

RED HAWK DARK RED KIDNEY BEAN

EXHIBIT A - ORIGIN AND BREEDING HISTORY:

- Winter 1988* Original cross 87K202 was made in E. Lansing MI.
Parentage: Charlevoix/2*Montcalm. The original F₁ between Charlevoix and Montcalm was backcrossed once to Montcalm. Charlevoix is an older anthracnose resistant dark red kidney bean variety from MSU. Montcalm is a full-season dark red kidney bean variety from MSU which exhibits good adaptation and excellent canning quality. F₁ plants were selfed during spring in the greenhouse in E. Lansing, MI.
- Summer 1988* Single plant selection no. 3 was made in F₂ nursery at Montcalm, MI on the basis of agronomic and seed traits.
- Winter 1989* A single F₃ progeny row was grown in Isabela Puerto Rico. Remnant seed was screened for anthracnose resistance and only resistant lines were returned to MI.
- Summer 1989* A single F₄ row was grown and mass selected for seed and agronomic traits at Montcalm, MI.
- Winter 1990* A single F₅ progeny row was grown at Isabela, PR and mass selected on the basis of agronomic and seed traits.
- Summer 1990* F₆ breeding line 87K202-03-01-01 entered replicated yield trials at Entrican, MI with the permanent code number K90101. Canning tests were initiated.
- Summer 1991-96* Replicated yield trials were conducted annually in both the mid Michigan area and in Presque Isle Co. in NE Michigan. Canning trials were also conducted annually on seed grown at both locations.
- Winter 1995* A source of breeder seed was screened for resistance to anthracnose races 7 & 73 and resistant individuals were increased in the greenhouse in E. Lansing, MI.
- Summer 1995* Continued production of breeder seed was continued in isolation in field plots in E. Lansing. Strip trials were conducted near Millersburg, MI to measure agronomic performance, mechanized harvest and milling. Samples were canned commercially by one processor in 1993 & 1994.
- Winter 1996* A breeder seed source of K90101 was increased in the greenhouse and a western seed source was established in Idaho in 1996.
- Winter 1997* Dark red kidney bean breeding line **K90101** was officially released as the variety **RED HAWK** on March 21, 1997. Western breeder seed was available for seed increase and distribution as foundation seed.

EXHIBIT B - STATEMENT OF DISTINCTNESS

RED HAWK is most similar to the dark red kidney bean variety Montcalm, but differs in its reaction to bean anthracnose, incited by *Colletotrichum lindemuthianum* (Sacc. & Magnus) Lams.-Scrib.

RED HAWK dark red kidney bean possesses the combination of *Co-1* and *Co-2* genes which conditions resistance to all known North American races of anthracnose. Montcalm carries only the *Co-1* gene. RED HAWK is resistance to race 7, to which Montcalm is highly susceptible.

References:

Kelly J.D., L. Afanador and L.S. Cameron. 1994. New races of *Colletotrichum lindemuthianum* in Michigan and implications in dry bean resistance breeding. *Plant Dis.* 78:892-894.

Kelly, J.D. and R.A. Young. 1996. Proposed symbols for anthracnose resistance genes. *Annu. Rept. Bean Improv. Coop.* 39:20-24.

Kelly, J.D., G.L. Hosfield, G.V. Varner, M.A. Uebersax, R.A. Long, and J. Taylor. 1998. Registration of 'Red Hawk' dark red kidney bean. *Crop Sci.* 38:280-281.

Uniformity: Observations indicate that through five generations of self pollination from the F₆ to the F₁₀ generation, no offtypes nor variants were observed during the course of repeated multiplication and selfing of RED HAWK.

Stability: RED HAWK released as a F₁₀ generation pure line (selfed 10 generations) bean variety is uniform and stable within commercially acceptable limits of dark red kidney bean varieties.

OBJECTIVE DESCRIPTION OF VARIETY
 Dry Edible Bean (*Phaseolus vulgaris* L.)

NAME OF APPLICANT(S) Michigan State University	EXPERIMENTAL NAME K90101	VARIETY NAME Red Hawk
ADDRESS (Street and No. or R.F.D. No., City, State, ZIP) 109 Agriculture Hall Michigan State University East Lansing, MI 48824		FOR OFFICIAL USE ONLY PVPO NO.

Provide data for all characters unless indicated as "optional." Place numbers in the boxes for the characters or numerical values which best describe this variety. Measured data should be the mean of an appropriate number of well spaced (15-20 cm) plants. The Royal Horticultural Society or any recognized color standard may be used to determine plant color. Designate the color system used below.

