

# White Navy Bean ‘Lighthouse’



Developed by University of Guelph Dry Bean Breeding Program  
Breeders: Tom Smith & K. Peter Pauls

‘Lighthouse’ is a full season maturity navy bean with excellent yield, good harvestability, and resistance to bacterial blight

## Performance Data\*

Variety	Market Class	Yield <sup>a</sup> (lbs/ac)	Maturity <sup>b</sup> (DAP)	Suitability for Direct Harvest <sup>c</sup>
<b>Lighthouse</b>	<b>Navy</b>	<b>3784.9</b>	<b>103.2</b>	<b>2.0</b>
Apex	Navy	3784.7	104.8	2.3
Mist	Navy	3714.8	102.9	2.0
Medalist	Navy	3831.7	102.6	2.2
Rexeter	Navy	3732.0	106.1	2.5
Mean		3769.6	103.9	2.2
LSD(0.05) <sup>d</sup>		217.5	1.0	0.2

<sup>a</sup> 2012-2014 OPCC Performance data, 15 location years

<sup>b</sup> Days to maturity after planting

<sup>c</sup> Suitability for direct harvest (harvestability) is based on a scale of 1-5, where 1 = upright plant type, standing erect with good bottom pod height and 5 = more prostrate plant type that are not erect, with poor bottom pod height\*

<sup>d</sup> LSD (0.05) – the LSD is a measure of variability within a trial. There is a ninety five percent probability that yields that differ by an amount greater than the LSD are different. Yields that differ by an amount less or equal to the LSD should be considered the same.\*

\* Adapted from GoBeans.ca Infosheets



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## Disease Reaction <sup>a</sup>

Variety	BCMV		Anthracnose <sup>b</sup>			Common Bacterial Blight <sup>c</sup>
	Race 1	Race 15	Race 17	Race 23	Race 73	
<b>Lighthouse</b>	R	R	na	R	S	R
Rexeter	R	S	S	S	S	R
T9905	R	R	R	R	S	S
Mist	R	R	S	S	S	R
Nautica	R	R	S	S	S	S
Lightning	R	R	S	S	S	S
Bolt	R	R	S	S	R	S
Thunder	R	R	S	S	S	S
Compass	R	R	S	S	S	S

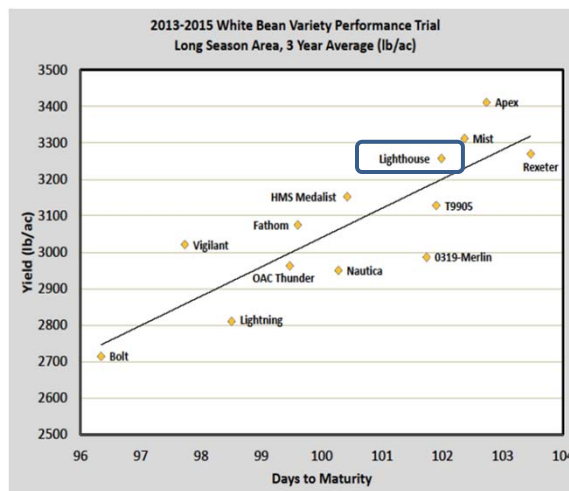
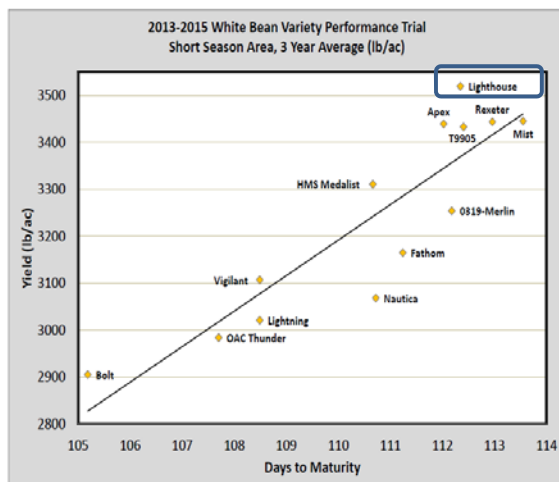
<sup>a</sup> R = Resistant, S = Susceptible, na = Not Available

<sup>b</sup> Anthracnose ratings, the predominant race found now in Ontario is Race 73. Race 17 (binary system) is equivalent to the Alpha race, race 23 (binary system) is equivalent to the Delta race.\*

