

## The winter that really isn't

With temperatures forecast to be in the 40s all week, with a bit of cold next weekend, it seems like it's practically over. Odd. One correction from the small engine discussion, thanks to David Holm of Northeast SARE: "Yes, the two stroke engine accomplishes a complete combustion cycle in one rotation of the crankshaft (a down stroke and up stroke of the piston). The four stroke engine accomplishes a complete combustion cycle in two rotations of the crankshaft (a down stroke and up stroke for combustion, and a second down stroke and up stroke for exhaust – four stroke happening with two crankshaft rotations)."

--> **Need to discuss? Got something you need looked at? URI Extension: 401-874-2967/andy\_radin@uri.edu, hfaubert@uri.edu**

## Nice, Clean Eggs for Sale!

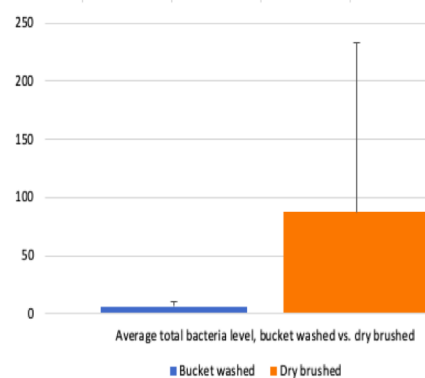
Chickens are a vital component to many small scale farms and producers in Rhode Island, and serve an important role in local agriculture. Eggs that come from a farm with less than 3,000 hens are not required to follow FDA guidelines for hen and egg management, including egg washing methods. At industrial scale or cooler-by-the-side-of-the-road scale, risks of salmonella and other causes of food borne illnesses in eggs are real.

Much of what people do with their own eggs is learned from their community: people wash their eggs the way their family did growing up, or they take tips from their friends and community. The lab of Dr. Becky Sartini, professor of animal science at URI, in collaboration with food safety scientists at UCONN, has been working for the past year to determine what method of egg washing reduces bacteria on the shell and how the chickens can be better managed to produce eggs with low levels of bacteria.

This summer, as part of a Coastal Fellowship, Bridget Craig, URI Undergraduate, looked at the relationship of bacterial presence on egg surfaces to varying levels of *visual* cleanliness. These



levels are described as: visibly clean but unwashed; low proportion of surface covered with manure; moderate proportion of surface covered with manure; and high proportion surface covered with manure. As you might expect, the more visually dirty the eggs are, the more bacteria can be found on their surfaces.



Bridget also looked at how two common egg handling methods for small-scale egg producers fared in reducing bacteria: **the Incredible Egg washing bucket and dry brushing**. The bucket wash method significantly reduced egg shell bacteria levels, while dry brushing **did not**.

These results are only the start. Dr. Sartini's graduate student, Julie Bosland, has a NE SARE Graduate research grant to look at other types of washing, hen management, and egg handling to produce the cleanest eggs. More great information will come out of this lab at URI by the end of 2020. Stay tuned!

## 2019 Variety Trial for Basil Downy Mildew Resistance

If you didn't make it out to the URI Agronomy Farm last summer, then you may not know that Dr. Rebecca Brown of URI's Department of Plant Science and Entomology put many of the new basil varieties to the test. If you grow basil, even just a small patch, you have no-doubt had the misfortune of getting BDM. It starts as barely visible chlorotic patches on fully expanded leaves, and then patches of dusty black spores can be found on the leaf undersides. It can migrate in during the summer months, but it can also start from infected seed. From Dr. Brown's fact sheet: "In 2018 several new varieties of Genovese-type basil were introduced with high levels of resistance to basil downy mildew. These varieties have the potential to be game-changing for growers who prefer not to use synthetic fungicides, or do not have the resources to maintain a rigorous spray program. However, the unpredictable arrival of basil downy

mildew each year means that for best results the resistant varieties should yield comparably to the best susceptible varieties in the absence of basil downy mildew. The objective of the 2019 basil variety trial was to compare the new resistant varieties with the current tolerant varieties and the susceptible yield standard ‘Nufar’.”

### Entrants in the 2019 Basil Variety Trial

Variety	Source
Emma	Osborne Seeds
Prospera	Johnny’s Selected Seeds
Everleaf	Johnny’s Selected Seeds
Eleonora	Johnny’s Selected Seeds
Devotion	VDF Specialty Seeds
Obsession	VDF Specialty Seeds
Thunderstruck	VDF Specialty Seeds
Passion	VDF Specialty Seeds
Nufar	Johnny’s Selected Seeds

