‘KnuckleHull-VNR’, a Crowder-type Southernpea Resistant to Blackeye Cowpea Mosaic Virus and Root-knot Nematode

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‘KnuckleHull-VNR’ is a new southernpea [*Vigna unguiculata* (L.) Walp.] released 18 Oct. 2002 by the U.S. Dept. of Agriculture, Agricultural Research Service (USDA–ARS). ‘KnuckleHull-VNR’ was developed as a replacement for ‘Knuckle Purple Hull’, a crowder-type cultivar widely grown by home gardeners throughout the southeastern United States for many years despite susceptibility to blackeye cowpea mosaic virus (BICMV) and root-knot nematodes (*Meloidogyne* spp.). The major attributes of the new cultivar are its excellent resistances to BICMV and root-knot nematodes.

Origin

Efforts to develop ‘KnuckleHull-VNR’ were initiated in 1997 with the field evaluation at Charleston, S.C., of a collection of 61 knuckle purple hull-type breeding lines received from Auburn Univ. at the closeout of its southernpea breeding program. Exact pedigrees and degree of inbreeding of the original lines are unknown, but each line was believed to be the result of a cross between US-427 and an Auburn Univ. BICMV-resistant, knuckle purple hull-type breeding line. US-427 is a root-knot nematode resistant breeding line developed at the U.S. Vegetable Laboratory and released in 1987; it is the product of a recurrent backcross breeding effort (five backcrosses) to incorporate the dominant *Rk* gene for root-knot nematode resistance into ‘Knuckle Purple Hull’ (Fery and Dukes, 1988). Patel (1985) noted that ‘Worthmore’ was used in the Auburn Univ. southernpea breeding program to improve ‘Knuckle Purple Hull’ for BICMV resistance; Walker and Chambliss (1981) reported that a

single recessive gene (*b1c*) controls BICMV resistance in ‘Worthmore’. The 61 lines in the 1997 field planting were subjected to a selection effort between and within lines to develop homozygous, knuckle purple hull-type populations. Progenies of single plants selected from the 1997 field planting were grown in a Winter 1997–98 greenhouse planting and an additional cycle of single-plant selection was completed. ‘KnuckleHull-VNR’ originated as the bulk of the progeny of one of the Winter 1997–98 single-plant selections grown in a Spring 1998 greenhouse planting.

Description

Plant and pod characteristics of ‘KnuckleHull-VNR’ are quite similar to those of ‘Knuckle Purple Hull’ (Fig. 1). ‘KnuckleHull-VNR’ has a high bushy growth habit and produces dry pods at Charleston, S.C., in 68 to 74 d. Flower color is purple (completely pigmented). There is extensive purple pigmentation on the stems, branches, and peduncles, but only intermediate pigmentation on petioles. ‘KnuckleHull-VNR’ has smooth, nonglossy, green-colored leaves. Pod set is concentrated,

and pods are borne above foliage level in a scattered fashion. Dry pods are attached to the peduncles in a pendant fashion. Each peduncle typically produces two pods.

A typical ‘KnuckleHull-VNR’ pod is slightly curved, 20 cm long, and contains 14 peas (Fig. 2). Pod color is light green (with purple pigmentation at both ends) when immature, purple (glossy) at optimum green-shell maturity, and dark purple (nonglossy) when dry. Fresh peas have a semi-crowder to crowder shape and a light green color. Dry ‘KnuckleHull-VNR’ peas have a brown-colored, smooth seedcoat, and are smaller than ‘Knuckle Purple Hull’ (weight per 100 dry peas: ‘KnuckleHull-VNR’, 15.2 g, and ‘Knuckle Purple Hull’, 19.7 g) (Table 1).

Results of 3 years (1999–2001) of replicated field testing at Charleston, S.C., indicate yield potential of ‘KnuckleHull-VNR’ is similar to that of ‘Knuckle Purple Hull’ (‘KnuckleHull-VNR’ yield of dry peas over the entire 3-year period of replicated testing was 107% of the yield of ‘Knuckle Purple Hull’) (Table 1). ‘KnuckleHull-VNR’ was tested as US-1035 throughout the southern United States in the 2000 and 2001 Regional Southernpea Cooperative Trials.

The results of an inoculated greenhouse test and 3 years (1999–2001) of inoculated (susceptible spreader row technique) field tests conducted at Griffin, Ga., using enzyme-linked immunosorbent assay methodology indicate that ‘KnuckleHull-VNR’ is highly resistant to BICMV. This demonstrated resistance to BICMV indicates that ‘KnuckleHull-VNR’ is also resistant to cowpea stunt, an extremely devastating viral disease caused by a synergistic effect of BICMV and cucumber mosaic virus (Pio-Ribeiro et al., 1978).

‘KnuckleHull-VNR’ is homozygous for the *Rk* gene that conditions resistance to southern root-knot nematode [*M. incognita* (Kofoid and White) Chitwood], Javanese root-knot nematode [*M. javanica* (Treub.) Chitwood], and northern root-knot nematode [*M. hapla* Chitwood] (Fery and Dukes, 1980). A South Carolina isolate of *M. incognita* race 3 was used to bioassay for presence of the *Rk* gene during the development of ‘KnuckleHull-VNR’,

Fig. 1. Space-planted field (single plants spaced 90 cm apart on beds 102 cm apart) of ‘KnuckleHull-VNR’ southernpea.

