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WINTER LINSEED PERFORMANCE TRIALS

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WINTER LINSEED VARIETY PERFORMANCE TRIALS

by

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Summary

The following report describes a programme of trials for winter linseed varieties. Winter linseed is a new crop, with the first varieties only added to the UK National List in time for sowing in Autumn 1996. Offering apparent advantages, in terms of ease of establishment and earliness of maturity, over the traditional spring linseed crop, strong interest from growers during 1996 and 1997 presented a clear need for independent variety advice for growers.

A total of 10 varieties have been included in trials during the two year test period. Of the six varieties to have completed two years of tests, the variety Oliver has shown the best combination of yield, quality and agronomic characteristics. Other varieties have shown significant defects, particularly in their yield and their resistance to lodging.

In the two years of the project, yields were below those reported from private trials during 1995. This has been largely attributed to disease and lodging developing from prolonged wet weather at flowering.

Potential problems for the crop, in the form of attacks from thrips, pigeon grazing and the fungal Pasmo disease were identified. An interaction between sowing date, population, fertiliser rate, lodging and yield was seen as perhaps the area requiring the greatest attention in addition to a variety testing programme.

Given a steadily improving understanding of management of winter linseed and making the best variety choice, the crop remains an attractive alternative to spring linseed. The genetic yield potential of the first generation of winter varieties is not thought to be superior to current spring varieties but with a root system developed over winter, yield stability is likely to prove a long term advantage, through drought avoidance.

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1.0 Introduction

Winter linseed is a new crop, with the first commercial varieties only made available for the 1996 autumn sowing and in the absence of a routine system for the assessment of varieties. Contract trials for seed companies over the previous four years had, however, indicated a clear potential for the crop when compared with spring linseed. Prior to 1996, minimal National Listing requirements for winter linseed varieties provided little independent information for growers.

A six trial programme was put in place in 1996, with two official National List trials, supported by breeders' fees and four further trials to which HGCA contributed funds in 1996/7 and fully-funded in 1997/8.

So far, the number of varieties has been small, compared with spring linseed but variety trials have provided significant information for growers. Large differences in yield potential, standing ability and maturity have now been observed. and, in the year preceding the current series, winter conditions had exposed major hardiness defects in some lines submitted as winter varieties.

The advantages of winter linseed over spring linseed, in dry years, have been described as a consequence of an earlier HGCA funded project, (Kightley, 1997). With a rooting system established over winter it is felt that the crop may offer better stability of yield than a drought susceptible spring crop. The window for autumn establishment tends to be wider and more favourable than for spring crop and remains, so far, free of flea beetle infestation. Most importantly perhaps, harvest maturity is much earlier than for the spring crop, hopefully avoiding the damp, autumn conditions that can make combining so difficult for linseed.

In addition to the essential screening of the first generation of winter linseed varieties, the series has also provided general experience of the crop to add to the growing understanding of its agronomy.

2.0 Materials and methods

2.1 Varieties

The following varieties have been included in trials:

Table 1 Varieties in trial

Variety	Year	
	1997	1998
Oliver	✓	✓
Arctica	✓	✓
Nordica	✓	✓
Fjord	✓	✓
Tarka	✓	✓
Tundra	✓	✓
WAGRF 1	✓	
WAGRF 2	✓	
WAGRF 3	✓	
FCW 12	✓	

2.2 Trial locations:

NIAB, Cambridge†

Advanta, Boothby Graffoe, Lincs.*

NIAB, Morley, Norfolk

NIAB, Bridgets, Hants.

NIAB, Headley Hall, Yorks.

SAC, Edinburgh, Lothian

† Combined National/List Descriptive List site

* National List site - Additional varieties grown by kind co-operation of Advanta Seeds in 1997

In 1997 trials at Cambridge and Bridgets were abandoned because of pre-emergence damage to plants as a consequence of an interaction with the commercially (albeit off-label) advised herbicide, Treflan. The incorporation of full rate Treflan is now discouraged, in favour of half-rate, post-drilling, pre-emergence applications. The Cambridge trial was re-drilled in late October but was lost through frost heave.

