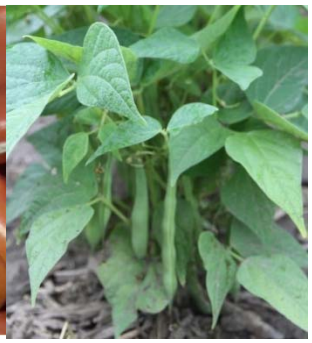
Light Red Kidney Bean ‘OAC Inferno’



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

‘OAC Inferno’ is a full season maturity light red kidney bean with excellent yield and good seed size

Performance Data*

Variety	Market Class	Yield [a] (lbs/ac)	Maturity [b] (DAP)	100 Seed Weight (g)
OAC Inferno	**LRK**	**100**	**2523**	**66**
Pink Panther	LRK	93	2234	70
Dynasty	DRK	96	2392	67
Red Hawk	DRK	96	1962	59
Majesty	DRK	97	2231	73
GTS 104	DRK	97	2035	59
Yeti	WK	99	2258	61
Mean		97	2234	65

[a] 2013-2015 OPCC Performance data, 13 location years
[b] Days to maturity after planting
* Adapted from GoBeans.ca Infosheets

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RESEARCH INNOVATION

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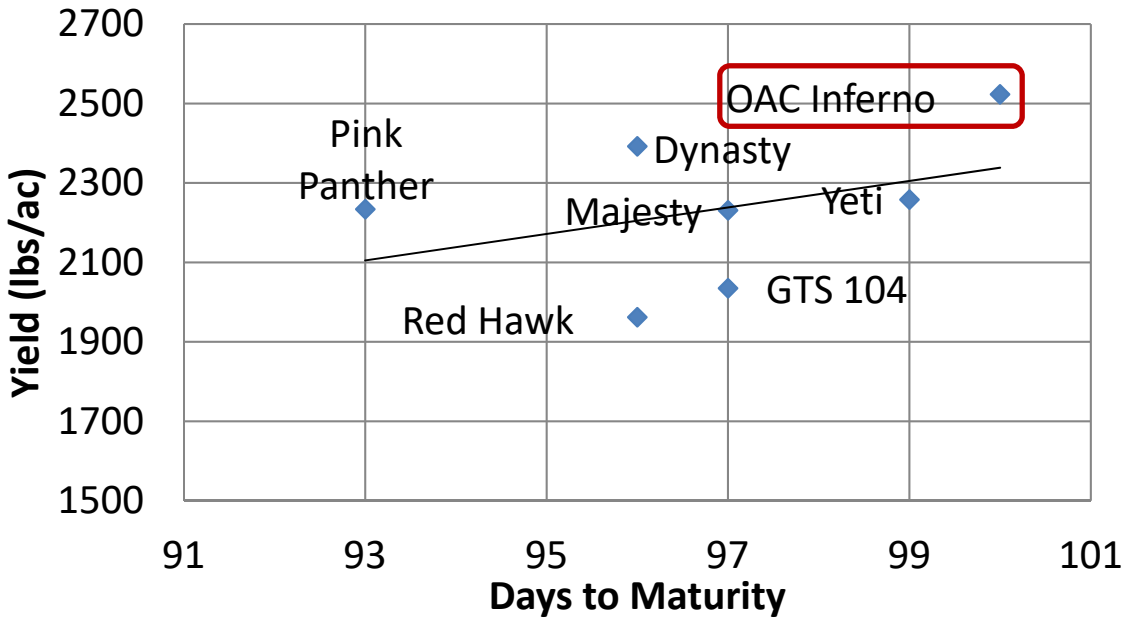
Disease Reaction [a]

Variety	BCMV		Anthracnose [b]			Common Bacterial Blight[c]
	Race 1	Race 15	Race 17	Race 23	Race 73	
OAC Inferno	**R**	**S**	**R**	**S**	**R**	**S**
Pink Panther	R	R	R	S	R	S
Dynasty	R	S	R	S	R	S
Red Hawk	R	R	R	S	R	S
Majesty	R	R	R	S	S	S
GTS 104	NA	NA	NA	NA	NA	NA
Yeti	R	R	NA	S	R	S

[a] R = Resistant, S = Susceptible, NA = Not Available.
[b] Anthracnose ratings, the predominant race found 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.
[c] Resistance gene for common bacterial blight (*Xanthomonas campestris pv. phaseoli*).

