UMass Winter Spinach Variety Trials: Winter 2019-2020 Report

The UMass Extension Vegetable Program has been evaluating spinach varieties with resistance to an emerging pathogen, spinach downy mildew, under winter growing conditions with the goal of finding varieties that work well for New England winter markets. Over the winter of 2019-20, we compared 32 spinach varieties with broad resistance to spinach downy mildew performance in an unheated high tunnel at the UMass Crop Research & Education Farm in South Deerfield, MA. Importantly, downy mildew did not develop in the trial—there were relatively few reports over the winter of 2019-20—so we only have data on growth characteristics like germination, vigor, and regrowth to report this year.

Spinach downy mildew symptoms on the top and underside of the leaf. Photos: G. Higgins

For general information on spinach downy mildew, see our 2018-19 Winter Spinach Variety Trial Report.

We have compiled photos of each variety trialed in 2019-20. For each variety, there is a whole-plot picture showing germination 2 weeks after seeding, followed by photos taken before each harvest, showing growth habit, leaf shape and color, and regrowth quality. **Click here for photos of each of the varieties trialed in 2019-20.**

Conclusions from 2 years of spinach variety trials:

- **Plan for downy mildew by using the latest, widest resistance.** Spinach downy mildew appears sporadically on farms throughout New England and we're not yet sure if the pathogen is overwintering in the soil, moving from field to high tunnel to field, or being re-introduced every year from another source. We do know that when it does show up on a farm, it can be devastating, leading to total crop loss. We've seen strains 12, 14, and 15 in the Northeast in past years, and we also regularly see novel strains that don't match any of the numbered strains. The best resistance to novel strains is afforded by using varieties with resistance to strains 1-17.
- **Use PSNTs to time sidedressing.** In this trial, we found that soil nitrate levels dropped below the recommended minimum of 20 ppm once daylight started to lengthen significantly beyond 10 hours of daylight and the plants started to grow more quickly again. At that point (below 20 ppm), it is recommended to sidedress with 20-30 lb/A nitrogen.
- **Spinach is very sensitive to soil moisture levels and compaction.** Take the time to prepare uniform beds and set up irrigation that will provide uniform amounts of water across beds. Plants in wetter beds may germinate more quickly but if they remain in wet soil for too long while the plants aren't growing much through the darkest part of winter, they won't do well.
- **Keep soil pH above 6.** Spinach is very sensitive to soil pH, and doesn't grow well if it drops below 6. It's ideal range is 6.5-6.8.
- **Germination and damping off are big issues for high tunnel spinach**, especially in tunnels that have been in production for more than a few years. We received a SARE Research & Education grant this past spring to fund our spinach production research, and we're excited to dive into some novel approaches for managing those 2 issues, as well as continuing our variety trials. Stay tuned for more research reports and (virtual?) field days, and get in touch with us at umassveg@umass.edu if you grow winter spinach and are interested in getting involved!
- **Let us know if you have spinach downy mildew!** We are tracking which strains are popping up in the Northeast, and every sample is useful, even if it's not causing a huge economic loss on your farm. Send us an email, or call us at

(413) 577-3976 and we'll get your downy mildew race identified, free of charge.

2019-20 Methods

The tunnel was amended based on soil test results—20 lb N/A (Allganic 15-0-2), 20 lb P/A (bone char), and 150 lbs lime were incorporated into the soil.

Spinach was seeded by hand between October 7 and 10. Plots were organized in randomized complete blocks and were 2 feet long with 5 rows of spinach, with rows 2 inches apart. Plots were 8 inches apart within the bed, and beds were 4 feet wide. Spinach was seeded at a rate of 3,000,000 seeds/A (550 seeds/plot)—a rate commonly used by large-scale spinach growers in California and Arizona. Seeds were sown at a ½ inch depth. For the duration of the trial, circulating fans remained on, exhaust fans remained off, and roll-up sides were programmed to open at 50°F and close at 40°F. The tunnel was irrigated with overhead sprinklers as needed, based on soil moisture sensor readings, and hand-weeded as needed. Soil nitrate was monitored over the course of the growing season by taking PSNTs—sidedressing is recommended when soil nitrate is below 20ppm. The crop was fertigated on February 28 via overhead irrigation with 30 lb/A (calcium nitrate 15.5-0-0). In retrospect, this fertilizer should have gone down earlier in February, when the Persephone period (less than 10 hours of daylight) ended.

Plot germination was rated 12 days after seeding, and then plot vigor was rated weekly, taking into account stand, plant size, and, after initial harvest, regrowth quality. Each variety was harvested as it sized up, resulting in 6 harvest dates, the earliest being December 4. The latest harvest would have been on March 11, but we were not able to access the tunnel due to the COVID-19 pandemic, so we are not able to report total yield from this trial.