COLOR SYSTEM USED	LOCATION OF THE TEST(S) TO EVALUATE THIS VARIETY
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1. MARKET CLASS <table border="1"> <tr> <td>0</td> <td>9</td> <td>CLASS</td> <td>CHECK</td> </tr> <tr> <td></td> <td></td> <td>1 = Navy (Pea)</td> <td>Seafarer</td> </tr> <tr> <td></td> <td></td> <td>2 = Small White</td> <td>Aurora</td> </tr> <tr> <td></td> <td></td> <td>3 = Black</td> <td>Midnight</td> </tr> <tr> <td></td> <td></td> <td>4 = Pinto</td> <td>UI-114</td> </tr> <tr> <td></td> <td></td> <td>5 = Great Northern</td> <td>UI-59</td> </tr> <tr> <td></td> <td></td> <td>6 = Small Red</td> <td>NW-59</td> </tr> <tr> <td></td> <td></td> <td>7 = Pink</td> <td>Viva</td> </tr> <tr> <td></td> <td></td> <td>8 = Cranberry</td> <td>UI-50</td> </tr> <tr> <td></td> <td></td> <td>9 = Dark Red Kidney</td> <td>Montcalm</td> </tr> <tr> <td></td> <td></td> <td>10 = Light Red Kidney</td> <td>Redcloud</td> </tr> <tr> <td></td> <td></td> <td>11 = Yellow Eye</td> <td>Steuben</td> </tr> <tr> <td></td> <td></td> <td>12 = Other (specify)</td> <td></td> </tr> </table>	0	9	CLASS	CHECK			1 = Navy (Pea)	Seafarer			2 = Small White	Aurora			3 = Black	Midnight			4 = Pinto	UI-114			5 = Great Northern	UI-59			6 = Small Red	NW-59			7 = Pink	Viva			8 = Cranberry	UI-50			9 = Dark Red Kidney	Montcalm			10 = Light Red Kidney	Redcloud			11 = Yellow Eye	Steuben			12 = Other (specify)		2. MATURITY <table border="1"> <tr> <td>2</td> <td colspan="2">1 = Early (80-90 days); 2 = Medium (90-100 days); 3 = Late (>100 days)</td> </tr> <tr> <td></td> <td>9</td> <td>9</td> </tr> <tr> <td colspan="3">Days from planting to harvest maturity</td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="3">Heat units from planting to harvest maturity (optional). Specify base temperature used: _____</td> </tr> <tr> <td>1</td> <td>0</td> <td>4</td> </tr> <tr> <td colspan="3">Days from planting to harvest maturity of check variety (use check appropriate to market class shown in item 1)</td> </tr> </table>	2	1 = Early (80-90 days); 2 = Medium (90-100 days); 3 = Late (>100 days)			9	9	Days from planting to harvest maturity						Heat units from planting to harvest maturity (optional). Specify base temperature used: _____			1	0	4	Days from planting to harvest maturity of check variety (use check appropriate to market class shown in item 1)		
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4. LEAFLET MORPHOLOGY (Use terminal leaflet of a fully expanded trifoliolate)

1	1 = Smooth; 2 = Wrinkled	1	1 = Dull; 2 = Glossy; 3 = Semiglossy; 4 = Variable
3	SHAPE:	1 = Ovate	2 = Lanceolate
		3 = Deltoid	4 = Cordate
		5 = Rhomboid	
2	APEX OF LEAFLET:	1 = Acute	2 = Acuminate
		3 = Cuspidate	4 = Obtuse
1	BASE OF LEAFLET:	1 = Obtuse	2 = Oblique
		3 = Cordate	4 = Cuneate
			5 = Attenuate

1 COLOR OF STANDARD: 1 = White; 2 = Cream; 3 = Pink; 4 = Blue; 5 = Purple

1 COLOR OF KEEL: 1 = White; 2 = Cream; 3 = Pink; 4 = Blue; 5 = Purple

1 COLOR OF WINGS: 1 = White; 2 = Cream; 3 = Pink; 4 = Blue; 5 = Purple

4 2 Days to 50% bloom

6. POD MORPHOLOGY (Green pod morphology optional)

Green Mature

1 COLOR PATTERN: 1 = Solid; 2 = Striped; 3 = Blotched; 4 = Mottled; 5 = Other _____

5 PRIMARY COLOR: 1 = Purple; 2 = Red; 3 = Green; 4 = Yellow; 5 = Tan; 6 = Brown; 7 = Other _____

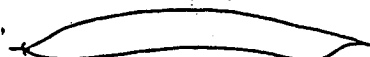
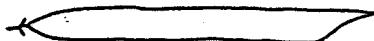
3 COLOR MODIFIER: 1 = Light; 2 = Light Medium; 3 = Medium; 4 = Medium Dark; 5 = Dark

