EFFECTIVENESS OF SELECTION FOR HIGHER OIL AND PROTEIN CONTENTS USING NIR ANALYSIS OF SEED FROM SINGLE PLANTS

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ABSTRACT

Oil and protein contents of Australian cultivars need to be increased significantly to compete with other exporting countries. This paper looks at the relationship between oil and protein contents of seed from single F_2 plants of *Brassica napus* and that of progeny plots derived from these plants. The effectiveness of such selection is discussed.

INTRODUCTION

Canola production in Australia has increased dramatically over the last few years. As a consequence, annual export of seed has become a reality. This has placed the Australian crop in direct competition with other countries, in particular, Canada.The quality of our crop has become a significant issue, with a critical focus on oil and protein contents.

Potter *et al.* (1989) showed that while, over time, yielding ability of Australian cultivars had increased markedly, oil contents of these same cultivars had generally decreased. A similar trend would be true for protein levels. Two exceptions are the cultivars Yickadee and Dunkeld. As a result, oil and protein levels of our commercial crop are lower than those for the Canadian crop, particularly with respect to protein. The Australian crop matures under, generally, hot and dry conditions, in contrast to the cool and moist conditions usually experienced in Canada. The lower oil and protein contents of Australian cultivars compared with Canadian appear to be the result of both genetic and environmental influences.

EXPERIMENTAL

As a normal practice in the breeding programme at Wagga, F_2 rows are sown in a blackleg (*Leptosphaeria maculans*) nursery. Initial selection, on a single plant basis, is for absence of basal stem canker. Seed from these selections is then assessed for oil and protein, using an NIRSystems 4500 scanning NIR spectrophotometer. Promising lines are then evaluated for yield in preliminary trials.

From the 1992 harvest, 1720 single plant selections were assessed for oil and protein. In the following year, the best 250, on the basis of sum of oil and protein, were included in Preliminary Trial 1; the second best 250 in Preliminary Trial 2.

A summary of oil and protein data is shown in Table 1. Data for the worst 250 selections is included to indicate the range involved in the complete set of data. To test these for yield was considered a waste of time. Two sums of oil and protein are presented viz. the more traditional of oil and protein in the seed and also oil in the seed and protein in the meal. The latter assigns more value to protein in those lines that are high in both oil and protein in the seed. A moisture content of 13% is used since this is the value used by Japanese buyers.

The relationship between oil and protein of the progeny (ie. plot data) and parents (ie. single plant data) was examined by calculating regression (b) and correlation (r) coefficients. In addition, the percentage of variation explained (R_2) was estimated from the regression ANOVA. The results are presented in Table 2. A t-test was used to test for significance.

The following general conclusions can be drawn:-

1) the mean value for all parameters was higher for those selections in Preliminary Trial 1 than those in Trial 2. Thus the advantage shown as a group of single plants was maintained in the next generation.

2) regression and correlation coefficients were generally highly significant. The exception was protein in the meal.

3) narrow-sense heritability can be estimated by doubling the regression coefficient (Mayo, 1980). In this set of data, oil content had a higher heritability than protein, and the value is higher than found by Olsson (1960).

4) narrow-sense heritabilities for the sum of oil and protein are obviously not valid. This would appear to be due to negative correlation between oil and protein (Grami *et al.*, 1977) cancelling the impact of environment.

5) despite the highly significant coefficients, a disappointing percentage of variation was explained by the regression analysis.

The results of this study are currently being used to revise selection strategies.

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TABLE 1. Oil and protein contents for original single plant selections and plots derived form these selections.

	Oil in seed[1] (%)		Protein in seed (%)[1]		Sum of oil and protein in seed		Protein in meal (%)[2]		Sum of oil and protein, seed and meal[3]	
	SP[4]	PT[4]	SP	PT	SP	PT	SP	PT	SP	PT
Selections used in Preliminary Trial 1										
Mean	41.5	40.7	21.8	22.8	63.3	63.4	37.9	39.0	79.4	79.7
Range	36.3 - 49.2	37.0 - 43.2	15.1 - 26.3	20.8 - 25.1	61.8 - 66.8	61.8 - 66.4	30.4 - 42.7	37.1 - 41.6	76.8 - 85.5	76.2 - 84.5
Selections used in Preliminary Trial 2										
Mean	41.0	40.1	21.0	22.4	61.9	62.5	36.1	38.0	77.0	78.0
Range	36.8 - 46.6	36.4 - 42.6	16.1 - 24.9	20.3 - 24.4	60.4 - 62.8	59.8 - 64.8	31.2 - 39.8	34.5 - 40.4	74.4 - 78.3	73.3 - 82.1
Worst 250 selections										
Mean	38.6		20.1		58.7		32.8		71.4	
Range	30.6 - 46.6		12.7 - 28.0		56.1 - 60.0		24.7 - 40.1		67.3 - 73.2	

[1] at 8.5% moisture
[2] at 13.0% moisture
[3] oil at 8.5% moisture, protein at 13.0% moisture
[4] SP = single plants data; PT = preliminary trial data

TABLE 2. Regression coefficients (b), percentage variation explained (R^2) and correlation coefficients(r) for the two sets of data.

	Oil in seed	Protein in seed	Sum of oil and protein in seed	Protein in meal	Sum of oil and protein, seed and meal
Selections used in Preliminary Trial 1					
b	0.23**	0.10**	0.49**	0.05^{ns}	0.51**
R^2	19	4	30	1	33
r	0.43**	0.21**	0.55**	0.12^{ns}	0.58**
Selections used in Preliminary Trial 2					
b	0.20**	0.07*	0.77**	-0.03^{ns}	0.71**
R^2	14	2	13	0	10
r	0.37**	0.13*	0.36**	-0.06^{ns}	0.32**

*, **, Significant at 5% and 1% respectively.