

Request for Support for Registration of DT1028

Crop Kind: Canada Western Amber Durum

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

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Experimental Designations: DT1028; D15.044M.280.1

Origin and Breeding: DT1028 is derived from the cross D10.52M.133.004/A1005-PR06//DT862 made at the Crop Development Centre (CDC), University of Saskatchewan in the summer of 2015. The F₁ generation was increased in a greenhouse in Saskatoon, SK and resulting F₂ plants were grown in a space-planted nursery at Saskatoon. In 2016, approximately 300 single F₂ spikes were selected and the resulting F₃ generation was grown as head rows at a contra-season nursery in New Zealand. In 2017, the F₄ generation was grown in un-replicated yield trials conducted in the Saskatoon area at the University of Saskatchewan Kernen Crop Research Farm and Crop Science Seed Farm, and Regina, SK. Six spikes were selected from each F_{2:4} family and the resulting F_{4:5} generation was planted as head rows in New Zealand. DNA marker testing on the F₅ embryos confirmed D15.044M.280.1 carries the alleles for reduced lipoxygenase activity and orange wheat blossom midge resistance. In 2018, D15.044M.280.1 was evaluated in un-replicated F₆ yield trials conducted at the University of Saskatchewan Kernen and Campus Seed Farms, and at Elrose, SK. The F₆ lines were also evaluated for reactions to leaf, stem and stripe rust in inoculated nursery at Saskatoon and resistance to Fusarium head blight (FHB) at Saskatoon and Carman, MB. Quality evaluations on F₆ harvested seed indicated appropriate yellow pigment, and acceptable grain protein concentration and gluten strength for the CWAD class. In 2019, D15.044M.280.1 was evaluated in replicated trials at Kernen, Swift Current, Indian Head, SK, and Lethbridge, AB as an entry in the Durum Western A Test (and associated disease nurseries) and advanced after evaluation of end-use functionality on a composite sample. D15.044M.280.1 was evaluated as DT1028 in the Durum wheat Registration Test over three years (2020-2022).

Breeder Seed: Approximately 280 single spikes of DT1028 were selected from an F₈ increase grown at Saskatoon in 2020. The F_{8:9} spikes were threshed individually and grown as single 1-m row plots in 2021 and off-type rows were discarded. In total, 272 head rows were used to establish 27-meter paired rows in 2022. Again, off-type rows were discarded, and bulk harvested to produce breeder seed. In total, 186 F_{8:10} breeder lines were composited to form the breeder seed.

Area of Adaptation: Durum growing regions of Western Canada

Strengths: DT1028 combines resistance to the orange wheat blossom midge (*Sm1*) with high grain yield, excellent end-use suitability, resistance to common bunt, leaf, stem, and stripe rusts, and low lipoxygenase activity and grain cadmium content.

Weaknesses: FHB reaction of DT1028 is variable.

Description:

Agronomy: Averaged over 27 station-years, DT1028 yielded more than all checks - 12% more than AC Navigator, 7% more than AAC Cabri (Table 1). Yields were statistically similar ($P>0.05$) to Brigade and AAC Schrader (Table 1). CDC Precision was included as a transition check since 2021 and in the two years, DT1028 yielded 7% more than CDC Precision. DT1028 yielded similar to AAC Weyburn that was included as a transition check in 2022. DT1028 is shorter than Brigade, taller than AC Navigator and is similar height to AAC Cabri and AAC Schrader (Table 2). Maturity and test weight of DT1028 were similar to the check cultivars. (Table 2). DT1028 had better straw strength than AC Navigator and AAC Cabri but was similar to Brigade and AAC Schrader. Grain protein concentration of DT1028 was similar to the check cultivars (Table 3).

Disease and Pest: DT1028 is resistant to prevalent races of leaf, stem, and stripe rusts, and common bunt (Table 4). FHB reaction of DT1028 was variable and ranged from moderately resistant to moderately susceptible ratings. DON concentration of DT1028 was within the range of the check cultivars. Fusarium damaged kernels of DT1028 were lower than all check cultivars in 2020 and 2021 but were similar to AAC Weyburn in 2022. DT1028 expressed resistance to the orange wheat blossom midge (Table 6).