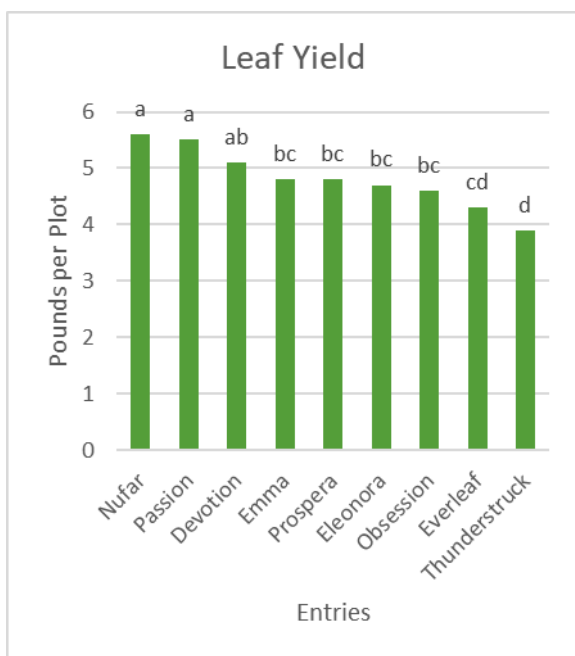
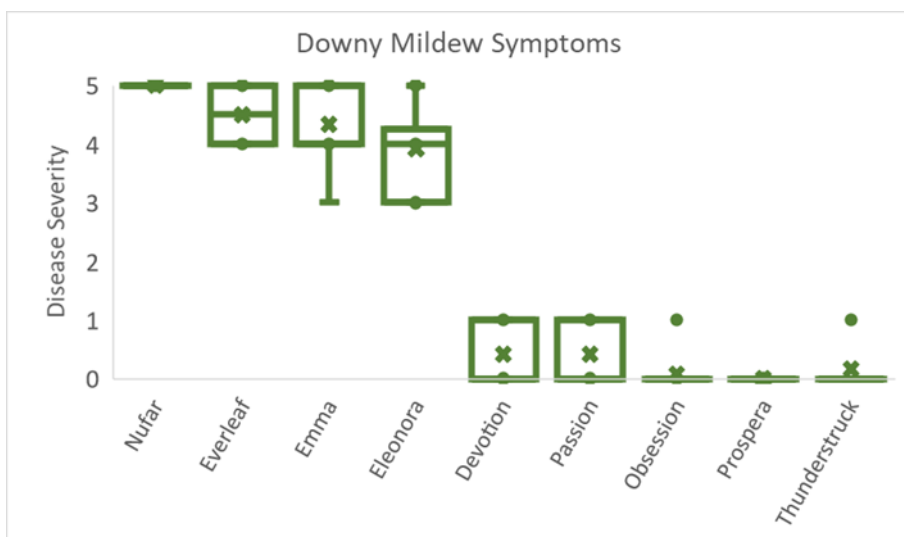


Basil Downy Mildew, topside of leaf above, underside, right



By the way, no fungicides were applied in the plantings: the idea was to look at relative resistance and production of marketable leaves. Shown to the right is a chart showing *disease severity*, meaning that those down near zero on the right side are the most resistant. The three varieties on the right, Obsession, Prospera, and Thunderstruck, exhibited the least variability— their resistance was more reliable across the board.

So good news: there’s some good resistance! But yield was also measured, and this may play a role in which varieties you choose. The figure below shows relative yields between the varieties for the July 16 harvest.



The letters on the top of each bar indicate statistical differences. Remember that each variety’s 20-plant plot was replicated several times. The yields for each variety are averages of all the replicates for each variety, and variability between all replicates is taken into account in order to determine if the yields of each variety are actually different from each other. Each variety is compared to each of the other varieties in “pairwise” fashion. For instance, while Passion or Nufar does not differ statistically from Devotion (all have the letter “a”), and Devotion does not differ from Emma, Prospera, Eleonora, and Obsession (all have a letter “b”), Nufar and Passion *do* differ from anything without a letter “a” on top.

There are more very interesting details to look at in the full report, which can be seen at [https://digitalcommons.uri.edu/riaes\\_bulletin/](https://digitalcommons.uri.edu/riaes_bulletin/). There are also many other reports from previous years, and more will be uploaded in the near future.

## Grow your own seedlings?

### Let's talk about the Media.

No, not that media... Media, as in the substrate that roots grow in, which technically (for most growers), has absolutely no soil in it. Still, it's more commonly referred to as potting soil or potting mix, and they call it compost in the UK. In the past, actual compost or leaf mold was a common ingredient. These can be inconsistent materials and in the last 50 years, materials like **peat moss** and **perlite** began to be predominant, and they still are. **Coir** (ground coconut husk) has also recently gained in popularity. A small percentage of **vermiculite** is also sometimes incorporated. In the meantime, organic growers have been mixing up their own media for decades, and genuine, finished **compost** is an almost universal ingredient. This prompted larger scale compost producers to enter the market of certified organic media sales. There are a variety of formulations sold by quite a few companies, and compost-containing media are becoming more easily available. Here are things to consider about any container media which is made with compost.

The reason why peat moss and perlite are such commonly used container media ingredients is because they provide excellent physical properties for plant growth. Roots need access to moisture, but not excessive moisture. Peat moss can absorb as much as 20 times its weight in water, and can stay wet for a relatively long period of time. (Remember, though, that this is a function of cell size. Small cells dry quickly no matter what the media being used.) Perlite, when evenly distributed through peat moss, provides air space, since it does not absorb water at all. Roots must have access to air because every root cell respire, and respiration requires oxygen. Furthermore, these two materials are stable: they don't break down through constant watering or microbial activity.

