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CULTIVAR DESCRIPTION

# AAC Elie hard red spring wheat

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**Abstract:** AAC Elie hard red spring wheat (*Triticum aestivum* L.) has grain yield and time to maturity within the range of the checks. AAC Elie has an awned spike, a low lodging score indicative of strong straw, and a short plant stature typical of a semidwarf. These traits were comparable to the check Carberry. AAC Elie expressed resistance to prevalent races of leaf and stem rust, and intermediate resistance to fusarium head blight, yellow rust, common bunt, and loose smut. Compared with the five Canada Western Red Spring checks, AAC Elie has improved flour yield, and lower flower ash. AAC Elie is eligible for grades of Canada Western Red Spring.

*Key words: Triticum aestivum* L., wheat, cultivar description, grain yield, disease resistance, semidwarf.

**Résumé :** AAC Elie est une variété de blé roux vitreux de printemps (*Triticum aestivum* L.) dont le rendement grainier et le laps de temps pour parvenir à maturité se situent dans la fourchette des valeurs des variétés témoins. AAC Elie se caractérise par un épi barbu, un faible taux de verse signalant une paille robuste et une taille peu élevée, typique des variétés semi-naines. Ces caractères sont comparables à ceux du cultivar témoin Carberry. AAC Elie résiste aux races courantes de rouille des feuilles et de la tige et jouit d'une résistance moyenne à la brûlure de l'épi causée par *Fusarium*, à la rouille jaune, à la carie et au charbon nu. Comparativement aux cinq cultivars témoins de blé roux de printemps de l'Ouest canadien, AAC Elie donne une plus grande quantité de farine contenant moins de cendres. AAC Elie est admissible à la catégorie « blé roux de printemps de l'Ouest canadien< ». [Traduit par la Rédaction]

*Mots-clés : Triticum aestivum* L., blé, description de cultivar, rendement grainier, résistance à la maladie, semi-nain.

## Introduction

AAC Elie, a hard red spring wheat (*Triticum aestivum* L.) cultivar, was developed at the Semiarid Prairie Agricultural Research Centre (SPARC), Agriculture and Agri-Food Canada (AAFC), Swift Current, SK. It received registration No. 7362 from the Variety Registration Office, Plant Production Division, Canadian Food Inspection Agency (CFIA) on 23 Apr. 2013. AAC Elie was granted Plant Breeders' Rights certificate No. 4959 by the Plant Breeders' Rights office, CFIA on 26 Nov. 2014.

## Origin and Breeding

AAC Elie derives from the cross Superb/CDC Osler//ND744 made in 2003 at the Semiarid Prairie Agricultural Research Centre of Agriculture and Agri-Food Canada, Swift Current, SK. Superb derives from the cross of Grandin*2/AC Domain (Townley-Smith et al. 2010). CDC Osler derives from the cross AC Cora/PT534 (Hucl 2003). ND744 derives from the cross of ND2831/Parshall//ND706 (Mergoum et al. 2005). In 2003, about 10 000 $F_2$ seeds were inoculated with common bunt [*Tilletia laevis* Kühn in Rabenh., and

