Saffron: A New Alternative Crop for Northern New England High Tunnels

Margaret Skinner, Bruce L. Parker, Khalil Mirza & Arash Ghalehgolabbehbahani
University of Vermont Entomology Research Laboratory
Research Summary – January 2017

Introduction. Saffron (*Crocus sativus* L.) is the most expensive spice in the world, with a retail price of up to $5,000/lb. Saffron is made from the flower stigmas, which contain hundreds of aromatic volatile and non-volatile compounds, most importantly crocins, picrocrocin and saffranal (Fig. 1). It is commonly used as a culinary flavoring and coloring agent in Asian and European cuisine, but also is reported to have medicinal properties, which increases its economic value above other spices. Saffron is adapted to arid and semi-arid regions and is somewhat resistant to cold, tolerating a low temperature of around -4°F. It is recommended for USDA plant cold hardiness zones 6-9. Over 90% of the saffron produced globally is from Iran. However, saffron has been produced by the Pennsylvania Dutch since the late 1600s. Unlike most crocus bulbs, saffron blooms for 2-4 weeks from September to November, then continues to grow in the early winter and spring when temperatures are warm enough. The corms go into dormancy in June, and begin to sprout again in September. The market for locally grown saffron is unknown, but the US imported 46 tons in 2016, suggesting the demand could be significant.

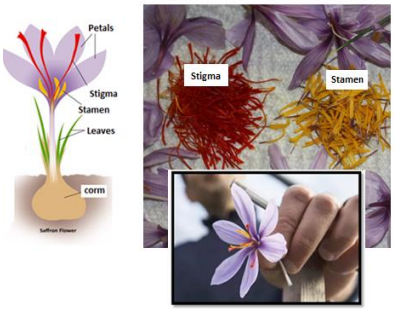

Fig 1. Parts of the saffron flower.

Project Goals. According to the 2012 Census of Agriculture, over 90% of the farms in New England are small family farms with <$350,000 in gross income. Nationally these operations manage 48% of all US farmland, and contribute significantly to the "Working Landscape" that we value and seek to preserve. To be economically sustainable, these farms need to diversify their crop production. Based on the climate in northern New England, saffron may be a suitable alternative crop, particularly if grown in high tunnels (hoop houses lacking direct sources of heat or ventilation). This project was carried out to evaluate the possibility of growing saffron in Vermont high tunnels by using two different planting methods; in plastic milk crates (12x12x11 in.) and in the ground. Our theory is that if grown in crates, growers could remove them in the spring when the saffron is dormant, and store them until Sept. This would allow growers to use the high tunnel for other crops from March – September.

Methods. This 2-year project (2015 to 2017) took place in northern Vermont (St. Albans) (USDA plant cold hardiness zone 5a [-20 to -15°F). In Yr. 1 saffron corms were obtained from a Pennsylvania grower (zone 6b [-5-0°F]) and in Yr. 2 from American Meadows, a distributor of corms from the Netherlands (zone 8 [10-20°F]). Corms were planted in late August at a density of 100 corms/m^2 (11 corms/crate). Two strips of weed cloth were secured within the crates to prevent the soil from spilling out. Top soil (fine sandy loam) from the site was put in the bottom to a depth of 4 in. Corms were planted tip side up in the top soil and covered with 2 in. of top soil and then 4 in. of an organic perennial blend potting mix containing compost and sandy soil (Fig. 2).


Fig. 2. Saffron production: in ground (L); in crates (R).

For the in-ground treatment, wooden frames were constructed to make raised beds. Four inches of top soil was placed in the frames, and the corms were planted as described for the crate treatment. In a part of the experiment, saffron corms (Pennsylvania corms that were planted in 2015) remained in the soil for two years to determine the yield of saffron when is planted as a perennial crop. In both years, the blooming period started in early October (~48 days after planting) and ended in late November. Flowers were harvested every two days to obtain high quality saffron. After harvesting, stigmas were separated from the flowers by hand and air dried. The dehydrated stigmas were weighed to determine yield.

Results. In Yr. 1 saffron yield (stigmas only) averaged 0.88 – 1.39 grams/m^2 (Fig. 3). Yield was significantly greater for saffron grown in crates than in the ground. The yield from our study was greater than that reported in other traditional saffron growing regions. For example, in Iran, yields are ~0.34 gr/m^2, and in Spain yields of ~0.6 gr/m^2 are common. The retail price of organic saffron in Vermont health food stores is $19/gr. Based on the

yield in Vermont, saffron could generate revenues of $100,000/acre, which greatly exceeds revenues from most other vegetable crops often grown in high tunnels (Est. revenues: saffron: $4.03/ft^2; tomatoes: $3.51/ft^2; winter greens: $1.81/ft^2). Results in Yr. 2 were similar to Yr. 1, with greater yield when saffron was grown in crates than in the ground. These results showed that when saffron corms are kept for 2 years in crates or in the ground, they produce more flowers/m^2 (75%) and saffron yield (Fig. 3).

