INDUSTRIAL SWEETPOTATO PLANT NAMED ‘NCPUR06-020’

Latin Name: Ipomoea batatas (L.) Lam.
Varietal Denomination: NCPUR06-020

Applicant: North Carolina State University, Raleigh, NC (US)

Inventors: George Craig Yencho, Raleigh, NC (US); Kenneth Vincent Pecota, Raleigh, NC (US); Jarred Edward Driscoll, Raleigh, NC (US)

Assignee: North Carolina State University, Raleigh, NC (US)

Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 56 days.

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Int. Cl.
A01H 5/00 (2006.01)

ABSTRACT

‘NCPUR06-020’ is a purple-fleshed sweetpotato with high levels of anthocyanin pigments in its storage roots. ‘NCPUR06-020’ was developed using conventional crossing and breeding methods. The variety is primarily grown as a food crop, but it may also be used as a resource for the food industry. The variety is resistant to common pests and diseases. It has a high nutritional value, particularly in terms of vitamin C and antioxidants.

BACKGROUND OF THE INVENTION

‘NCPUR06-020’ is a deep purple-fleshed sweetpotato with high levels of anthocyanin pigments in its storage roots. ‘NCPUR06-020’ was developed using conventional crossing and breeding methods. It is the first purple-fleshed variety in our industrial-type breeding programs to be released and it is intended for use in the natural colorant industry. Most colorants are synthetic and obtained from a wide variety of organic and inorganic sources. Natural and synthetic coloring additives are widely used in the food, cosmetic, and pharmaceutical industries to enhance the appearance of products. There has been a recent trend to replace the use of synthetic colorants in food products with natural food colorants that have functional health properties and the natural colorant sector is increasing globally. The storage roots of purple-fleshed sweetpotatoes produce several purple red anthocyanins in large quantities. Anthocyanins are an attractive source of natural colorants because they also possess many beneficial human health properties including antioxidative radical-scavenging abilities, anti-mutagenic, anti-hypertensive, anti-hyperglycemic and hepatoprotective properties.

Using conventional breeding techniques and a diverse array of germplasm, the sweetpotato breeding program developed a population of high pigmentation value, purple-fleshed sweetpotatoes. These varieties are suitable for anthocyanin extraction, and they are better than the current lines available in the US as they have increased color yields and better disease resistance compared to the existing purple-fleshed sweetpotatoes in the US.

‘NCPUR06-020’ is the first purple-fleshed sweetpotato variety to be released by the North Carolina State University sweetpotato breeding program. Several purple-fleshed sweetpotato varieties are currently grown and subjected to extraction in Japan and China. As with many other sweetpotato products, China is the largest producer of purple-fleshed sweetpotatoes. We believe there is a significant market for a “made in the USA” purple-fleshed sweetpotato derived colorant and expect the ‘NCPUR06-020’ variety to be the first in a series of new purple-fleshed sweetpotatoes to be developed and released by NC State University sweetpotato breeding program for the natural colorant and functional foods sectors.

Lineage: The Ipomoea batatas ‘NCPUR06-020’ variety originated from a conventional cross between Ipomoea batatas breeding lines BM85-42 (the female parent; not patented) and NC414 (the male parent; patented as ‘Stokes Purple’ (U.S. Plant Pat. No. 17,976)). Botanical seed was harvested from this and other purple sweetpotato lines planted in our...
winter greenhouse-crossing block between September of
2005 and February of 2006. The breeding line BM85-42 is a
white-fleshed biomass line from the USDA Vegetable Lab
sweetpotato breeding program. The breeding line NC414 was
a line provided to the program by a local farmer, which was
subsequently patented and named ‘Stokes Purple’ (Sizemore
et al. 2007). Botanical seed from the BM85-42 x NC414 cross
were planted in a greenhouse located in Raleigh, N.C. on Feb.
8, 2006. Seedlings with storage roots were cut and evaluated
for flesh color with purple-fleshed selections being planted in
Clinton, N.C. on May 9, 2006 to increase for multiple plant
cuttings. Five plant cuttings were taken Jul. 5, 2006 and
planted in Kinston, N.C. on Jul. 6, 2006. The variety
‘NCPUR06-020’ was selected from a five hill plot Oct. 23,
2006 because of its combination of exceptional features.
‘NCPUR06-020’ was increased, evaluated, and advanced as
the variety ‘NCPUR06-020’, with “06” referring to the year
in which it was selected, and “020” indicating that this was the
20th purple selection made by the breeding program in 2006.
It has been propagated asexually since this time.

