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OPEN ACCESS | Cultivar description

AAC Kongsore oat

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Abstract

AAC Kongsore is a white-hulled spring oat (*Avena sativa* L.) cultivar selected and developed under organic management. AAC Kongsore had high yields under organic and conventional production systems, compared to check cultivars (AAC Oravena, Leggett, AC Morgan and CDC Dancer). AAC Kongsore has good physical and milling quality traits.

Key words: oat, *Avena sativa* L., cultivar description, milling oat, organic

Résumé

AAC Kongsore est une variété d'avoine de printemps (Avena sativa L.) sélectionnée et améliorée de manière biologique. Comparativement aux cultivars témoins (AAC Oravena, Leggett, AC Morgan et CDC Dancer), la variété donne un rendement élevé, qu'on la cultive de façon biologique ou classique. AAC Kongsore présente de bonnes propriétés physiques et meunières. Le 2 mars 2018, le Bureau d'enregistrement des variétés de l'Agence canadienne d'inspection des aliments lui a attribué le numéro d'homologation 8443. [Traduit par la Rédaction]

Mots-clés : avoine, Avena sativa L., description de cultivar, avoine de mouture, biologique

Introduction

AAC Kongsore is a white-hulled oat (*Avena sativa* L.) cultivar developed under organic management by Agriculture and Agri-Food Canada (AAFC), Cereal Research Centre (AAFC-CRC), Winnipeg, MB and Brandon Research and Development Centre, in collaboration with the University of Manitoba, Winnipeg, MB. AAC Kongsore was supported for registration at the Prairie Grain Development Committee Meeting in February 2017. It was registered (Reg. No. 8443) by the Variety Registration Office, Canada Food Inspection Agency, on 2 March 2018. AAC Kongsore exhibits good yield potential and agronomic performance under organic management systems in the oat producing areas of western Canada. AAC Kongsore was named to honour Christian Frederik Kongsore, Sr. (1927–2017), co-founder of Grain Millers, Inc., a staunch developer and supporter for milling of organically produced oat.

Pedigree and breeding method

Stainless/OT3013 where OT3013 = SA02468 = AC Morgan/OT299 and OT299 = W96382 = 97RAT23 = AC Rebel/Dumont 48.

AAC Kongsore was developed from a cross made in the spring of 2008 at the AAFC-CRC in Winnipeg, MB. The parents for this cross were selected in an attempt to combine the oat stem rust (OSR) (*Puccinia graminis* Pers. f. sp. *avenae* Eriks. and E. Henn.) and oat crown rust (OCR) (*Puccinia coronata* Cda f. sp. *avenae* Eriks.) resistance genes from Stainless (Mitchell Fetch et al. 2011) with the genetics of a breeding line (OT3013) from the Crop Development Centre, University of Saskatchewan, Saskatoon, SK. The parentage of OT3013 was AC Morgan (Kibite and Menzies 2001) and OT299, a breeding line developed from the cross between AC Rebel (Duguid et al. 2001) and Dumont 48. Dumont 48 resulted from crossing

Table 1. Grain yield (kg·ha^{-1}) of AAC Kongsore (OT8006) and check cultivars in the "B" Organic Yield Trial (BORG) for 2014 and 2016 in western Canada by soil zones.

	Soil zone			
Cultivar	Black*	Black and Grey†	Brown‡	Mean
CDC Dancer	4096.9a	5861.4ab	4783.1b	5040.4ab
AC Morgan	4142.6a	6201.3a	4867.0b	5306.4a
Leggett	4142.6a	5581.0b	5138.4ab	5016.9b
AAC Oravena	3466.9b	5449.6b	4625.0b	4601.8c
AAC Kongsore	**4159.3a**	**5681.4b**	**5513.7a**	**5163.8ab**
LSD§ ($P = 0.05$)	557.2	453.9	623.5	313.4
Station-years	5	7	4	16

Note: Means within a column not sharing a lowercase letter differ significantly at the $P < 0.05$ level.
*Tests grown near Carman and Roblin (2014, 2016), Glenlea (2016), MB.
†Tests grown near Dawson Creek, BC (2014, 2016), Edmonton and Fort Vermilion, AB (2014, 2016), and Lamont, AB (2014).
‡Tests grown near Kermen and Swift Current, SK (2014, 2016).
§Means separation and LSD were calculated utilizing the SAS PROC Mixed Macro (Saxton 1998).