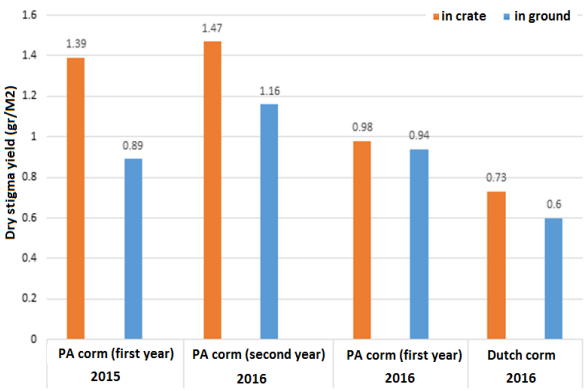

Fig. 3. Dry weight stigmas harvested per m^2.

The market price for saffron varies with the quality of the crop. Therefore, we arranged for chemical analysis of our saffron and samples from Pennsylvania, Iran, Spain and Italy. The relative ratio of crocin (linked with saffron color) for the Vermont samples ranged from 0.68-0.91, and was not significantly different among samples regardless of how they were grown (in crates or in ground), how they were dried (room temperature or room temperature and in the oven) or when the sample was harvested (early season or late season) (Fig. 4). The crocin content of the Vermont samples was equal to or greater than for saffron from other locations, including those from traditional saffron growing areas in the US and overseas (Iran, Italy and Spain). The safranal relative ratio for the Vermont samples were around 0.21 and were considerably lower than for samples from Spain and Iran, but not significantly different from those from Italy or Pennsylvania. Interestingly, the crocin and safranal content levels for both the Vermont and Pennsylvania samples were very similar.

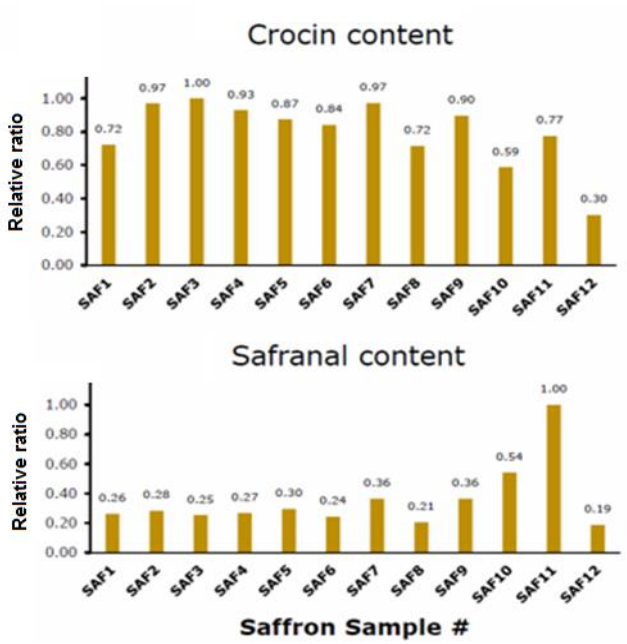

Fig. 4. Crocin and safranal content for samples harvested in Vermont (SAF1-8), Pennsylvania (SAF9), Iran (SAF10), Spain (SAF11) and Italy (SAF12).

Safranal is a derivative compound, and its concentration is strongly linked to the postharvest and dehydration methods. Low temperature dehydration (air drying) is common in Middle Eastern and Asian countries, while in European and Western countries saffron is dried with high temperatures. The variable results from year to year showed that research is needed to determine the best drying method to maximize on safranal concentration.

Developing low cost test methods to assess saffron is an important component of strengthening the US saffron industry. The quality of a saffron product is critical for developing a local or global market for this high value specialty crop. The quality of saffron produced in the Vermont research site suggests that there is potential to include saffron in Northeast agroecosystems.

For more information:
Website: https://www.uvm.edu/~saffron/

Margaret Skinner
mskinner@uvm.edu

Arash Ghalehgolabbehbahani
aghalego@uvm.edu

Acknowledgements. Support for this project has been provided by Univ. of VT College of Agric. & Life Sci.; Herb Society of America; American Meadows, Inc., VT; Charles Cantrell, USDA ARS; and Peter Johnson, Director, Amish-Mennonite Center for Sustainable Agriculture, Wenham, MA.