The identification and production of varieties that increase the value of oats as a profitable component of organic production

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Summary

Two experiments, one comprising husked, and the other naked, oats were established at Wakelyns Agroforestry, Suffolk in October 2004 to determine traits and varieties of oats suited to organic systems, and whether growing variety mixtures conferred any advantage. Unselected F2 breeding lines were also included for selection. Husked varieties had relatively higher yields; this may have been partly the result of poor establishment in the naked varieties. Variety height was found to be an important characteristic; tall oat varieties out-yielded the dwarfs. Two of the three variety mixtures containing the naked oat variety Expression yielded 8 and 9 % higher than the average of the component varieties. The data will be verified in the second year of replicated trials (2005/06), which will include the best performing husked and naked varieties, and a mixture of superior IGER-bred F2 breeding lines.

Key words: Oats, organic, husked oats, naked oats, mixtures, varieties

Introduction

Oats have the potential to be a valuable and profitable crop for organic farmers. The crop has a high nitrogen use efficiency (Sylvester-Bradley, 1993) and is competitive against weeds (Seavers & Wright, 1999). As well as use for milling, oats are useful as a feed crop, especially for non-ruminant production, the market for which is likely to increase with the reduction of the allowed non-organic component in rations over the next few years (Trump, 2006 *Pers. Comm.*).

The aim of this project is to identify, in existing and novel husked and naked oat varieties, traits that are a priority for organic farmers. These traits include competitiveness, pest and disease resistance and good combining ability in variety and species mixtures (e.g. when mixed with a legume such as clover) that may help to overcome variability caused by biotic or abiotic stresses. This paper discusses the results of the first year of trials.

Materials and Methods

Two trials, one of husked, and the other of naked oat varieties were established at Wakelyns Agroforestry, Suffolk, in October 2004. The husked oat trial involved four current varieties (Buffalo, Gerald, Kingfisher, Penderi) and two new varieties from IGER, Tardis and the provisionally named Brochan. The naked oat trial included three current varieties (Expression, Grafton, Hendon) and a new high oil variety, Racoon, along with all their two-way mixtures. Half the trial plots were then under-sown with clover in March. The trials were of a replicated split-plot design with 1.2m x 10m plots. Twelve F2 lines supplied by IGER were also sown in

small plots (1 m x 1 m). Variety assessments included crop emergence and establishment, early crop and weed cover, pest and diseases, crop height, lodging, canopy cover, and grain yield. The grain quality analyses were carried out by IGER.

Results

Husked oats

The husked oat experiment established well. There was a significant ($P < 0.001$) difference among the varieties in the number of plants that emerged, but the number of plants that actually established did not differ (Table 1). Therefore there were differences ($P < 0.05$) in the percentage of plants that survived, with Tardis having the highest plant survival percentage, and Buffalo the lowest.

Crop ground cover in April differed ($P < 0.001$) among husked varieties (Table 1). Penderi had the lowest crop cover with only 43.5%. However, despite varieties differing in crop cover, the percentage of weed cover was not affected by variety.

Table 1. *Establishment, early crop cover, height and yield of husked varieties at Wakelyns*

Husked Variety	Establishment (Plants/ m^2)	Early crop cover (%)	Crop Height (cm)	Yield (t ha^{-1} @ 15%mc)
Gerald	189	50.6	82.8	8.48
Tardis	166	54.9	80.6	8.28
Penderi	164	43.5	70.4	8.19
Kingfisher	171	60.8	96.6	8.05
Brochan	177	62.3	79.8	7.78
Buffalo	184	55.6	54.6	7.53
SED (33 df)	10.6	3.82	1.59	0.200

There were significant ($P < 0.001$) differences in yield among the husked varieties (Table 1). Gerald and Buffalo yielded the highest and lowest, respectively, with the new variety, Tardis, giving the second highest yield. However, the relative yields of the varieties could not be explained by how the varieties established or the crop cover earlier in the season, rather yields could be partially or wholly attributed to the height of the variety (Table 1).