5 SECONDARY COLOR: 1 = Purple; 2 = Red; 3 = Green; 4 = Yellow; 5 = Tan; 6 = Brown; 7 = Other _____

1 CROSS SECTION SHAPE: 1 = Flat 2 = Pear 3 = Round 4 = Figure Eight



1 POD CURVATURE: 1 = Straight 2 = Slightly Curved



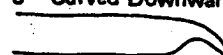
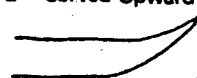
3 = Curved



4 = Reurved



1 POD BEAK ORIENTATION: 1 = Straight 2 = Curved Upward 3 = Curved Downward 4 = Variable Average beak length, in cm. _____



1 CONstrictions: 1 = None; 2 = Slight; 3 = Deep

4 8 Average number of seeds per pod

7. SEED COLOR

1 1 = Shiny; 2 = Dull; 3 = Semishiny; 4 = Variable

1 1 = Monochrome; 2 = Polychrome

0 7 PRIMARY COLOR: 1 = White; 2 = Yellow; 3 = Buff; 4 = Tan; 5 = Brown; 6 = Pink; 7 = Red; 8 = Purple; 9 = Blue; 10 = Black; 11 = Other _____

SECONDARY COLOR: 1 = White; 2 = Yellow; 3 = Buff; 4 = Tan; 5 = Brown; 6 = Pink; 7 = Red; 8 = Purple; 9 = Blue; 10 = Black; 11 = Other _____

1 COLOR PATTERN: 1 = Solid; 2 = Splashed; 3 = Mottled; 4 = Striped; 5 = Flecked; 6 = Dotted

1 HILAR RING: 1 = Absent; 2 = Present

HILAR RING COLOR: 1 = White; 2 = Yellow; 3 = Buff; 4 = Tan; 5 = Brown; 6 = Pink; 7 = Red; 8 = Purple; 9 = Blue; 10 = Black; 11 = Other _____

8. SEED SHAPE AND WEIGHT

4 SHAPE OF SEED TAKEN FROM MIDDLE OF POD: 1 = Round 2 = Oval 3 = Cuboid 4 = Kidney 5 = Truncate Fastigate



6 2 Dry seed weight in g/100g seeds (adjusted to 12% moisture)

PHOCCYANIN PIGMENTATION

1 = ABSENT
2 = PRESENT

<input checked="" type="checkbox"/> Flowers	<input checked="" type="checkbox"/> Stems	<input checked="" type="checkbox"/> Pods	<input checked="" type="checkbox"/> Seeds
<input checked="" type="checkbox"/> Leaves	<input checked="" type="checkbox"/> Petioles	<input checked="" type="checkbox"/> Peduncles	<input checked="" type="checkbox"/> Nodes

10. KNOWN DISEASE REACTION

DISEASES - COMMON NAME: Anthracnose, Rust, Powdery mildew, Fusarium root rot, Pythium root rot, Rhizoctonia root rot, Pythium wilt, Sclerotinia white mold, Angular leaf spot, Bacterial wilt, Halo blight, Fuscous blight, Common bacterial blight, Red node virus, Pochota mottle virus, Bean common mosaic virus, Bean yellow mosaic virus, Curly top virus, Bacterial brown spot, Bean southern mosaic virus, Other (specify) _____

REACTION: 1 = Susceptible; 2 = Resistant; 3 = Tolerant; 4 = Avoidance

(Give the common name (CN), scientific name (SN), and race(s), where applicable)

DISEASE: CN Rust; SN Uromyces appendiculatus; Race(s) Michigan isolates

DISEASE: CN Bean Common Mosaic Virus; SN BCMV, BCMNV; Race(s) All strains

DISEASE: CN Common Bacterial Blight; SN Xanthomonas campestris; Race(s) Michigan isolates

DISEASE: CN Anthracnose; SN Colletotrichum lindemuthianum; Race(s) Races 7, 65, 73, 89

DISEASE: CN Root Rot; SN Fusarium solani; Race(s) Michigan isolates

DISEASE: CN White Mold; SN Sclerotinia sclerotiorum; Race(s) Michigan isolates

11. KNOWN INSECT/NEMATODE RESISTANCE

PESTS - COMMON NAME: Aphids, Bean pod weevil, Bruchid beetle, Corn earworm, Flea beetle, Leaf hopper, Lesion nematode, Lygus, Mexican bean beetle, Root knot nematode, Corn seed maggot, Spider mites, Thrips, Weevils, Western bean cutworm, Other (specify) _____

