‘White Regal’, a Multiple-pest and Disease-resistant, Cream-fleshed Sweetpotato

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The sweetpotato [*Ipomoea batatas* (L.) Lam.] cultivar White Regal was developed jointly by the U.S. Dept. of Agriculture (USDA), Agricultural Research Service (ARS), and the South Carolina Agriculture and Forestry Research System, Clemson Univ. This cultivar is a cream-fleshed, bland type with an attractive scarlet skin. Similar to ‘Regal’, it produces excellent yields of high quality storage roots, has a high level of resistance to diseases and insect pests, and is allelopathic to some weed species. ‘White Regal’ is a dry-fleshed, bland type in contrast to ‘Regal’, which is orange, sweet, and strong in sweetpotato flavor. ‘White Regal’ shows potential to be better for processed products than do orange, moist, sweet cultivars like Jewel and Beauregard. ‘White Regal’ should also be utilized instead of ‘Regal’ by breeders of dry-fleshed sweetpotatoes to transfer the multiple resistance traits of ‘Regal’, without introducing the sweetness and strong flavor not desired in these types. As a cultivar with multiple-pest and disease resistance, White

Regal, like its parent ‘Regal’, has potential use in integrated pest management systems.

Origin

‘White Regal’ originated in 1990 as a stable, somatic mutant of ‘Regal’. ‘Regal’ was developed using a recombinant mass selection breeding technique (Jones et al., 1985) and was obtained from an open-pollinated polycross nursery containing 30 breeding lines and cultivars selected for high levels of multiple pest resistances and good horticultural traits. W-99, a breeding line from the USDA program, was the maternal parent of ‘Regal’.

Description

‘White Regal’ has large, dark-green, cordate leaves, some with very slight teeth on the margin. The leaf blade has prominent dark purplish veins on the lower surface, radiating from the juncture of the petiole. The vines are moderate in length, vigorous, and the canopy develops rapidly and shades the ground. Several years of observation in South Carolina have shown that the bedded roots sprout rapidly in the spring, and more shoots are produced per flat of seed roots than is the case with the leading cultivars Jewel and Beauregard. ‘White Regal’ flowers profusely without grafting and produces large amounts of viable seed. These traits make ‘White Regal’ a good parent for use in polycross breeding nurseries.

‘White Regal’ is highly resistant to Fusarium wilt [*Fusarium oxysporum* f. sp. *batatas* (Wr.) Snyd. & Hans] (Dukes et al., 1993b) and the southern root-knot nematode [*Meloidogyne incognita* (Kofoid and White) Chitwood, races 1 and 3] (Table 1) (Dukes et al., 1993a). ‘White Regal’ does not exhibit the symptoms of internal cork virus (caused by a strain of the sweetpotato feathery mottle virus) under field conditions where symptoms are exhibited by the susceptible cultivar Porto Rico. ‘White Regal’ was observed to be free of symptoms of sclerotial blight (*Sclerotium rolfsii* Sacc.) under plant bed conditions where the susceptible check clone, W-13, exhibits disease symptoms and subsequently reduced sprouting. Methods of testing and evaluation are described in Jones et al. (1986).

The levels of resistance of ‘White Regal’ to damage by the Wireworm-*Diabrotica*-*Systema* (WDS) complex are similar to those of ‘Regal’ (Table 2). The WDS complex includes the southern potato wireworm (*Conoderus falli* Lane), the tobacco wireworm (*Conoderus vespertinus* Fabricius), the

Fig. 1. ‘White Regal’ sweetpotato [*Ipomoea batatas* (L.) Lam.].

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banded cucumber beetle (*Diabrotica balteata* Le Conte), and the spotted cucumber beetle (*Diabrotica undecimpunctata howardi* Barber). 'White Regal' is similar to 'Regal' in resistance to larvae of the white grub (*Plectris aliena* Chapin and *Phyllophaga ephilida* Say). Methods of testing and evaluation are described in Jones et al. (1982, 1986).