Naked oats

The naked oats took longer to emerge than the husked varieties and did not establish as well leading to fewer plants per m^2 (Table 2). In contrast to the husked material, there were no differences in emergence counts between varieties or variety mixtures, but there were significant differences in the number of plants established (Table 2). However, this was not due to any significant differences in the plant survival percentage.

Largely because of the lower emergence, the percentage ground cover of the naked oats (Table 2) was generally less than that of the husked oats (Table 1). Nevertheless, the crop cover of the naked oats did differ among varieties ($P < 0.001$). For example, Hendon had a particularly limited ground cover at only 29.1% (Table 2). It can also be seen that the crop cover values for the variety mixtures were as high as, and usually higher, than the component varieties.

Table 2. *Emergence, establishment, plant survival and early crop cover of naked varieties at Wakelyns*

Naked variety/ mixture	Emergence (Plants/m^2)	Establishment (Plants/m^2)	Plant survival (%)	Early crop cover (%)
Expression	132	95.3	81.1	34.5
Grafton	171	100.0	65.5	45.8
Racoon	138	95.5	72.8	49.9
Hendon	121	81.8	88.6	29.1
Grafton/ Expression	154	117.0	79.4	52.4
Expression/ Racoon	139	106.8	78.4	50.0
Hendon/ Expression	124	82.8	69.7	36.8
Hendon/ Grafton	133	96.8	74.4	41.8
Grafton/Racoon	130	92.5	74.5	51.1
Hendon/Racoon	136	87.8	65.2	39.9
SED (54 df)	19.3	9.59	12.71	6.65

Table 3. *Heights and yields of naked varieties and mixtures, with the expected yields of the mixtures and the percentage difference to actual yields*

Variety	Crop Height (cm)	Yield (t ha^{-1} @ 15%mc)	Expected mixture yields (mean of parents)	Percentage difference to means
Expression	100.3	5.43	-	-
Grafton	98.3	4.83	-	-
Racoon	112.7	4.05	-	-
Hendon	51.2	3.84	-	-
Grafton/ Expression	101.8	5.54	5.13	108%
Expression/ Racoon	108.0	5.15	4.74	109%
Hendon/ Expression	89.4	4.51	4.63	97%
Hendon/ Grafton	82.6	4.41	4.33	102%
Grafton/ Racoon	104.9	4.13	4.44	93%
Hendon/ Racoon	96.3	3.93	3.95	99%
SED (57 df)	3.81	0.303	-	

The naked varieties (Table 3) yielded less than the husked varieties (Table 1), which may have resulted from the relatively poor establishment. As with the husked oats, there were significant ($P < 0.001$) differences among the varieties (Table 3) with Expression the highest yielding variety. Mixtures with Expression as one of the components also performed well. In particular, Expression/Racoon and Grafton/Expression yielded 9% and 8% higher than their component varieties, respectively. On the other hand, Grafton/Racoon yielded 7% less than its component varieties.

Again the shortest variety, Hendon, gave the poorest yield (3.84 t ha^{-1}). Hendon also had the lowest percentage crop cover earlier in the season (Table 3). However, relative yields were not always related to crop cover. For example, Expression had a very low crop cover early in the season but went on to be the highest yielding pure variety.

Discussion

The husked varieties generally performed better that the naked varieties throughout the season, from establishment to final yield. The taller varieties of both husked and naked varieties generally out-yielded the dwarfs, which is likely to be the result of increased competition against weeds. However, crop cover measured earlier in the season, despite being a potential measure of weed competitive ability, did not generally relate to final yields.

New varieties, especially the husked oat Tardis, performed promisingly. Also, the yields of certain mixtures, especially those involving the naked variety Expression, yielded more than was expected from the yields of the components grown individually.

Husked varieties Gerald, Tardis and Brochan, and the 3-way mixture, and naked varieties Expression, Grafton and Racoon and their 3-way mixture are being trialled in the harvest year 2006 to verify the last season's results. A mixture of new breeding lines from IGER that performed well as F2s at Wakelyns Agroforestry in 2005 is also being tested. The replicated plots will be drilled either at a medium (200 kg ha^{-1}) or low (150 kg ha^{-1}) seed rate; low seed rates will be under-sown with clover.

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