REACTION: 1 = Susceptible; 2 = Resistant; 3 = Tolerant; 4 = Avoidance

(Give the common name (CN), scientific name (SN), and biotype, where applicable)

PEST: CN Potato Leafhopper; SN Empoasca fabae; Biotype Michigan

PEST: CN _____; SN _____; Biotype _____

PEST: CN _____; SN _____; Biotype _____

12. KNOWN PHYSIOLOGICAL STRESS REACTION

1 = Susceptible; 2 = Resistant;
3 = Tolerant; 4 = Avoidance

Heat Cold Drought Air Pollution

Nutrient toxicity or deficiency (specify nutrient) _____

Other _____

13. COMMENTS

Red Hawk carries the I gene for resistance to Bean Common Mosaic Virus; Co-1 and Co-2 genes for resistance to anthracnose.

EXHIBIT D - ADDITIONAL DESCRIPTION

Registration of 'Red Hawk' Dark Red Kidney Bean

'Red Hawk' dark red kidney bean (*Phaseolus vulgaris* L.) (Reg. no. CV-144, PI 596751) was developed and released cooperatively by the Michigan Agricultural Experiment Station and the USDA-ARS in 1997 as a full-season, disease-resistant, dark red kidney bean cultivar with excellent processing quality.

Red Hawk, tested as K90101, was derived from a cross made in 1988 between dark red kidney bean cultivars, Charlevoix/2* Montcalm. The cross was designed to incorporate the earliness and resistance to anthracnose [caused by *Colletotrichum lindemuthianum* (Sacc. & Magnus) Lams.-Scrib.] of Charlevoix (1) with the superior canning quality and resistance to halo blight [caused by *Pseudomonas syringae* pv. *phaseolicola* (Burkholder) Young et al.] of Montcalm (2). The F₁ plants were advanced in the greenhouse and space-planted in an F₂ nursery at the Montcalm Research Farm near Entrican, MI. A single-plant selection was identified as possessing the desired agronomic and kidney seed traits. The F₃ progeny were advanced as a plant row in Puerto Rico. A single-plant selection was made in a space-planted F₄ nursery in Michigan on the basis of agronomic and seed traits and resistance to bean anthracnose. The F₅ progeny were advanced as a plant row in Puerto Rico. The F₆ breeding line coded K90101 entered replicated yield trials in 1990.

Red Hawk was extensively tested for yield and agronomic traits at 36 locations in Michigan over seven seasons (1990–1996). Red Hawk averaged 2190 kg ha⁻¹; it outyielded Montcalm by 5% over 35 locations, and outyielded the commercial dark red kidney cultivars Isles and Drake by 2 and 11%, respectively.

Red Hawk averaged 51 cm in height and exhibits the Type I upright determinate bush growth habit with improved resistance to lodging over Montcalm. Red Hawk flowers 42 d after planting and has a white flower with a slight pink blush on the banner and wing petals. Red Hawk is a full-season bean, maturing 99 d after planting and with a range in maturity from 95 to 100 d, depending on season and location. Red Hawk matures 5 d earlier than Montcalm, 1 d earlier than Isles and 2 d later than Drake. Red Hawk has demonstrated more uniform maturity, has senesced more rapidly and has exhibited less tendency towards green stem at maturity than Montcalm.

Red Hawk carries the single dominant hypersensitive *I* gene resistance to bean common mosaic virus (BCMV) and is sensitive to the temperature-insensitive necrosis-inducing strains of bean common mosaic necrosis virus (BCMNV) such as NL 3 and NL 8, which induce the black root reaction. Red Hawk possesses the combination of *Co-1* and *Co-2* genes, which conditions resistance to all known North American races of anthracnose. Red Hawk is essentially immune to the indigenous races of rust [*Uromyces*

appendiculatus (Pers.:Pers.) Unger] prevalent in Michigan, is tolerant to Minnesota isolates of halo blight and to Michigan isolates of common blight [*Xanthomonas campestris* pv. *phaseoli* (Smith) Dye], but is susceptible to Michigan isolates of root rot [primarily *Fusarium solani* (Mart.) Sacc. f. sp. *phaseoli* (Burkholder) W.C. Snyder & H.N. Hans.].