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Table 1. Number of days to harvest, weight per 100 dry peas, and dry pea yield for 'KnuckleHull-VNR' and 'Knuckle Purple Hull' southernpeas grown in spring trials, Charleston, S.C., 1999–2001.^z

Cultivar	Days to harvest (no.)	Wt/100 dry peas (g)	Dry pea yield (kg·ha ⁻¹)
<i>Trial I—1999</i>			
KnuckleHull-VNR	68.6 b ^y	14.6 b	960 a
Knuckle Purple Hull	70.4 a	17.5 a	583 b
<i>Trial II—2000</i>			
KnuckleHull-VNR	74.5 b	16.0 b	993 a
Knuckle Purple Hull	86.5 a	22.4 a	938 a
<i>Trial III—2001</i>			
KnuckleHull-VNR	74.2 a	15.1 b	796 b
Knuckle Purple Hull	73.9 a	19.2 a	1,048 a
<i>Combined analysis of all trials</i>			
KnuckleHull-VNR	72.4 b ^{***}	15.2 b ^{***}	916 a ^{***}
Knuckle Purple Hull	76.9 a	19.7 a	856 a

^zSpring 1999, 2000, and 2001 trials planted on 2 June, 1 June, and 5 June, respectively. Experimental design of each trial was a randomized complete block with 10 replications. Results of combined analyses of all trials indicated a significant cultivar × trial interaction for days to harvest, weight per 100 dry peas, and dry pea yield. Consequently, results are presented for both single trial and combined analyses to aid interpretation.

^yMean separation within columns and trials by Student–Newman–Keuls multiple range test, $P < 0.05$.

^{***}Significant interaction between cultivar and trial at $P < 0.001$.

Table 2. Average root gall index, average egg mass index, and average number of eggs per gram fresh root tissue for 'KnuckleHull-VNR', 'Knuckle Purple Hull', US-427, 'Mississippi Silver', and 'Pinkeye Purple Hull-BVR' plants grown in soil infested with the southern root-knot nematode, *Meloidogyne incognita* race 3 (Greenhouse Expt.).^z

Cultivar	Root gall index ^y	Egg mass index ^x	No. of eggs/g fresh root tissue
KnuckleHull-VNR	1.50 b ^w	1.37 b	14,306 b
Knuckle Purple Hull	4.97 a	4.97 a	109,336 a
US-427 ^v	1.50 b	1.42 b	7,800 b
Mississippi Silver ^v	1.50 b	1.22 b	16,038 b
Pinkeye Purple Hull-BVR ^u	4.93 a	4.98 a	118,644 a

^zRandomized complete-block experiment with six replications (five plants per plot; seeds sowed in a steam-pasteurized mixture of soil, sand, and peat on 25 Feb. 1999; each seed inoculated with ≈2700 *M. incognita* race 3 eggs at sowing; roots of all plants evaluated for galling and egg masses on 27 May 1999). The NaOCl procedure described by Hussey and Barker (1973) was used to extract *M. incognita* eggs from a fibrous root sample taken from each plot.

^vRated on a scale of 1 to 5: 1 = no galls; 2 = light galling, 1% to 25% of root system galled; 3 = moderate galling, 26% to 50% of root system galled; 4 = heavy galling, 51% to 80% of root system galled; and 5 = severe galling, 81% to 100% of root system galled.

^wRated on a scale of 1 to 5: 1 = no egg masses evident, 2 = scattered egg masses covering 1% to 25% of root system, 3 = moderate number of egg masses covering 26% to 50% of root system, 4 = numerous egg masses covering 51% to 80% of root system, and 5 = extremely large number of egg masses covering 81% to 100% of root system.

^xMean separation within columns by Student–Newman–Keuls multiple range test, $P < 0.05$.

^yResistant control.

^uSusceptible control.

and results of all greenhouse tests indicated that resistance exhibited by 'KnuckleHull-VNR' is equal to the resistance exhibited by the widely grown crowder-type cultivar Mississippi Silver. Numbers of galls and egg masses on the roots were always minimal. Results of a 1999 replicated test conducted in a soil-filled greenhouse bench infested with *M. incognita* showed that fresh 'KnuckleHull-VNR' roots yielded 87% fewer *M. incognita* eggs/gram than did fresh 'Knuckle Purple Hull' roots (Table 2).

'KnuckleHull-VNR' is recommended for

use by home gardeners who are concerned about yield losses to their 'Knuckle Purple Hull' plantings caused by BICMV, cowpea stunt, and root-knot nematodes. BICMV and cowpea stunt can cause devastating yield losses to southernpeas in home gardens, and plant resistance is the only feasible method of control. Home gardeners often do not have easy access to needed nematicides or garden sites not infested with root-knot nematodes. 'KnuckleHull-VNR' should perform well in all areas where 'Knuckle Purple Hull' has been successfully grown.

Availability

Breeder's seed of 'KnuckleHull-VNR' has been released to seed producers. Small samples of 'KnuckleHull-VNR' breeder's seed are available from R.L.F. for distribution to interested research personnel. Genetic material of this release will be deposited in the National Plant Germplasm System where it will be available for research purposes, including the development and commercialization of new cultivars. It is requested that appropriate recognition of source be given when this germplasm contributes to research or development of a new breeding line or cultivar.

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Fig. 2. Fresh pods and peas of 'KnuckleHull-VNR' southernpea.