Dumont (McKenzie et al. 1984) with the single gene differential line *Pc48* and backcrossing the progeny to Dumont six times. The population produced from the cross of Stainless/OT3013 was labelled 08P14A.

Six F_1 seeds from 08P14A were increased in one multiseed hill in New Zealand during the winter of 2008–2009 near Palmerston North under conventional management. The bulked F_2 seed was increased in a yield-sized plot (3.3 m^2) grown at the University of Manitoba Point land, Winnipeg, MB, again under conventional management. The population was exposed to oat loose smut (*Ustilago avenae* (Pers.) Rostr.) and OCR and OSR through artificial inoculations with each pathogen. A subsample of this bulk was then advanced in a large F_3 bulk plot (12 rows, 5 m long), grown under organic management, at the University of Manitoba Organic site at Glenlea, MB during the 2010 growing season. Any diseases encountered in this nursery were from natural inoculum or artificially inoculated nurseries (OCR, OSR, or Barley Yellow Dwarf Virus (BYDV)) from the AAFC disease nurseries located to the east. The harvested seed from this bulk plot was sieved to obtain the plumpest filled seed for planting a bulk F_4 plot the following generation in 2011, at the University of Manitoba organic site near Carman, MB. An F_5 bulk population was grown the following year at the Carman, MB site, from which about 50 panicles were collected randomly, threshed, and the seed was sent to the 2012–2013 winter nursery near Palmerston North, New Zealand. Forty-eight lines, each planted in two multiseed hills (at least 10 seeds per hill, nonreplicated), was evaluated for resistance to lodging, and for resistance or tolerance to the native disease inoculum of oat crown and stem rusts, and BYDV.

Twelve out of sixteen selected lines from this nursery produced enough seed (>220 g) and were planted in the 2013 Preliminary Organic Oat Trial (Prelim O), grown at two organically managed sites (Carman and Glenlea, MB), as well as at

Table 2. Summary of agronomic data for AAC Kongsore (OT8006) and check cultivars in the "B" Organic Test (BORG) for 2014 and 2016 in western Canada.

Cultivar	Days to head	Days to mature	Height (cm)	Lodging resistance* (1–9)	Test weight (kg·hL^{-1})	Kernel weight (mg)	Plump (%)†	Thin (%)‡	Hull (%)§	Protein (%)¶	Oil (%)¶	β-glucan (%)¶
CDC Dancer	54b	88c	100.5bc	2.6a	54.9ab	37.6bc	90.4ab	9.6bc	23.1c	15.3bc	7.3c	4.3c
AC Morgan	53b	90b	98.4c	2.8a	54.4b	39.0ab	91.6ab	8.4bc	26.6ab	15.0c	7.3c	4.5bc
Leggett	53bc	90b	93.3d	2.6a	55.3ab	37.0c	89.4b	10.6b	25.4b	16.4a	7.6c	4.8b
AAC Oravena	52c	88 bc	107.7a	3.1a	55.0ab	38.1abc	83.7c	16.3a	26.1ab	16.0ab	8.3b	5.9a
AAC Kongsore	**57a**	**93a**	**101.3b**	**2.8a**	**55.9a**	**39.6a**	**93.3a**	**6.7c**	**27.4a**	**16.7a**	**9.0a**	**4.9b**
LSD ($P = 0.05$)	1.1	1.3	2.5	0.6	1.2	1.9	3.6	3.6	1.6	0.8	0.5	0.4
Station years	8	11	15	11	16	16	16	16	10	10	10	10

Note: Means within a column not sharing a lowercase letter differ significantly at the $P < 0.05$ level. Means separation and LSD were calculated utilizing the SAS PROC Mixed Macro (Saxton 1998).
*1 no lodging; 9 completely lodged.
†Plump % based on proportion of a 50 g sample remaining on top of a 2.18 mm × 19.05 mm ($5\frac{1}{2}$/64 × 3/4″) sieve.
‡Thin % based on proportion of a 50 g sample passing through a 1.98 mm × 19.05 mm (5/64 × 3/4″) sieve.
§Fifty gram samples were dehulled with a Codema dehuller.
¶Dehulled samples were Retsch milled for wholemeal Near Infrared Reflectance scanning on a Unity Spectra Star 2400.

