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CULTIVAR DESCRIPTION

AAC Richard soybean

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Abstract: AAC Richard is a food grade soybean [*Glycine max* (L.) Merr.] cultivar with yellow hilum, high protein concentration, and good processing quality for foreign and domestic soymilk, tofu, and miso markets. It has resistance to soybean cyst nematode (SCN) (*Heterodera glycines* Ichinohe). AAC Richard was developed at the Agriculture and Agri-Food Canada (AAFC) Harrow Research and Development Centre (Harrow-RDC), Harrow, Ontario, and is adapted to areas of southwest Ontario with 3100 or more crop heat units and has a relative maturity of 2.3 (MG 2.3).

Key words: Glycine max (L.) Merr., soybean, cultivar description, tofu.

Résumé : AAC Richard est une variété de soja [*Glycine max* (L.) Merr] destinée à l'alimentation humaine. Le cultivar à hile jaune se caractérise par une teneur élevée en protéines ainsi que des propriétés qui se prêtent bien à la transformation en lait de soja, en tofu et en miso, selon les normes canadiennes et étrangères. Il résiste au nématode du soja (*Heterodera glycines* Ichinohe). AAC Richard a été créé au centre de recherche et de développement d'Agriculture et d'Agroalimentaire Canada (AAC) de Harrow, en Ontario, et est acclimaté aux régions du sud-ouest de l'Ontario qui cumulent au moins 3 100 unités thermiques du maïs. AAC Richard obtient une note de 2,3 pour la maturité relative (MG 2,3). [Traduit par la Rédaction]

Mots-clés : Glycine max (L.) Merr., soja, description de cultivar, tofu.

Introduction

AAC Richard is a food grade soybean [*Glycine max* (L.) Merr.] cultivar with resistance to soybean cyst nematode (SCN) (*Heterodera glycines* Ichinohe) developed at the Agriculture and Agri-Food Canada (AAFC) Harrow Research and Development Centre (Harrow-RDC), Harrow, Ontario. AAC Richard is intended for use in tofu, soymilk, and miso production in foreign and domestic markets. It yielded the same as AAC Malden, the check cultivar. In tests conducted at Harrow-RDC, AAC Richard had acceptable processing quality that can be used to make tofu and demonstrated good soymilk characteristics. A Certificate of Eligibility for Certification no 2461–2021 was issued for OX-191 (AAC Richard) by the Canadian Seed Growers' Association on the 9 November 2021.

Pedigree and Breeding Method

AAC Richard (tested as OX-191; SN12-0037D-2-8E) is a high protein, large-seeded, food grade soybean cultivar with a yellow hilum and resistance to SCN. It was developed at the AAFC Harrow-RDC in Harrow, Ontario, from the cross AAC Malden/OAC Marvel made in 2012. AAC Malden is a SCN resistant soybean cultivar developed by Harrow-RDC (Poysa et al. 2013). OAC Marvel is a SCN resistant soybean cultivar developed by the University of Guelph (https://inspection.canada.ca/active/netapp/regvar/regvare.aspx?id=4152).

AAC Richard was developed by pedigree selection. It is adapted to areas of southwestern Ontario with 3100 or more crop heat units and has a relative maturity (MG) of 2.3.

F_1 seeds were produced in the field during summer 2012 and planted in the greenhouse in the fall of 2012 at Harrow. The F_3 plants grown in the field at Harrow were selected for maturity, lodging, and plant vigour and were threshed individually. Selected seeds were sent to Puerto Rico for two generations of seed advancement by modified single seed descent in 2013. The F_6 plants were grown in a nursery at Harrow in 2014 with single plant selection based on maturity, lodging resistance, plant vigour, disease resistance, and apparent seed size.

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Table 1. Performance of experimental line AAC Richard and the check cultivar AAC Malden in southwestern Ontario, 2018 and 2019 AAFC trials.

	Plant							
Cultivar	Yield ($t \cdot ha^{-1}$)	Maturity (d)	Seed weight (g/100sd)	Protein %	Oil %	Sugar %	Plant eight (cm)	Lodging (1–5)[a]
AAC Richard	4.92a	113a	22.8a	44.4a	19.9a	12.6a	82a	1.2a
AAC Malden	4.89a	114a	22.6a	45b	19.4b	12.5a	78a	1.3a
LSD	0.52	2	2	0.54	0.4	0.3	4.5	0.3
No. Sites	11	8	11	11	11	11	8	6

Note: Performance based on eleven trials conducted at Chatham, Harrow, Malden, Merlin, Palmyra, and Woodslee in 2018 (BY18), and at Chatham, Harrow, Malden, Palmyra, and Woodslee 2019 (BY19). For protein, oil, and sugar, value is determined by whole dry matter basis by near infrared spectroscopy; sugars are total of sucrose, raffinose and stachyose. Different lowercase letters between corresponding means indicate significant difference ($P < 0.05$). LSD is Least Significant Difference between the corresponding means of AAC Richard and the check AAC Malden ($P < 0.05$).
[a]1 = no lodging to 5 = complete lodging.

The selected plants were threshed individually and additional selection was conducted on seed samples in the lab for uniformity of seed size, seed shape, hilum colour, and seed coat colour and integrity. The F_7 seeds were also selected for protein content by near-infrared reflectance spectroscopy analysis. The F_7 plants were grown in a plant row combine harvest (CH15) nursery in 2015 at Harrow with the MAD 2 design (Lin and Voldeng 1989). The line SN12-0037D-2-8E was selected based on yield, maturity, lodging resistance, plant height, seed size, and percentage of protein, oil, and sugars in the seed.

