PROJECT REPORT 314

EFFECTS OF NITROGEN, SEED RATE, FUNGICIDE AND PGR ON YIELD AND STANDING POWER OF SPRING OATS

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by

A D GILCHRIST AND K JACK

SAC Scottish Agronomy, Arlary Farm, Milnathort, Kinross, KY13 9SJ

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ABSTRACT

The recent development of a market for oats grown without plant growth regulators (PGR) has meant that an urgent reappraisal of agronomy techniques is required to ensure that yield and quality criteria can be consistently attained. Trials on spring oats were established in Fife, Scotland in spring 2002 to examine the effects of manipulating the key agronomic variables of nitrogen, seed rate, fungicide and PGR.

The results were achieved in a low lodging pressure season and conclusions were limited due to the absence of differential lodging data. Nitrogen level had the greatest influence on yield and crop height, with step reductions in applied nitrogen from the current commercial practice resulting in a linear reduction in yields and crop height. Seed rate differences did not have a significant effect on yield or quality. The other variables did not have any significant effects on yield or quality, but there was a trend for PGR treatment to depress yield and reduce specific weights. The use of strobilurin fungicide tended to give yield increases compared to triazole fungicides.

The trial series was continued and expanded for season 2002-03 to include winter oats and includes UK wide sites. This series is wholly industry funded.

1. INTRODUCTION

Conventional production systems for oats traditionally rely heavily on the use of plant growth regulators (PGR's) – in particular chlormequat - with a very high majority of crops receiving treatment each year. The major effect of these PGR's is to reduce the incidence of lodging, which can have potentially disastrous effects on yield and grain quality.

The recent development of markets for oats grown without the use of PGR's has meant that an urgent reappraisal of agronomy techniques is required to ensure that quality and yield criteria can be economically and consistently attained. This is crucial not only to the grower but also to the processor.

This small-scale trial on spring oats was established to determine the effects of the key agronomic variables; seed rate, nitrogen, and pesticides (fungicides and plant growth regulators), on the standing ability of oats.

Objectives

- To determine the relative standing power of oats grown under various PGR management options; zero PGR, chlormequat, Moddus, plus a novel PGR formulation.
- To examine the effect of different seed rates on crop density and lodging.
- To examine the influence of reduced nitrogen inputs on standing power.
- Investigation of the role of strobilurin use in nitrogen uptake.

2. MATERIALS AND METHODS

The trial was initiated in April 2002, near Kirkcaldy in Fife. Site details are presented in Appendix 1. Two varieties were chosen for the trial.

Firth – Is the most popular of the current spring varieties. It provides high yield, with short, stiff straw. It has good overall milling characteristics.

Dula - Was the most commonly grown variety in Scotland prior to Firth. Dula is included to provide more reliable differential lodging and quality criteria, as it is tall and rather weak strawed. It also has poorer specific weight and screenings compared to Firth.

The trial comprised two separate elements: -

Trial 1 Seed rate / fungicide / nitrogen interaction

Varieties	Firth + Dula		
Seed Rates	300 + 400 seeds/m2		
Fungicide Input		T1	T2
	Non-Strobilurin	Alto 240 0.35 l/ha Orka 0.5 l/ha	Alto 240 0.35 l/ha
	Landmark based	Landmark 0.5 l/ha	Landmark 0.5 l/ha
	Opera based	Opera 1.25 l/ha	Opera 1.25 l/ha

Nitrogen Levels	3; 100, 80, 60 kg/ha - (Current commercial practice and 20 and 40% reduction.)
Replicates	3; incomplete block design – varieties randomised separately. Total treatment numbers = 18.
Assessments	Plant population, panicle count, height, lodging, specific weight, screenings, yield.