We also desired to evaluate the level of resistance of 'White Regal' to other insects in an environment different from that of South Carolina. Therefore, an experiment was conducted in Jamaica to determine the level of resistance to the local pest complexes (Lawrence, et al., 1998). In addition to resistance to the WDS complex, 'White Regal' was found to have moderate resistance to the sweetpotato weevil, *Cylas formicarius* (a damage index of 0.7 for 'White Regal' compared with an index of 2.2 for the susceptible standard SC1149-19). 'White Regal' also exhibited resistance to the grub of the sweetpotato leaf beetle species (4.1% of 'White Regal' roots were damaged compared with 20.5% for the susceptible standard SC1149-19). Since a red-skinned, white-fleshed cultivar is preferred to a copper-skinned, orange-fleshed cultivar in Jamaica, 'White Regal' is being used in an integrated pest management (IPM) system designed to measure grower acceptance. 'White Regal', like its parent 'Regal', has been shown in field trials to have potential use in IPM systems (Lawrence et al., 1998; Schalk et al., 1993).

A greenhouse experiment was conducted to compare the allelopathic effects of 'Regal' and 'White Regal' on growth of yellow nutsedge (*Cyperus esculentus* L.) using the methods described by Harrison and Peterson (1991). Experimental conditions were designed to prevent competition for light, nutrients, and water. The sweetpotato cuttings were planted through holes 8 cm below the bucket rim to grow downward and prevent the vines from shading the nutsedge. Both 'Regal' and 'White Regal' cultivars strongly inhibited nutsedge growth (Table 3), which indicates that the allelopathic resin glycoside complexes present in 'Regal' (Peterson et al., 1998) are present at similar levels in 'White Regal'. Experiments conducted with 12 sweetpotato genotypes verified that the inhibition of yellow nutsedge was caused by the resin glycosides, and that there was a quantitative relationship between glycoside content and inhibition (Peterson et al., 1999). Genotypes without these glycosides did not inhibit the growth of nutsedge.

During the 1998 growing season, 114 sweetpotato clones were selected for genetic diversity. Many of these were from the USDA's world collection of diverse germplasm. The clones were grown in two locations and roots were collected and the periderm analyzed for resin glycoside content. 'White Regal' was ranked eleventh in resin glycoside content in the periderm, with an average of 2.7% resin glycosides per total periderm dry weight. This high level of resin glycosides is correlated with the degree of allelopathy found in 'White Regal' (Table 3).

'White Regal' yields well and is similar to

'Regal' in the production of well-shaped roots (US #1s). In 1992 trials, the total marketable yields (TMY) for 'White Regal' and 'Regal' were not significantly different from the leading sweetpotato cultivar Beauregard, but in 1994, 'Beauregard' was significantly higher (Table 4).

The storage roots of 'White Regal' are

fusiform and uniformly shaped, with an attractive scarlet skin and cream-colored flesh. Years of observation have shown that unlike other tropical, white-fleshed cultivars like Tanzania or Piccadito that deteriorate in a few weeks, 'White Regal' roots were in excellent condition after 9 months in storage. Very few roots showed damage or sprouting,

Table 1. Reactions of 'White Regal' and standard sweetpotato cultivars to *Fusarium oxysporum* f. sp. *batatas* and *Meloidogyne incognita*-races 1 and 3 in a greenhouse test.

Entry ^z	Root knot nematode		Fusarium wilt ^y	
	GI ^x (1-5)	EMI ^w (1-5)	DI ^v (0-5)	Plants killed ^u (% P. Rico)
White Regal	1.6	1.8	0.5	0
Regal	1.8	1.9	0.6	0
Beauregard	4.7	4.7	0.2	10
Jewel	1.7	1.9	0.3	15
Sumor	1.0	1.0	0.5	35
Porto Rico	2.9	3.0	3.5	100
Sulfur	4.4	4.0	4.3	100
LSD _{0.05}	1.1	1.1	0.7	25

^zVine cuttings with intact terminal buds were selected and cut from field-grown plants. Each cutting was trimmed and rooted in greenhouse benches containing sandy soil. For each entry, four replicates, including 10 cuttings per replication, were arranged in a randomized complete-block design. The rooted cuttings were inoculated with ≈ 2500 freshly extracted *M. incognita* eggs. After 60 d, roots were dug, washed, and evaluated under $\times 5$ magnification (Dukes et al., 1992).

^yVine cuttings were inoculated by dipping in an aqueous suspension of *Fusarium* spores ($10^5 \cdot \text{mL}^{-1}$) and planted in a greenhouse bench. After 60 d, roots were dug, washed, and evaluated under $\times 5$ magnification.

^xGall index. Plants rated on scale of 1 to 5; 1 = no galling, 5 = severe galling, i.e. roots contain large numbers of galls (over one fourth of fibrous root area containing galls).