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*T. tritici* (Bjerk.) G. Wint. in Rabenh.] races L16 and T19 (Hoffmann and Metzger 1976) and space-planted 15 cm apart in 90 m long rows. The rows were 23 cm apart with every second row planted with CDC Kestrel winter wheat (Fowler 1997), which is susceptible to leaf rust (*Puccinia triticina* Eriks.) and stem rust (*P. graminis* Pers.:Pers. f.sp. *tritici* Eriks. & E. Henn.). A leaf rust and stem rust epiphytotic nursery was established by planting genotypes susceptible to prevalent races of leaf and stem rust in every fifth spring wheat row and needle inoculating a sample of these plants followed by regular irrigation. Representative leaf rust races found the previous year were applied (McCallum and Seto-Goh 2006). Stem rust races used were: QTHST (C25), RHTSK (C20), RKQSR (C63), RTHJT (C57), TMRTK (C10) and TPMKR (C53) (Roelfs and Martens 1988; Fetch 2005). From the disease nursery, 365 disease-free, semidwarf statured, strong strawed, and early maturing $F_2$ plants were selected, threshed individually, and further selected for kernel characteristics. The $F_3$ seed of 293 $F_2$ derived individuals was planted as 2 m long head-rows in a contra season nursery near Lincoln, New Zealand. From these, 121 lines were selected on the basis of time to maturity comparable to the checks, plant height, straw strength, shattering, and were harvested as individual rows. The seed of 121 $F_{2:4}$ lines was grown in four-row plots with a harvested area of 2.76 $m^2$ near Swift Current, Indian Head, and Regina to assess agronomic performance. Response to fusarium head blight (FHB) was assessed in a specialized nursery near Portage la Prairie, MB. Agronomic plots were harvested at maturity and grain weight of each plot was measured. Grain protein concentration and volume weight were measured using near infrared reflectance spectroscopy (Williams 1979) on a whole grain sample of each experimental line within each location. Seed size and kernel attributes were measured on the same whole grain sample. A subsample was submitted to the Central Quality Lab, Cereal Research Centre, AAFC, Winnipeg, MB to determine end-use suitability for the Canada Western Red Spring (CWRS) market class. Prior to harvest, five spikes were collected from yield trial plots of each $F_4$ line at Swift Current. The best 28 families each with four lines per family were grown as the $F_5$ generation in 2 m long head-rows near Irwell, NZ. The $F_5$ families were selected on the basis of grain quality and kernel attributes assayed on the grain from the $F_4$ yield trial. Experimental $F_5$ lines within acceptable families were selected on the same basis as in the $F_3$ generation. In the $F_{4:6}$ generation, 69 lines were grown in agronomic trials near Swift Current and Indian Head, SK, and Morden, MB, following a protocol similar to that of the $F_4$ generation. Five spikes were collected from plots of each $F_6$ line at Swift Current, as well as five spikes from plots expressing low FHB symptoms in the FHB nursery near Carman

**Table 1.** Grain yield of AAC Elie compared with the check cultivars in the Western Bread Wheat Cooperative test[a], 2009–2011.

| | Yield (kg ha$^{-1}$) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Zone 1[a] | | | | Zone 2 | | | | Zone 3 | | | | Mean[b] |
| Entry | 2009 | 2010 | 2011 | Mean | 2009 | 2010 | 2011 | Mean | 2009 | 2010 | 2011 | Mean | 2009–2011 |
| Katepwa | 3393 | 3614 | 3336 | 3414 | 3927 | 3500 | 4185 | 3873 | 6418 | 5367 | 5920 | 5825 | 4185 |
| Laura | 3597 | 3478 | 3600 | 3574 | 4256 | 3815 | 4451 | 4177 | 6693 | 5923 | 5468 | 6013 | 4458 |
| Lillian | 3572 | 3464 | 3562 | 3546 | 4220 | 3358 | 4398 | 4001 | 6750 | 5623 | 6163 | 6099 | 4335 |
| Carberry | 3945 | 3362 | 3401 | 3611 | 4183 | 3661 | 4576 | 4142 | 6427 | 5889 | 6205 | 6133 | 4462 |
| CDC Kernen | 3602 | 3747 | 3727 | 3681 | 4417 | 4020 | 4645 | 4363 | 7373 | 6485 | 6597 | 6771 | 4731 |
| Mean of the Checks | 3622 | 3533 | 3525 | 3565 | 4201 | 3671 | 4451 | 4111 | 6732 | 5857 | 6071 | 6168 | 4434 |
| AAC Elie | 3681 | 3991 | 3846 | 3809 | 4482 | 3866 | 4535 | 4302 | 6927 | 6039 | 6400 | 6396 | 4637 |
| LSD[c] $_{0.05}$ | 393 | 384 | 371 | | 283 | 282 | 406 | | 680 | 501 | 578 | | 323 |
| No. of trials | 2 | 1 | 2 | 5 | 9 | 8 | 8 | 25 | 2 | 3 | 2 | 7 | 37 |

[a]Locations: Zone 1: Stewart Valley, Swift Current; Zone 2: Beiseker, Goodale, Indian Head, Kernen, Lethbridge, Neapolis, Three Hills, Regina, Scott, Watrous; Zone 3: Edmonton, Lacombe, Melfort.

[b]Means are based on LS Means procedure of SAS®.

[c]Least significant difference, $P \leq 0.05$, includes the appropriate genotype by environment interaction variation.

