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# 'Weihing' Great Northern Disease-resistant Dry Bean

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Nebraska is the leading provider in the United States of Great Northern (GN) dry beans (*Phaseolus vulgaris* L.). Rust [(*Uromyces appendiculatus* (Pers.) Unger], common bacterial blight [(*Xanthomonas campestris* pv. *phaseoli* (Smith) Dye) (*Xcp*), and white mold [*Sclerotinia sclerotiorum* (Lib.) de Bary] diseases cause serious reductions in bean yield and seed quality in Nebraska. Halo blight (*Pseudomonas syringae* pv. *syringae* van Hall) has been observed in some years, but is not considered a major problem. Disease-resistant cultivars should ensure improved seed yields and yield stability, and seed quality, and reduce pesticide application. Upright growth habit, combined with a porous plant canopy, can provide an avoidance mechanism to reduce white mold by improving air circulation, resulting in rapid drying of dew on the foliage (Deshpande et al., 1995). An adapted, high-yielding Great Northern cultivar with resis-

tance to strains of the above bacterial and rust pathogens prevailing in Nebraska is needed. An architectural avoidance of white mold is also required because there is no high level of physiological resistance in common beans to that pathogen. Presently, there is no Great Northern variety with this combination of desirable traits. The Great Northern 'Weihing' cultivar released in 1998 has the above combination of traits, and should reduce production costs.

## Origin

'Weihing' was derived from intercrosses of advanced lines developed from crosses of adapted and exotic dry bean parents possessing desired traits (Fig. 1). Pedigree selection was used to develop near-homozygous lines for intercrossing cycles. The advanced lines used for intercrossing possessed resistance to rust and levels of resistance to common bacterial blight and halo blight, as well as some avoidance of white mold disease because of upright and more open architecture. Multiple parents were used in the crosses. GN Nebr. #1 sel. 27 was a source of resistance to common blight and halo blight (Coyne and Schuster, 1974). 'Tacaragua' (black bean) (source: N.E. Valladares-Sanchez, Universidad de Oriente, Jusepin, Venezuela), 'Aurora' (small white), and Pinto 12689 (source: D. Wood, Colorado State Univ., Fort Collins, Colo.) provided resistance to rust. Pinto 'UI 111' and GN '1140' contributed genes for earliness. GN 'Emerson' and 'Bulgarian White' possessed bright white seedcoats (Korban et al., 1981a), and were resistant to seedcoat cracking (Korban et al., 1981b). The upright and porous plant habit of 'Tacaragua', 'Aurora' (Anderson et al., 1974), and lines A222 and A51-1 [Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia] provided some architectural avoidance to the white mold pathogen. Fuller et al. (1984), using plastic-covered ground beds in greenhouse tests, also found that 'Tacaragua' had partial resistance to white mold.

## Description

A randomized complete-block design was used in separate replicated nondisease (10 tests), white mold (seven tests), rust (seven tests), and common bacterial blight (seven tests) nurseries at several locations in western Nebraska to evaluate the performance of 'Weihing' in comparison with standard cultivars Beryl and Harris (1993–97). Separate disease nurseries were used to avoid problems due to pathogen interactions. The cultivars also were grown in 17 nonreplicated on-farm trials in Nebraska and Colorado in 1997. In addition, the cultivars were tested in replicated experiments in five calcareous soil sites (1996–97) to obtain ratings for Fe-induced leaf chlorosis. Seed yield, seed weight, and days to maturity were recorded in all nurseries, except in the common blight and rust nurseries. In the white mold experiments, each furrow was irrigated about every 7 d after flowering to provide moist, cooler conditions within the canopies favorable for disease development. The white mold reaction of the cultivars was recorded at maturity as the percentage of the aboveground canopy showing white mold symptoms. Spreader rows of the susceptible 'UI 114' were planted around the rust nurseries and inoculated in July and August with rust spores of races 49 and 50, and pathotype NP-95-10 (source: J.R. Steadman, Dept. of Plant Pathology, Univ. of Nebraska, Lincoln, NE 68583) diluted to 1% in talc to induce disease development. The lines also were inoculated in the greenhouse with known rust races. The rust reaction was recorded as susceptible (predominant pustule size >300 µm) or resistant (hypersensitive). The cultivars in the common blight nurseries were inoculated with a 10<sup>6</sup> colony forming units/mL suspension of two *Xcp* strains EK-11 and SC-4A from Nebraska (source: A.K. Vidaver, Dept. of Plant Pathology, Univ. of Nebraska, Lincoln, NE 68583), using a leaf-water soaking procedure (Schuster, 1955). The percentages of the leaf area of the cultivars with common blight symptoms were recorded. 'Weihing' and control cultivars also were inoculated in the greenhouse with bean common mosaic virus (BCMV) NY-15 Zaumeyer strain and bean common mosaic necrotic virus (BCMNV) (NL3 strain), using the primary leaf rubbing method, and reactions were recorded as described by Drijfhout (1978).