AAC Richard was evaluated for agronomic performance and seed quality in two-row, two-replication preliminary yield trials (PY16) at Harrow and Woodslee in 2016; in five-row, two-replication advanced yield trials (AY17) at three locations (Harrow, Woodslee, and Malden, ON) in 2017; and in five-row, three-replication yield trials at six locations (Harrow, Chatham, Palmyra, Merlin, Woodslee, and Malden, ON) in 2018 (BY18), and again at five locations (Chatham, Harrow, Malden, Palmyra, and Woodslee, ON) in 2019 (BY19). Selection criteria during yield testing were high yield and acceptable maturity and lodging, seed protein concentration, seed size, seed colour and appearance, high water uptake during soaking, and quality and yield of soymilk and tofu. In 2019, seed of 50 individual $F_{7:11}$ plants were evaluated for uniformity and 26 $F_{7:11}$ plant rows were sown and purified to establish Breeder Seed. Breeder seed was produced by bulking seed of the 26 uniform $F_{7:12}$ plots in 2020.

Performance

The agronomic performance of AAC Richard and the check cultivar, AAC Malden, in the AAFC 2018 (BY18) and 2019 (BY19) breeder yield trials are presented in Table 1. AAC Richard yielded the same as the check cultivar AAC Malden. AAC Richard matured about 1 day earlier than AAC Malden. The seed size of AAC Richard was about 0.2 g/100 seed larger than AAC Malden. The protein concentration of AAC Richard was about 1.6% lower than AAC Malden. AAC Richard was about 4 cm taller than the check but had a better lodging score than the check.

Disease Response

AAC Richard had resistance to SCN. In a heavily infested field, AAC Richard was rated 1 to 2 on a 1 = resistant, 5 = susceptible scale (Harovinton = 4.7; RCAT Ruthven = 1.2). In controlled temperature, replicated root inoculations with a mixture SCN HG 1-7 types cysts, AAC Richard showed resistance to SCN, with a Female Index of 1.3, compared with 100 for Lee74 and 16.4 for PI 88788.

Processing Quality

In tests conducted at Harrow, AAC Richard exhibited satisfactory tofu performance and quality, and good soymilk performance and quality (colour and sugars) in comparison with the processing check cultivar Harovinton (Buzzell et al. 1991) (Table 2). AAC Richard is offered as a food grade soybean cultivar with yellow hilum and resistance to SCN for the soymilk and tofu markets.

Other Characteristics

AAC Richard has an indeterminate growth habit, white flowers, green hypocotyls, and grey pubescence. The seeds are dull yellow with yellow hila.

Maintenance and Distribution of Pedigreed Seed

Breeder seed of AAC Richard is maintained by the AAFC Harrow-RDC, Harrow, Ontario. SeCan Association, 501–300 March Rd, Kanata, Ontario, Canada K2K 2E2 has exclusive rights to AAC Richard soybean for contract production of pedigreed seed for use in contract production.

Table 2. Soymilk and tofu yield and quality of AAC Richard and Harovinton in 2018, 2019, and 2020.

Quality	AAC Richard	Harovinton	LSD
Water Uptake[a]	2.23	2.22	0.03
Soymilk yield (L·kg^{-1} protein)	16.71a	16.60b	0.11
Soymilk yield (L·kg^{-1} bean)	7.10a	7.58b	0.08
Solids content of soymilk (%)	10.6a	10.2b	0.10
Sugar content of soymilk (%)	1.41a	1.27b	0.04
Soymilk colour[b] L	84.40a	84.2a	0.33
Soymilk colour[b] a	0.75a	0.61a	0.11
Soymilk colour[b] b	14.24a	14.83b	0.41
Tofu (GDL)[c] yield (kg·kg^{-1} protein)	16.53a	16.47a	0.12
Tofu (GDL)[c] yield (kg·kg^{-1} bean)	7.02a	7.52b	0.07
Tofu (GDL)[c] compression hardness (N)[d]	1.18a	1.65b	0.10
Tofu (GDL)[c] compression firmness (N·mm^{-1})[f]	0.23a	0.31b	0.02
Tofu (GDL)[c] compression springiness (ratio)	0.70a	0.81b	0.02
Tofu ($CaSO_4$)[e] yield (kg·kg^{-1} protein)	16.61a	16.52a	0.13
Tofu ($CaSO_4$)[e] yield (kg·kg^{-1} bean)	7.05a	7.54b	0.10
Tofu ($CaSO_4$)[e] compression hardness (N)[d]	0.63a	0.95b	0.07
Tofu ($CaSO_4$)[e] compression firmness (N·mm^{-1})[f]	0.15a	0.20b	0.02
Tofu ($CaSO_4$)[e] compression springiness (ratio)	0.55a	0.68b	0.02

Note: Seed of cultivars evaluated from trials in Chatham and Woodslee in 2018, 2019; Chatham, Woodslee and Malden in 2020. Different lowercase letters between corresponding means indicate significant difference ($P < 0.05$). LSD is Least Significant Difference between the corresponding means ($P < 0.05$).

[a](weight of hydrated beans after 22 h soaking at 13°C) /(initial weight of beans).

[b]HunterLab opponent colour scale; L, light (51–100) vs. dark (0–50); a, red (+) vs. green (−); b, yellow (+) vs. blue (−).

[c]Tofu made with glucono-delta-lactone coagulant.

[d]Hardness in Newtons.

[e]Tofu made with calcium sulphate dihydrate coagulant.

[f]Firmness in Newtons per mm.

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