**Table 2.** Three year means[a] for agronomic characteristics of AAC Elie compared with the check cultivars in the Western Bread Wheat Cooperative test, 2009–2011.

| Entry | Maturity (d) | Height (cm) | Lodging[b] (1–9) | Test weight (kg h $L^{-1}$) | Kernel size (mg) | Protein (%) |
|---|---|---|---|---|---|---|
| Katepwa | 103.4 | 96 | 2.5 | 78.8 | 33.7 | 13.9 |
| Laura | 106.5 | 94 | 2.8 | 78.7 | 33.2 | 14.2 |
| Lillian | 103.6 | 93 | 2.1 | 78.3 | 36.9 | 14.8 |
| Carberry | 107.5 | 81 | 1.2 | 80.3 | 36.2 | 14.2 |
| CDC Kernen | 105.7 | 96 | 2.1 | 79.7 | 36.8 | 14.3 |
| Mean of checks | 105.3 | 92 | 2.1 | 79.2 | 35.4 | 14.3 |
| AAC Elie | 107.1 | 79 | 1.5 | 80.3 | 36.3 | 14.0 |
| No. of trials | 34 | 38 | 13 | 38 | 38 | 38 |
| $LSD^{c}_{0.05}$ | 1.5 | 3.0 | 0.6[c] 0.4[d] | 0.6 | 2.0 | 0.5 |

[a]Averages are based on LS Means procedure of SAS®.
[b]Straw strength rated on a scale of 1 indicating that all plants in plot are erect to 9 indicating that all plants in a plot are lying horizontal.
[c]Least significant difference, $P \leq 0.05$, includes the appropriate genotype by environment interaction variation.
[d]Least significant difference, $P \leq 0.1$, includes the appropriate genotype by environment interaction variation.

MB. Samples from harvested plots were measured for grain yield weight. Grain protein concentration and volume weight of each $F_6$ line were measured using near infrared reflectance spectroscopy on a whole grain sample within each location. Nineteen families of five lines per family, selected from the FHB nursery near Carman, were grown as $F_7$ head-rows near Irwell, NZ. Families were selected on the basis of grain quality and kernel attributes assayed on grain from the $F_6$ yield trial. In the $F_{6:8}$ generation, 72 lines were grown in agronomic trials near Swift Current and Indian Head, SK, and Morden, MB. Grain was harvested and processed similarly to grain from $F_6$ plots. In the $F_8$ generation response to FHB was again assessed near Carman, MB. Selected $F_8$ lines were screened for reaction to a T2, T9, T10, and T39 mixture of races of loose smut [*Ustilago tritici* (Pers.) Rostr.] (Nielsen 1987), and races L16 and T19 of common bunt. In the $F_4$, $F_6$, and $F_8$ generations, response to leaf and stem rust was used as a selection criterion by assessing response to the rusts in an epiphytotic nursery near Glenlea, MB. Through this breeding process, the experimental line B0313-CK03W met all selection criteria at each generation.

B0313-CK03W was evaluated in the Western Bread Wheat A_2 test in 2008, and entered in the Western Bread Wheat Cooperative (WBWC) tests from 2009 to 2011 as BW931. Annually, the WBWC consisted of 25 experimental lines and five check cultivars grown in a 5 × 6 lattice design with three replications at up to 13 locations per year. The check cultivars were Carberry (DePauw et al. 2011), Katepwa (Campbell and Czarnecki 1987), Laura (DePauw et al. 1988), Lillian (DePauw et al. 2005), and CDC Kernen (Hucl 2012). The variables measured and protocols followed in the WBWC test were described in the operating procedures of the Prairie Recommending Committee for Wheat, Rye, and Triticale (Anonymous 2013 http://www.pgdc.ca/committees_wrt.html). The MIXED procedure of SAS® (Littell et al. 2006) was used to perform yearly and multiyear analyses for agronomic data with years, environments, and their interactions considered random effects and cultivar treated as a fixed effect. Mean separation tests were performed using Fisher's protected LSD procedure. Nine trials out of the remaining 13 trials had a test mean lodging score of less than two with lodging scored on a one (all plants in a plot vertical) to nine (all plants lying horizontal within a plot). To examine the genotype environment interaction for lodging, an extension of the GLIMMIX procedure, sensitivity/stability analysis, was undertaken. The analysis included 11 genotypes which were trialed together at all 13 sites, and used site mean for lodging as a covariate to explain variability for cultivar differences among sites for lodging. Cultivar and covariable by cultivar effects were included as fixed effects for the analysis. A regression coefficient was estimated for each cultivar; coefficients <1 indicated cultivar responses were less sensitive to lodging. Pairwise comparisons of AAC Elie to other genotypes were performed.