Yield and Maturity*



Data from 2013-2015 OPCC Performance Trials, 13 location years

* Adapted from GoBeans.ca Infosheets

Pedigreed seed available at:
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CULTIVAR DESCRIPTION

OAC Inferno common bean

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Smith, T. H., Michaels, T. E., Navabi, A. and Pauls, K. P. 2012. **OAC Inferno common bean**. Can. J. Plant Sci. **92**: 589–592. OAC Inferno (CFIA registration no. 7020) is dark red kidney bean (*Phaseolus vulgaris* L.) cultivar with a determinate bushy growth habit, mid to full season maturity and good yield potential. Seed has acceptable cooking and canning quality.

Key words: *Phaseolus vulgaris* L., light red kidney, common bean, cultivar description

Smith, T. H. Michaels, T. E., Navabi, A. and Pauls, K. P. 2012. **OAC Inferno common bean**. Can. J. Plant Sci. **92**: 589–592. OAC Inferno (CFIA registration no. 7020) est un cultivar nain de haricot rouge foncé (*Phaseolus vulgaris* L.) à type de croissance définie, démontrant une maturité et une bonne productivité. Le grain convient pour la cuisson et pour la mise en conserve.

Mots clés: *Phaseolus vulgaris* L., haricot rouge, haricot commun, description de cultivar

OAC Inferno is a mid to full season maturity light red kidney bean developed by the University of Guelph, Department of Plant Agriculture, Guelph, Ontario, Canada. It has good yield potential, large seed size and acceptable cooking quality. In addition, the cultivar is resistant to bean common mosaic virus race 1 and anthracnose races 17 and 73. OAC Inferno was registered by the Canadian Food Inspection Agency Cultivar Registration Office (Reg. No. 7020) on 2011 May 16.

Pedigree and Breeding Methods

OAC Inferno was developed from the conical cross HR85-1885/Montcalm//USWA-39/AC Litekid///Foxfire/AC Elk//Sacramento/AC Calmont made in growth room in 1999. HR85-1885 is a dark red kidney line with an indeterminate growth habit developed by the Agriculture and Agri-Food Canada Greenhouse and Processing Crops Research Center (AAFC GPCRC), Harrow, registered as the cultivar Majesty. Montcalm is a dark red kidney bean cultivar from Michigan State University, USA, with tolerance to halo blight. USWA-39 is a dark red kidney line, which has race 1 resistance to BCMV (bean common mosaic virus) and complete resistance to CTV (curly top virus). The line was released by the Agricultural Research Service, US Department of Agriculture and the Agricultural Research Centers of Washington State University, the University of Idaho and the Oregon State University. AC Litekid is a medium to full season maturing and high-yielding light red kidney bean cultivar developed by AAFC GPCRC, Harrow, Ontario. The cultivar has high yield potential and resistance to 17 (alpha) and 89 (alpha Brazilian) races of anthracnose and to race 1 and 15 of bean common mosaic virus (BCMV). Foxfire is a light red kidney cultivar developed by Rogers Seed Co., Nampa, Idaho. The cultivar is tolerant to halo blight and has resistance to BCMV race 1 and rust. AC Elk is an early maturing, high-yielding light red kidney bean cultivar resistant to race 1 of BCMV and anthracnose race alpha and alpha Brazil developed at the AAFC GPCRC, Harrow, Ontario. Sacramento is early maturing, type I plant habit light red kidney bean cultivar developed by the Sacramento Valley Milling, Inc., Ordbend, CA. AC Calmont is a dark red kidney bean cultivar resistant to BCMV (1 and NY15 strains) and anthracnose (alpha, delta and alpha Brazil races) developed by the AAFC GPCRC, Harrow, Ontario.

The F_1 plants were grown in the growth room in the winter of 2000 at the University of Guelph. The F_2 plants were grown in the field at the University of Guelph Elora Research Station (ERS), near Elora, Ontario, in 2000 and were bulk harvested. The F_3 generation was grown in a winter nursery in New Zealand. The F_4 generation was grown at the ERS in the summer of 2001. Single plant selections for high pod number, upright plant architecture and early maturity were performed on F_5 population bulk plots in the field at the ERS in 2002. The F_5 derived F_6 lines ($F_{5:6}$) were grown in 2003 at the ERS in progeny rows. The $F_{5:7}$ selections were grown in preliminary yield trials at the ERS. Selected lines from the preliminary yield trials

were tested in advanced yield trials in two locations, at the ERS and in a farmer's field near St. Thomas, Ontario, in collaboration with Dr. S. J. Park, AAFC GPCRC, Harrow. Preliminary yield trials were grown in one row plots, 6 m long with a 60-cm spacing between rows, using three replications in a randomized complete block design. Advanced trials were grown in two row plots, 6 m long with a 60-cm spacing between rows, using four replications of a randomized complete block design. In all trials, the seeding rate was 90 seeds per row. Selection criteria in the preliminary and advanced yield trials were the same agronomic traits as for the F_5 population as well as high seed yield.