Trial 2 PGR / fungicide interaction

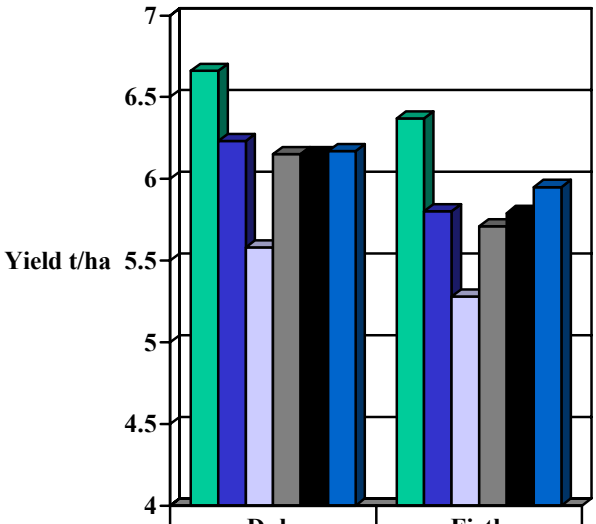
Varieties	Firth + Dula
Seed Rate	400 seeds/m2
PGR Input	No PGR Chlormequat only Moddus @ 50% full recommended rate Moddus @ 25% full recommended rate Experimental treatment @ 50% full rate Experimental treatment @ 25% full rate
Fungicide Input	Non-strobilurine treatment applied without PGR and with chlormequat @ T1. Landmark treatment applied without PGR and with all other PGR treatments @ T1 (Appendix 1.)
Nitrogen Levels	100 kg/ha.
Replicates	3; incomplete block design – varieties randomised separately. Total treatment numbers = 8.
Assessments	Panicle count, height, lodging, specific weight, screenings, yield.

3. RESULTS

Trial 1 Seed rate / fungicide / nitrogen interaction

The trial results obtained were achieved in the complete absence of lodging in any of the treatments. The input that had the largest effect on yield was nitrogen level (table 1). There was a significant ($p<0.001$) drop in yield for each 20 kg/ha reduction in applied nitrogen, with a similar trend in both varieties. There was no significant overall difference in yield between the different fungicide regimes, but Firth showed a trend towards higher yields with strobilurin treatments.

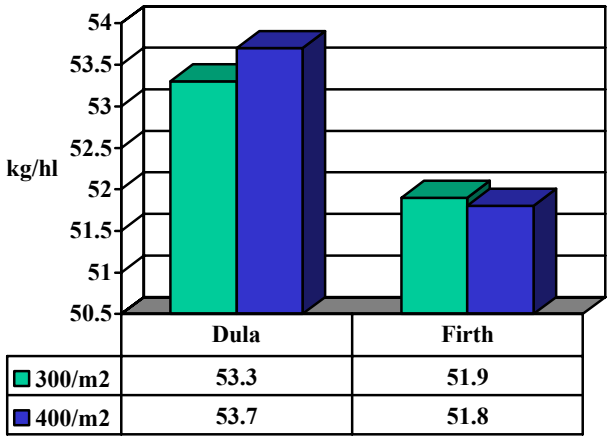
Table 1 – Nitrogen input and fungicide effect on yield



	Dula	Firth
100 kg	6.66	6.37
80 kg	6.23	5.8
60 kg	5.58	5.28
Non-strob.	6.15	5.71
Landmark	6.15	5.79
Opera	6.17	5.95

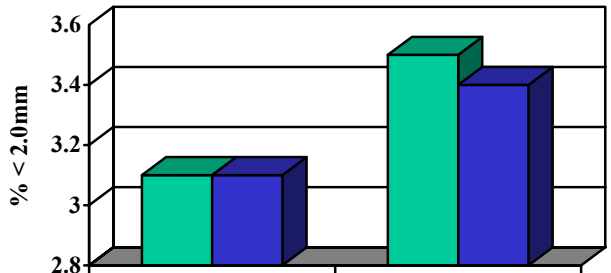
There was no significant difference in yield between the two seed rates, and specific weight and screening analysis also showed no significant differences (tables 2 & 3). This may be explained by the similarity in plant counts and panicle counts between the two seed rates. Firth produced 260 and 297 plants /m2 from the 300 and 400 seeds/m2 seed rates respectively, and 310 and 320 panicles/m2 respectively. The figures for Dula were 261 and 345 plants/m2 and 336 and 348 panicles/m2. A slightly surprising result was the higher quality of the samples from Dula, which normally produces inferior grain quality compared to Firth.