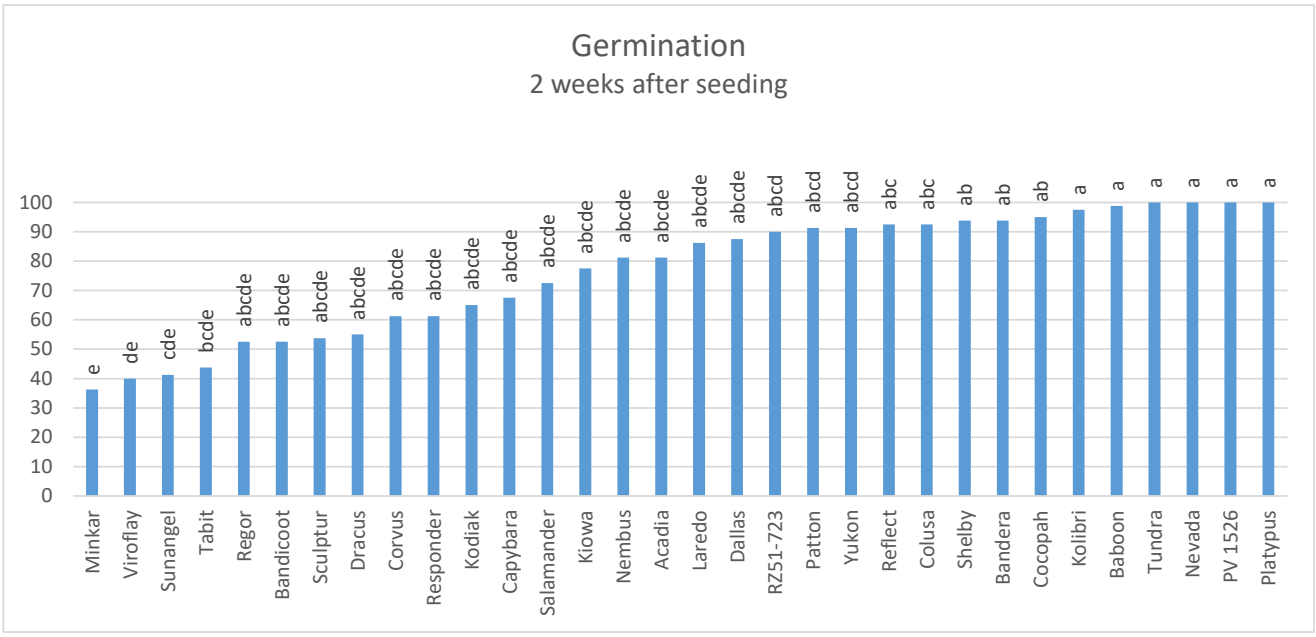
Table 1. Downy mildew resistance of varieties included in 2019-20 trial.
Varieties carry intermediate resistance to the races listed in parentheses

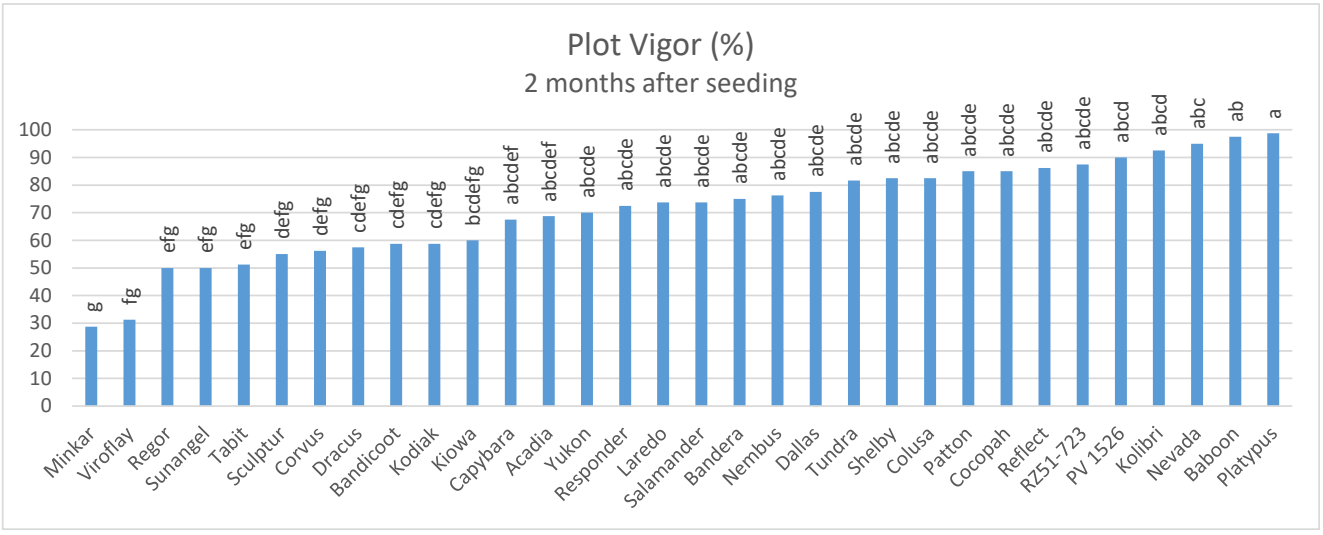
Variety	DM Resistance
Corvus	1-17
Dracus	1-17
Nembus	1-17
Regor	1-17
Sculptur	1-17
Tabit	1-17
Patton	unknown
Reflect	1-11, 13, 15, 16
Responder	1-12, 14-16
Acadia	1-13, 15
Shelby	1-13, 15
Tundra	1-13, 15, 16
Yukon	1-12, (13), 14-16
Colusa	1-17
Kiowa	1-17
Nevada	1-17
PV 1449/ Cocopah	1-17
PV 1514/Laredo	1-17
PV 1526	1-17
PV1512/Bandera	1-17
PV1513/Dallas	1-17
Minkar	1-17
RZ51-723	1-17
Baboon	1-7, (8), 9, (10), 11-17
Bandicoot	1-16, (17)
Capybara	1-7, (8), 9, (10), 11-17
Kodiak	1-17
Platypus	1-15, 17
Salamander	1-9, (10), 11-17
Sunangel	1-9, (10), 11-17
Viroflay	none
Kolibri	1-9, (10, 11), 12-15