End-use Suitability: Grain and semolina protein concentration of DT1028 measured from composite samples was within the range of check cultivars (Table 7). Cadmium concentration of DT1028 was lower than all check cultivars. The average falling number of DT1028 was higher than AAC Schrader but lower than the other checks. Total yellow pigment of DT1028 was higher than AC Navigator, Brigade, and AAC Weyburn, similar to AAC Cabri and AAC Schrader. Pasta colour, alveograph P/L, HVK and semolina yield of DT1028 were within the range of the check cultivars. DT1028 exhibited a higher gluten index than AC Navigator, AAC Cabri, AAC Schrader, and AAC Weyburn but lower than Brigade (Table 7). Milling yield of DT1028 was lower than AC Navigator but similar to the other check cultivars. The semolina ash of DT1028 was lower than the check cultivars (NS, $P > 0.05$ from AAC Cabri, AAC Schrader and AAC Weyburn) (Table 7).

Table 1. Grain yield (kg ha⁻¹) of DT1028 and check cultivars in the Durum Registration Test (2020-2022).

Entry	2020			2021			2022			2020 – 2022		
	Black	Brown	Mean	Black	Brown	Mean	Black	Brown	Mean	Black	Brown	Mean
CDC Precision	–	–	–	5261	2387	3103	3475	4091	3936	–	–	–
AC Navigator	4484	4598	4573	4624	2433	2985	2660	3914	3599	3922	3680	3734
Brigade	5425	4901	5007	5022	2588	3208	3741	4348	4200	4737	3997	4158
AAC Cabri	4897	4566	4624	5093	2325	3017	3100	4445	4110	4363	3808	3925
AAC Weyburn	–	–	–	–	–	–	3982	4292	4224	–	–	–
AAC Schrader	5353	4845	4943	5045	2571	3186	3627	4554	4321	4678	4035	4170
DT1028	5216	4976	5027	4990	2627	3225	3438	4566	4284	4550	4098	4196
LSD	707	244	229	413	202	191	422	263	250	317	279	245
No. Tests	2	9	11	2	6	8	2	6	8	6	21	27

–, data not available.

Table 2. Maturity, test weight, 1000-kernel weight, height and lodging of DT1028 and check cultivars in the Durum Registration Test (2020-2022).

Entry	Maturity (days)			Test weight (kg hL ⁻¹)			1000-kernel weight (g)	Height (cm)	Lodging (1-9)
	Black	Brown	Mean	Black	Brown	Mean	Mean	Mean	Mean
CDC Precision	–	–	–	–	–	–	–	–	–
AC Navigator	96.6	96.5	96.0	79.4	81.4	81.1	44.1	73	3.0
Brigade	102.9	96.9	97.3	79.7	80.2	80.2	41.7	89	1.8
AAC Cabri	100.3	96.2	96.3	80.0	81.0	80.8	39.3	86	3.4
AAC Weyburn	–	–	–	–	–	–	–	–	–
AAC Schrader	101.4	95.9	96.3	80.2	80.4	80.4	39.8	86	2.1
DT1028	99.7	96.0	96.0	79.9	80.7	80.6	41.6	85	2.1
LSD	8.3	0.8	1.3	1.4	0.7	0.7	1.5	4	0.8
No. Tests	4	16	20	6	21	27	27	27	10

–, data not available.

Table 3. Grain protein concentration (%) of DT1028 compared to check cultivars in the Durum Registration Test (2020-2022).

