Request for Support for Registration of DT1014

Crop Kind: Canada Western Amber Durum

Scientific name: *Triticum turgidum* L. var. *durum*

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Experimental Designations: DT1014; D012.059X.067

Origin and Breeding: DT1014 is derived from the cross CDC Vivid/DT809//DT789 made at the Crop Development Centre (CDC), University of Saskatchewan in the summer of 2012. The F_1 generation was increased at a contra-season nursery in New Zealand and resulting F_2 plants were grown in a space-planted nursery at Saskatoon. In 2013, approximately 300 single F_2 spikes were selected and subjected to single seed descent in the F_3 and F_4 generations. The $F_{4:5}$ generation was planted as head rows in New Zealand during winter 2015. D012.059X.067 was evaluated in un-replicated F_6 yield trials conducted at Saskatoon during summer 2015. DNA marker testing confirmed D012.059X.067 carries the alleles for reduced cadmium content. Quality evaluations on F_6 harvested seed indicated appropriate yellow pigment, and acceptable grain protein concentration and gluten strength for the CWAD class. In 2016, D012.059X.067 was evaluated along with appropriate check cultivars for agronomic traits in replicated yield trials in the Saskatoon area at the University of Saskatchewan Kernen and Goodale farms, Swift Current, Regina, and Elrose. In the same year, resistance to leaf and stripe rusts were evaluated in inoculated nurseries at Saskatoon and resistance to Fusarium head blight was evaluated at Carman, MB. In 2017, D012.059X.067 was evaluated at Kernen and Goodale as an entry in the Durum Western B Test (and associated disease nurseries) and advanced after evaluation of end-use functionality on a composite sample. D012.059X.067 was evaluated as DT1014 in the Durum wheat Registration Test over three years (2018-2020).

Breeder Seed: Approximately 275 single spikes of DT1014 were selected from an F_9 increase grown at Saskatoon in 2018. The $F_{9:10}$ spikes were threshed individually and grown as single 1-m row plots in 2019 and off-type rows were discarded. The remaining 256 head rows were harvested individually and used to establish 27-meter rows in 2020. Again, off-type rows were discarded and bulk harvested to produce breeder seed. In total, 226 $F_{9:11}$ breeder lines were composited to form the breeder seed.

Area of Adaptation: Durum growing regions of Western Canada

Strengths: DT1014 combines high grain yield, acceptable time to maturity, disease resistance, and end-use suitability.

Weaknesses: The FHB reaction of DT1014 was variable, but within the range of the check cultivars.

Description:

Agronomy: Averaged over 28 station-years, DT1014 yielded 9% more than AC Navigator, 4% more than Strongfield, 2% more than AAC Cabri and similar to Brigade (**Table 1**). DT1014 has similar height to AAC Cabri, and straw strength similar to the checks (**Table 2**). Maturity of DT1014 was similar to AC Navigator and

AAC Cabri, later than Strongfield but earlier than Brigade. Test weight of DT1014 was higher than Strongfield and Brigade but it was not significantly different from the other checks. Kernel weight of DT1014 was similar to AAC Cabri but lighter than the other checks **(Table 2).** Grain protein concentration of DT1014 was similar to Strongfield but slightly higher than all the checks ($P > 0.05$) (**Table 3**).

Disease and Pest: DT1014 was rated as resistant or moderately resistant to prevalent races of leaf, stem rust, and stripe rust (**Table 4**). Based on available data, DT1014 was resistant to common bunt (**Table 4**). Overall, FHB reaction and DON concentration of DT1014 was within the range of the check cultivars except in Morden 2020 where it had lower FHB reaction and DON concentration than all checks (**Table 5**). Based on available data, DT1014 expressed lower ISD than AC Navigator, Strongfield, and AAC Cabri (**Table 5).** Loose smut reaction of DT1014 and the checks was variable across the years but overall the reaction of DT1014 to loose smut and leaf spot was within the range of the check cultivars (**Table 4**).

End-use Suitability: Grain and semolina protein concentration of DT1014 measured from composite samples was higher than AC Navigator and Brigade and similar to Strongfield and AAC Cabri (**Table 6**). DT1014 expressed low cadmium concentration, and higher yellow pigment. Pasta colour was within the range of the check cultivars. The average falling number of DT1014 was within the range of the check cultivars. DT1014 exhibited gluten index within the range of the checks but higher alveograph P/L value than the checks (**Table 6**). The semolina yield of DT1014 was similar to AAC Cabri (**Table 6**). Semolina ash content was similar to AC Navigator and Brigade but higher than Strongfield and AAC Cabri.