Table 2 – Seed rate and specific weight



	Dula	Firth
300/m2	53.3	51.9
400/m2	53.7	51.8

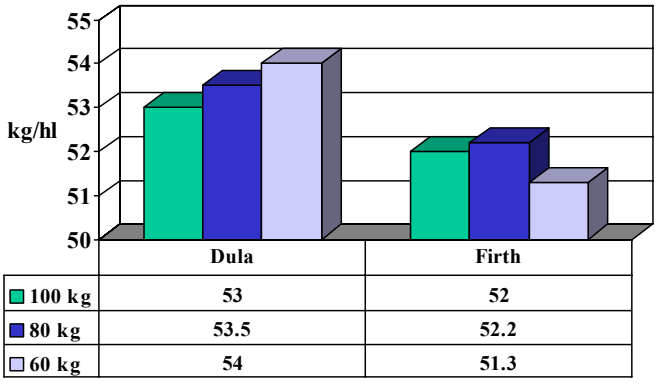
Table 3 – Seed rate and screenings



	Dula	Firth
300/m2	3.1	3.5
400/m2	3.1	3.4

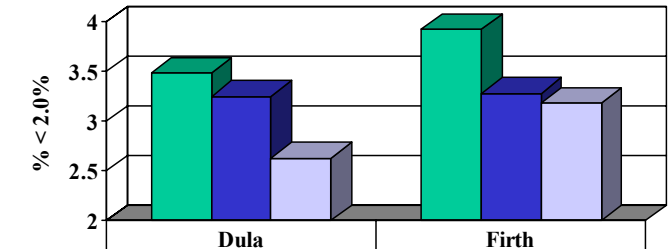
The effect of nitrogen level on specific weight and screenings was investigated and the results are shown in table 4 & 5. There was a trend in Dula of increased specific weight with reduced nitrogen level, but this was not repeated with Firth. Both varieties showed a similar trend to reduced screenings with reduced nitrogen level. Neither of these trends was statistically significant.

Table 4 – Nitrogen level and specific weight



	Dula	Firth
100 kg	53	52
80 kg	53.5	52.2
60 kg	54	51.3

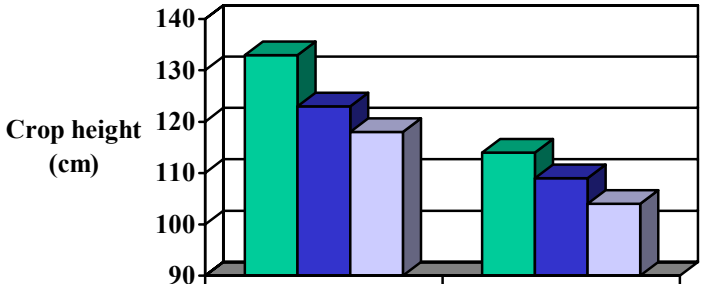
Table 5 – Nitrogen level and screenings



	Dula	Firth
100 kg	3.48	3.92
80 kg	3.25	3.28
60 kg	2.63	3.18

Plot height was recorded once the crop had reached its full height in July. The results showed a linear reduction in height for both varieties with decreasing nitrogen input. The height reduction was approximately 10% for a 40kg/ha reduction in nitrogen input. The results in table 6 confirm that Firth is significantly shorter strawed than Dula.