'Weihing' was resistant to rust in all field tests, while 'Beryl' and 'Harris' were susceptible (Table 1). Inoculation with known rust races in the greenhouse at Beltsville, Md., indicated the presence of resistance genes *Ur-3* and *Ur-6* in 'Weihing' (Kelly et al., 1996; Stavelly, 1983). 'Weihing' and 'Beryl' had similar levels of resistance to common blight (16% to 30% leaf area with symptoms) while 'Harris' was more resistant (5% to 15% leaf area with symptoms) (Table 1). 'Weihing' and 'Harris' were resistant to halo blight in some naturally infected plots, while 'Beryl' was susceptible. 'Weihing' and 'Beryl' had low to moderate white mold infection (12% to 30%), while 'Harris' had severe infection

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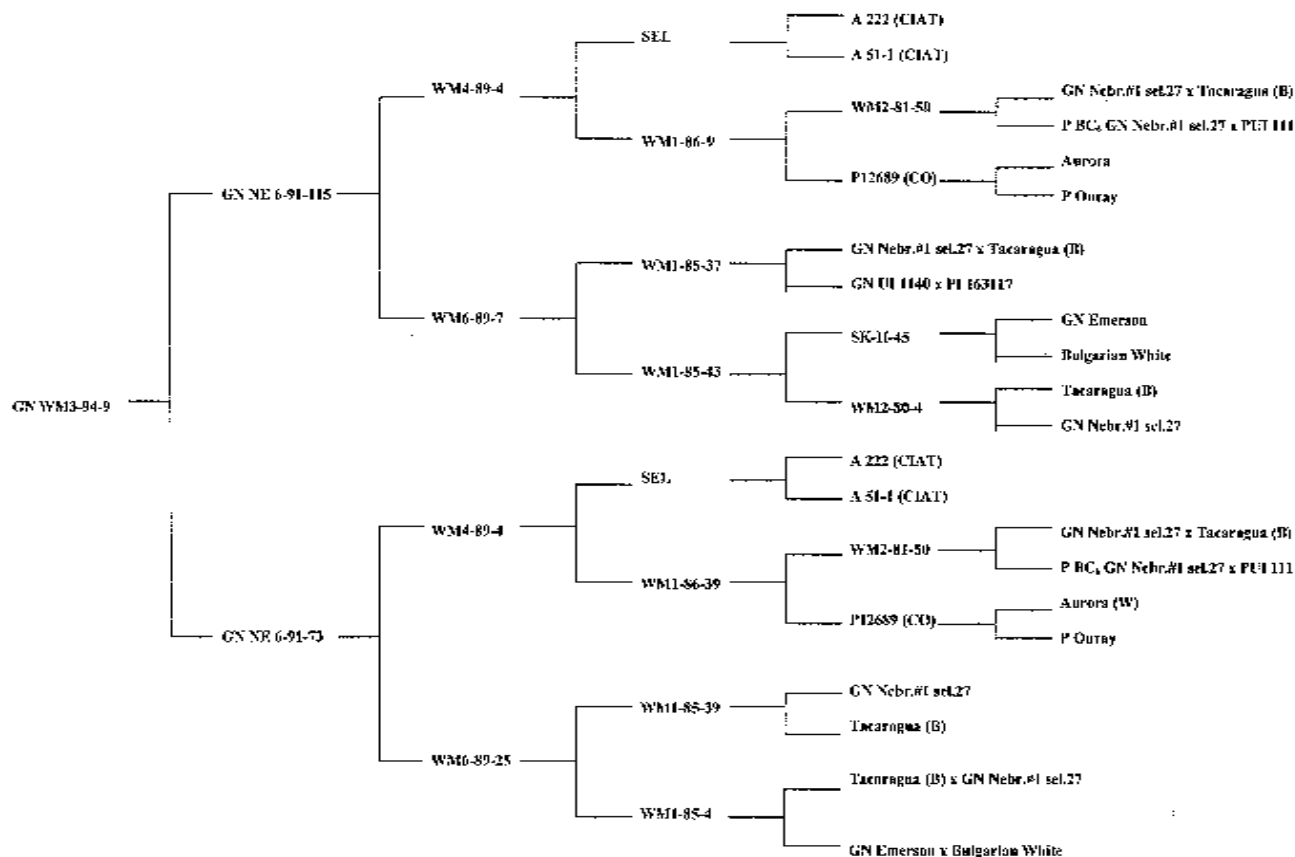