Response to several diseases was assessed in specialized disease nurseries from 2009 to 2011. Leaf and stem rust seedling infection types were assessed using stem rust races QTHST (C25), RHTSK (C20), RKQSR (C63), RTHJT (C57), TMRTK (C10), and TPMKR (C53) (Roelfs and Martens 1988; Fetch 2005), and leaf rust races MBDS (12-3), MBRJ (128-1), MGBJ (74-2), TDBG (06-1-1), TDBJ (70-1), and TJBJ (77-2) (McCallum and Seto-Goh 2006). Field evaluations of leaf and stem rust reactions, using leaf rust races representative of those found the previous year and the same stem rust races as for the seedling tests, were

**Table 3.** Summary of response of 11 genotypes to lodging (rated on a scale of 1 indicating that all plants in a plot are erect to nine indicating that all plants in a plot are lying horizontal) and sensitivity of the response to the site environment; pairwise estimated mean difference based on 13 environment of AAC Elie to the 11 genotypes for lodging. Data from the Western Bread Wheat Cooperative tests, 2009–2011.

| | Sensitivity coefficient[a] | | | Summary of environments with low lodging scores | | Summary of environments with high lodging scores | |
|---|---|---|---|---|---|---|---|
| Genotype | Estimate | SE | | Lodging (1–9) | <1.1[b] | Lodging (1–9) | >2.9[b] |
| Katepwa | 1.0 | 0.54 | | 1.6 | * | 4.1 | * |
| Laura | 1.7 | 0.54 | * | 1.0 | | 4.8 | * |
| Lillian | 0.0 | 0.54 | | 1.0 | | 3.1 | |
| Carberry | −0.7 | 0.54 | | 1.0 | | 2.3 | |
| CDC Kernen | 0.7 | 0.54 | | 1.0 | | 3.6 | * |
| AAC Elie | −0.7 | 0.54 | | 1.0 | [c] | 2.3 | [c] |
| BW918 | −0.3 | 0.54 | | 1.0 | | 2.7 | |
| BW922 | −0.7 | 0.54 | | 1.0 | | 2.2 | |
| BW927 | −1.0 | 0.54 | | 1.0 | | 2.0 | |
| BW930 | −0.3 | 0.54 | | 1.0 | | 2.8 | |
| BW932 | 0.0 | 0.54 | | 1.0 | | 3.1 | |
| $LSD^{d}_{0.05}$ | | | | 0.4 | | 1.2 | |

| Genotype | Genotype | Estimated difference[e] | SE[f] | |
|---|---|---|---|---|
| Katepwa | AAC Elie | 0.97 | 0.24 | ***[g] |
| Laura | AAC Elie | 1.33 | 0.24 | *** |
| Lillian | AAC Elie | 0.56 | 0.24 | * |
| Carberry | AAC Elie | −0.28 | 0.24 | |
| CDC Kernen | AAC Elie | 0.59 | 0.24 | * |
| BW918 | AAC Elie | 0.18 | 0.24 | |
| BW922 | AAC Elie | −0.26 | 0.24 | |
| BW927 | AAC Elie | −0.31 | 0.24 | |
| BW930 | AAC Elie | −0.13 | 0.24 | |
| BW932 | AAC Elie | 0.08 | 0.24 | |

[a]Sensitivity coefficients are slope coefficients of the regression variable (lodging site mean) and cultivar lodging. Lower coefficients reflect less sensitivity to environments suitable for lodging to be expressed as indicated by site mean lodging.
[b]Cultivar means were estimated at low (minimum site mean for lodging) and high (maximum site mean for lodging) scores.
[c]Control cultivar to which means were compared; statistical significance indicated at $P \le 0.05$.
[d]LSD, least significant difference, $P \le 0.05$ was obtained as on a site basis.
[e]Estimated difference of cultivar means for lodging averaged over three replications at each of 13 sites.
[f]Standard error of genotype mean difference.
[g]Statistical significance indicated as ***$P \le 0.001$, and *$P \le 0.05$ and $\ge 0.01$.



measured annually in epiphytotic nurseries near Glenlea, MB. Reaction to fusarium head blight was assessed in artificially inoculated field tests conducted annually near Glenlea and Carman, MB, Ottawa ON, Lévis, QC, and Charlottetown, PEI (Gilbert and Woods 2006). To determine the response to loose smut, a mixture of the prevalent races T2, T9, T10, and T39 was injected into florets at anthesis of plants grown in the field and the inoculated seed subsequently grown out and rated in a greenhouse (Menzies et al. 2003). To determine the response to common bunt, a mixture of prevalent races L1, L16, T1, T6, T13, and T19 was used to inoculate the seed planted in mid-April of each year near Lethbridge, AB (Gaudet and Puchalski 1989). The race designations are those described by Nielsen (1987) for loose smut and Hoffmann and Metzger (1976) for common bunt.