^wEgg mass index. Plants rated on a scale of 1 to 5, 1 = no egg masses, 5 = large numbers of egg masses (over one-fourth of fibrous root area containing egg masses).

^vDI = Disease index based on the rate of disease development, where 0 = no disease, 5 = all plants killed in 7 d.

^uPercentage of plants killed when all 'Porto Rico' (susceptible check) plants were dead.

Table 2. Reaction of 'White Regal' and 'Regal' sweetpotato to soil insects in South Carolina compared with susceptible breeding line SC1149-19.

Entry	Noninjured roots (%)	WDS severity index ^z	Roots damaged (%) by:	
			SPFB ^y	Grub ^x
White Regal	56.0 a ^w	0.18 b	0.0 b	9.7 b
Regal	60.7 a	0.14 b	0.7 b	7.2 b
SC1149-19	10.4 b	1.13 a	14.4 a	43.5 a

^zWDS = Wireworm, *Diabrotica*, *Systema* complex. Severity index: 1 = 1 to 5 scars; 2 = 6 to 10 scars; and 4 = >10 scars, averaged over total number of harvested roots.

^ySPFB = Sweetpotato flea beetle.

^xWhite grubs of *Plectris aliena* and *Phyllophaga ephilida*.

^wMean separation within columns by Fisher's unprotected LSD, $P \leq 0.05$.

Table 3. Comparison of the allelopathic effect of 'Regal' and 'White Regal' sweetpotato clones on growth of yellow nutsedge.

Treatment	Yellow nutsedge growth parameter			
	Shoots		Tubers	
	(no./pot)	(g/pot) ^y	(no./pot)	(g/pot) ^y
Yellow nutsedge (control)	19	155	230	106
Yellow nutsedge + Regal ^z	11	74	116	61
Yellow nutsedge + White Regal	12	70	115	58
LSD _{0.05}	4	36	57	30

^zFour pre-germinated yellow nutsedge tubers were planted 5-cm deep in 8-L plastic bucket containing a mixture of 1 field soil (Lynchburg loamy fine sand) : 1 commercial peat-vermiculite potting mixture. Two 15-cm 'Regal' or 'White Regal' vine cuttings were planted through holes 8 cm below the bucket rim to grow downward and prevent the vines from shading the nutsedge.

^yOven-dried.

Table 4. Marketable yields of 'White Regal', 'Regal', and 'Beauregard' sweetpotatoes.

	Yield (t·ha ⁻¹)			
	U.S. #1 ^z	Canners ^y	Jumbo ^x	Total marketable ^w
<i>Blackville, SC 1992</i>				
White Regal	8.4 b ^y	8.4 a	0.2 b	17.0 b
Regal	9.1 b	8.3 a	0.6 ab	18.0 b
Beauregard	13.8 a	5.6 a	1.4 a	20.8 b
<i>Blackville, SC 1994</i>				
White Regal	14.1 b	14.0 a	0.0 b	28.0 b
Regal	16.3 b	17.5 a	0.0 b	33.8 b
Beauregard	28.6 a	15.9 a	1.4 a	46.0 a

^zUS # 1 = Roots 5 to 7.6 cm in diameter, length of 7.6 to 22.9 cm, well-shaped and free of defects

^yCanner = Roots 2.5 to 5.1 cm in diameter, 5.1 to 17.8 cm in length.

^xJumbo = roots that exceed the diameter, length, and weight requirements of the above two grades, but are of marketable quality.

^wTotal weight of roots classified as US #1, Canners, and Jumbos.

^vMean separation within columns and locations by Fisher's unprotected LSD, $P \leq 0.05$.

and the roots produced many shoots when placed in the planting beds. 'White Regal' was subjected to in-house baking tests over a 6-year period. 'White Regal' is blander in flavor, lower in sweetness, and dryer in texture than 'Regal'. It has excellent flavor, comparable with that of 'Sumor' (Dukes, et al., 1987), but moister and sweeter than 'HighDry' (Hamilton et al., 1985).

Availability

Limited quantities of foundation seed roots and cuttings will be available to breeders and other researchers for the 2002 crop season. Requests for plant material should be made no later than 15 June 2002, to Janice Bohac, U.S. Vegetable Laboratory, 2875 Savannah Highway, Charleston, SC 29414. Genetic material of this release will be deposited in the National

Plant Germplasm System where it will be available for research purposes, including development and commercialization of new cultivars.

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