Entry	2020			2021			2022			2020-2022
	Black	Brown	Mean	Black	Brown	Mean	Black	Brown	Mean	Mean
CDC Precision	–	–	–	13.4	15.3	14.8	12.1	14.8	14.1	–
AC Navigator	14.0	13.5	13.6	13.5	14.7	14.4	12.7	14.4	14.0	14.0
Brigade	13.4	13.9	13.8	12.6	14.8	14.2	11.6	14.7	13.9	14.0
AAC Cabri	14.5	14.0	14.1	13.7	14.9	14.6	12.6	14.8	14.2	14.3
AAC Weyburn	–	–	–	–	–	–	11.5	14.6	13.8	–
AAC Schrader	14.4	14.3	14.3	13.9	14.9	14.7	12.2	14.9	14.2	14.4
DT1028	13.7	13.9	13.9	12.7	14.9	14.3	11.7	14.9	14.1	14.1
LSD	1.1	0.4	0.4	0.8	0.4	0.4	1.0	0.4	0.4	0.3
No. Tests	2	9	11	2	6	8	2	6	8	27

–, data not available.

Table 4. Disease reactions of DT1028 and check cultivars grown in the Durum Registration Test (2020-2022).

Year	Entry	Stem Rust	Leaf Rust	Stripe Rust	Common Bunt	Loose Smut
2020	CDC Precision	–	–	–	–	–
	AC Navigator	1R	0R	5R	–	70S
	Brigade	1R	0R	70S	–	71S
	AAC Cabri	1R	0R	5R	–	93S
	AAC Weyburn	–	–	–	–	–
	AAC Schrader	1R	0R	5R	–	56MS
	DT1028	1R	0R	15MR	–	90S
2021	CDC Precision	–	9R	–	0R	0R
	AC Navigator	–	8R	–	7MR	28I
	Brigade	–	13MR	–	0R	3R
	AAC Cabri	–	4R	–	0R	18I
	AAC Weyburn	–	–	–	–	–
	AAC Schrader	–	10R	–	0R	45MS
	DT1028	–	5R	–	0R	21I
2022	CDC Precision	1R	0R	2R	4R	91S
	AC Navigator	1R	0R	2R	2R	78S
	Brigade	1R	2R	38I	0R	14MR
	AAC Cabri	1R	2R	2R	14I	0R
	AAC Weyburn	1R	2R	2R	1R	20I
	AAC Schrader	1R	0R	4R	28I	0R
	DT1028	1R	0R	4R	1R	13MR

Note: R, resistant; MR, moderately resistant; I, Intermediate resistance; MS, moderately susceptible; S, susceptible; –, data not available. Stem and leaf rusts scored from Morden, and stripe rust from Lethbridge.

Table 5. FHB reactions of DT1028 and check cultivars evaluated in the Durum Registration Test (2020-2022).

Year	Entry	FHB Index ^a		DON (mg kg ⁻¹)		FDK (%)
		Carman	Morden	Carman	Morden	Carman
2020	CDC Precision	–	–	–	–	–
	AC Navigator	41I	40S	38S	44S	25.4
	Brigade	12MR	6R	28MS	22MS	23.4
	AAC Cabri	28I	11MR	23MS	22MS	12.6
	AAC Weyburn	–	–	–	–	–
	AAC Schrader	15MR	8MR	21MS	13MR	12.1
	DT1028	28I	14MR	21MS	23MS	8.6
2021	CDC Precision	20I	24MS	7S	8MS	2.5
	AC Navigator	32MS	25MS	22S	16S	8.7
	Brigade	32MS	11I	8S	6I	1.5
	AAC Cabri	23I	25MS	12S	8MS	3.5
	AAC Weyburn	–	–	–	–	–
	AAC Schrader	31MS	13I	8S	8MS	1.8
	DT1028	31MS	15I	9S	6I	1.4
2022	CDC Precision	48MS	29MS	57S	28S	34.5
	AC Navigator	67S	35MS	77S	45S	33.6
	Brigade	23MR	35MS	62S	26MS	22.6
	AAC Cabri	27MR	47S	57S	36S	25.1
	AAC Weyburn	32I	49S	75S	26MS	24.7
	AAC Schrader	24MR	36MS	57S	23MS	23.1
	DT1028	37I	32MS	49S	20MS	24.8

Note: DON, deoxynivalenol; FDK, fusarium damaged kernels; –, data not available.