Performance

OAC Inferno was tested as OAC 07-L1 for performance and registration in the Ontario Coloured Bean Cultivar Registration Trials in 2007, 2008 and 2009. Registration trials were planted in two locations in 2007 (Monkton and Thorndale) and five locations in both 2008 and 2009 (Monkton, Kippen, St. Thomas, Elora and Thorndale). Yield trial were grown in two row plots, 6 m long with a spacing of 60 cm between rows, using four replications of a nearest neighbour complete block design. In all trials, the seeding rate was 90 seeds per row. Full registration of OAC Inferno was supported by the Ontario Pulse Crop Committee in 2009. During 2007 and 2008, the line was also grown in seed increase plots at the ERS to produce $F_{5:9}$ and $F_{5:10}$ generations. One hundred single plants from the $F_{5:11}$ generation, grown in a growth room in the winter of 2008–2009, were rogued for uniformity and trueness to type, and the seed from the remaining plants was bulked individually and planted in plant rows near Twin Falls, Idaho, USA, for breeder seed production in 2009.

Canned bean samples of OAC Inferno grown at three locations were assessed for appearance, flavour and texture by a panel at AAFC GPCRC, Harrow, Ontario. The texture of canned beans was evaluated mechanically with the Ottawa texture measurement system for firmness (N mm^{-1}) and plateau force (N) (Voisey 1971) with the wire extrusion cells [Instron texture measurement system model 441 (Instron Corporation, Canton, MA)]. The degree of packing of canned beans was examined visually. The washed-drained weight of the cooked samples was determined to quantify percent solid weight of each sample. The hydration coefficient was estimated as the water uptake of 1000 g of dry beans.

OAC Inferno has high yield potential. Its average yield over 3-yr trials was 3216 kg ha^{-1}, which was 15% (581 kg ha^{-1}) higher than the mean of 16 cultivars included in trials (not shown) and out-yielded both checks, AC Elk by 24% (616 kg ha^{-1}) and Red Kanner by 12% (339 kg ha^{-1}) (Table 1). Seed weight (grams per 1000 seeds at 14% moisture) was 649 g, higher than both check cultivars (Table 1). It matured in 102 d (3-yr mean), which is 3 d shorter than check Red Kanner but 8 d longer than AC Elk (Table 1). Therefore, it is suitable for the short season regions in Ontario with over 2600 crop heat units (Brown and Bootsma 1997). OAC Inferno has acceptable cooking quality (Table 2).

OAC Inferno is susceptible to common bacterial blight (CBB, caused by *Xanthomonas axonopodis* pv. *phaseoli*). Initial screening ratings were taken in the field in 2006 and 2008 with natural infection. Two indoor testings were conducted in growth chambers using artificial inoculation with the multiple-pin technique (Andrus 1948) in 2009. The inoculum was generated from leaves isolated from infected plants in the field using the dry leaf inoculum method (Gilbertson et al. 1988).

The cultivar is resistant to BCMV race 1. The trials were conducted under controlled conditions in growth chambers at the AAFC GPCRC, Harrow, Ontario, using plants with fully expanded unifolate leaves (approximately 10 d old). Inoculum was maintained by harvesting seeds from infected plants and prepared from infected leaves by grinding them with a mortar and pestle in a 0.01 M phosphate buffer (pH 7.0) with carborundum powder (Fisher Scientific, Pittsburgh, PA). The upper surfaces of the unifoliate leaves were covered with the race 1 or race 15 inoculums. The leaves were allowed to dry and the plants were misted with

Table 1. Average performance of OAC Inferno and check cultivars, AC Elk and Red Kanner, tested in twelve trials in the Ontario Pulse Crop Committee Coloured Bean Cultivar Registration Trials[z] in 2007–2009

	Yield (kg ha^{-1})				Maturity (d)				Seed weight (g 100 $seed^{-1}$)			
Cultivar	2007	2008	2009	Mean[y]	2007	2008	2009	Mean[y]	2007	2008	2009	Mean[y]
OAC Inferno	2966	3303	3229	3216	102	102	103	102	58.1	68.3	64.2	64.9
AC Elk	2611	2835	2361	2600	93	92	94	94	58.0	63.7	64.6	63.1
Red Kanner	2672	3098	2739	2877	102	105	105	105	51.6	55.0	54.1	54.0
SE[x]	59.9	43.2	74.9	52.4	1.0	1.0	0.7	0.9	0.98	1.18	1.10	1.06

[z]Trials were conducted at Kippen and Thorndale in 2007; Monkton, St. Thomas, Elora, Kippen and Thorndale in 2008 and 2009.
[y]Based on total number of trials.
[x]Based on trial means of 16 cultivars (not shown). Standard error of means, estimated in combined analysis over trials within each year and over years.