Asexual Reproduction. Since its selection, Ipomoea batata
‘NCPUR06-020’ has been asexually reproduced at by
vegetative propagation of vine cuttings and/or cuttings from
root sprouts. Vegetative propagation was done in Clinton, N.C.
for increase and field evaluation and tissue culture micro
propagation and tissue culture propagation was done in
Raleigh, N.C. Successively, there have been six cycles of
vegetative propagation, one cycle of tissue culture micro
propagation, and multiple vegetative propagation cycles to
increase the plant population.

Asexual reproduction of ‘NCPUR06-020’ using these
methods has shown that the unique features of the new variety
are stable and the plant reproduces true to type in successive
generations of asexual reproduction.

SUMMARY OF THE INVENTION

Ipomoea batatas ‘NCPUR06-020’ is a purple-fleshed
sweetpotato with high levels of anthocyanin pigments in its
storage roots. ‘NCPUR06-020’ was developed using conven
ventional crossing and breeding methods, and it is intended for
use in the natural colorant industry. The anthocyanins present
in sweetpotatoes have a number of beneficial properties and
can be used for a wide range of purposes in the food process
ning and functional food industries.

BRIEF DESCRIPTION OF THE DRAWINGS

The photographs in the drawings were made using conven
ventional techniques and show the colors as true as reasonably
possible by conventional photography. Colors in the photos
graphs may differ slightly from the color values cited in the
detailed botanical description, which accurately describe the
colors of the new Ipomoea batatas.

FIG. 1 is a color photograph of representative storage roots
of ‘Covington’ (U.S. Plant Pat. No. 18,516) (upper left), ‘Oki
nawa’ (not patented) (upper right), ‘Stokes Purple’ (lower left)
and ‘NCPUR-06-020’ (lower right).

FIG. 2 is a color picture of the abaxial and adaxial surface
of representative leaves with petioles attached of ‘Covington
(U.S. Plant Pat. No. 18,516) (upper left), ‘Okinawa’ (not patented) (upper right), ‘Stokes Purple’ (lower left) and
‘NCPUR-06-020’ (lower right).

FIG. 3 is a color picture of glasshouse grown 55 day old
representative plants of ‘Covington’ (upper left), ‘Okinawa
(upper right), ‘Stokes Purple’ (lower left) and ‘NCPUR-06-
020’ (lower right).

DETAILED BOTANICAL DESCRIPTION

The following is a detailed description of the botanical
characteristics of the new and distinct variety of Ipomoea batatas
plant known by the denomination ‘NCPUR-06-020’. All
colors cited herein refer to The Royal Horticultural Society
Colour Chart (The Royal Horticultural Society, London,
1995, 4th edition) designations except where general terms of
ordinary dictionary significance are used. Botanical descrip
tors are based on those described by the International Potato
Center (CIP), Asian Vegetable Research & Development
Center (AVRDC), and International Board for Plant Genetic
Resources (IBPGR) in Descriptors of Sweetpotato, Human,
Where specific dimensions, sizes, colors, and other char
acteristics are given, it is to be understood that such characteristic
are approximations or averages set forth as accurately as
practicable.