Table 3. Grain yield (kg·ha^{-1}) of AAC Kongsore (OT8006) and check cultivars in the Western Cooperative Oat Registration Yield Trial (WCORT) for 2015 and 2016 by soil zones.

	Soil zone				
Cultivar	Black*	Black and Grey†	Brown‡	Brown and Dark brown§	Mean
CDC Dancer	6044.9b	5643.6b	4616.4c	7681.8a	5783.4c
AC Morgan	6706.2a	6867.1a	5171.4a	8485.5a	6575.0a
Leggett	6456.2a	6015.1b	4640.1bc	8422.2a	6131.4b
AAC Kongsore	**6547.8a**	**6848.9a**	**5026.7ab**	**8589.7a**	**6476.4a**
LSD ($P = 0.05$)	368.0	557.2	391.6	1458.0	261.8
Station-years	11	6	5	2	24

Note: Means within a column not sharing a lowercase letter differ significantly at the $P < 0.05$ level. Means separation and LSD were calculated utilizing the SAS PROC Mixed Macro (Saxton 1998).
*Tests grown near Brandon, Glenlea, Morden, (2015, 2016) and Portage la Prairie (2015), MB; Indian Head and Melfort SK (2015, 2016).
†Tests grown near Beaverlodge and Lacombe, AB and Dawson Creek, BC (2015, 2016).
‡Tests grown near Fish Creek (2015), Kernen and Swift Current (2015, 2016), SK.
§Test grown under irrigation when required near Lethbridge, AB (2015, 2016).

two conventionally managed sites (Portage la Prairie, MB and Lacombe, AB) with one replication per location. The plot size was approximately 3.3 m^2 and the trial design was a randomized complete block design. Lines grown under organic management were exposed to natural disease infections of OCR and OSR, as well as competitive pressure from various weeds. Disease reaction nurseries were conducted concurrently on conventionally managed land, grown as hill plots at the University of Manitoba Point land in Winnipeg, Manitoba. Seed planted in these hill plots was artificially inoculated prior to planting with loose smut, and seedlings were inoculated in early growth stages with OCR and OSR in separate nurseries. Each year the crown rust inoculum was a composite of all the races collected from the annual survey in previous years. For OSR, an epidemic mixture of races FDJ, NGB, TDD, TGB, TGL, and TJJ increased in a greenhouse was used. As well, a BYDV nursery was grown under conventional management at AAFC-CRC Glenlea, MB where virulent *Rhopalosiphum padi* L. (oat bird-cherry aphid) nonspecific isolate Y9301 (PAV-like) was used to infect the young plants.

Agronomically superior lines with resistance to diseases were evaluated using near-infrared reflectance spectrophotometry (NIRS) on whole oat to identify lines with superior nutritional quality traits such as lower hull content, higher % protein and β-glucan, and lower oil content. Superior lines, including 08P14A-OA23, were selected for advancement to the 2014 B Organic Trial (BORG), grown at eight organically (or no inputs) managed locations across western Canada, where it was tested as 14BORG25 (Carman and Roblin, MB, Saskatoon and Swift Current, SK, Edmonton, Lamont and Fort Vermilion, AB, and Dawson Creek, BC). This trial attempted to target a seeding rate of over 23 plants/ft^2 in each of three replicated plots per location (plot size varied over locations). The trial design was a 5 × 5 lattice. The checks matched those included in the western oat registration trial (CDC Dancer, Morgan, and Leggett). Concurrent disease nurseries were grown at Morden, MB under conventional management to evaluate reactions to smut, rusts, and BYDV. Seedling reactions to selected races of OSR were carried out under greenhouse conditions. Selections for advancement to the next year of testing were based on agronomic merit compared to the check cultivars, disease resistance, and NIRS quality evaluations, including oil, protein, and β-glucan contents, performed on dehulled ground groats.

The selected line, 08P14A-OA23, was labelled as OT8006 and entered into the first year of testing in the Western Cooperative Oat Registration Trial (WCORT) in 2015, and was tested at 13 conventionally managed sites in western Canada and 3 in eastern Canada. In 2016, OT8006 was selected for a second year of testing in the WCORT, as well as in the 2016 BORG, again at organically managed sites across western Canada. Disease reaction nurseries with artificial inoculations were conducted in 2013–2016 on conventionally managed land, including evaluations for BYDV in 2016 at the University of Illinois, Urbana, IL, USA. Fusarium head blight (FHB) reactions were evaluated in nurseries infected with *Fusarium graminearum*-infested corn at Morden, MB, and at Harrington, PE. Deoxynivalenol (DON) data from ground whole oat were provided by AAFC Ottawa Research and Development Centre, Ottawa, ON.