A sample of grain of the check cultivars from each location was submitted to the Canadian Grain Commission to determine grain grade and protein concentration. End-use suitability was determined on a composite sample made up from sites with grain samples representative only of the top hard red spring wheat grades available. The quantity of grain from a location was adjusted to achieve a final composite protein concentration approximating that of the average for the crop that year. A consistent quantity of grain within a location for all experimental lines was used to make up the composite each year. All end-use suitability analyses were performed by personnel at the Grain Research Laboratory, Canadian Grain Commission, Winnipeg, MB following protocols of the AACC (American Association of Cereal Chemists 2000).

**Table 4.** Disease reactions of AAC Elie and check cultivars in the Western Bread Wheat Cooperative test 2009–2011 grown at various locations.

| Entry | Field leaf rust Glenlea | | | | | | Field stem rust | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2009 | | 2010 | | 2011 | | Glenlea 2009 | | Glenlea 2010 | | Portage 2011 | | Winnipeg 2011 | |
| | Severity[a] (%) | Rating[a] | Severity (%) | Rating | Severity (%) | Rating | Severity[b] (%) | Disease response[c] | Severity (%) | Disease response | Severity (%) | Disease response | Severity (%) | Disease response |
| Katepwa | 30 | MR | 70 | S | 30 | I | 10 | RMR | 10 | R | 5 | R | 10 | MR |
| Laura | 0 | R | 2 | R | 0 | R | 7 | RMR | 10 | R | 5 | R | 10 | R |
| Lillian | 3 | R | 2 | R | 0 | R | 10 | RMR | 10 | R | 5 | R | 7 | MR |
| Carberry | 0 | R | 5 | R | 0 | R | 10 | RMR | 10 | RMR | 5 | R | 10 | MR |
| CDC Kernen | 10 | R | 8 | R | 1 | R | 15 | RMR | 10 | RMR | 5 | R | 1 | R |
| AAC Elie | 0 | R | 0 | R | 0 | R | 5 | R | 5 | R | 5 | R | 2 | R |
| LSD[d] 0.05 | 6 | | 10 | | | | | | | | | | | |

| Entry | Yellow rust | | | | | | Bunt | | | | | | Loose smut | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010 | | | | 2011 | | Lethbridge | | | | | | Glenlea | | | | | |
| | Lethbridge | | Creston | | Lethbridge | | 2009 | | 2010 | | 2011 | | 2009 | | 2010 | | 2011 | |
| | Severity[d] | Reaction[e] | Severity | Reaction | Severity | Reaction | Infection[f] (%) | Reaction[e] | Infection (%) | Reaction | Infection (%) | Reaction | Infection[g] (%) | Reaction[e] | Infection (%) | Reaction | Infection (%) | Reaction |
| Katepwa | 8 | VR | 25 | I | 30 | I | 23 | I | 5 | R/RMR | 22 | I | 3 | R | 8 | R | 0 | R |
| Laura | 2 | VR | 5 | R | 47 | S | 49 | S | 46 | S | 40 | MS | 31 | MR | 72 | MS | 29 | MR |
| Lillian | 1 | VR | 1 | R | 2 | VR | 4 | R | 8 | R/RMR | 6 | MR | 30 | MR | 56 | MS | 69 | MS |
| Carberry | 0 | VR | 0 | R | 10 | R | 1 | R | 4 | R/RMR | 1 | MR | 17 | MR | NA | NA | 5 | R |
| CDC Kernen | 8 | I | 5 | R | 47 | S | 16 | MR/I | 25 | MS | 23 | I | 0 | R | 2 | R | 0 | R |
| AAC Elie | 0 | R | 0 | R | 30 | I | 9 | MR | 18 | I | 27 | I | 0 | R | 11 | R | 44 | I |
| LSD[d] 0.05 | | | | | | | 14 | | 19 | | 10 | | | | | | | |

[a]Severity is the percentage of leaf area affected by rust; reaction is the descriptive classification of disease based on percent severity: R (resistant) = 0%–10%, MR (moderately resistant) = 11%–30%, I (intermediate resistance) = 31%–39%, MS (moderately susceptible) = 40%–60%, S (susceptible) >60%.

[b]Severity is the percentage of the stem infected with stem rust using the Modified Cobb Scale.

[c]Disease response category: R = resistant, MR = moderately resistant, MS = moderately susceptible, and S = susceptible. Ratings such as RMR indicate a range in disease response, in this example resistant to moderately-resistant.