TECHNICAL DESCRIPTION OF THE VARIETY

Storage root characteristics and comparison with other Ipo
moea batatas varieties: The storage root descriptions pro
vided below are for sweetpotatoes harvested 149 days after
planting, then cured for 1 week at 85°F., then stored at 85 F.
for seven months. The storage roots of ‘NCPUR06-020’ are
round-elliptic to blocky in shape and dark purple-fleshed (RHS
Violet Group N83A to N86A) and they have a dark purple skin
color (RHS Greyed Purple Group N117A to N116D) that is
smooth to slightly flaky in texture (Table 2 and Fig. 1). The storage roots of ‘NCPUR06-020’ are not similar in appearance to
‘Covington’; the dominant variety produced in the US, which is an orange-fleshed (RHS Orange Group 28B to 28C), smooth-skinned, rose
colored (RHS Orangish-Red Group 33D to 34D to Greyed
Orange 170C to 170 D to N170C to N171D), table-stock
sweetpotato. Of the purple-fleshed varieties currently pro
duced in the U.S., both ‘NCPUR06-020’ and ‘Stokes
Purple’ have similar skin colors while ‘Okinawa’, a variety
from Hawaii, has a distinct cream to light brown colored skin
(RHS colors not determined). The most desirable attribute of
‘NCPUR06-020’ is its dark purple flesh color, which is the result of high levels of extractable anthocya
mins. ‘NCPUR06-020’ possesses significantly higher levels
of anthocyanins and they occur in different ratios com
pared to ‘Stokes Purple’ (Tables 1 and 2, and FIG. 1). In
terms of anthocyanin production, ‘NCPUR06-020’ is one of
the highest anthocyanin producers in our breeding popula
tions. The average yield (kg/ha), percent dry matter and
pigment content (mg/g dry wt.) and total anthocyanin pig
ment yield (kg/ha) of ‘NCPUR06-020’ in 6 yield trials
during 2009-2011 were 49,656 kg/ha, 30% dry matter con
tent, 3.83 mg/g dry wt, and 58 kg anthocyanins produced per
hectare compared with 43,976 kg/ha yield, 29% dry
matter content, and anthocyanin production of 1.46 mg/g
dry wt and 19 kg/ha for ‘Stokes Purple’. Another important
diagnostic trait for sweetpotato is the dry matter content
of its storage roots. ‘NCPUR06-020’ storage roots average
30% dry matter content. ‘Stokes Purple’ and ‘Okinawa’
average 29% and 26%, respectively, while the orange
fleshed variety ‘Covington’ averages 19-20% (Table 1).
Plant characteristics: To describe and compare the plant characteristics of the reference varieties to ‘NCPUR06-020’, three representative specimens of each variety were planted in six-inch azalea pots in a greenhouse. After rooting, plants were treated with 200 ppm 20-10-10 fertilizer daily. Plant measurements were taken in May 2012 from 55-day-old specimens. ‘NCPUR06-020’ has not been observed under all possible environmental conditions; therefore, the phenotype may vary under different environmental conditions such as season, temperature, light intensity, day length, cultural conditions, and the like, without any variance in the genotype.

Growth conditions.—‘NCPUR06-020’ has excellent vigor and a moderate to rapid growth rate (FIG. 3). In locales with mild winter conditions, ‘NCPUR06-020’ will grow perennially; otherwise it is an annual plant. Similar to other cultivated sweetpotatoes, wind or rain rarely causes much damage to ‘NCPUR06-020’, but if damage does occur, the plant drops the damaged leaves and grows new shoots at nodes where the leaves were lost. Under low light levels in a greenhouse, ‘NCPUR06-020’ can develop intumescence, which will remain on the affected foliage, but will be outgrown with new foliage.

Aboveground structure and coloration.—FIG. 3 shows the shape and coloration of a typical specimen of ‘NCPUR06-020’. Color will vary somewhat due to temperature and nutrient stress. Overall, this variety is a moderately spreading, semi-erect herbaceous plant that has an average height of 15.4 cm and an average area spread of 52.8 cm. The growth habit of this plant is slightly upright with shoots growing outward.

Branching habit.—‘NCPUR06-020’ will produce about 4 lateral branches coming off the stem, averaging about 34.0 cm long with a diameter of about 0.4 cm.

Vegetative lateral shoots.—The number of lateral shoots varies, but averages about 6 with several short secondary shoots. Sparse pubescence can be observed on young tips. Lateral branch length: about 14.6 cm. Diameter: about 0.4 cm. Internodes are intermediate with an average length of about 9.8 cm.

Stem.—The stems of ‘NCPUR06-020’ are round and glabrous with an outward, slightly undulating aspect and very strong strength. Color: green (RHS 144A-B) with some purple spots at nodes (RHS 59A).

