

North Dakota State University - Dry Bean Breeding Program

ND Twilight (NDF120287) Black

Attributes:

- Superior seed yield compared to Zorro
- Upright architecture
- 2-3 days earlier than Eclipse black bean
- Uniform drydown
- Resistance to BCMV (*I* gene)
- Resistance to rust (race 20-3)
- Moderate resistance to Soybean Cyst Nematode (SCN)
- Intermediate resistance to Common Bacterial Blight (CBB)
- Good canning quality

Limitations:

- Higher but non-significant seed yield compared with Eclipse and Loreto

ND Twilight black bean is the result of the cross ND021717/VAX-5. NDSU breeding line ND021717 is a black-seeded genotype with excellent upright plant architecture, early maturity and high seed yield obtained from the cross VAX-4/Raven//T-39. Germplasm lines VAX-4 and-5 are highly resistant to CBB and are the product of interspecific crosses with tepary bean (*Phaseolus acutifolus* Asa. Gray). Raven and T-39 are well-known black bean cultivars with high seed yield and quality. In fact, T-39 (a selection of Black Turtle Soup or BTS) is the cultivar that started production of black beans in the U.S. back in the 1960s and 1970s. The goal of this cross was to combine the excellent agronomic attributes of breeding line ND021717 with increased levels of CBB resistance.

Routine greenhouse screening of ND Twilight in 2016 with race 20-3 of *U. appendiculatus* showed that the line is resistant. The presence of the diagnostic marker for the *Ur-11* resistance gene was confirmed in the line. Leaf symptoms were similar to the typical reaction of the original source of the *Ur-11* gene (PI 191899), which is known to confer resistance to race 20-3. However, inconsistent virulence to 20-3 was identified in additional evaluations made in 2018. Therefore, an additional test was made in December 2019 using race 20-3, which included all the parental lines of ND Twilight. In this screening, all plants of ND Twilight, Raven and T-39 were resistant (no symptoms), suggesting that the resistance may be coming from Raven and/or T-39 while VAX-4 and VAX-5 exhibited pustules characteristic of infection by *U. appendiculatus*. The susceptible control (Othello pinto bean) showed high levels of rust infection as expected. While the preponderance of evidence supports that ND Twilight is resistant, we will test additional pathogen isolates (races 20-3) from different collection points in North Dakota during the winter to ensure broad resistance.

Table 1. Seed yield of ND Twilight along with commercial cultivars across 21 environments in North Dakota (2014-2019).

Year	Trial [†]	Location	ND Twilight [‡]	ECLIPSE	LORETO	ZORRO	Mean	C.V.	LSD
			cwt/acre				%	cwt/acre	
2014	BPYT	Hatton	33.2	24.5	31.2	22.2	28.1	21.4	NS
2014	BPYT	Johnstown	36.2	37.8	34.9	30.5	35.2	13.2	NS
2015	BAYT	Carrington	<u>18.3</u>	14.7	14.0	10.4	15.2	13.1	3.3
2015	BAYT	Hatton	20.3	18.9	14.8	14.1	18.1	16.7	NS
2015	BAYT	Johnstown	18.4	18.9	12.0	12.8	14.6	28.3	NS
2015	BAYT	Prosper	14.9	10.5	10.4	13.9	14.1	23.6	5.4
2016	BAYT	Carrington	<u>16.8</u>	12.8	13.4	9.0	13.9	17.4	3.9
2016	BAYT	Hatton	26.0	21.8	18.8	18.9	22.6	14.0	NS
2016	BAYT	Johnstown	19.1	24.1	14.3	14.5	18.9	36.2	11.1
2016	BAYT	Prosper	<u>19.2</u>	17.3	15.6	14.3	18.9	15.2	4.6
2017	BAYT	Carrington	<u>21.4</u>	17.1	16.3	12.7	20.9	13.1	4.5
2017	BAYT	Hatton	<u>19.6</u>	17.3	13.1	12.8	16.7	15.8	4.3
2018	BAYT	Carrington	17.3	15.3	16.4	17.2	16.6	14.2	3.8
2018	BAYT	Hatton	16.8	18.2	14.9	16.9	15.7	20.8	5.4
2018	BAYT	Johnstown	16.1	19.4	14.7	14.0	17.9	19.2	5.6
2018	BAYT	Prosper	<u>25.7</u>	23.4	21.3	16.5	22.9	13.8	5.2
2019	BAYT	Carrington	<u>22.8</u>	18.9	19.9	22.4	21.8	9.8	3.5
2019	VT	Carrington - dryland	23.9	24.4	22.7	24.8	25.1	11.3	NS
2019	VT	Carrington - irrigated	<u>38.5</u>	34.0	31.5	30.0	34.0	17.3	8.3
2019	VT	Minot	<u>14.8</u>	16.9	10.8	14.9	16.0	11.6	3.0
2019	VT	Langdon	24.5	21.8	21.7	23.4	23.9	10.8	4.3
Mean*			22.1a	20.4ab	18.2ab	17.4b			