Breeder Seed of AAC Kongsore was developed by collecting 250 panicles from a rogued increase grown at Lacombe, AB in 2014. An isolation of 220 1 m long rows was grown at Brandon, MB in 2015, separated from each other adjacently by fall cereal, and isolated from other cereals by at least 10 m. The isolation rows were visually evaluated and selected for uniformity. One hundred fifty-two 15 m rows were planted in 2016 in Indian Head, Saskatchewan from rows selected from the isolation. Twelve nonuniform lines were discarded from this increase. One hundred forty rows were used to produce approximately 260 kg of Breeder Seed.

Performance

Area of adaptation

Grown under organic management systems, AAC Kongsore had high yields, significantly higher than AAC Oravena (Mitchell Fetch et al. 2022), except in the Black and Grey soil zone (Table 1). AAC Kongsore had the highest mean yield compared to the checks in the Brown soil zone, but similar

Table 4. Summary of agronomic data for AAC Kongsore (OT8006) and check cultivars in the Western Cooperative Oat Registration Trial (WCORT) for 2015 and 2016 in western Canada.

Cultivar	Days to head	Days to mature	Height (cm)	Lodging resistance* (1–9)	Test weight (kg·hL^{-1})	Kernel weight (mg)	Plump (%)†	Thin (%)‡	Groat (%)§	Protein (%)	Oil (%)	β-glucan (%)	TDF (%)
CDC Dancer	52c	96c	102.3b	3.4a	52.5a	36.2c	88.9ab	2.7ab	77.3a	14.9c	6.8c	4.7c	9.3b
AC Morgan	53b	97b	99.7b	2.5b	50.4b	38.7b	86.1b	2.9a	71.2c	14.9c	6.6c	4.5c	9.9b
Leggett	52c	98b	95.7b	3.8a	52.4a	37.3c	86.5b	2.7ab	74.1b	17.7a	7.3b	5.5a	9.7b
AAC Kongsore	**57a**	**99a**	**105.9a**	**2.5b**	**53.3a**	**40.8a**	**92.7a**	**1.7b**	**71.9c**	**17.0b**	**8.6a**	**4.8b**	**10.8a**
LSD ($P = 0.05$)	0.6	0.7	1.6	0.4	0.9	1.4	4.1	1.0	2.0	0.5	0.4	0.2	0.7
Station-years	12	17	22	14	24	24	12	12	12	12	12	12	3

Note: Means within a column not sharing a lowercase letter differ significantly at the $P < 0.05$ level. Means separation and LSD were calculated utilizing the SAS PROC Mixed Macro (Saxton 1998). Protein: wholemeal samples analysed by a standard combustion procedure using the Flash 2000. Standard analytical procedures used to quantify oil (AOAC 922.06), β-glucan (AACC32_23) on duplicate samples, and total dietary fibre (TDF; AACC Method 32.45.01 (AOAC method 2009.01)).

*1 no lodging; 9 completely lodged.

†Plump % based on proportion of a 50 g sample remaining on top of a 2.18 mm × 19.05 mm ($5\frac{1}{2}$/64 × 3/4″) sieve.

‡Thin % based on proportion of a 50 g sample passing through a 1.98 mm × 19.05 mm (5/64 × 3/4″) sieve.

§Fifty gram samples were dehulled with a Codema dehuller (Groat).

to AC Morgan and CDC Dancer across all of the testing zones in 2014 and 2016 (Table 1). Means for agronomic, physical quality, and milling quality traits are presented in Table 2. The mean height of AAC Kongsore was taller than the conventionally developed checks, but significantly shorter than AAC Oravena, the organically developed check cultivar in the test. Lodging resistance was good, similar to AC Morgan, the lodging resistant check. Test weight was higher than all of the checks, as well as thousand kernel weight. Percent plump kernels was significantly higher than that of AAC Oravena (Table 2). Mean kernel protein content for AAC Kongsore was higher than the checks, while β-glucan content was similar to or significantly higher than the conventionally developed checks. Oil content was significantly higher than all the checks.