Petiole.—Leaf petiole length varies with an average of about 9.8 cm. Diameter: about 0.25 cm. Color: green (RHS 144A-B) with flush of purple (RHS 59A) at point of attachment to leaf. The surface texture of the petiole is glabrous.

Foliage.—Leaves are alternate and tend to slightly spiral around the stem. They are simple and deltoid to cordate with an entire margin. Leaf shape is somewhat variable as is size (see FIG. 2 and FIG. 3). Quantity: Heavily foliated, with about 18 leaves per lateral branch. Mature leaf length: about 11.1 cm. Mature leaf width: about 8.3 cm. The leaf tip is acute. Both the upper and lower surface of the leaf has a glabrous texture and a matte finish with slight pubescence. Both the upper and lower surface of the immature leaves have slight pubescence on the upper surface. Mature leaf color: Green (RHS 137A-B) upper surface, green (RHS 137C) lower surface. Immature leaf color: Green (RHS 137D, 138A). Upper surface, green (RHS 138B) lower surface. There is slight purple (RHS 59C) coloration where the leaf meets the petiole (FIG. 2). Venation is pinnate-arcuate. Color: Mature venation color: Green (RHS 144A) upper surface, green (RHS 145B) lower surface with secondary purple (RHS 59B) at petiole junction. Immature venation color: Green (RHS 144B) upper surface, green (RHS 145C) lower surface with secondary purple (RHS 59C) at petiole junction and leaf margin.

Flowers.—‘NCPUR06-020’ flowers sporadically throughout the season in response to a variety of stressful conditions (e.g., drought, nutrient stress, cloudy weather). Flowering is enhanced by short day lengths (<12 hours), but the precise photoperiod for flower induction is currently unknown. The inflorescence is generally a cyme in which there is one solitary peduncle. Peduncules (RHS 143A-B, 59A-B) are green with purple spots at the base, averaging 38.6 mm long from mature leaf axils with an average diameter of 4.1 mm. The surface texture of the peduncle is slightly pubescent. Usually buds of the first and second order are developed, but often, single flowers are produced. Buds (RHS 152D-151D, 777D) are light green with slight light lavender at the tip, and around 27.4 mm in length and 7.7 mm in diameter 24 hours before opening. Bud shape is elliptic to slightly lanceolate. The corolla is composed of five fused petals that form a funnel with a rounded to slightly pentagonal limb. Corolla width: ~49.4 mm, corolla length: ~52.1 mm. The corolla has slight to no fragrance. The limb color is light lavender, while the outer throat color is light lavender and the inner throat color is purple. Inner limb color: RHS 76D-C, Outer limb color: RHS 76A-D, Inner throat color: RHS 77A-B, Outer throat color: RHS 76B-D). There are five sepals, with an average length of 9.4 mm and width of 4.9 mm. The sepals have an obvolute to elliptic shape with an obtuse apex and are light green in color with slight purple spots. Outer sepal color: RHS 144A-144A, 59A, Inner sepal color: RHS N14A-144A. Each flower has one pistil with a cream-colored style (RHS 155B). The stigma is cream colored (RHS 155D) and the style averages about 1 mm wide and 18.3 mm long. The stigma is at the same height to slightly inserted relative to the stamens. The ovary is light yellow (RHS 1D) and superior with two locules that contain one or two ovules. At the base of the ovary there are orange basal glands (RHS N16C) containing nectar continuing halfway up the ovary. There are five cream colored anthers (RHS 155B) that are approximately 3.2 mm long. There are five cream fading to purple (RHS 155A, 77B) colored stamens averaging 14.2 mm in length. Pollen (RHS 155B) is moderate. True seed can be obtained via compatible crosses. There is some variation in flower size and color, depending on the environmental conditions.

Disease resistance or pest resistance/susceptibility.—‘NCPUR06-020’ is susceptible to silverleaf whiteflies (Bemisia tabaci) and two spotted spidermites (Tetranychus urticae) in a greenhouse environment. Based on multyear disease evaluations using standardized greenhouse and field screening methods as well as field-based observations of the disease reaction of ‘NCPUR06-020’ to the most important pathogens of sweetpotato in North Carolina, ‘NCPUR06-020’ is moderately resistant to Fusarium wilt.
Plant production characteristics:

The sprout production of ‘NCPUR06-020’ on plant beds prior to cutting and transplanting in the field is very good with transplant survival in the field being good to excellent.