*. Different letters indicate significant differences ($P \leq 0.05$) based on LSD.

†. Trials: BPYT, Black Preliminary Yield Trial; BAYT, Black Advanced Yield Trial, VT, Variety Trial.

‡. Underscored values indicate trials in which ND Twilight was significantly higher than at least one of the commercial checks.

Figure 1. Least Square Means for Seed Yield (Cwt/A) of ND Twilight and commercial cultivars using unbalanced data across ~50 environments in North Dakota (2014-2019).

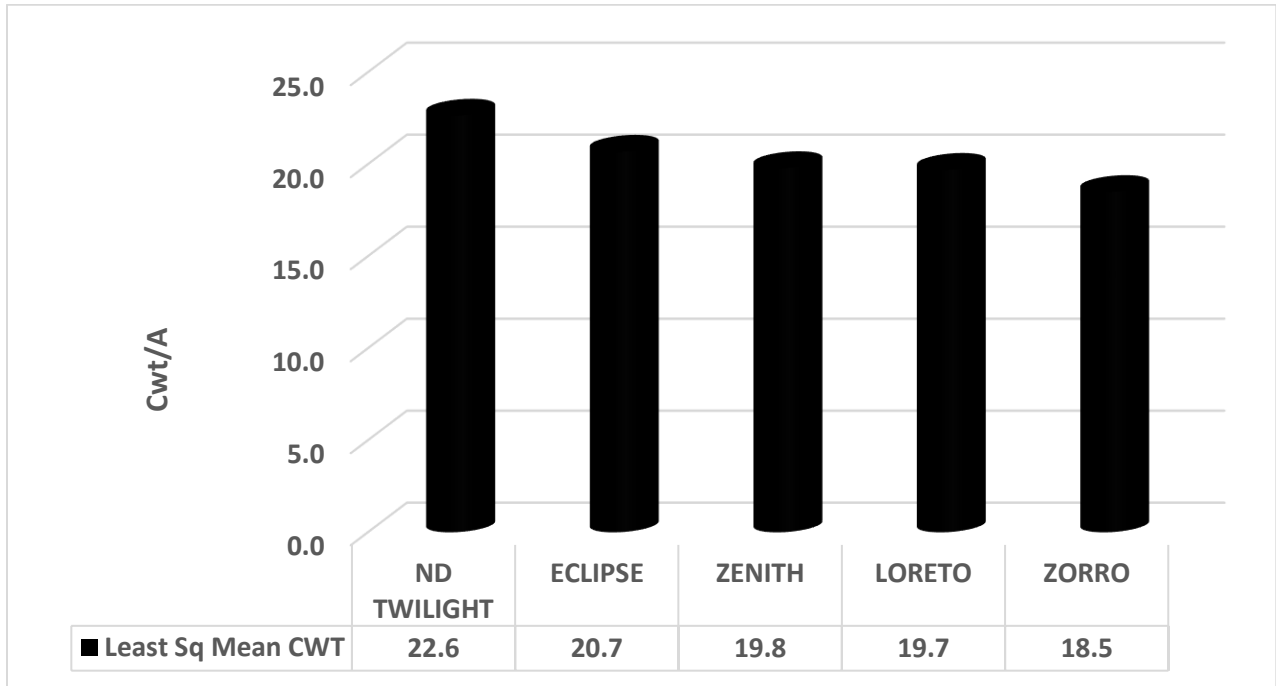


Figure 2. Seed yield stability of ND Twilight and commercial checks across 21 environments in North Dakota (2014-2019).