[d]Least significant difference, $P \leq 0.05$, includes the appropriate genotype by environment interaction variation.

[e]Dominant pustule reaction in case of yellow rust and descriptive classification in the case of common bunt and loose smut; categories: VR = very resistant, R = resistant, MR = moderately resistant, I = intermediate, MS = moderately susceptible, NA = not available.

[f]Percentage of spikes with common bunt symptoms.

[g]Percentage of plants with loose smut symptoms.



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**Table 5.** Response to fusarium head blight and DON of AAC Elie and check cultivars based on the Western Bread Wheat Cooperative Trials 2009–2011 at Glenlea and Carman MB, Ottawa ON, Lévis QC, and Prince Edward Island.

| 2009 | Fusarium head blight | | | | | | |
|---|---|---|---|---|---|---|---|
| | Glenlea | | Carman | | Ottawa | Lévis, QC | |
| Entry | Index[a] (%) | Rating[b] | Index (%) | Rating | Score[c] | Index (%) | Rating |
| Katepwa | 16 | MR | 15 | I | 25 | 58 | MS |
| Laura | 26 | I | 15 | I | 27 | 73 | S |
| Lillian | 41 | S | 53 | S | 42 | 75 | S |
| Carberry | 15 | MR | 13 | I | 22 | 56 | MS |
| CDC Kernen | 11 | MR | 25 | MS | 18 | 53 | MS |
| AAC Elie | 24 | I | 10 | MR | 20 | 67 | S |
| Mean | 23 | | 19 | | 26 | 67 | |
| CV | 40 | | 28 | | 13 | 14 | |
| $LSD^{d}_{0.05}$ | 15 | | 9 | | 6 | 17 | |

| 2010 | Fusarium head blight | | | | | |
|---|---|---|---|---|---|---|
| | Glenlea | Carman | Ottawa | Lévis, QC | PEI | |
| Entry | Index (%) | Index (%) | Score (0–100) | Index (%) | Index (Aug 9) (%) | Index (Aug 12) (%) |
| Katepwa | 13 | 25 | 42 | 6 | 70 | 88 |
| Laura | 52 | 19 | 78 | 5 | 90 | 100 |
| Lillian | 65 | 57 | 60 | 7 | 65 | 85 |
| Carberry | 5 | 11 | 36 | 2 | 70 | 90 |
| CDC Kernen | 37 | 28 | 32 | 5 | 48 | 85 |
| AAC Elie | 3 | 17 | 30 | 5 | 58 | 88 |
| Mean | 17 | 24 | 48 | 5 | 67 | 91 |
| CV | 71 | 25 | 16 | 15 | | |
| $LSD_{0.05}$ | 20 | 10 | 12 | 1 | 24 | 17 |

| 2011 | Fusarium head blight | | | | | |
|---|---|---|---|---|---|---|
| | Glenlea | | Ottawa | Lévis, QC | PEI | |
| Entry | Index (%) | Rating | Score (0–100) | Index (%) | Index (Aug 15) (%) | Index (Aug 19) (%) |
| Katepwa | 16 | MS | 48 | 65 | 28 | 68 |
| Laura | 16 | MS | 48 | 79 | 44 | 87 |
| Lillian | 41 | S | 73 | 90 | 44 | 83 |
| Carberry | 6 | MR | 22 | 32 | 21 | 44 |
| CDC Kernen | 11 | I | 27 | 57 | 23 | 55 |
| AAC Elie | 4 | R | 32 | 47 | 24 | 35 |
| Mean | 11 | | 41 | | 52 | 76 |
| CV | 67 | | 15 | | | |
| $LSD_{0.05}$ | 12 | | 10 | | 11 | 15 |

| | DON[g] (ppm) | | | ISD[e] Glenlea | | | DON[g] (ppm) |
|---|---|---|---|---|---|---|---|
| | Glenlea | | | Index | | Rating[f] | PEI |
| | 2009 | 2010 | 2011 | 2010 | 2011 | 2011 | 2011 |
| Katepwa | 16.1 | 6.4 | 1.6 | 4.7 | 27.2 | I | 13 |
| Laura | 22.9 | 24.4 | 4.8 | 14 | 24.9 | I | 35 |
| Lillian | 19.9 | 15.7 | 10.7 | 11.1 | 43.8 | S | 14 |
| Carberry | 18.3 | 7.5 | 3.2 | 4.4 | 15.3 | MR | 18 |
| CDC Kernen | 9.3 | 9.3 | 4.5 | 7.4 | 20.8 | I | 12 |
| AAC Elie | 44.6 | 12.6 | 4.3 | 6.1 | 18 | I | 12 |