2.3 Trial layout

Four-replicate trials of plots with a harvest are of 40m^2 were sown, using a complete block randomisation.

2.4 Sowing rate

A sowing rate of 600 seed/m^2 was originally adopted but was increased to 700 seeds for the 1998 season. This was to achieve a better rate of establishment but did not go as far as the recommendation for principal commercial variety, Oliver, of 900 seeds/m^2. In the light of the lodging in 1998, the seed rate for 1999 trials was reduced

to 600 seeds once more and will continue to be reviewed.

2.5 Sowing date

A target period of the second half of September is currently preferred, to give sufficient plant development to avoid frost heave. Earlier sowings are likely to give too much autumn growth and tall crops in the summer, which will be vulnerable to lodging. However, when followed by a mild winter, sowings as late as the first week in November have proved successful. Sowing dates are given in Appendix 1.

3.0 Results and discussion

The two trial seasons were very different in their weather. The 1996-97 winter was marked by severe frosts in late October and then again in January, this time accompanied by strong drying winds. Serious plant loss ensued at two locations where plant development was backward. Moderate rainfall during the flowering period stimulated disease development but failed to induce serious lodging. The 1997/98 winter was comparatively mild and winter damage was not reported. Prolonged wet weather for much of the flowering period caused serious lodging in most varieties, which, at some sites, lead to very low yields. The lodging was also responsible for generally later harvest dates in 1998, because of the difficulty in reaching dry enough conditions within the crop to allow combining.

Data for the six varieties which have completed National List tests and 2 years of the HGCA Project are presented in Table 2. Data for varieties still undergoing National List tests remains confidential at this stage.

Table 2 Summary of yield, quality and agronomic data 1997-1998

	YIELD		Oil Content	Earliness of flowering	Plant height	Standing ability	Earliness of maturity
	t/ha	% control					
			(%)	(1-9)	(cm)	(1-9)	(1-9)
Oliver (c)	1.72	132	38.1	3.7	72	7.6	5.4
Arctica (c)	0.89	68	38.8	7.4	67	3.1	8.4
Nordica	1.15	88	37.5	7.5	68	4.3	7.4
Fjord	1.37	105	36.9	7.0	65	6.9	6.6
Tarka	1.03	79	38.2	2.1	71	4.6	4.5
Tundra	0.86	66	38.2	6.6	61	4.4	7.0
Mean of controls (t/ha)	1.31			9 = early		9 = good	9 = early

3.1 Yield

Yields during the two year period were disappointing and below those reported by Kightley (1997) for the 1996 season, (Table 4). In both 1997 and 1998 weather during

Table 3 Seed yield (t/ha) for Oliver and Arctica for the 3-year period, 1996-1998, compared with control mean yields for spring linseed over the same period.

	Year			
Variety	1996*	1997	1998	Mean
Oliver	2.34	1.85	1.64	1.94
Arctica	1.87	1.13	0.72	1.24
Mean of Oliver and Arctica	2.11	1.49	1.18	1.59
Spring linseed control mean †	1.65	2.00	1.80	1.82

* The varieties Oliver and Arctica were included as controls for private trials in 1996

† Mean of Barbara, Jupiter, Mikael and Zoltan

the flowering period was dull and wet, and the 1998 season continued with relatively low light levels during the seed formation period. Several factors became apparent during the period of the project, which are potentially detrimental to yield:

- Frost damage was seen in 1997, principally in the form of frost heave in late sowings, where plants had not developed much beyond the cotyledon stage. In these situations very low populations survived. The variety Fjord had shown exceptional seedling vigour and survived well at Cambridge, while all other varieties were severely affected.
- Disease, in particular Pasmo disease, as discussed below, appears to be a major factor.
- In 1997 thrips caused serious damage in crops by attacking the growing points. This resulted in branching of the stems with the knock-on effects of delayed flowering and maturity and possibly on yield.
- In 1998 lodging was a major factor in our trials with the majority of varieties showing susceptibility. Lodged plots invariably gave very poor yields, having created a microclimate for disease build up and very difficult conditions for combining.