^aFusarium head blight index: (% infected spikelets × % infected heads)/100.

Table 6. Assessment of DT1028 and check cultivars to the orange wheat blossom midge in select environments of the Durum Registration Test (2020-2022).

Year	Entry	Brandon			Indian Head			Interpretation
		R	S	U	R	S	U	SmI
2022	CDC Precision	0	1	9	0	9	0	Susceptible
	AC Navigator	0	2	8	0	10	0	Susceptible
	Brigade	0	1	9	0	10	0	Susceptible
	AAC Cabri	0	2	8	0	10	0	Susceptible
	AAC Weyburn	1	0	9	6	4	1	Resistant
	AAC Schrader	0	0	10	0	10	0	Susceptible
	DT1028	1	0	9	10	0	0	Resistant
2021	CDC Precision	0	10	0	0	7	3	Susceptible
	AC Navigator	0	10	0	0	9	1	Susceptible
	Brigade	0	10	0	0	9	1	Susceptible
	AAC Cabri	0	9	0	0	9	1	Susceptible
	Strongfield	0	10	0	0	8	2	Susceptible
	AAC Schrader	0	9	0	0	10	1	Susceptible
	DT1028	8	0	2	8	0	2	Resistant
2020	AC Navigator	0	9	1	0	9	1	Susceptible
	Brigade	0	6	4	0	10	0	Susceptible
	AAC Cabri	0	5	5	0	10	0	Susceptible
	Strongfield	0	8	2	0	9	1	Susceptible
	AAC Schrader	0	6	4	0	8	2	Susceptible
	DT1028	4	0	6	8	0	2	Resistant

Table 7. Average values for quality traits measured on yearly composite samples of DT1028 and check cultivars evaluated in the Durum Registration Test (2020-2022).

Entry	Wheat Characteristics			Milling Performance			Protein Content and Gluten Strength				Semolina Pigment and Pasta Colour		
	FN (sec)	Cd (ppb)	HVK (%)	Milling Yield (%)	Semo Yield (%)	Semo Ash (%)	Wht Pro (%)	Semo Pro (%)	GI (%)	P/L	TYP (ppm)	b*	a*
AC Navigator	466	272	90	76.1	66.8	0.66	14.2	13.3	80.0	0.86	10.4	66.3	5.3
Brigade	402	91	88	74.6	65.7	0.67	14.4	13.4	95.1	0.63	10.6	65.8	4.5
AAC Cabri	398	81	92	74.9	65.7	0.66	14.8	13.8	72.6	0.55	10.9	66.3	4.7
AAC Schrader	365	99	90	74.9	65.9	0.66	14.9	14.0	81.7	0.59	11.3	66.5	5.1
DT1028	386	73	87	74.5	66.0	0.64	14.6	13.6	88.4	0.75	11.2	66.7	5.0
<i>CDC Precision^a</i>	<i>340</i>	<i>94</i>	<i>84</i>	<i>74.0</i>	<i>65.8</i>	<i>0.69</i>	<i>15.0</i>	<i>14.0</i>	<i>82.7</i>	<i>0.78</i>	<i>11.6</i>	<i>66.8</i>	<i>5.6</i>
<i>AAC Weyburn^a</i>	<i>481</i>	<i>93</i>	<i>94</i>	<i>74.7</i>	<i>65.9</i>	<i>0.66</i>	<i>14.9</i>	<i>13.8</i>	<i>83.8</i>	<i>1.10</i>	<i>10.5</i>	<i>66.4</i>	<i>5.4</i>
LSD _{0.05}	47	5	7	0.7	1.0	0.02	0.2	0.3	5.7	0.11	0.2	1.0	0.5

^aData for CDC Precision is only from 2021 and 2022, and for AAC Weyburn only from 2022 and are included for information only.