<sup>c</sup> Resistance gene for common bacterial blight (*Xanthomonas campestris* pv. *Phaseoli*). Very little disease will develop on this variety.\*

\* Adapted from GoBeans.ca Infosheets

## Yield and Maturity



Data from 2013-2014 OPCC Performance Trials, 9 location years

**Pedigreed Seed Available at:**  
R.T. Bolton and Sons  
43234 Winthrop Road, RR#1  
Dublin, ON N0K 1E0  
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# Lighthouse common bean

Raja Khanal, Thomas H. Smith, Thomas E. Michaels, and K. Peter Pauls

**Abstract:** Lighthouse is an indeterminate, full-season navy bean (*Phaseolus vulgaris* L.) cultivar with an upright plant architecture, suitable for direct harvest, with a high yield potential, and a high level of resistance to common bacterial blight (CBB; caused by *Xanthomonas axonopodis* pv. *phaseoli*). Lighthouse is adapted to and recommended for the dry bean growing areas in southwestern Ontario.

**Key words:** *Phaseolus vulgaris* L., navy bean, lighthouse, common bacterial blight.

**Résumé :** Lighthouse est un cultivar tardif de haricot (*Phaseolus vulgaris* L.) à croissance indéterminée. La variété se caractérise par un port droit et peut être récoltée directement. D'un rendement potentiel élevé, elle résiste fortement à la brûlure bactérienne causée par *Xanthomonas axonopodis* pv. *phaseoli*. Lighthouse est bien acclimaté aux régions du sud-ouest de l'Ontario où l'on cultive le haricot, pour lesquelles on la recommande. [Traduit par la Rédaction]

**Mots-clés :** *Phaseolus vulgaris* L., haricot, Lighthouse, brûlure bactérienne.

## Introduction

Lighthouse is a full season maturity, upright, white bean variety (*Phaseolus vulgaris* L.) with a high yield potential and resistance to common bacterial blight. Lighthouse was developed at the University of Guelph and tested in the Ontario White Bean Registration and Performance Trials in 2009, 2010, and 2011. Lighthouse was registered by the Variety Registration Office, Canadian Food Inspection Agency, Ottawa, ON, on 5 Mar. 2012 (Registration no. 7213).

## Parentage and Ancestry

Lighthouse was developed by single plant selection from a F<sub>5</sub> family from a conical cross (modified 8-way cross) with the pedigree spscbbr136/PI207262//ICB-10/Vax4//OAC Speedvale/Avanti//OAC 99-1/OAC Rex. The breeding line spscbbr136 is derived from the cross OAC Rex/OAC Seaforth. OAC Rex (Michaels et al. 2006) traces back to an interspecific cross with *Phaseolus acutifolius* PI 440795. ICB-10 is a source of CBB resistance derived from inter-specific crosses to *Phaseolus coccineus* (Miklas et al. 1999). Vax 4 is a derivative of the CBB tolerant line XAN159, with the pedigree UI-14/PI 319441//PI 319443/3/Masterpiece; where PI 319443 was a tepary bean

(*P. acutifolius* A. Gray *latifolius* 'Freeman') (Thomas and Waines 1984; Singh et al. 2001). OAC Speedvale, developed from Seafarer/PI 324685, is a registered navy bean variety with a determinate type I growth habit, early maturity, and good yield (Beattie et al. 2003). Avanti is an indeterminate short vine variety with midseason maturity and excellent seed and canning quality (Kelly et al. 1998). OAC 99-1 is an elite line entered in the registration trials in 1999 with pedigree OAC Gryphon/W72988.

## Breeding Method

Conical crosses (Bett and Michaels 1994) involving the parental lines were made in the growth room during the winter of 2001 and 2002. F<sub>2</sub> plants were grown in the field in 2002 at the Elora Research Station, Ariss, ON, and all seeds were bulked. The F<sub>3</sub> and F<sub>4</sub> generations were advanced using the direct bulk method. Single plant selections were made from F<sub>5</sub> population bulk plots in the field at the Elora Research Station in 2005. Selection criteria included days to maturity, upright plant architecture, resistance to common bacterial blight, seed size, and seed type. F<sub>6</sub> plants from F<sub>5</sub> selections were grown in the field at the Elora Research

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**Table 1.** Yield, days to maturity, and seed weight of Lighthouse navy bean compared with commercial cultivars, tested in the Ontario White Bean Registration and Performance Trials during 2009–2011.<sup>a</sup>