It was noted that while pigeon grazing has become a problem in winter linseed, areas of farm crop affected maintained viable populations. Plants eventually grew away and though flowering and maturing later than the protected trial areas, avoided lodging. The effects on yield are not known.

The comparison with spring linseed yields is made in the table above. This provides a guide only and it should be noted that the two trials series are conducted at different locations. The only scientific comparison available for the two crops grown at the same locations was made in the 1996 HGCA project, (Kightley, 1997). In a dry season, autumn sown Oliver produced 2.11 t/ha, compared with top spring sown variety in the series, (Blue Chip) on 1.48 t/ha when sown early and 1.26 t/ha when sown in late spring.

3.2 Oil Content

Oil content varied from 38.8% in Arctica to 36.9% in Fjord. The variation appeared to be genetic rather than a response to disease pressure. As with spring linseed there is an oil premium payable to, or deductible from growers, on their crop price of +/- 1% of the contract price for every 1% oil content above/below 38%. It is not yet clear whether the oil content of the seed of winter linseed will tend to be higher than that of the spring crop.

3.3 Earliness of flowering

The onet of flowering spans 8 to 10 days in the current variety set. With winter sown linseed no clear importance of flowering date has been identified. The character may, however, become useful in the interpretation of disease/weather interactions. In spring linseed there is a tendency for late flowering varieties to suffer in dry years, as soil moisture is progressively lost. In winter linseed the root system, developing as it does over winter, should normally allow even the later flowering types to avoid drought stress.

3.4 Plant height and standing ability

Table 3 reveals a mean height difference of only 11cm between tallest and shortest varieties and suggests no clear relationship between plant height and standing ability. In fact we found the seasonal height variation of the crop as a whole was much greater. In mild conditions linseed will grow throughout the winter, and tall crops coming out of the winter are much more prone to lodging than short crops. Some of the varieties tested have shown a major weakness in terms of standing ability. Growers would be advised to treat with extreme caution varieties with a rating of less than 6 on the table.

The relationship between standing ability, plant population, rainfall, fertility and fertiliser is undoubtedly extremely complicated and beyond the scope of this report to explore in detail. The contribution of plant population is itself not straight forward because of the tendency of the winter types to produce secondary and even tertiary stem growth, so that the stem population is frequently 3-5 times greater than in spring linseed crops.

3.5 Earliness of maturity

Winter linseed will mature about a month before spring linseed. Harvest in late July or early August will be typical but it is important to watch the crop carefully and desiccate as soon as possible to achieve this. Amongst the varieties there is a considerable range of maturity. In the south of England, Arctica for example, would be fit to combine in mid-July in most seasons while Oliver would tend to mature at the end of the month. Harvest dates become progressively later towards the north. For many linseed growers, an early harvest and avoidance of combining in the damp conditions of autumn will outweigh the importance of yield. The pattern of harvest dates for the two crops is indicated in Table 4.

Table 4 Harvest dates for winter and spring linseed

Trial site	1996/7		1997/8	
	Winter	Spring	Winter	Spring
Cambridge	-	05/09/97	21/07/98	14/08/98
Boothby Graffoe	29/07/97	08/09/97	05/08/98	14/09/98
Bridgets	-	01/09/97	13/08/98	19/09/98
Morley	14/08/97	03/09/97	13/08/98	22/09/98
Headley Hall	11/08/97	*	18/08/98	*
Edinburgh	12/08/97	*	14/09/98	*