[a]Fusarium head blight disease index = (percentage of infected heads × percentage of diseased florets on infected heads)/100.
[b]Disease response category: R = resistant, MR = moderately resistant, I = intermediate in reaction, MS = moderately susceptible, S = susceptible.
[c]Fusarium head blight score based on a scale of 1 (no symptoms of fusarium) to 100 in which all florets in all spikes are infected with fusarium.
[d]Least significant difference, $P \leq 0.05$, includes the appropriate genotype by environment interaction.
[e]Incidence Severity DON Index = [(0.3 × Incidence) + (0.3 × Severity) + (0.4 × DON)].
[f]Response rating based on ISD in 2011.
[g]DON = deoxynivalenol.

**Table 6.** Fusarium damaged kernels and DON of AAC Elie and checks based on six replicates in the 2011 fusarium head blight nursery near Portage la Prairie, MB.

| | Fusarium damaged kernels[a] (%) | | DON[b] (ppm) | |
|---|---|---|---|---|
| Entry | Mean | $Duncan_{0.05}$ | Mean | $Duncan_{0.05}$ |
| AC Barrie | 11.7 | ABCD | 3 | A |
| Carberry | 9.0 | AB | 4 | A |
| Katepwa | 18.9 | CD | 2 | A |
| CDC Kernen | 15.8 | BC | 6 | AB |
| AAC Elie | 6.2 | A | 1 | A |

[a]Fusarium damaged kernels as a percentage of all kernels.
[b]Duncan's mean separation test ($P \leq 0.05$) using PROC MIXED.

## Performance and Adaptation

Averaged over 37 trials in three years, AAC Elie yielded more than Katepwa and within the range of the other checks (Table 1). AAC Elie was later maturing than the mean of the checks but still matured within the range of the checks (Table 2). AAC Elie is a semi-dwarf genotype with plant height shorter than all of the checks including Carberry, which was only 2 cm taller. AAC Elie displayed superior strong straw characteristics (1.6 out of 9) over Katepwa (2.5) and Laura (2.8). Because test mean lodging was only greater than 2 at 4 of the 13 trials, a genotype by environment interaction was studied using test mean lodging as a covariate. Laura had a significant sensitivity coefficient (Table 3). In an environment with low lodging, Katepwa had significantly weaker straw than the control cultivar, AAC Elie. In an environment with high lodging scores, Katepwa, Laura, and CDC Kernen had inferior lodging scores to AAC Elie. Using pairwise comparisons averaged over 13 sites, AAC Elie had lower lodging scores than Katepwa, Laura, Lillian, and CDC Kernen (Table 3).

AAC Elie had higher test weight than Laura, Lillian and Katepwa. The seed size of AAC Elie was within the range of the checks, and similar to Carberry. AAC Elie has a grain protein concentration within the range of the checks but lower than Lillian.

AAC Elie expressed resistance to prevalent races of leaf rust and stem rust, and resistance to intermediate resistance to yellow rust (Table 4). AAC Elie expressed intermediate resistance to common bunt and to loose smut. AAC Elie tended to have lower fusarium head blight and expressed symptoms similar to Carberry. The DON content from the inoculated nurseries was similar to Carberry except for an atypical response at Glenlea in 2009 (Tables 5 and 6).

## Other Characteristics

SPIKE: Tapering to parallel sided, medium density, erect to inclined attitude at maturity, medium glaucosity, chaff colour at maturity white with copper striations, medium length awns.

LOWER GLUME: Glabrous with medium width, medium-long length.

LOWER GLUME SHOULDER: Broad and somewhat elevated with a medium length beak that is slightly curved.

KERNEL: Hard red type, medium red colour, medium size, oval to broad elliptical shape, rounded to angular cheek shape, medium wide to wide crease of shallow depth, and short brush hairs.

GERM: Medium to large, round in shape.

END-USE SUITABILITY: In general, AAC Elie had quality attributes within the range of the checks (Table 7). Relative to the mean of the five checks, AAC Elie expressed improved flour yield and lower flour ash. AAC Elie tended to have low flour color like Katepwa. AAC Elie is eligible for grades of CWRS.

