SHORT COMMUNICATION

Groat yield of naked and covered oat

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Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, K.W. Neatby Bldg., Central Experimental Farm, Ottawa, Ontario, Canada K1A 0C6. *Received 6 December 2000, accepted 25 May 2001.*

Burrows, V. D., Molnar, S. J., Tinker, N. A., Marder, T., Butler, G. and Lybaert, A. 2001. **Groat yield of naked and covered oat**. Can. J. Plant Sci. **81**: 727–729. Near-isogenic covered (CN 18941) and naked (CN 18942) lines of the oat (*Avena sativa* L.) cultivar NO 141-1 were developed to determine if the contrasting spikelet morphologies of the two lines affected groat yields differentially. Molecular markers verified the high level of genetic similarity between the two lines. Their groat yields were not significantly different under field conditions.

Key words: Hulless oats, Hulled oats, *Avena sativa L.*, near- isogenic lines, groat yield, amplified fragment polymorphism

Burrows, V. D., Molnar, S. J., Tinker, N. A., Marder, T., Butler, G. et Lybaert, A. 2001. **Rendement en gruau de l'avoine à grains nus et à grains vêtus**. Can. J. Plant Sci. **81**: 727–729. Les auteurs ont créé des lignées presque isogéniques à grains vêtus (CN 18941) et à grains nus (CN 18942) du cultivar d'avoine (*Avena sativa* L.) NO 141-1 pour déterminer si la morphologie contrastante des épillets modifiait le rendement en gruau des deux lignées. Les marqueurs moléculaires confirment une grande similitude génétique entre les deux lignées. Le rendement en gruau de chacune n'était pas significativement différent lors de la culture en pleine terre.

Mots clés: Avoine à grains nus, avoine à grains vêtus, *Avena sativa* L, lignées presque isogéniques, rendement en gruau, AFLP

The major determinant of the spikelet of naked oat (*Avena sativa* L.) is the N-1 locus (Moule 1972; Jenkins and Hanson 1976). This multiflorous spikelet has led some investigators to speculate that the groat yield of naked oat should be higher than that of covered oat because more florets are produced per spikelet. Others disagree because the groat yields of naked oat cultivars have, in the past, failed to equal those of covered oat cultivars. The latter is thought by many to be due to less breeding effort being devoted to improving the naked oat. Others believe the floral morphology of the naked oat somehow lowers yield potential. Over the past 20 yr, a progressive increase in the yield potential of naked oat cultivars has been achieved through breeding.

An experiment was conducted using near-isogenic naked and covered lines derived from the naked oat breeding line NO 141-1 to address this issue. The parentage of NO 141-1 is Tibor /5/CAV 2700/Gemini /2/Rodney /3/5811a1-8B/4/Gemini/3932-16 /2/AC Percy/3932-16 /6/Tibor/Dumont/7/Premier. CAV 2700 is an *Avena byzantina* C. Koch accession line collected from Bodrum Turkey; 5811 a1-8B is a winter oat from the breeding program at Cornell University; 3932-16 is a strong strawed, naked oat derived from a series of complex crosses made at Ottawa involving the variety Laurel as the donor of the major hulless gene.

Development of Near-isogenic Lines

An F_{10} plant suspected of being heterozygous for nakedness was selected from a 1 ha pedigreed Breeder Seed increase plot of the unregistered naked oat genotype NO 141-1. A panicle was harvested from this plant and the seeds were planted in a growth room. Progenies that were either naked or covered, based on visual phenotype, were kept and those that were heterozygotes were discarded. Samples of the naked and covered phenotypes were grown in the greenhouse and the seed harvested from these plants were multiplied again in the field. The contrasting sets of lines exhibiting the naked or the covered phenotypes bred true and seed harvested from lines within each group were bulked to obtain sufficient seed for a field scale yield trial. Seed samples of the near-isogenic lines were submitted for long-term storage and preservation at the Plant Gene Resources of Canada, Saskatoon Research Centre, 107 Science Place, Saskatoon, Saskatchewan S7N 0X2. The covered and naked lines were assigned the accession numbers CN 18941 and 18942, respectively, by the Plant Gene Resources of Canada.