Table 6 – Nitrogen level and crop height

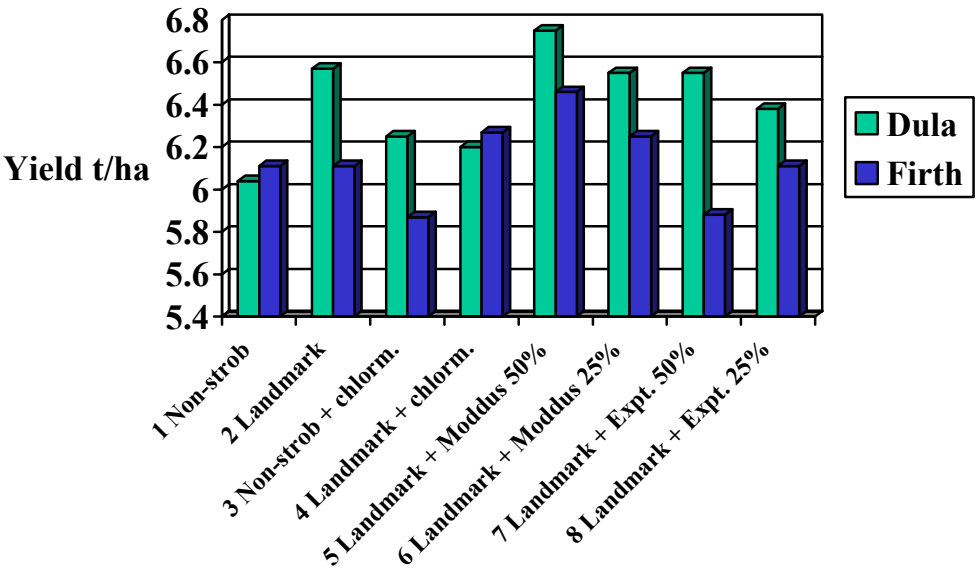


	Dula	Firth
100 kg	133	114
80 kg	123	109
60 kg	118	104

Trial 2 PGR / fungicide interaction

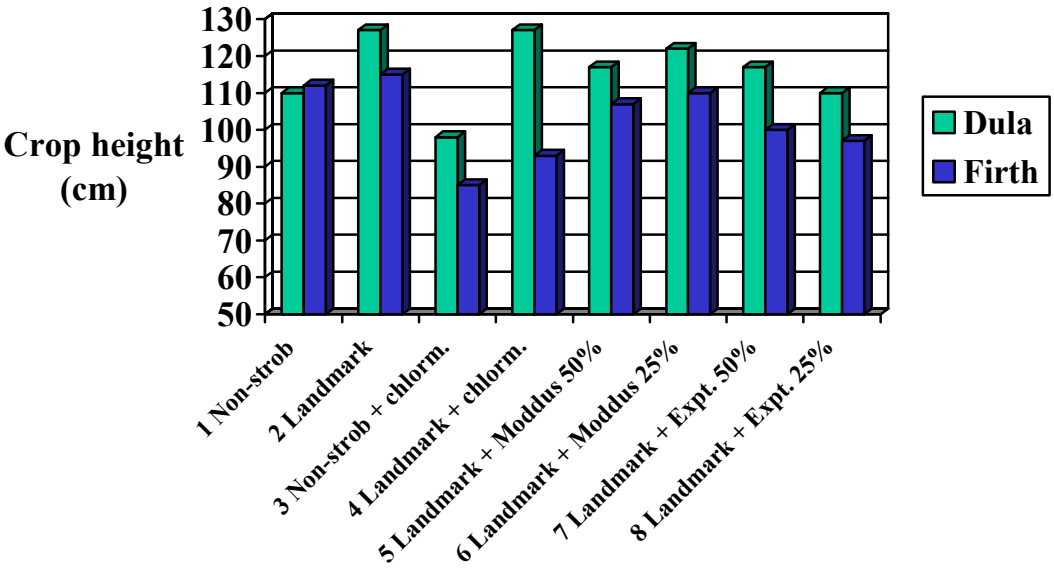
As with trial 1, trial 2 experienced no lodging. The yield results in table 7 show some yield differences between treatments. There were no significant differences in yield between treatments with Firth. In the Dula block, the Landmark treatment without PGR was significantly higher yielding than the non-strobe treatment without PGR. The Landmark treatment alone was also significantly higher yielding than the Landmark + chlormequat treatment, although this was not the case with the non-strobe treatments. The Moddus and experimental treatments at 50% and 25% rates were all significantly higher yielding than the Landmark + chlormequat treatment.

