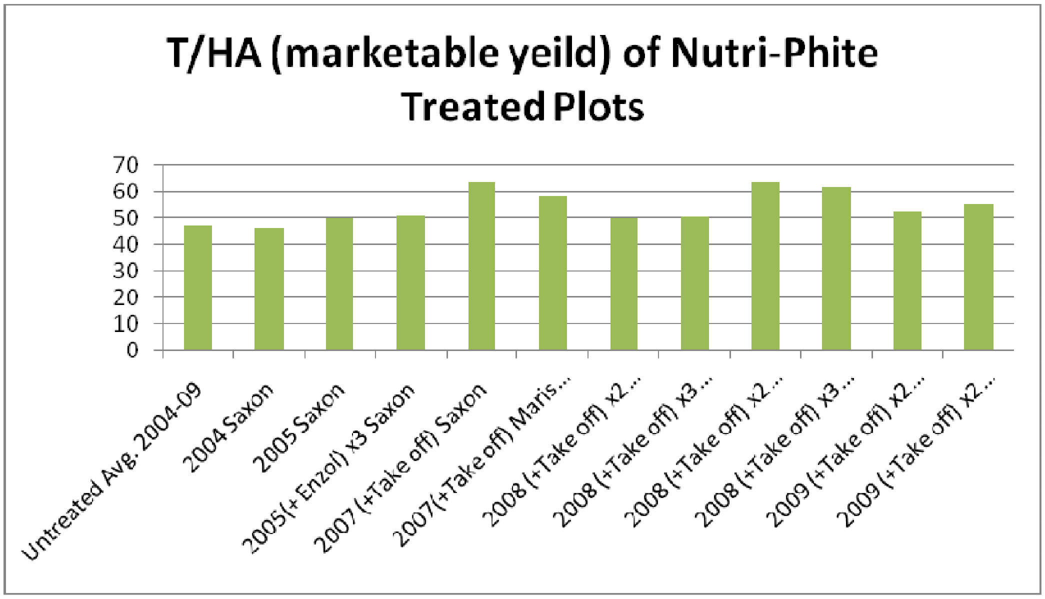
Table 2 – 'Marfona' and 'Maris Piper' Foliar Nutrition

	Product	Rate	Timing
1	Phosphate Potash Ammonium Nitrate	230 275 200	Bed Bed Bed
2	Phosphate Potash Ammonium Nitrate	170 275 200	Bed Bed Bed
3	Phosphate Potash Ammonium Nitrate	170 200 200	Bed Bed Bed
4	Phosphate Potash Ammonium Nitrate Nutri-Phite + Take Off	170 275 200 2.0L/HA	Bed Bed Bed TI+TB
5	Phosphate Potash Ammonium Nitrate Calci-Phite + Take Off	170 275 200 4.0L/HA	Bed Bed Bed TI+TB
6	Phosphate Potash Ammonium Nitrate Intrafol Ca High K Intrafol Ca High K	170 275 200 5.0L/HA 5.0KG/HA 5.0L/HA 5.0KG/HA	Bed Bed Bed TI TB TB+14DAYS TB+14DAYS
7	Phosphate Potash Ammonium Nitrate Fastmix KMan Intrafol Ca Fastmix KMan Intrafol Ca	170 275 200 5.0KG/HA 5.0L/HA 5.0KG/HA 5.0L/HA	Bed Bed Bed TI TB TB+14DAYS TB+14DAYS
8	Phosphate Potash Ammonium Nitrate Hi-Phos Hi-Phos Hi-Phos Hi-Phos	170 275 200 10.0L/HA 5.0L/HA 5.0L/HA 5.0L/HA	Bed Bed Bed TI TB TB + 14DAYS D + 14DAYS
9	Phosphate Potash Ammonium Nitrate HA187 HA187 HA187 HA187	170 275 200 5.0L/HA 5.0L/HA 5.0L/HA 5.0L/HA	Bed Bed Bed TI TB TB + 14DAYS D + 14DAYS

Best treatment over the last six years:

Over the last six years one of the top yielding treatment has been Nutri-Phite + Take Off which have also consistently given some of the best quality skin finish. In chart 1 below shows the yield of the Nutri-Phite trials from 2004 to 2009, with the addition of Take Off (now included in the formulation of Nutri-Phite) the yield increased again. The untreated is an average of all the foliar nutrition trials over the last 6 years.

Chart 1: Nutri-Phite trials 2004-2009 (not used in 2006 trial)



2009 Results and Conclusions

The 2009 foliar nutrition trial results did not show what we expected to see, since the site was very fertile to start with, therefore the foliar products have had less of an improvement and did not show any significant differences. But this year's trials do go to show that in good fertile soils it is possible to reduce fertiliser inputs when the growing season is favourable to the break down of soil minerals. Our highest yielding treated plot was the Fastmix KMan + Intrafol Ca (58.11t/ha) in the 'Marfona' and Nutri-Phite (52.57t/ha) in the 'Maris Piper' these also had the highest brightness score which is consistent with our previous trials.