Under conventional management during testing in the 2015 and 2016 WCORT, AAC Kongsore yielded comparably to AC Morgan in all soil and climactic zones (Table 3), but significantly outyielded Leggett (Mitchell Fetch et al. 2007) and CDC Dancer when averaged across years and zones. The mean test weight of AAC Kongsore was higher than the checks in conventional production systems (Table 4). Thousand kernel weight was significantly higher than the checks (Table 4).

Under both types of production management, heading and maturity were significantly later than the checks (Tables 2 and 4), height was taller than the checks, but lodging resistance was similar to the checks. Mean % plump seeds and protein content were high under both types of management, and β-glucan and total dietary fibre (Table 4) content was suitable for milling. Oil content was significantly higher than the checks, but may be well-suited for cosmetic production or feeding end uses (Tables 2 and 4).

Disease reaction

AAC Kongsore showed a moderately susceptible to susceptible reaction to BYDV when tested in Canada (2013–2014; data not presented) but was resistant compared to the check cultivars in the Illinois nursery in 2016 (Table 5), possibly due to the presence of different viral races, or environmental conditions during screening. AAC Kongsore was consistently resistant to loose smut.

AAC Kongsore had a moderately resistant to moderately susceptible field rating to OCR, but was resistant to the individual races of OCR applied at the seedling stage, except for LQCB-91 (CR259), indicating it may carry the single gene, *Pc91*, for resistance (Table 5). This gene has been recently reduced in resistance capacity due to changes in the pathogen populations in the eastern prairies of Canada (Menzies et al. 2019). The gene was effective until 2011, when changes began to occur in the prevalent crown rust pathogen population, with virulence to *Pc91* increasing. By 2015, when AAC Kongsore was being tested in the WCORT, more than 67% of the isolates in the rust population were virulent to *Pc91*. AAC Kongsore ranged from moderately susceptible to intermediate with low severity in field reactions to OSR, which is similar to the checks, and it is resistant to the individual races of OSR, including TJJ (NA67) (Table 5).

AAC Kongsore had higher DON levels compared to the checks in the 2015 and 2016 WCORT (Table 5).

Table 5. Summary of disease reactions for AAC Kongsore (OT8006) and check cultivars in the Western Cooperative Oat Registration Test 2015–2016.

2015 WCORT field and greenhouse disease reactions

						OCR greenhouse rating									OSR greenhouse rating					
Entry	BYDV	Smut (%)	FHB DON (ppm)	FHB field rating	OCR field rating	SJGL-96 CR13	NGCB-94 CR223	DSGB CR241	DQGB-94 CR249	LRBG CR254	BRBG-94 CR257	NTGG CR258	LQCB-91 CR259	OSR field rating	FDJ (NA8)	NGB (NA16)	TDD (NA25)	TGB (NA27)	TGL (NA28)	TJJ (NA67)
CDC Dancer	5.75 (MS)	1	1.4	MR	5MS	;	;	2	4	3	4	3	;4f	20 MS	;1−	11+	12−	11+	2–2	4
AC Morgan	3.5 (RMR)	0	2.1	MS-MR	15S	4	4	4	4	4	4	3	4	90S	33+	4	33+	34	33+	34
Leggett	5.75 (MS)	0	2.4	MS-MR	R	;	;	;	0	0	4	0(4)	0	25MS	1−	1−	2–2	12	2+	34
AAC Kongsore	**Not tested**	**0**	**3.4**	**MS**	**5S**	**;**	**;**	**;**	**0**	**;**	**0**	**;**	**4**	**20I**	**1−**	**11+**	**1–1**	**1–1**	**1–1**	**2–2**