Table 7 – PGR treatment and yield



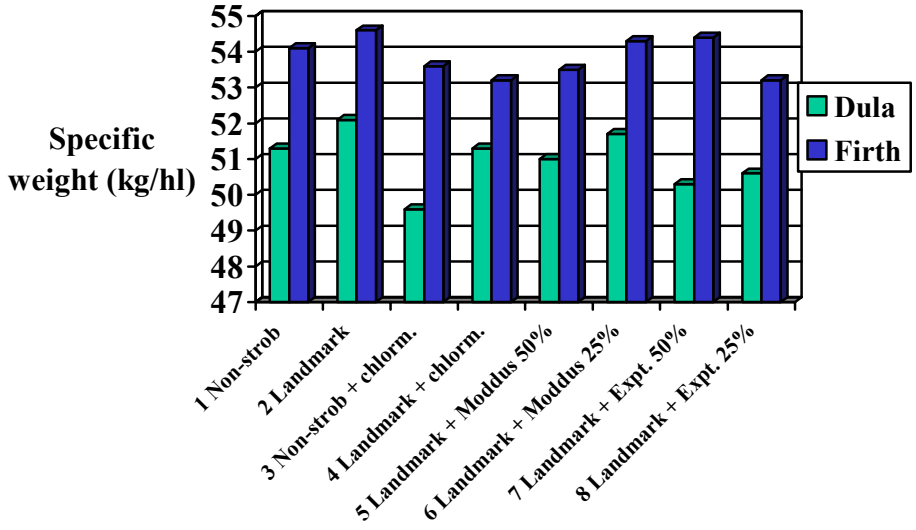
The measurements of crop height in table 8 indicate that both varieties responded in a generally similar manner to the PGR treatments. The greatest height reduction in both varieties was provided by the non-strobe + chlormequat treatment. The other PGR treatments provided only modest reductions in height.

Table 8 – PGR treatment and crop height



The effect of PGR treatment on grain quality was examined by measuring specific weight. The results in table 9 show a trend towards slightly depressed specific weights with PGR application. This was more pronounced with the chlormequat treatments.

Table 9 – PGR treatment and specific weight



4. DISCUSSION

Conclusions from this one year project are necessarily limited due to the lack of any differential lodging. The dry late spring conditions in Fife, followed by a dull and wet summer did not encourage vigorous, lush growth and yield potential was consequently limited.

The single variable that had the biggest influence in the trial series was nitrogen input. The variation in nitrogen level produced the largest difference to yield in both varieties. There was a linear reduction in yield with the reduction in applied nitrogen from 100 kg/ha to 80 and 60 kg/ha. This reduction in nitrogen level also had an influence in crop height – the lower the nitrogen level, the shorter the crop. The higher nitrogen input also tended to produce an increase in screenings. This can probably be attributed to an increase in smaller grain sites produced through the additional fertility.

The reduced yield potential, combined with low disease pressure resulted in the strobilurine fungicide treatments having less of an impact on yield than anticipated. They still tended to produce a modest yield and quality advantage over the non-strobe treatment.

The influence of seed rate on yield and quality was small. A greater range of seed rates would have been useful to examine the extremes at either end.

