Developing Markers for Canola Seed Quality – Relationship of Seedcoat Colour and Lignin Content in *Brassica carinata.*

M. A. S. Marles*†, M.Y. Gruber†, G.J. Scoles*, G.F.W. Rakow†

* Department of Crop and Horticultural Sciences and Plant Ecology, University of Saskatchewan

† Agriculture and Agri-Food Canada, Saskatoon, Saskatchewan, Canada

INTRODUCTION

Canoia Meal Quality Problems

Canola meal has 10% less protein and 33% more fibre than soybean meal (Bell, 1993). Canola breeders are investigating ways to increase protein and reduce fibre so that canola meal will be a competitive feed and provide a better return for farmers. Canola meal contains high levels of anti-nutritional chemicals (e.g. sinapine), (640 mg/g meal) (Shahidi, 1992). These chemicals should be reduced to the amounts found in soybean meal (23 mg/g meal).

The 'Yellow Seed' Trait and Canola Meal Quality

One plant breeding approach to address meal quality concerns used yellow-seeded *Brassica carinata* (A. Braun) (Ethiopian mustard) as a source of canola breeding material (Rashid et *al, 1994).* Yellow-seeded *Brassica* lines have unpigmented seedcoats. These lines are better than brown-seeded ones for improving canola. Higher oil concentration was correlated with a reduced fibre content and the yellow seed trait in *B. carinata* lines (Getinet *et al, **1996).*** Overall, yellow types of *Brassica* species have 2% higher protein and 6% less fibre than brown-seeded types (Simbaya *et al., **1995).***

Lignin vs Fibre Analysis

Most fibre is measured as a weight of the residue from strong acidic digests rather than as a precise assay for the chemical units that make up fibre. Lignin, a key component of fibre, is one of the most indigestible aspects of canola meal and yet has not been evaluated specifically. Moreover, the relationship of lignin to seedcoat colour has not been examined.

Objectives

Our first objective was to determine if lignin content correlated specifically with seedcoat pigmentation in *B. carinata.* Our intent was to evaluate this trait for developing molecular markers for the unpigmented, low fibre seed trait.

MATERIALS AND METHODS

Plant material: B. carinata lines homozygous for unpigmented or pigmented seed were developed by self-pollination (Figure 1). Mature seed from each plant was harvested separately.

Lignin assays: seeds were dissected into seedcoat and embryonic tissues. Lignin was measured separately in each tissue type by thioglycollic hydrolysis and detection of the monolignol residues, the subunit that forms lignin (Campbell and Ellis, 1992).

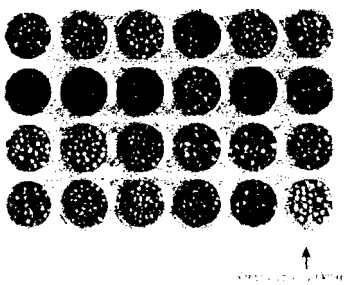

Figure 1. Variation in seed colour of Brassica ***carinata*** ***Sinupis alba cv Ochre*** is included to illustrate visual appearance of seed with no pigmentation.

RESULTS AND CONCLUSIONS

Low lignin content in seedcoat tissue was significantly correlated with unpigmented seed colour in *Brassica carinata* (Figure 2). Differences in lignin content for embryonic tissue were not significant.

Yellow seed is a difficult trait to select because the genetics producing the unpigmented seedcoat are very complex. Breeders need another way to select the low fibre lines other than yellow seed. Lignin assays for seed quality traits use mature seed so are not able to screen segregating populations of B. *napus* (Argentine canola) and *Brapa* (Polish canola) at the seedling stage.

Ideally, an efficient screening procedure occurs at an early plant stage. Our results provide evidence that it is appropriate to develop molecular markers associated with genes that control lignin formation. These markers will be useful for selecting plants with the low fibre, yellow seed trait.

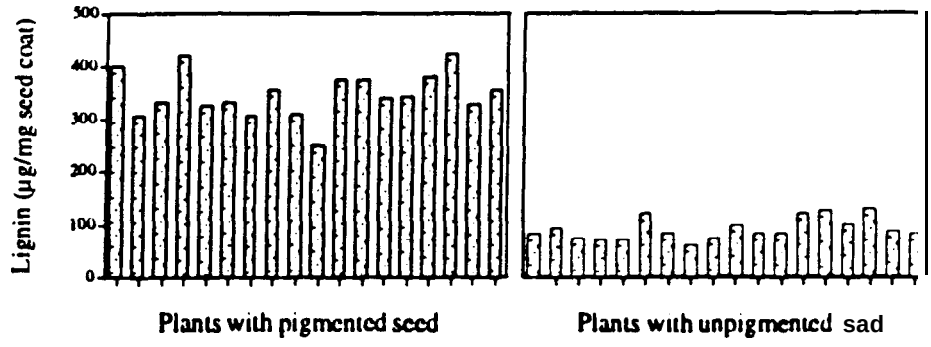

Figure 2. Lignin content in *Brassica carinata* seedcoats.
Lignin was significantly lower in seeds with an unpigmented seedcoat. Lignin content was very low in the embryo and similar in both pigmented and unpigmented seed.

Why do Plant Breeders Need Molecular Markers?

Molecular markers are DNA sequences that are used to assay plant DNA in the laboratory. Plant breeders want to find the best progeny with the desired traits (e.g. low fibre, high protein, high oil content) at the seedling stage. If a plant carries the desirable trait, the markers will act as a visual signal to indicate that the seedling has inherited the traits.

Thousands of seedlings can be screened quickly using molecular markers. Only seed from the plants with the correct set of traits will be selected and grown in the field plots. In this way, marker-assisted selection improves the use of plant breeding resources by reducing the amount of time and plot size required to develop new cultivars.

REFERENCES

1. Campbell, M.M. and Ellis, B.E. 1992. Fungal elicitor-mediated response in pine cell cultures. I. Induction of phenylpropanoid metabolism. ***Planta 186: 409-417.***

2. Getinet, A., Rakow, G., Downey, R.K. 1996. Agronomic performance and seed quality of Ethiopian mustard in Saskatchewan. ***Can. J. Plant Sci. 76: 387-392.***

3. Rashid, A., Rakow, G., Downey, R.K. 1994. Development of yellow seeded ***Brassica napus*** through interspecific crosses. ***Plant Breed. 112: 127- 134.***

4. Shahidi, F. 1992. Phenolic compounds of ***Brassica*** oilseeds In "Phenolic compounds in food and their effects on health. I. Analysis, occurrence and chemistry." Ho, C-T., Lee, C.Y., Huang, M-T. Eds. ACS Symposium Ser. 506. Pp. 130-142.

5. Simbaya, J., Slominski, B.A., Rakow, G., Campbell, L.D., Downey, R.K., Bell, J.M. 1995. J. ***Agric. Food Chem. 43: 2062-2066.***

ACKNOWLEDGEMENTS

M.A.S.M. thanks Natural Sciences and Research Council of Canada (NSERC) and the College of Graduate Studies and Research, University of Saskatchewan for Ph.D. scholarships. Thanks are also due to Dr. M.Y. Gruber (AAFC) for laboratory facilities and supplies and Dr. G. Rakow (AAFC) for the ***B. carinata*** germplasm.