Table 1. Grain yield (kg ha^{-1}) of DT1014 and check cultivars in the Durum Cooperative Test (2018-2020).

	2018			2019			2020			2018 – 2020		
	Black	**Brown**	**Mean**	**Black**	**Brown**	**Mean**	**Black**	**Brown**	**Mean**	**Black**	**Brown**	**Mean**
AC Navigator	4841	4174	4333	4247	4637	4556	4484	4598	4573	4529	4491	4496
Brigade	5598	4191	4540	5706	5201	5306	5425	4901	5007	5580	4833	4978
Strongfield	4891	4023	4236	5007	4909	4938	5338	4839	4924	5085	4650	4727
AAC Cabri	4965	4299	4463	5235	5248	5249	4897	4566	4624	5026	4755	4805
DT1014	**5100**	**4243**	**4460**	**5494**	**5224**	**5284**	**5353**	**4799**	**4889**	**5315**	**4816**	**4905**
$LSD_{.05}$	534	340	286	673	371	317	707	242	227	419	324	311
No. Tests	2	6	8	2	7	9	2	9	11	6	22	28

Table 2. Maturity, test weight, 1000-kernel weight, height and lodging of DT1014 and check cultivars in the Durum Cooperative Test (2018-2020).

	Maturity (days)			TWT (kg/hL)			1000 KWT (g)	HT (cm)	Lodg. (1-9)
Entry	**Black**	**Brown**	**Mean**	**Black**	**Brown**	**Mean**	**Mean**	**Mean**	**Mean**
AC Navigator	98.2	100.2	99.8	80.3	81.9	81.6	46.5	76	2.0
Brigade	99.1	100.8	100.4	80.6	80.7	80.7	44.0	94	1.5
Strongfield	96.8	98.4	98.0	81.0	81.0	81.0	44.0	87	2.2
AAC Cabri	99.5	99.6	99.4	81.0	81.4	81.4	41.8	91	2.6
DT1014	**98.0**	**99.9**	**99.5**	**81.9**	**82.1**	**82.1**	**42.1**	**92**	**2.0**
$LSD_{.05}$	3.8	0.9	0.8	1.4	0.9	0.9	1.4	3	1.1
No. Tests	4	19	23	6	23	29	29	29	7

Table 3. Grain protein concentration (%) of DT1014 compared to check cultivars in the Durum Cooperative Test (2018-2020).

	2018			2019			2020			2018–2020
Entry	**Black**	**Brown**	**Mean**	**Black**	**Brown**	**Mean**	**Black**	**Brown**	**Mean**	**Mean**
AC Navigator	13.4	14.2	14.0	12.9	12.9	12.9	14.0	13.5	13.6	13.5
Brigade	13.3	14.5	14.2	12.0	13.4	13.1	13.4	13.9	13.8	13.7
Strongfield	14.6	14.7	14.6	13.0	14.0	13.8	14.7	14.2	14.3	14.2
AAC Cabri	13.7	14.7	14.4	11.5	13.3	12.9	14.5	14.0	14.1	13.8
DT1014	**14.3**	**15.1**	**14.9**	**12.2**	**13.9**	**13.5**	**14.2**	**14.3**	**14.3**	**14.2**
$LSD_{.05}$	0.9	0.5	0.4	1.2	0.5	0.5	1.1	0.4	0.4	0.4
No. Tests	2	7	9	2	7	9	2	9	11	29

Table 4. Disease reactions of DT1014 and check cultivars grown in the Durum Registration Test (2018-2020).