Table 2. Cooking quality of canned beans and disease reaction of OAC Inferno and check cultivars, AC Elk and Red Kanner, in the Ontario Pulse Crop Committee Coloured Bean Cultivar Registration Trials[z] (2008)

	Cooking quality						Disease reaction				
		Texture[x]					BCMV[t]		Anthracnose[s]		
Cultivar	Panel[y] (1–5)	Plateau force (N)	Firmness (N mm^{-1})	Packing[w] (1–5)	Drainedry wt.[v] (%)	Hydration coefficient[u] (%)	1	15	17	23	73
OAC Inferno	2.5	276	12.7	2.7	69.1	1.71	−	+	−	+	−
AC Elk	1.7	193	17.5	2.7	71.1	1.87	+	+	+	−	NA[r]
Red Kanner	3.3	230	20.0	3.3	66.9	1.81	+	−	NA	NA	NA
SE[q]	0.06	9.5	0.74	0.10	0.64	0.016					

[z]Trials were conducted at St. Thomas, Thorndale and Monkton.
[y]Eight panelists evaluated the appearance, flavour and texture of canned beans in a brine sauce using a scale of 1–5; 1, poor; 5, excellent.
[x]Texture of washed-drained canned beans measured on Instron Texture measurement system using wire extrusion cells for plateau force (N) and firmness (N mm^{-1}).
[w]Degree of clumping of canned beans scored visually from 1 to 5: 1, no clumping; 5, over half clumped.
[v]Drained weight: weight of washed-drained canned beans expressed as a percentage of unwashed-undrained weight.
[u]Soaked weight/dry weight (determined for 500 g of dry beans soaked for 40 min at 88°C).
[t]Resistance (−) or susceptibility (+) to bean common mosaic virus (BCMV) races 1 and 15.
[s]Resistance (−) or susceptibility (+) to Anthracnose races 17, 23 and 73.
[r]Not available.
[q]Based on trial means of 11 cultivars.

water to enhance inoculum absorption. Inoculated plants were maintained at 23/18°C day/night temperatures with a 14 h photoperiod. Disease ratings were performed 7–10 d after inoculation.

OAC Inferno is resistant to anthracnose [caused by *Colletotrichum lindemuthianum* (Sacc. & Mangus)] race 17 and 73. The trials were conducted under controlled conditions in growth chambers at the AAFC GPCRC, Harrow, Ontario. For each test 10–15 plants were inoculated by brushing both the upper and lower surfaces of the unifoliate leaves with a suspension *C. lindemuthianum* spores (10^6 spores mL^{-1}), in Mathur's medium (0.1% yeast extract, 0.1% Bacto Peptone, 1% sucrose, 0.25% $MgSO_47H_2O$, 0.27% KH_2PO_4, 2% agar supplemented with 25 mg of ampicillin in 1 L of sterile distilled water). Inoculated plants were placed into a mist chamber with 100% humidity at 23°C for 48 h, and then transferred to a growth cabinet at 23/18°C day/night temperature with a 14 h photoperiod. Disease ratings were performed 5 d after inoculation and were repeated 3 d later.

Other Characteristics

OAC Inferno has a determinate, bushy growth habit with short vines (<30 cm) and plant height at maturity of 45.5 cm. It has a green hypocotyl at the seedling stage and medium green leaf colour (measured at time of full flowering) with large (kidney type) terminal leaflets. It has pink flowers, which appear approximately 37.5 d after planting. The pods (measured when pod filling is complete, prior to yellowing) are long and broad (kidney type) with a slight curvature towards the ventral part. At maturity, pods are tan in colour. The seed is kidney shaped with a light red seed coat colour.

Maintenance and Distribution of Pedigreed Seed

Pedigreed breeder seed of the bean cultivar OAC Inferno is maintained by the University of Guelph, Department of Plant Agriculture, Guelph, Ontario, Canada N1G 2W1.

Pedigreed seed will be distributed through Hensall District Co-operative, P.O. Box 219, Hensall, Ontario, Canada N0M 1X0 (telephone: 519–262-3002).

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