UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
WASHINGTON, D.C.

NOTICE OF RELEASE OF USVL156 AND USVL160 INBRED LINES OF BROCCOLI (*Brassica oleracea L. var. italica*) THAT ARE ADAPTED TO HOT SUMMER ENVIRONMENTS OF THE EASTERN UNITED STATES

The Agricultural Research Service, U.S. Department of Agriculture, announces the release of two enhanced inbred lines of broccoli (Brassica oleracea L. var. italica) designated USVL156 and USVL160. These two lines are adapted to hot summer environments of the eastern United States, producing market quality vegetable heads under high temperatures (day and night) when other conventional broccolis will not. USVL156 is a conventional inbred line (F8) produced by self-pollination and selection in successive generations, while USVL160 is an inbred line derived from a doubled-haploid plant. All of the stocks used in developing these germplasm lines are maintained in the U.S. Vegetable Laboratory (USVL) collection at Charleston, SC and were developed at the location by Dr. Mark W. Farnham (Research Geneticist).

USVL156 was derived from a cross of two parental inbreds that were developed by the USVL broccoli breeding program. Both parents (designated L109 and L124) used to form the segregating population from which USVL156 was selected, were identified as broccoli lines that produce moderate quality heads in high temperature environments. To initiate line development, the parental lines were crossed by hand pollination in a greenhouse during winter 2007-08. The resulting F1 seed was planted in the greenhouse in fall 2008, and F2 seed was generated by manual self-pollinations of the F1 plant over winter. About 400 F2 plants were grown to vegetable maturity in the field at Charleston during summer 2009, and individual plants were selected for good head qualities and moved to the greenhouse where they were maintained through the winter and self-pollinated to produce F3 generation seed. The resulting F3 family (approximately 50 individuals) was grown in the field at Charleston during summer 2010, an individual plant was selected, and again moved to a greenhouse where it was self-pollinated during winter. The resulting F4 family was similarly grown in the field during summer 2011, and an individual plant was again selected, moved to a greenhouse, and self-pollinated. The selection process was repeated in 2012 with the F5 generation, and a new selection was advanced to the F6 as described for the two previous years. The F6 selection was then advanced for two generations by single seed descent in the greenhouse where self-pollinations were conducted to produce F7 and F8 seed. The resulting F8 line was designated USVL156. Seed of this line has been increased by hand pollinations in a greenhouse annually following its development.

USVL160 was also derived from a cross of two inbred broccoli parents (designated L108 and L123) developed at Charleston. The F1 made by crossing the parents was created in the same timeframe as the F1 from which USVL156 was derived, but in this case, the F1 was allowed to go to head maturity during winter 2008-09 and microspores were cultured from its immature flower buds using standard procedures employed by the USVL broccoli program for development of double-haploid plants in vitro. Resulting doubled-haploid regenerants were developed from the microspore cultures, and during fall 2009 through winter 2010, doubled-haploid line seed was generated by controlled self-pollinations of regenerants in a greenhouse. A resulting population of about 100 doubled-haploid lines was evaluated in the field in the summers of 2010 and 2011, and USVL160 was identified as a promising line in these initial screens. Seed of this line has also been increased by hand pollinations annually since 2011.

Testing in numerous field trials has verified that both USVL156 and USVL160 are adapted to high temperature environments in which average daily high temperatures are 30 C or higher and average nighttime lows are 25 C or higher. Under such conditions, USVL156 and USVL160 produce market quality heads while essentially all other commercial broccoli cultivars produce very poor-quality heads or no heads at all. The pedigrees of these two lines are very similar, but they likely differ in the exact complements of alleles that contribute to high temperature adaptation, a trait which the USVL program has shown to be controlled by at least seven genetic loci.