Confirmation of Near-isogenic Lines

The amplified fragment polymorphism (AFLP) method (Vos et al. 1995) was used to assess the genetic similarities between CN 18941 and 18942. Twenty-one primer pairs were screened on DNA pooled from 20 plants per isoline

Abbreviations: **AFLP**, amplified fragment polymorphism

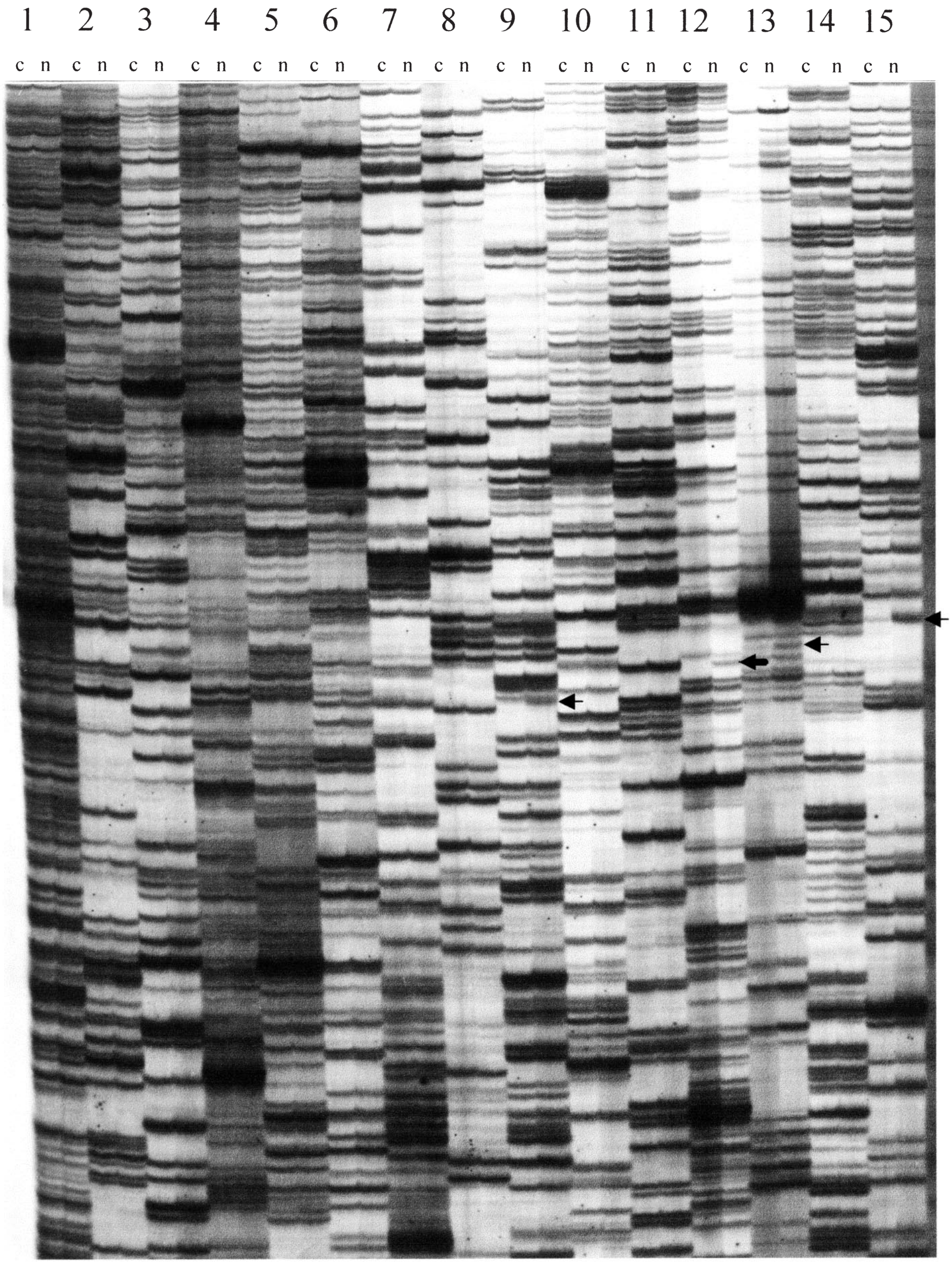

Fig. 1. AFLP amplification products from covered (c) and naked (n) lines derived from the oat variety NO 141-1. Primer pairs are identified based on their selective bases. Lane 1: ACC-CAA; Lane 2: ACC-CAG; lane 3: ACC-CAG; lane 4: ACC-CAT; lane 5: ACC-CTA; lane 6: ACC-CTC; lane 7: ACG-CAA; lane 8: ACG-CAG; lane 9: ACG-CTA; lane 10: ACT-CAA; lane 11: ACT-CAC; lane 12: ACT-CTA; lane 13: ACT-CTC; lane 14: AGA-CAA; lane 15: AGC-CAC. Loci showing clear allelic differences are indicated by arrows. The wide-shafted arrow indicates a polymorphism that has been mapped near the naked locus identified in other studies.

using methods and reagents from the AFLP analysis system (Life Technologies Inc., Rockville, MD). Partial results are shown in Fig. 1. Only four clear polymorphisms were observed, or an average of 0.19 polymorphism per primer pair. Our experience with mapping AFLP in segregating oat populations indicates that this level of polymorphism is extremely low. In comparison, the average primer pair shows at least 10 polymorphisms in mapping populations involving diverse oat parents (unpublished observations). One of the four polymorphic markers (lane 12) has been mapped to the region of the N-1 (naked) locus at a distance of approximately 5 cM in an independent mapping population (unpublished results). Additional studies are needed to determine whether the other three AFLP polymorphic regions are linked to any of the loci governing nakedness in oats.

Field Trial

In 1998, a field experiment was carried out at the Central Experimental Farm, Ottawa, to compare the groat yield and agronomic performance of CN 18941 and 18942. A randomized complete block design with eight replications was used. Plots consisted of four rows, 3 m long, with the rows spaced 30 cm apart. Broadleaf weeds were controlled with the herbicide Buctril M (Rhone-Poulane, Canada, Inc.) composed of a mixture of bromoxynil and 