Fig. 1. Pedigree of GN 'Weihing' (GN WM3-94-9) (GN = great northern, P = pinto, B = black, W = white).

Table 1. Summary of disease reactions in Great Northern (GN) control dry bean cultivars and in GN 'Weihing'.

Cultivar	Rust (1993-97)	Common blight <sup>z</sup> (1993-97)	White mold (%) <sup>y</sup>			BCMV <sup>x</sup>
			1994	1995	1997	
Weihing	R <sup>w</sup>	MR	12	24	18	R <sup>w</sup>
Beryl	S <sup>w</sup>	MR	30	20	14	R
Harris	S	HR	48	65	34	R
LSD <sub>0.05</sub>	---	---	20	15	18	---

<sup>z</sup>MR = moderate resistance (16% to 30% foliage with disease symptoms). HR = highly resistant (5% to 15% foliage with disease symptoms).

<sup>y</sup>Percentage of aboveground plant with white mold symptoms.

<sup>x</sup>BCMV = bean common mosaic virus (*I* gene resistance).

<sup>w</sup>R = resistant, S = susceptible.

(34% to 65%). 'Weihing' and 'Beryl' possessed the dominant *I* gene providing resistance to BCMV strains under low temperature, but both were susceptible to BCMNV-NL3 strain.

There were no significant differences ( $P \leq 0.05$ ) between the mean seed yields of 'Weihing' (2092 kg·h<sup>-1</sup>), 'Harris' (2020 kg·h<sup>-1</sup>), and 'Beryl' (2117 kg·h<sup>-1</sup>) in either the 17 on-farm trials (1997), or in the replicated trials (2988, 2776, and 2763 kg·h<sup>-1</sup>, respectively). 'Weihing' and 'Harris' seeds were similar in weight (29 to 40 g/100 seed) and were heavier than 'Beryl' seeds (25 to 34 g/100 seed). Seed of 'Weihing' is shown in Fig. 2.

'Beryl' (85-90 d) was earlier in maturity than either 'Weihing' (90-95 d) or 'Harris' (93-98 d). 'Weihing' has a more upright plant habit (Type IIb) than does 'Beryl' (Type III) or 'Harris' (Type III) (Singh, 1982).

No significant difference in leaf chlorosis

was noted among the three cultivars at three sites. However, at two sites 'Weihing' was more susceptible to leaf chlorosis than were the other two cultivars, but no significant differences in yield were detected ( $P \leq 0.05$ ).

Canned samples of seed of the three cultivars were deemed to be acceptable based on visual examination of the samples for color and numbers of split seed (1996-97).

The principal merits of 'Weihing' are its resistance to prevailing strains of rust, common blight, and halo blight in Nebraska, and its moderate avoidance to white mold because of its upright and porous plant canopy. Seed can be produced in Idaho because of BCMV resistance, but BCMV is not a problem in Nebraska. The multiple-disease resistance of 'Weihing' reduces disease risk and lowers cost of production for growers. 'Weihing' is more upright than 'Beryl' and 'Harris', thus facilitating furrow irrigation and cultivation.

## Availability

Seed for testing or increase of 'Weihing' may be obtained from the Foundation Seed Division (Attn.: Ronald Helsing), 3115 N. 70 Street, Lincoln, NE 68507. Certified seed of 'Weihing' is now available for planting in 2000. Further information on availability of certified seed may be obtained from Roger Hammons, Manager, Nebraska Crop Improvement Association, 266 Plant Science, Univ. of Nebraska, Lincoln, NE 68583.

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Fig. 2. Seed of 'Weihing' Great Northern dry bean (formerly GN WM3- 94-9).

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