UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Washington, D.C.

And

CALIFORNIA AGRICULTURAL EXPERIMENT STATION
University of California - Davis
Davis, California

NOTICE OF RELEASE OF ICEBERG GERMPLASM WITH RESISTANCE TO VERTICILLIUM WILT

The Agricultural Research Service, United States Department of Agriculture and the University of California - Davis announce the release of three breeding lines of lettuce (Lactuca sativa L.). Lines RH05-0336, RH05-0339, and RH05-0340 are F9 iceberg type lettuce breeding lines with resistance to Verticillium wilt caused by V. dahliae. They have partially covered heads with medium-dark-green and crisp textured leaves. Seeds are black. These breeding lines were selected from the cross La Brillante x Pacific. Resistance is derived from La Brillante, a Batavia type lettuce cultivar with resistance to race 1 of V. dahliae. These breeding lines are the first iceberg type lettuce with resistance to Verticillium wilt, but are not suitable for commercial production. They should be used as parents for further development of Verticillium wilt cultivars.

Verticillium wilt of lettuce is a major concern to the California lettuce industry, which is a 1 billion dollar industry in the Salinas Valley in Monterey County, CA alone. The pathogen, Verticillium dahliae, is a soil-borne fungus that can colonize the vascular tissues of a broad range of plants, and was first identified as a pathogen on lettuce in 1995 in the central coast of California (Subbarao et al., 1997). Since the initial discovery, V. dahliae isolates pathogenic on lettuce have been found throughout Monterey and Santa Cruz counties.

Symptoms of Verticillium wilt first appear on the basal leaves as areas of chlorosis and angular necrotic lesions along the leaf margins prior to wilting. These foliar symptoms progress acropetally, eventually leading to plant death. Other key foliar symptoms include stunting, defoliation and other developmental abnormalities. Prior to the onset of foliar symptoms, the vascular discoloration of root and stem tissues, revealed by vertical sectioning of the plant, are the only other diagnostic features available. These disease symptoms are most devastating to iceberg cultivars, since the lower leaves envelope the entire head and essentially suffocate the plant as the disease progresses. Verticillium wilt symptoms in lettuce are absent until they near harvest maturity or initiate reproductive growth, at which time an entire lettuce crop can be lost within one week (Subbarao et al. 1997). Plants which succumb to V. dahliae produce large quantities of microsclerotia that can persist in the soil for 10 - 15 years.

Control of V. dahliae through cultural practices is limited due to the existence of cross-pathogenic isolates capable of affecting most crops grown in rotation with lettuce (Bhat and Subbarao et al. 1999, Subbarao et al. 1997). Furthermore, the economic and environmental costs that would be associated with the routine use of soil fumigants during vegetable production are considerably high (Subbarao 2002). Therefore, lettuce cultivars resistant to Verticillium wilt are needed to maintain the agronomic sustainability within the region.

RH05-0336, RH05-0339, and RH05-0340 were selected from the cross La Brillante x Pacific. The Verticillium wilt resistance in these breeding lines is derived from La Brillante, which is a yellow-green Batavia type lettuce cultivar that is not used for commercial production. The origin of La Brillante is unknown. Two races of V. dahliae isolates from lettuce are reported, of which La Brillante is resistant to race 1 and susceptible to race 2 (Vallad et al., 2006). Pacific is a modern iceberg type cultivar developed by the USDA and adapted for coastal California production conditions (Ryder and Robinson, 1991). Pacific is susceptible to races 1 and 2 of V. dahliae.

RH05-0336, RH05-0339, and RH05-0340 were developed by selecting for horticultural characteristics and the absence of foliar and root symptoms in experiments conducted in V. dahliae infested field sites. Using this approach, single plant selections were made using the pedigree method of breeding through 6 generations of self pollinations. In 2005 and 2006 resistance was evaluated in RH05-0336, RH05-0339, RH05-0340, Pacific, and La Brillante in infested field experiments with 3 replications. The breeding lines were in the F7 and F8 generations respectively. Both trials were maintained using standard cultural practices for coastal California lettuce production. Approximately 1 week past market maturity, disease incidence was determined by evaluating root and foliar symptoms of Verticillium wilt on 10 plants per plot. In 2005, the disease incidence for Pacific was 20%. No disease was found in La Brillante, RH05-0336, RH05-0339, and RH05-0340. In 2006, the disease incidence was 47% in Pacific and 5% in La Brillante. The disease incidence in RH05-0336, RH05-0339, and RH05-0340 was 3%, 0%, and 0% respectively. In both years, Pacific had significantly more disease than La Brillante, RH05-0336, RH05-0339, and RH05-0340 ($P < 0.01$); La Brillante, RH05-0336, RH05-0339, and RH05-0340 were not significantly different from each other. Other than Verticillium wilt, RH05-0336, RH05-0339, and RH05-0340 have not been characterized for their reaction to other lettuce pathogens or their propensity for physiological defects. While these breeding lines are the first iceberg type lettuce with Verticillium wilt resistance, they lack the necessary yield and quality needed for commercial production. Therefore, they are intended to be used as parents to develop Verticillium wilt resistant cultivars.

Limited samples of seed are available for distribution to all interested parties for research purposes, including the development and commercialization of new cultivars. Samples will also be deposited in the National Plant Germplasm System. It is requested that appropriate recognition be made if the breeding lines contribute to research or the development of new germplasm, breeding lines, or cultivars. Written requests should be sent to Dr. Ryan Hayes, USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905.

Director, California Agricultural Experiment Station
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Date

Deputy Administrator, Agricultural Research Service
U.S. Department of Agriculture

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Date

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