In the absence of lodging, it was expected that the application of PGR's would depress both yield and quality – such has been the case in numerous other cereal trials. The results in this case were inconclusive. The Dula strobe treatment was significantly higher yielding than the strobe + chlormequat treatment, but this was not the case with the non-strobe treatment. The Moddus and experimental treatments all seemed to be 'kinder' than the chlormequat treatments and had a significant advantage in yield. There were no significant differences between the Firth treatments. There were no significant differences between treatments in specific weight, although there was a tendency for the chlormequat treatments to produce a lower result. The effect of PGR on crop height was not as pronounced as the nitrogen influence, although there was a trend for PGR treatment to reduce height. The chlormequat treatment combined with the non-strobe fungicide produced the greatest height reduction.

This project has been expanded into a larger industry funded study involving winter and spring varieties and expanded into England. The emphasis on the continuing work is on

nitrogen timing and totals as well as a greater range of seed rates. The expansion of the non-PGR oats market has highlighted the urgency required in producing a reliable agronomy blueprint to ensure that the correct specification for this developing market can be delivered as efficiently as possible.

5. APPENDICES

Appendix 1. Site Details

Location	**Kilrie** Kirkcaldy Fife
Grid Reference	NT 237 895
Soil Type	CSL
Drilling Date	04/04/2002
Seed Rate	400 seeds/m^2
Previous Crop	S Oats
Fertiliser **Seedbed PKS**	 63:63:15 Kg/ha 11/04/02
Herbicides	Ally 07/05/2002 CMPP / Starane 04/06/2002
Insecticides	Hallmark Zeon 30/07/2002
Trace Elements	$MnSO_4$ 3.0 Kg/ha 07/05/2002 $MnSO_4$ 3.0 Kg/ha 04/06/2002
Desiccated	Roundup 12/09/2002
Harvested	18/09/2002
Trial Type	Randomised Small Plots

Fungicide Tr. **Treatments 1-9 @ 300 s/m^2, 10-18 @ 400 s/m^1**

Site	**Timing**	
Kilrie	04/06/2002	24/06/2002
Growth Stage	GS 31-32	GS 39-45
1, 10 100 Kg N	Alto 240 0.35 l Orka 0.5 l	Alto 240 0.33 l
2, 11 100 Kg N	Landmark 0.5 l	Landmark 0.5 l
3, 12 100 Kg N	Opera 1.25 l	Opera 1.25 l
4, 13 80 Kg N	Alto 240 0.35 l Orka 0.5 l	Alto 240 0.33 l
5, 14 80 Kg N	Landmark 0.5 l	Landmark 0.5 l
6, 15 80 Kg N	Opera 1.25 l	Opera 1.25 l
7, 16 60 Kg N	Alto 240 0.35 l Orka 0.5 l	Alto 240 0.33 l
8, 17 60 Kg N	Landmark 0.5 l	Landmark 0.5 l
9, 18 60 Kg N	Opera 1.25 l	Opera 1.25 l

PGR Treatments

Site	**Timing**	
Kilrie	04/06/2002	24/06/2002
Growth Stage	GS 31-32	GS 39-45
1 - Non-Strob Only	Alto 240 0.35 l Orka 0.5 l	Alto 240 0.35 l Corbel 0.35 l
2 - Strob	Landmark 0.5 l	Landmark 0.5 l
3 - Non-Strob + 5C 100%	Alto 240 0.35 l Orka 0.5 l 5C 2.5 l	Alto 240 0.35 l Corbel 0.35 l
4 - Strob + 5C 100%	Landmark 0.5 l 5C 2.5 l	Landmark 0.5 l
5 - Strob + Moddus 50%	Landmark 0.5 l Moddus 0.2 l	Landmark 0.5 l
6 - Strob + Moddus 25%	Landmark 0.5 l Moddus 0.1 l	Landmark 0.5 l
7 - Strob + Expt 50%	Landmark 0.5 l Expt. 2.3 l	Landmark 0.5 l
8 - Strob + Expt 25%	Landmark 0.5 l Expt. 1.15 l	Landmark 0.5 l