There were few significant differences in germination, vigor, and harvest weight between the varieties in this trial. In each of the measures studied, many varieties performed similarly well, and without any downy mildew data, it is difficult to say that one variety clearly stood above the rest. There was lots of variation in performance between each rep of the trial, primarily due to soil moisture levels and compaction. Wetter plots germinated more quickly but grew unevenly, with the centers of the wetter plots becoming stunted and yellow as the season progressed. Drier plots germinated more slowly but had less stunting once they had germinated, to a point; the driest edges of the driest plots remained small throughout the entire season.

Germination: Four varieties—Tabit, Sunangel, Viroflay, and Minkar—had the worst overall germination rates, which translated into low overall plot vigor and low first harvest weight. Viroflay was included as a negative control for downy mildew infection, as it doesn't have resistance to any races of spinach downy mildew, and it was not developed for speed or growth at low light and temperatures, so it's not surprising that it performed poorly. Two varieties, Shelby and Tundra, were treated with thiram and metylaxyl, the standard fungicide treatments in the industry, but did not have significantly higher germination rates or lower rates of damping off than other varieties in the trial.

Growth speed is one of the most important factors for choosing spinach varieties for winter production: what varieties will grow quickly enough to produce a harvest by late-November/early-December and then re-grow quickly enough in





cold temperatures with low light. In this trial, assuming we had been able to complete the final harvest, most varieties would have been harvested twice, with some varieties harvested 3 times and a few only harvested once. Number of harvests for each variety is listed in Table 2.

Baboon and Bandicoot, which were all harvested 3 times, regrew very quickly after harvest and developed similar, distinctive looks after their 2nd harvest—light-green color, deltoid leaf shape, and long stems. Nevada, also harvested 3 times, developed a similar appearance after its second harvest, though it was not similar to Baboon or Bandicoot initially.

Cocopah and PV1526 also developed to be distinctively dense, with slightly elongate, shiny leaves, after their second harvests.

Acadia and Tundra grew the slowest of all the varieties. Despite germinating well and producing dense, high-yielding plants, neither variety was large enough to harvest until February 18, more than 4 months after seeding. These varieties may be good options for September seeding but did not grow fast enough to be suitable for early-October seeding.

Regrowth quality varied between varieties but also between cuttings of the same variety. Many varieties, listed below, produced high-quality regrowth, with few or no cut leaves visible. Other varieties showed cut leaves in their regrowth, and still others had high-quality regrowth after the 1st harvest but lower quality regrowth, showing cut leaves after the 2nd harvest. It's unclear whether this variation was due to the growth habit of the plants, which changed as day length increased in the spring, or differences in harvest cut heights.

Table 2. Number of harvests.		
3 Harvests	**2 Harvests**	**1 Harvest**
Baboon	Bandera	Acadia
Bandicoot	Capybara	Tundra
Colusa	Cocopah	
Dallas	Dracus	
Laredo	Kodiak	
Nevada	Minkar	
Platypus	Nembus	
Salamander	PV1526	
Yukon	Reflect	
Corvus (2-3 harvests)	Regor	
Patton (2-3 harvests)	Responder	
	RZ51-723	
	Sculptur	
	Shelby	
	Sunangel	
	Tabit	
	Viroflay	
	Kiowa (1-2 harvests)	

Table 3. Regrowth quality.	
Consistently Clean Regrowth	**Regrowth Showing Cut Leaves**
Bandera	Baboon
Capybara	Bandicoot
Cocopah	Dallas
Dracus	Kodiak
Kiowa	Laredo
Kolibri	Regor
Minkar	
Nembus	
PV1526	
Reflect	
Responder	
RZ51-723	
Sculptur	
Shelby	
Sunangel	
Tabit	
Tundra	

This work was conducted in cooperation with Dr. Jim Correll, University of Arkansas Division of Agriculture.

--Written by Genevieve Higgins, UMass Extension Vegetable Program