

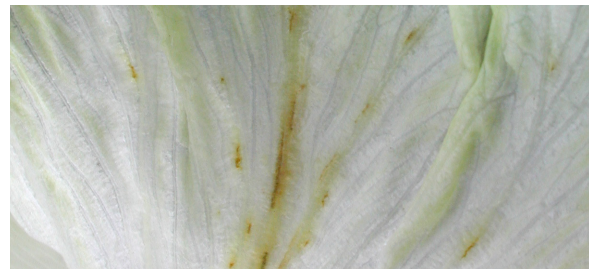


Crop genetic enhancement: Crisphead lettuce resistant to heat stress

In 1998, an *Agriculture and Agri-Food Canada* research team in Saint-Jean-sur-Richelieu started a collaborative research project with the *Fédération des Producteurs Maraîchers du Québec*, *Multiveg*, the *Société Coopérative du Sud de Montréal* and the processing industry. The goal of the project has been to create a crisphead lettuce variety resistant to rib discoloration and other heat-related physiological disorders, such as bolting, ribbiness and tipburn.



The lettuce variety 'Ithaca' is the most commonly grown in the muck soil area of Southern Quebec.



Rib discoloration symptom.

Midsummer crisphead lettuce grows under temperatures often greater than the optimal range of 7 to 24°C. Given these conditions, heads frequently develop a number of physiological disorders. Among them, rib discoloration results in important losses in lettuce quality. The variety 'Ithaca', commonly grown in the muck soil area of Quebec, is susceptible to this disorder. Affected plants develop a browning of the midribs of leaves inside the heads as they approach commercial maturity.

Selection methodology

After screening for sources of resistance to rib discoloration, the first crosses were made in 1998. Since then, more than 1000 crosses have been made in growth chambers. F₁ lines were advanced by one generation in

the greenhouse. F₂ progeny lines were then seeded in the greenhouse and transplanted into commercial and experimental fields for selection.

At optimal maturity, lettuce heads without rib discoloration symptoms and showing good agronomic characteristics were selected and prepared for *in vitro* culture in *Murashige and Skoog* medium (1962). Both apical and axillary meristems were cultured.

After rooting and acclimation, the *in vitro* plants were grown in the greenhouse during the fall and winter and seeds were harvested. ELISA tests were performed on all selections to establish their freedom from Lettuce Mosaic Virus.

Results

Breeding for resistance to physiological disorders is often difficult since symptoms are triggered by specific environmental conditions that may or may not be present in the field. Under commercial conditions in 2002, 23% of the fields showed rib discoloration symptoms, with an incidence up to 65%.

As part of the research program between 1999 and 2002, 2308 selections were collected. On average, 39% of apical meristem and 27% of axillary meristems regenerated from the *in vitro* process. Up to 61% of axillary meristems survived during the cooler year in 2000. Not including the first year of adjustment, survival rates through acclimation were 84% for apical and 76% for axillary meristems.

Since 2002, the most promising lines were sent to California for seed multiplication and evaluation. Advanced F₇ to F₉ lines obtained serve as basic material to determine a potentially new variety. Two advanced lines received registration. Very similar in weight and appearance to Ithaca, AC Hochelaga is more tolerant than Ithaca to bolting and rib discoloration. The second one, AC Estival, is a Vanguard type better adapted to the

processing market. The newest one, AAC Champlain, is similar to Hochelaga – with a greater tolerance to tipburn. Seeds of these cultivars have been available at the *Co-op Uniforce* since 2007 (Sherrington, Quebec). Royalties generated from the sale of the cultivars are collected by the *Foundation for Breeding Lettuce and Leafy Vegetables*. The Foundation is managed by Canadian lettuce growers who have decided to reinvest and support future breeding work in lettuce and leafy vegetables.

A new breeding program in romaine lettuce was initiated in 2008. The objective of the program is to develop high-quality cultivars for both the fresh and processing markets 1) with high tolerance to heat-stress-related disorders such as tipburn and premature bolting, 2) with high tolerance to bacterial leaf spot caused by *Xanthomonas campestris* pv. *Vitians* and 3) that comply with standards set by the processing sector. It generally takes about 10 years to develop a new cultivar. *Rendez-vous* in 2018!



Pollination is performed after pollen is washed (a); seeds of progeny lines are produced in the greenhouse (b, c).



Field evaluation of progeny lines at the Ste-Clotilde experimental farm (a). Meristems from selections are excised from the core apex and from axillary buds (b).

information

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In vitro culture regeneration (a); and acclimation of progeny lines (b, c).