Cultivar	Yield (kg ha <sup>-1</sup> )				Days to maturity				100-seed weight (g)			
	2009	2010	2011	Mean	2009	2010	2011	Mean	2009	2010	2011	Mean
Lightning	2956	3236	2795	2996	104.7	94.0	99.9	100	20.4	22.0	21.9	21.4
OAC Dublin	3011	3395	2612	3006	106.3	97.1	103.2	102	19.6	21.36	22.6	21.2
OAC Rex	2991	3471	2833	3098	112.0	97.5	104.3	105	19.6	21.05	23.5	21.4
OAC Rexeter	3414	3803	2853	3357	110.1	99.6	106.3	105	19.5	21.06	20.6	20.4
Lighthouse	3226	3750	3065	3347	110.8	98.0	104.5	104	20.2	22.0	23.1	21.8
LSD	214	196	184		1.2	1.2	1.1		0.40	0.56	0.60	

<sup>a</sup>Test locations were Blyth, Elora, Kippen, Granton, St. Thomas, and Winchester in 2009; Brussels, Elora, Granton, Kippen, St. Thomas, and Woodstock in 2010; and Brussels, Elora, Highbury, Kippen, St. Thomas, and Woodstock in 2011.

**Table 2.** Canning quality of Lighthouse compared with commercial check cultivars grown in the Ontario White Bean Registration and Performance Trials in 2010 and 2011 averaged over three locations.

Cultivar	Hydration coefficient <sup>a</sup>		Degree of packing (1–5) <sup>b</sup>		Washed drained solids (%) <sup>c</sup>		Texture measurement <sup>d</sup>			
							Plateau force (N)		Firmness (N mm <sup>-1</sup> )	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Lightning	n/a	2.33	3.00	1.00	59.10	57.78	269.55	169.99	20.36	11.35
OAC Thunder	n/a	2.27	3.00	1.00	57.74	56.62	275.65	228.42	21.51	10.19
OAC Rexeter	n/a	2.30	3.00	1.00	58.65	57.13	232.67	236.56	20.20	14.87
AC Compass	n/a	2.37	3.00	1.00	58.78	56.44	254.96	196.33	18.34	10.72
Lighthouse	n/a	2.30	3.00	2.33	59.57	58.98	246.78	253.41	17.11	13.60
SE <sup>e</sup>	n/a	0.06	0.33	0.98	1.1	1.74	21.5	79.56	2.23	3.37

<sup>a</sup>Soaked wt. (blanched in 88 °C water for 45 min) divided by dry weight (determined for 500 g of beans).

<sup>b</sup>Scored visually; 1 = no clumping and 5 = over half clumped.

<sup>c</sup>Weight of beans after washed and drained on a screen, presented as percentage of unwashed-undrained weight.

<sup>d</sup>Texture of canned beans was measured on Instron Texture measurement system using wire extrusion cells.

<sup>e</sup>Standard error.

Station in single plant rows. The selected F<sub>7</sub> lines were grown in preliminary yield trials and F<sub>8</sub> lines were grown in advanced yield trials at the Elora Research Station and St. Thomas, ON.

## Performance

Lighthouse was entered into the Ontario White Bean Registration and Performance Trials as OAC 09-4 and evaluated in multi-location yield-trials across Ontario in 2009, 2010, and 2011. These tests are performed under the guidelines set by the Ontario Pulse Crop Committee ([www.gobeans.ca](http://www.gobeans.ca)). Tests are conducted annually at various locations across the main bean growing areas in Ontario and contain four replications per location. Test locations with CV values lower than 15% were considered valid tests. Data on yield (adjusted to 18% moisture after combine harvest), days to maturity, and seed weight (estimated for 100 seeds) were collected for each plot in each location. Each year's data were subjected to analysis of variance and least square means and least significant difference ( $P = 0.05$ ) were estimated. A composite seed

sample from three locations was formed by mixing approximately 200 g of seed of each entry in each replication for the canning and cooking quality test. These samples were processed in the Food Pilot Plant at Agriculture and Agri-Food Canada (AAFC), Lethbridge Research and Development Center, Lethbridge, AB, and evaluated for cooking and canning quality parameters.