Red Hawk has a large dark red kidney seed which averages 62 g 100 seed⁻¹ (range: 58–63 g 100 seed⁻¹). The seed is similar in size to Montcalm but smaller than Isles. The dry seed color is similar to Isles but slightly darker in color than Montcalm. In canning trials, Red Hawk has been subjectively rated by a team of panelists as being equivalent to Montcalm in cooking quality. Red Hawk scored 4.3 on a five-point hedonic scale (where 5 is best). This evaluation is based on whole-bean integrity (no splitting or clumping), uniformity of size (uniform water uptake), color (no after darkening), and clear brine (no starch extrusion into canning liquid). After it is processed, Red Hawk does not differ significantly from other commercial dark red kidney bean cultivars for cooked color, texture, hydration, and drained weight ratios.

Red Hawk dark red kidney bean has been released as a public nonexclusive variety, with the option that Red Hawk may be sold for seed by name only under the certified class. A research fee will be assessed on each hundredweight unit of certified seed sold. Breeder seed is maintained by the Michigan Agricultural Experiment Station, East Lansing, MI 48824, in cooperation with the Michigan Crop Improvement Association.

J. D. KELLY,* G. L. HOSFIELD, G. V. VARNER,
M. A. UEBERSAX, R. A. LONG, AND J. TAYLOR (3)

References and Notes

1. Andersen, A.L., M.W. Adams, and G. Whitford. 1964. Charlevoix, anthracnose-resistant dark red kidney bean. Res. Rep. 6. Farm Science. Michigan Agric. Exp. Stn., Michigan State Univ., East Lansing.
2. Copeland, L.O., and M.H. Erdmann. 1977. Montcalm and Mecosta, halo blight tolerant kidney bean varieties for Michigan. Ext. Bull. 957. Michigan State Univ., East Lansing.
3. J.D. Kelly and J. Taylor, Dep. of Crop and Soil Sciences, and M.A. Uebersax, Dep. of Food Science and Human Nutrition, Michigan State Univ., East Lansing, MI 48824; G.L. Hosfield, Sugarbeet and Bean Res., USDA-ARS, East Lansing, MI; G.V. Varner, Michigan Dry Bean Prod. Res. Advisory Board, 3066 S. Thomas Rd., Saginaw, MI 48603; and R.A. Long, County Extension, 151 E. Huron Ave., Rogers City, MI 49779. Research supported by Michigan Foundation Seed Assoc., Michigan Dry Bean Prod. Res. Adv. Board, Michigan Agric. Exp. Stn., and the USDA-ARS. Joint contribution of the Michigan Agric. Exp. Stn. and USDA-ARS. Registration by CSSA. Accepted 30 June 1997. *Corresponding author (kellyj@pilot.msu.edu).

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U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE

The following statements are made in accordance with the Privacy Act 1974 (5 U.S.C. 552a) and the Paperwork Reduction Act (PRA) of 1995.

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

**EXHIBIT E
STATEMENT OF THE BASIS OF OWNERSHIP**

1. NAME OF APPLICANT(S)

Michigan State University

2. TEMPORARY DESIGNATION OR EXPERIMENTAL NUMBER

K90101

3. VARIETY NAME

Red Hawk

4. ADDRESS (Street and No., or R.F.D. No., City, State, and ZIP Code, and Country)

109 Agriculture Hall
Michigan State University
East Lansing, MI 48824

5. TELEPHONE (include area code)

517-355-0123

6. FAX (include area code)

517-353-5406

7. PVPO NUMBER

8. Does the applicant own all rights to the variety? Mark an "X" in appropriate block. If no, please explain:

YES NO

9. Is the applicant (individual or company) a U.S. national or U.S. based company? If no, give name of country:

YES NO

10. Is the applicant the original owner? YES NO If no, please answer the following:

a. If original rights to variety were owned by individual(s), is (are) the original owner(s) a U.S. national(s)?

YES NO If no, give name of country

b. If original rights to variety were owned by a company, is the original owner(s) a U.S. based company?

YES NO If no, give name of country

11. Additional explanation on ownership (if needed, use reverse for extra space):

PLEASE NOTE:

Plant variety protection can be afforded only to owners (not licensees) who meet one of the following criteria:

1. If the rights to the variety are owned by the original breeder, that person must be a U.S. national, national of a UPOV member country, or national of a country which affords similar protection to nationals of the U.S. for the same genus and species.
2. If the rights to the variety are owned by the company which employed the original breeder(s), the company must be U.S. based, owned by nationals of a UPOV member country, or owned by nationals of a country which affords similar protection to nationals of the U.S. for the same genus and species.
3. If the applicant is an owner who is not the original owner, both the original owner and the applicant must meet one of the above criteria.

The original breeder/owner may be the individual or company who directed final breeding. See Section 41(a)(2) of the Plant Variety Protection Act for definition.

According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0581-0055. The time required to complete this information collection is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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