Common Scab Reduction Demo

The common scab demo this season proved to be very interesting since we were using Syngenta's new seed treatment fludioxonil we expected to see some improvement in common scab but were surprised by what was seen. All plots were un-irrigated, the variety was 'Maris Piper' chosen because of its susceptibility to common scab.

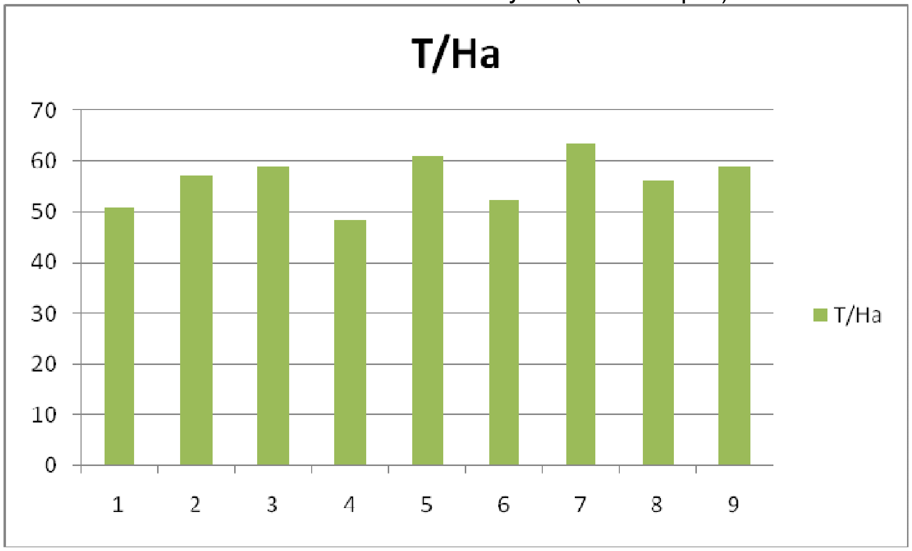
Table 3 – Common Scab reduction demo

	Treatment	Rate	
1	Ammonium Nitrate	180KG/HA	
2	Ammonium Nitrate	180KG/HA	Fludioxonil
3	Ammonium Nitrate Ammonium Sulphate	60KG/HA 1233L/HA	Fludioxonil
4	Ammonium Nitrate Ammonium Sulphate	60KG/HA 1233L/HA	
5	Ammonium Nitrate Ammonium Sulphate Zinc Pellets Sulphur Pellets	60KG/HA 822L/HA 50KG/HA 50KG/HA	Fludioxonil
6	Ammonium Nitrate Ammonium Sulphate Zinc Pellets Sulphur Pellets	60KG/HA 822L/HA 50KG/HA 50KG/HA	
7	Ammonium Nitrate Ammonium Sulphate Zinc Pellets Sulphur Pellets	60KG/HA 1233L/HA 50KG/HA 50KG/HA	Fludioxonil
8	Ammonium Nitrate Ammonium Sulphate Zinc Pellets Sulphur Pellets	60KG/HA 1233L/HA 50KG/HA 50KG/HA	
9	Ammonium Nitrate Ammonium Sulphate TTL Plus	60KG/HA 1233L/HA 5L/HA	

NB – Phosphate and Potash 230kg/ha and 275kg/ha respectively (applied to bed)

Results and Conclusions

Chart 2: Fludioxonil Effect on marketable yield (Maris Piper).



In every with and without treatment the fludioxonil (2, 3, 5 and7) improved the yield of the plot as can be seen in chart 2. Plot 9 is the same as Plot 4 with the addition of TTL (a fulvic acid product). The highest yield was achieved using the higher rate of ammonium sulphate along with the inclusion of zinc and sulphur pellets.

Table 4 – Level of scabbed tubers

Plot Number	Scab Levels (50 tubers)			
	None	Slight	Moderate	Severe
1	14	25	8	3
2	32	16	2	0
3	34	15	1	0
4	15	27	7	1
5	33	16	1	0
6	10	25	13	2
7	32	18	0	0
8	8	26	12	4
9	7	21	13	9

The reduction in common scab caused by the fludioxonil was interesting, plots 2,3,5 and 7 all had the fludioxonil treatment and the highlighted cells above indicate the best levels of reduction in scab with treatment 3 being the best overall with 34 out of 50 tubers having no scab and only 15 with slight and 1 with moderate. All of the fludioxonil treatments had no tubers with severe scab levels. The addition of TTL significantly increased yield but had no effect on scab levels. The mode of action that causes the reduction in common scab is still unknown yet it seemed to have had a consistent effect on this trial. One possible drawback of the product does seem to be a delay in emergence, however as can be seen in chart 2 this has not affected marketable yield in any way.