4-chloro-2-methyl phenoxyacetic acid. The herbicide was applied at the recommended stage of growth and at the recommended rate of application. Crown rust (*Puccinia coronata* Cda. f.sp. *avenae* Erkiss. and Henn.) was controlled with a single application of the fungicide propiconazole (Tilt 250E, Norvartis). The height, maturity, and straw strength of the plants in all plots were very uniform with no visible phenotypic differences between plots with the exception of panicle/spikelet morphology. The centre two rows of each plot were harvested, dried, threshed and weighed. Percentage groats was determined by removing the hulls by hand from a random 50-g sample of seed from each plot. An angular transformation was applied to percent groats before analysis (Snedecor and Cochran 1980). Data were analysed by analysis of variance (Table 1).

Table 1. Threshed grain yields and calculated groat yields per plot of covered (CN 18941) and naked (CN 18942) near-isogenic lines

	Covered		Naked		
	g plot^{-1}	SEM[z]	g plot^{-1}	SEM[z]	Significance[y]
Threshed yield	680.5	16.8	492.9	9.5	$P <$ 0.001
Groat percentage	71.5	0.3	99.2	0.1	$P <$ 0.001
Groat yield	486.7	11.9	489.1	9.5	$P =$ 0.90

[z]Standard error of mean.
[y]Significance of difference between lines.

Summary and Conclusion

The presence of a polymorphic band at a distance of 5 cM from the naked locus precludes spontaneous mutation as the origin of the covered isoline. The low level of genome wide polymorphism precludes a recent outcross to anything other than a highly related covered line. It is therefore proposed that the near-isogenic lines arose through residual heterozygosity within NO 141-1.

There was no significant difference in groat yield between the covered and naked isolines (Table 1). Therefore, the difference in floral morphology of covered and naked oat had no effect on determining the groat yield potential of this set of materials. Thus, if naked oat cultivars yield less groats than covered seeded cultivars, the reason probably resides with factors other than the gene controlling the naked condition. Therefore, the naked trait, should not act as a constraint to prevent breeders from breeding new cultivars with high groat yields.

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