All USVL156 and USVL160 plants exhibit a blue-green color that matches the Munsell color with Hue 2.5 G, Value (Brightness) 5, and Chroma 2. This color is exhibited by foliage and mature heads and is a relatively standard color for broccoli. Both inbreds are also among the earliest maturing lines grown in the USVL broccoli program, maturing to produce market-size in 45 to 50 days in summer trials and 55 to 60 days in fall when plants are completing development at cooler temperatures. As highly homozygous inbreds, USVL156 and USVL160 plants have a relatively small stature when compared to commercial cultivars which are almost exclusively F1 hybrids. ‘Castle Dome’ is one of the very few commercial hybrid cultivars evaluated that has a similar early maturity as the two released inbreds; nearly all other hybrid cultivars observed are much later. Both of the released inbreds exhibit self-incompatibility, which is common in broccoli; however, manual bud pollinations are easily accomplished with both lines to overcome incompatibility and accomplish selfing. Both inbreds also exhibit good combining ability when crossed to a variety of other broccoli inbreds.

USVL156 produces a marketable head that has a uniform, slight-dome shape in summer environments. These heads are free of typical flaws (e.g., bracts in the head and distorted shape) commonly exhibited by broccoli not adapted to or not tolerant of high temperatures. USVL156 heads harvested in summer (when crown diameter is 10-12 cm and the stem is cut to a 16 cm length) typically weigh 125-150 g, have a stem diameter of 23-25 mm, and exhibit uniform beads that are small to intermediate in size (e.g., ranging from 1.25 to 1.45 mm). USVL160 produces marketable heads that have a uniform, moderately domed shape and that are also free of flaws when grown under the high summer temperatures of the USVL selection environment. USVL160 heads harvested in summer with a 10-12 cm crown diameter and a stem length of 16 cm weigh from 140-160 g, have stem diameters from 24-26 mm and bead size that is intermediate to large in size (1.45-1.65 mm). To date, no commercial hybrids or other cultivars

have been identified that will produce a marketable quality head under the summer conditions in which USVL156 and USVL160 have been tested. Early or mid-season hybrids like 'Castle Dome' and 'Gypsy' will produce a head in summer tests, but quality is very poor, and they are always deemed unmarketable. Most later maturing hybrids (e.g., 'Iron Man', 'Emerald Crown', and 'Belstar') fail to produce any heads in the high temperature environments in which the ARS inbreds were selected and evaluated.

USVL156 and USVL160 have been grown and compared to each other and to numerous hybrid cultivar checks in fall trials, and in these cooler environments both inbred lines exhibit very similar characteristics as they do in summer tests. Specific quality ratings of fall-harvested heads of the two released lines is often better in fall versus summer, and head size attributes can also be slightly higher in fall, but these differences are not usually significant. On the contrary, hybrids like 'Castle Dome', 'Iron Man', 'Bay Meadows', 'Gypsy' and 'Emerald Crown' all typically produce larger and higher quality marketable heads in the fall that are dramatically different than what they produce in summer. The much more consistent performance observed for USVL156 and USVL160 indicates that they are adapted to a wide range of temperature environments.

Small amounts of USVL156 and USVL160 seed produced by manual self-pollinations in greenhouses or small outdoor cages will be available for distribution to interested research personnel, plant breeders, or commercial seed producers. Address all requests to Mark Farnham, USDA-ARS-U.S. Vegetable Laboratory, 2700 Savannah Hwy., Charleston, SC 29414 (email: Mark.Farnham@usda.gov). Seeds of the two inbreds will also be submitted to the National Plant Germplasm System where they will be available for research purposes, including the development of new varieties. It is requested that appropriate recognition of the source be given when this germplasm contributes to research or development of a new breeding line or cultivar.

ARS GIVES NO WARRANTIES OR GUARANTEES, EXPRESSED OR IMPLIED, FOR THE MATERIAL, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Signature:

DEEPAK BHATNAGAR

Digitally signed by DEEPAK BHATNAGAR
Date: 2020.07.16 12:04:48 -05'00'

Acting Deputy Administrator, Crop Production and Protection
Agricultural Research Service, U.S. Department of Agriculture

Date