## Maintenance and Distribution of Pedigreed Seed

The 105 Breeder Lines originate from random $F_{6:10}$ single plants of B0313-CK03W grown as 108 pre-Breeder-Lines in 3 m long rows in isolation near Swift Current in 2010 and again as 15 m long rows near Indian Head in 2011. Breeder Seed will be maintained by the Seed Increase Unit of the Research Farm, Indian Head, SK S0G 2K0. AAC Elie has been released for distribution and multiplication to Alliance Seed Corp., 24th Floor, 333 Main Street, Winnipeg, MB R3C 4E2.

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**Table 7.** End-use suitability[a] for AAC Elie and check cultivars, and differences from the mean of the check cultivars in the Western Bread Wheat Cooperative tests, 2009–2011.

| Entry | Wheat protein (%) | Flour protein (%) | Protein loss (%) | Hagberg Fall No. (s) | Amylograph viscosity (BU) | Flour yield[a] (%) | Flour ash (%) | Flour color (Agtron) | Starch damage (megazeme) | Particle size index |
|---|---|---|---|---|---|---|---|---|---|---|
| Katepwa | 13.6 | 12.8 | 0.8 | 385 | 460 | 75.4 | 0.47 | 83.4 | 9.0 | 53 |
| Laura | 13.7 | 12.7 | 0.9 | 388 | 475 | 76.4 | 0.45 | 89.3 | 7.5 | 55 |
| Lillian | 14.2 | 13.5 | 0.7 | 432 | 555 | 73.9 | 0.50 | 84.7 | 8.4 | 54 |
| Carberry | 13.8 | 13.0 | 0.8 | 362 | 430 | 76.7 | 0.45 | 84.1 | 8.5 | 52 |
| CDC Kernen | 13.6 | 13.0 | 0.6 | 412 | 483 | 77.7 | 0.44 | 87.1 | 8.5 | 54 |
| Mean of checks | 13.8 | 13.0 | 0.8 | 397 | 481 | 76.0 | 0.46 | 85.6 | 8.4 | 54 |
| AAC Elie | 13.8 | 12.9 | 0.9 | 367 | 450 | 77.8 | 0.42 | 82.8 | 9.2 | 50 |
| SD[b] | 0.05 | 0.05 | | 15 | 5 | 0.34 | 0.005 | 0.9 | 0.08 | 0.9 |

| | Farinograph | | | | Canadian short process (150 ppm ascorbic acid) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Entry | Absorption (%) | DDT[c] (min) | MTI[d] | Stability (min) | Baking absorption (%) | Work[e] (W-h kg$^{-1}$) | CSP mixing time (min) | Loaf volume (cm$^3$) | Appearance | Crumb structure | Crumb color |
| Katepwa | 68.8 | 5.4 | 20 | 10.7 | 68.0 | 6.2 | 4.0 | 1020 | 7.4 | 6.0 | 7.8 |
| Laura | 67.6 | 8.8 | 13 | 16.8 | 67.3 | 6.6 | 4.4 | 1103 | 7.6 | 6.0 | 7.9 |
| Lillian | 70.5 | 5.6 | 23 | 10.3 | 69.7 | 5.8 | 4.0 | 1068 | 7.5 | 6.0 | 7.6 |
| Carberry | 67.8 | 7.3 | 25 | 10.0 | 67.0 | 7.2 | 4.9 | 1077 | 7.5 | 6.0 | 7.8 |
| CDC Kernen | 68.7 | 7.3 | 22 | 12.0 | 68.0 | 7.3 | 4.9 | 1062 | 7.4 | 6.2 | 7.8 |
| Mean of checks | 68.6 | 6.9 | 20 | 12.0 | 68.2 | 6.6 | 4.4 | 1066 | 7.5 | 6.0 | 7.8 |
| AAC Elie | 70.1 | 9.0 | 22 | 12.3 | 69.3 | 7.3 | 4.9 | 1080 | 7.7 | 5.8 | 7.5 |
| SD[b] | 0.2 | 0.4 | 2.6 | 1.4 | NA[f] | 0.3 | 0.2 | 45 | NA | NA | NA |

[a]American Association of Cereal Chemists methods were followed by the Grain Research Laboratory, Canadian Grain Commission for determining the various end-use suitability traits on a composite of 6–10 locations each year.

[b]SD is the standard deviation based on repeated testing of Allis mill check samples, and standard bake flour sample with replicate tests carried out over an extended period of time each season, provided by GRL, CGC.

[c]DDT is the Farinograph dough development time measured in minutes.

[d]MTI is Farinograph mixing tolerance index expressed in Brabender Units (BU).

[e]Mixing energy reported in watt-hours per kilogram of dough.

[f]NA: not available.

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