2016 WCORT field and greenhouse disease reactions

						OCR greenhouse rating									OSR greenhouse rating					
Entry	BYDV	Smut (%)	FHB DON (ppm)	FHB field rating	OCR field rating	SJGL-96 CR13	NGCB-94 CR223	DSGB CR241	DQGB-94 CR249	LRBG CR254	BRBG-94 CR257	NTGG CR258	LQCB-91 CR259	OSR field rating	FDJ (NA8)	NGB (NA16)	TDD (NA25)	TGB (NA27)	TGL (NA28)	TJJ (NA67)
CDC Dancer	7 (S)	0	5.1	MR	10MS	;	;	4	4	;	4	4	;4 F	20 I	;1−	;1−	1	11+	11+	34
AC Morgan	4 (MR)	0	3.2	R	15S	4	4	4	4	4	4	4	4	60 S	34	34	4	4	4	34
Leggett	5.5 (I)	0	2.6	R	2R	;	;	;	;(4)	;	4	;	;	20 MS	;1−	1−	11+	1	12−	34
AAC Kongsore	**2 (R)**	**0**	**7.0**	**I**	**1MR**	**0**	**0**	**0**	**1**	**;**	**;**	**;**	**4**	**10 I**	**;**	**;1**	**;1-**	**1−**	**1**	**1**

Note: Virulent *Rhopalosiphum padi* nonspecific isolate Y9301 (PAV-like) was used. Barley yellow dwarf virus (BYDV) readings were taken at mid-dough using 1–9 (best–worst) scale; R = 1–3.5, MR = 3.51–4.5, MR-MS or I = 4.51–5.5, MS = 5.51–6.5, S = 6.51–9.0. Smut data: a mixture of three races of Black Loose Smut (*Ustilago avenae* (Pers.) Rostr.), A13, A60, and A617, was used as inoculum. % infection. R = 0%–15%, MR = 16%–35%, MR-MS = 36%–55%, MS = 56%–75%, S > 75%. DON Data: X. Wang; Field data based on a mean of four reps. DON data supplied by B. Blackwell. Oat crown rust: Field ratings based on artificial inoculation with composite of isolates bulked from the previous year annual crown rust survey in Manitoba. Ratings follow Peterson et al. (1948), where 0 = immune; VR = very resistant; Tr = trace; R = resistant; MR = moderately resistant; I = MRMS; MS = moderately susceptible; S = susceptible. OCR greenhouse ratings: All entries were inoculated with selected races of crown rust in greenhouse seedling tests. Ratings follow Stakman et al. (1962). Oat stem rust: Field ratings based on reaction to an artificially inoculated mixture of races (NA8, 16, 25, 27, 28, 55, and NA67). Ratings follow Peterson et al. (1948). OSR greenhouse ratings: All entries were inoculated with seven selected races of stem rust in greenhouse seedling tests. Ratings follow Stakman et al. (1962).

Other characteristics

Seedling characteristics

COLEOPTILE COLOUR: Green
JUVENILE GROWTH HABIT: Erect
SEEDLING LEAVES: Leaf blade and sheath are pubescent

Adult plant characteristics

FLAG LEAF: Short to medium length, medium width, erect
LEAF MARGIN: Glabrous
PLANT HEIGHT: 3–6 cm taller than AC Morgan

Panicle characteristics

SHAPE: Equilateral
LENGTH: Medium
DENSITY: Lax to Intermediate
PANICLE BRANCHES: Semi-erect to horizontal, 6 whorls, attached at angle $> 45^{\circ}$
RACHILLA: Glabrous; medium long

Spikelet characteristics

ATTITUDE: Seminodding
NUMBER OF FLORETS: Two or less
SPIKELET SEPARATION: Semi-abscission
GLUMES: Yellow at maturity

Kernel characteristics

SIZE: Short (12–15 mm long), wider than reference checks (>3.6 mm)
COLOUR: White to yellow
BASAL HAIRS: Present, short
LEMMA COLOUR: Yellow (similar to AC Morgan and Leggett), medium-pointed tip
LEMMA AWNS: Absent to very infrequent

Maintenance and distribution of pedigreed seed stocks

Breeder Seed of AAC Kongsore will be maintained by the Seed Increase Unit, Agriculture and Agri-Food Canada, Research Farm, Indian Head, Saskatchewan, Canada, S0G 2K0. Multiplication and distribution of pedigreed seed will be through Grain Millers Inc., 1 Grain Millers Drive, Yorkton, SK S3N 3Z4.

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Data availability

Primary Research Data could be accessed by contacting the corresponding author.

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Author notes

Jennifer W. Mitchell Fetch, T.G. Fetch, Jr. and N. Ames are retired.
Andrew Burt and Santosh Kumar served as Associate Editors at the time of manuscript review and acceptance; peer review and editorial decisions regarding this manuscript were handled by Ana Badea.

Competing interests

The authors declare there are no competing interests.

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