Year	Entry	Stem Rust		Leaf Rust	Stripe Rust	Common Bunt	Loose Smut	Leaf Spot[a]
		Morden	Brandon					
2018	AC Navigator	1R 1R	10I	0R	4R	0R	14R	3.6
	Brigade	1R	5MR	0R	28I	0R	9R	4.6
	Strongfield	10MR	1R	0R	8R	0R	13R	5.5
	AAC Cabri	**1R**	5MR	0R	5R	0R	0R	3.8
	DT1014		**5MR**	**0R**	**17MR**	**0R**	**8R**	**4.5**
2019	AC Navigator	1R	10MR	2R	13MR	2R	43MS	5.7
	Brigade	1R	1R	10R	13MR	0R	39MS	4.4
	Strongfield	1R	5MR	0R	8R	5R	31MS	4.3
	AAC Cabri	1R	1R	2R	5R	10MR	4R	4.4
	DT1014	**1R**	**2R**	**5R**	**10R**	**5R**	**11MR**	**4.7**
2020	AC Navigator	1R		0R	5R	–	70S	7.1
	Brigade	1R		0R	70S	–	71S	5.6
	Strongfield	1R		0R	5R	–	70S	6.2
	AAC Cabri	1R		0R	5R	–	93S	5.3
	DT1014	**1R**	**–**	**0R**	**5R**	**–**	**97S**	**6.0**

Note: VR= very resistant; R= Resistant; MR moderately resistant; I=Intermediate resistance; MS=moderately susceptible; S= susceptible. Leaf rust scored from Morden, and stripe rust from Lethbridge.

[a]2019: Mean adult plant rated at mid-grain fill using the McFadden Scale where <5=R, 6=MR, 7=I, 8-9=MS, and 10-11=S. 2018 measurements were from Kernen; 2019 from Kernen, Indian Head, Swift Current, Stewart Valley; 2020 from Brandon, Elrose, Hodgeville, Swift Current.

Table 5. FHB reactions of DT1014 and check cultivars evaluated in the Durum Registration Test (2018-2020).

		FHB Index[a]		DON[b] (mg kg^{-1})		ISD	
Year	**Entry**	**Carman**	**Morden**		**Carman**	**Carman**	**Morden**
2018	AC Navigator	38.0	41.3	23.	33.9	16.9	23.1
	Brigade	13.9	13.3	6	7.2	7.6	5.9
	Strongfield	31.3	42.5	9.5	19.6	10.8	14.5
	AAC Cabri	36.0	30.7	13.	17.7	12.3	13.0
	DT1014	**19.7**	**26.0**	9	**10.0**	**8.6**	**8.2**
2019	AC Navigator	54.2	55.4	56.0	33.7	–	–
	Brigade	23.3	32.1	21.8	11.5	–	–
	Strongfield	45.9	50.4	23.3	25.6	–	–
	AAC Cabri	39.9	39.7	23.2	21.8	–	–
	DT1014	**50.8**	**28.3**	**27.8**	**10.9**	**–**	**–**
2020	AC Navigator	40.6	39.8	38.4	44.3	–	–
	Brigade	12.3	6.3	28.3	22.2	–	–
	Strongfield	52.0	33.0	16.8	32.7	–	–
	AAC Cabri	27.8	11.1	22.8	22.0	–	–
	DT1014	**21.3**	**15.5**	**20.3**	**25.7**	**–**	**–**

[a]Fusarium head blight index: (% infected spikelets × % infected heads)/100.
[b]Deoxynivalenol.

Table 6. Average values for quality traits measured on yearly composite samples of DT1014 and check cultivars evaluated in the 2018-2020 Durum Registration Test.

			Semolina							Alveograph				
Entry	**Grain Protein (%)**	**FN[a] (Sec)**	**Yellow Pigment**	**Protein (%)**	**b***	**Yield (%)**	**Ash (%)**	**GI[b] (%)**	**Pasta b***	**P**	**W**	**L**	**P/L**	**Grain Cd (ppm)**
AC Navigator	13.7	462	10.1	12.6	32.5	68.1	0.67	73	65.8	77	213	97	0.77	234
Brigade	13.9	418	10.2	12.8	32.5	66.1	0.67	90	64.9	76	260	123	0.63	79
Strongfield	14.5	388	9.2	13.4	31.3	66.5	0.64	76	63.2	71	200	93	0.70	90
AAC Cabri	14.2	413	10.5	13.1	33.5	65.8	0.65	69	66.4	64	185	111	0.57	73
DT1014	**14.4**	**392**	**11.9**	**13.4**	**34.3**	**65.7**	**0.68**	**81**	**66.2**	**84**	**244**	**97**	**0.88**	**86**
$LSD_{.05}$	0.4	44	0.4	0.4	1.4	0.7	0.02	9	0.7	9	36	18	0.11	28

Note: data for grain Cd, Alveograph P, W, L, Semolina b* are only from 2018 and 2019.

[a] Falling Number

[b] GI=Gluten Index

Available Breeder Seed for distribution: 725 kg.