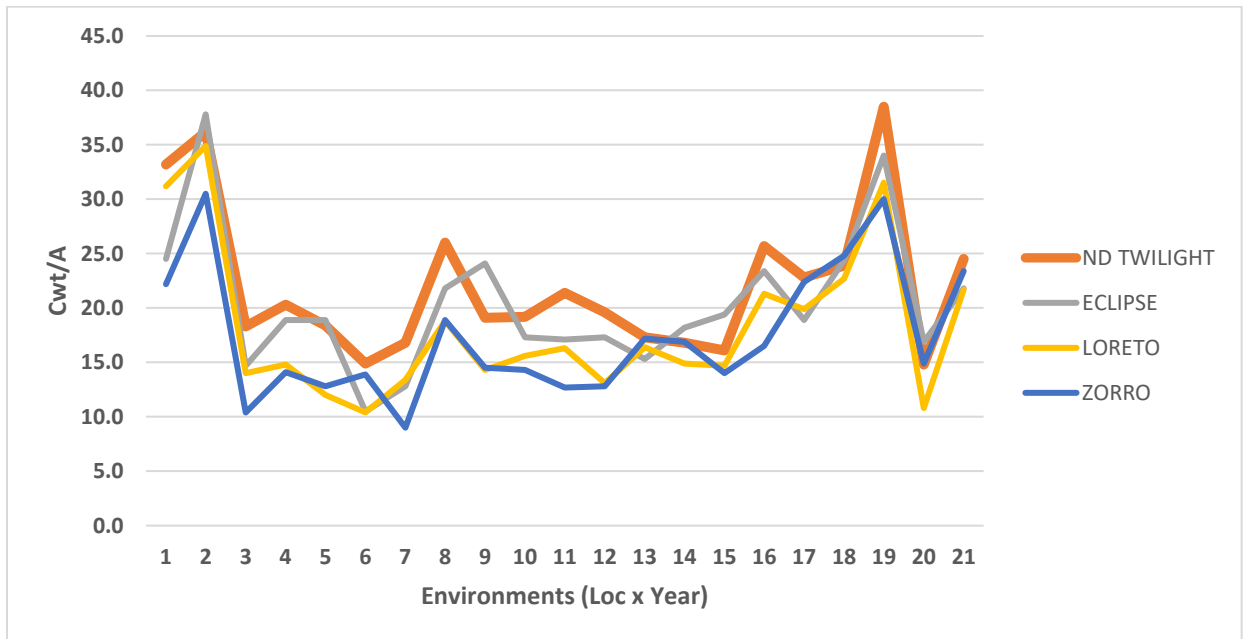


Table 2. Agronomic traits of ND Twilight and commercial cultivars across 21 environments in North Dakota (2014-2019).

Line/Variety	100-seed Weight g ± SE	Days to Maturity d ± SE	Plant Height cm ± SE	Canning Quality [‡] 1 to 6	Rust R/S	CBB [†] 1 to 9
ND Twilight	19.7 ± 0.21	99 ± 0.86	49 ± 0.46	4	R ⁺	4
ECLIPSE	18.3 ± 0.11	102 ± 0.43	50 ± 0.41	3	S	7
LORETO	18.2 ± 0.12	106 ± 0.47	46 ± 0.42	4	S	6
ZORRO	18.4 ± 0.13	102 ± 0.51	47 ± 0.43	4	S	6
ZENITH	17.5 ± 0.32	99 ± 1.15	51 ± 0.47	NT	S	7

+ . Resistant rust reaction is confirmed by the diagnostic marker for *Ur-11*. However, leaf symptoms are completely absent, which is different from the typical reaction for the *Ur-11* gene (small pustules), suggesting the presence of additional genetic factors for rust resistance.

† . Common Bacterial Blight (*Xanthomonas axonopodis* pv. *phaseoli*) CIAT scale: 1-3=Resistant, 4-6=Intermediate, and 7-9=Susceptible. Data obtained from 4 locations only.

‡ . Canning quality is a visual score where 1=unacceptable, 2=poor, 3-4=average, 5-6=above average, and 7=Excellent. Data obtained from 2 locations only.

NT. Not tested.

Other traits:

SCN Female Index = 26.9 (susceptible soybean check is 100%) = Moderately resistant based on Illinois SCN scale.