* No comparable spring linseed trial

4.0 Disease observations

Disease records from trials have confirmed the presence of Pasmo disease (*Mycosphaerella linicola*) to varying extents on all varieties tested. The disease has been noted on cotyledons and young leaves during the autumn, but symptoms then become difficult to see until stem infection occurs the following year. In autumn 1998, a suspected Pasmo infection was recorded on leaves in the Cambridge trial, though the pattern of variety infection differed considerably from previous records. Microscopic examination of the lesions revealed the presence of both *Phoma exigua* and *M. linicola*, though it proved impossible to differentiate between symptoms visually, illustrating the need for caution in interpreting autumn assessments. However, there were some consistent variety trends from late season scores of Pasmo disease at two sites, with Arctica and Nordica being the worst infected (Table 5). The development of significant levels of infection as early as mid May in 1998, at GS 53, would indicate that the disease has the potential to affect yield. In the absence of a replicated treated/untreated fungicide regime in trials no estimate of yield penalty can be made however.

A single record of powdery mildew from Cambridge in 1998 suggested substantial differences in resistance to the disease (Table 6). Effects on yield are unknown, though the high levels on some varieties by GS 65 might again indicate that significant losses could occur.

Table 5 Percentage stem area infected with Pasmo disease in 1997 and 1998 trials

	1997	1998	
	Headley Hall	Cambridge	
	GS 92 09.07.97	GS 53 14.05.98	GS 65 03.06.98
Oliver	0.0	.4.8	3.3
Arctica	6.3	10.0	8.3
Nordica	5.8	6.0	8.3
Fjord	1.5	4.8	5.6
Tarka	0.3	0.8	0.4
Tundra	3.0	0.3	1.0

Table 6 Percentage leaf area infected with powdery mildew

	Cambridge
	GS 65 03.06.98
Oliver	34.3
Arctica	93.8
Nordica	91.3
Fjord	70.0
Tarka	95.0
Tundra	77.5

5.0 Conclusions

Of the varieties tested to date, Oliver has shown consistently sound characteristics, albeit without extreme earliness of maturity. Other varieties have shown weaknesses either in terms of poor standing ability, oil content or disease susceptibility.

Yields of winter linseed, in two difficult trial seasons, appeared to be no greater than for spring linseed but ease of establishment and early harvest remain major attractions. Earliness of maturity, in particular, offers the opportunity to extend the geographical range of the crop.

Several aspects of agronomy remain to be fully explored, including seed rate, fertiliser inputs and control of pests and diseases.

The relatively small number of varieties involved at present should not detract from the importance of the testing programme's work. Failure to screen winter linseed varieties adequately will leave growers at considerable economic risk. Testing has now been added to the routine UK oilseeds variety trialling programme, funded by HGCA and co-ordinated by NIAB.

6.0 Acknowledgement

NIAB would like to thank the HGCA for their funding and support for the introduction of variety trials for winter linseed.

7.0 References

Kightley S P J, (1997), Winter linseed: I. Comparison of winter and spring varieties. HGCA Project Report No. OS22

Appendix 1

Site-by-site yields of winter linseed, relative to the mean of Oliver and Arctica

Year	**1997**				**1998**					
Location	Norf	Lincs	Yorks	Loth	Hants	Cambs	Norf	Lincs	Yorks	Loth
Variety										
Oliver (c)	127	111	114	139	135	127	147	141	100	174
Arctica (c)	73	89	86	61	65	73	53	59	-	26
Nordica	113	105	108	80	66	91	79	*	68	72
Fjord	134	112	107	75	93	115	127	*	91	114
Tarka	88	86	101	61	62	78	77	62	88	79
Tundra	75	97	110	66	38	59	20	54	56	47
Control mean yield (t/ha)	0.69	1.31	1.83	2.13	1.63	1.56	1.26	1.26	1.21	0.48
Sowing date	24.09	03.10	30.09	22.08	24.09	22.09	01.10	01.10	13.10	22.09