REFERENCES CITED


**TABLE 1**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Total dry matter yield (kg/ha)</th>
<th>Percent dry matter (%)</th>
<th>Anthocyanin content (mg/g dry wt)</th>
<th>Anthocyanin yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘NCPUR06-020’</td>
<td>49.66</td>
<td>30</td>
<td>3.83</td>
<td>58</td>
</tr>
<tr>
<td>‘Stokes Purple’</td>
<td>43.76</td>
<td>29</td>
<td>1.46</td>
<td>19</td>
</tr>
</tbody>
</table>

*Differences between total yield, anthocyanin content and anthocyanin yield are highly significant by ANOVA at p < 0.05

**TABLE 2**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>‘NCPUR06-020’</th>
<th>‘Stokes Purple’</th>
<th>‘Okinawa’</th>
<th>‘Covington’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin color</td>
<td>dark purple</td>
<td>dark purple</td>
<td>white to light tan</td>
<td>light medium rose</td>
</tr>
<tr>
<td></td>
<td>(RHS N83A</td>
<td>(RHS N86A)</td>
<td>to N86A</td>
<td>(RHS 33D</td>
</tr>
<tr>
<td></td>
<td>to N86A)</td>
<td>to N81B)</td>
<td>to N81B)</td>
<td>to 34D)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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**TABLE 2-continued**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>‘NCPUR06-020’</th>
<th>‘Stokes Purple’</th>
<th>‘Okinawa’</th>
<th>‘Covington’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin texture</td>
<td>moderately flaky</td>
<td>moderately flaky</td>
<td>moderately smooth</td>
<td>smooth-skinned</td>
</tr>
<tr>
<td></td>
<td>dark purple,</td>
<td>purple, avg</td>
<td>purple/cream</td>
<td>orange-fleshed</td>
</tr>
<tr>
<td></td>
<td>avg intensity</td>
<td>intensity 2.7</td>
<td></td>
<td>(RHS 28B)</td>
</tr>
<tr>
<td></td>
<td>3.5 (RHS N83A</td>
<td>(RHS N86A)</td>
<td></td>
<td>to 28C)</td>
</tr>
<tr>
<td></td>
<td>to N86A)</td>
<td>to N81B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flesh uniformity</td>
<td>uniform</td>
<td>uniform</td>
<td>not uniform</td>
<td>uniform</td>
</tr>
<tr>
<td>Yield (low, moderate, high)</td>
<td>moderate</td>
<td>moderate</td>
<td>very low</td>
<td>high</td>
</tr>
<tr>
<td>Dry matter data</td>
<td>30%</td>
<td>29%</td>
<td>26%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Fusarium wilt

Streptomyces soil

Southern root knot nematodes

Maturity

Root shapes

Length/diameter ratio

Transplant survival (poor, good, excellent?)

Storability (poor, good, etc)

Consumer Quality (backing quality, flavor)

Average Anthocyanin content (mg/g dry wt)

Average % Pseudo: Cyanidin Ratio

What is claimed is:

1. A new and distinct variety of *Ipomoea batatas* industrial sweetpotato plant named ‘NCPUR06-020’, substantially as illustrated and described herein.

* * * * *
It is certified that an error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

IN THE SPECIFICATION

Column 8, TABLE 2-continued, Line 22: Please correct:

<table>
<thead>
<tr>
<th>Streptomyces soil</th>
<th>susceptible</th>
<th>susceptible</th>
<th>susceptible</th>
<th>resistant rot</th>
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</table>

...to read as...

<table>
<thead>
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<th>Streptomyces soil</th>
<th>susceptible</th>
<th>susceptible</th>
<th>susceptible</th>
<th>resistant</th>
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<tbody>
<tr>
<td>rot</td>
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Signed and Sealed this
Tenth Day of November, 2015

Michelle K. Lee
Director of the United States Patent and Trademark Office