The resistance of Lighthouse to anthracnose caused by *Colletotrichum lindemuthianum* (Sacc. & Magnus), races 23 and 73, was tested under controlled conditions in separate growth chambers at the Greenhouse Processing Crop and Research Center, Harrow, ON. Similarly, the resistance to bean common mosaic virus (BCMV) races 1 and 15 was tested in growth chambers. Common bacterial blight (CBB) severity was assessed in an artificially inoculated disease nursery in Harrow, ON using a 0 to 5 visual scale, where 0 = no symptoms, 1 = <5%, 2 = 5%–10%, 3 = 10%–25%, 4 = 25%–50%, and 5 = 50%–100% (Yu et al. 2000). The severity of CBB was visually estimated as percentage of necrotic leaf area in the plot, rated 14 and 21 days after inoculation (Mutlu et al. 2005).

**Table 3.** Response of Lighthouse to anthracnose, common bacterial blight (CBB), and bean common mosaic virus (BCMV) compared with commercial check cultivars.

Cultivar	Anthracnose <sup>a</sup>			BCMV <sup>c</sup>	
	Race 23	Race 73	CBB <sup>b</sup>	Race 1	Race 15
OAC Thunder	S	S	S	R	R
OAC Rex	S	S	R	R	R
Lightning	S	S	S	R	R
Rexeter	S	S	R	R	S
Lighthouse	R	S	R	R	R

<sup>a</sup>Reactions against Anthracnose race 23 and 73 were assessed after artificial inoculation under controlled conditions using a visual score of 1–9, with 9 being the most susceptible (Corrales and van Schoonhoven 1987).

<sup>b</sup>Common bacterial blight severity was rated based on leaf area infection with a 0 to 5 scale where 0 = no symptoms, 1 = <5%, 2 = 5%–10%, 3 = 10%–25%, 4 = 25%–50%, and 5 = 50%–100% (Yu et al. 2000).

<sup>c</sup>Reactions against bean common mosaic virus race 1 and 15 were assessed after artificial inoculation under controlled conditions as susceptible (S) or resistant (R).

### Agronomy

Across 18 location–years in the Ontario White Bean Registration and Performance Trials during 2009, 2010, and 2011, Lighthouse navy bean on average yielded 3347 kg ha<sup>-1</sup>, which was between 8% and 12% higher than the check cultivars OAC Rex, OAC Dublin, and Lightning, but similar to Rexeter (Table 1). Lighthouse was rated as a full-season maturity cultivar with days to maturity not significantly different from the check cultivar OAC Rex. Seed weight was similar to all check cultivars, with seed mass ranging between 20 to 23 g 100 seed<sup>-1</sup>.

### Canning and Cooking Evaluation

Lighthouse had a similar hydration coefficient as check cultivars in 2011. In texture measurements, Lighthouse had a significantly lower or similar plateau force as check cultivars in 2010, but higher plateau force in 2011 (Table 2). Lighthouse had a degree of packing score similar to all check cultivars in 2010, but a higher score than the checks in 2011. Its washed drained solids value was similar to the checks in both years.

### Disease Evaluation

Lighthouse had high levels of resistance to common bacterial blight, which was similar to OAC Rex (Michaels et al. 2006). It carries the SU91 SCAR marker, which is significantly associated with CBB resistance, on chromosome Pv08 (Pedraza et al. 1997). Lighthouse is also resistant to races 1 and 15 of BCMV and possesses the SCAR marker SW13 (Melotto et al. 1996) known to be linked to the hypersensitive response gene on

chromosome Pv02. Lighthouse is resistant to anthracnose race 23, but susceptible to race 73 of anthracnose (Table 3).

### Other Characteristics

Lighthouse has an indeterminate growth habit with erect branching and an upright plant type with high podding nodes. It has a green hypocotyl and white flowers. Plants have leaves with a medium green colour. The pods are light tan coloured when ripe and covered with short pubescence. Seeds are white with dull seed coat lustre and a white hilum.

### Maintenance and Distribution of Pedigreed Seed

Lighthouse was planted in isolation plots at Elora Research Station for purification and multiplication of seed. It was further increased to breeder seed in a disease-free environment in Idaho, USA in 2011. The University of Guelph Bean Breeding Program, Guelph, ON NL1 2W1, Canada will maintain the breeder seed. Pedigreed seed will be distributed by R.T. Bolton and Son's, 43234 Winthrop Rd., RR No. 1 Dublin, ON N0K 1E0, Canada, Phone: 519-527-0455.

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