Compost, however, is a very different sort of substance. The most important difference is that compost is biologi-

cally active. For the most part, this is an attribute. In fact, a recent study performed at URI showed that aged (three month) compost-based media handily suppressed *Pythium*, one of the organisms that causes "damping off", while freshly assembled mix components (including compost) did not. Biological activity means that microorganisms (bacteria, mainly, along with fungi) are actively decomposing the organic matter in the compost, resulting in mineralization (release) of some nutrients, which can be used by the plants that you are growing. Bear in mind that compost has very low concentrations of essential plant nutrients, although peat moss has zero. But since this microbial activity is breaking down organic matter, it is also breaking down the three-dimensional structure of the

compost, resulting in subsidence and compaction. That means loss of oxygen inside of the media. That can lead to root rot, regardless of the presence of microorganisms that are antagonistic to root pathogens. Compost is fine to use, but not in excess.

Physical properties of media can be measured. **Particle size distribution** influences all the other properties. It is measured by sorting a sample of the media into different size ranges. We don't do this with our fingers or a pair of tweezers! We use a series of sieves stacked on top of each other and strapped into a shaking machine



(known, logically, as a Sieve Shaker). The sieves are stacked, top to bottom, coarsest to finest, with a solid pan on the very bottom. An air-dried sample of known weight is placed on the top sieve and the whole stack is shaken for five minutes. At the end, each sieve contains the fraction of the particles that are too large to pass through, and so on down through the stack. Each of these fractions are weighed and expressed as a percent of the total original weight of air-dried media.

Typical "good" ranges for particle size distribution as well as other parameters are shown in the table (next page). We tested several products and found that in general, percentages of fine particles (<0.5 mm) was too high: the



lowest among these was 30% and one was even up to 52%! With this much fine particle content, mixes are sure to “brick up.” Once that has happened, not only

Physical Property	“Ideal” Peat-Perlite type media
Particle Size Distribution	Fine: 10-20%/Med: >60%/Coarse: 10-20%
Total Porosity	60-85
Container Capacity	50-65
Air Porosity	10-20
Bulk Density	0.15-0.30 g/cc
Sources: Rutgers Fact Sheet 812; Sun Gro Horticulture.	

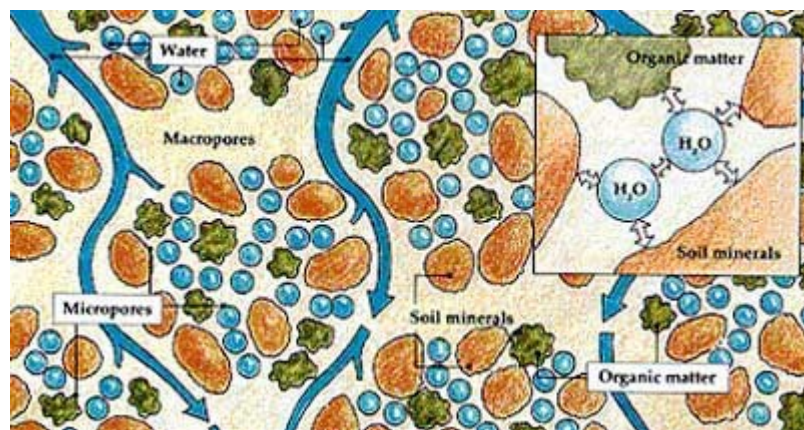
cules themselves is stronger than the force of gravity. Water molecules can form bridges between particles until the pore size is too large for water mole-

do roots struggle to get oxygen; it’s also very hard to get water from above to penetrate into the cells. Instead, it tends to run off the surface and work its way off the edges of the flats or down into the sides of cells without wetting the media much on the way through.

What factors affect particle size distribution? Certainly, the fineness and/or coarseness of your starting ingredients. But the act of mixing can have a significant effect as well. Media ingredients that have been over-mixed or mixed using the wrong kind of physical process can grind larger particles too much and work the air out of the media. Batters for baking suffer from over-working, too!

**Porosity** is a measure of space inside of a mixture of solids. Like soil, media has **macropores** and **micropores**. If the media is completely saturated with water, pores of both sizes are filled. If the media is allowed to drain by force of gravity, the macropores are displaced by air, but the micropores remain filled. Micropores don’t drain by gravity because the cohesive forces between the particles and the water molecules AND between the water mole-

cules to stick to each other. Then gravity takes over. When water has drained by gravity out in the field after a heavy rain, the soil is said to be at “field capacity.” When this takes place in a container, it is said to be at “**Container Capacity**.” So, container capacity is a measure of micropore space. If you have a known volume of media, completely saturate it with water, and allow the water to drain out by force of gravity, the volume of water



**Macropores and Micropores.** Blue branches represent water flow through macropores.

collected is the “**Air Porosity**,” which is a measure of macropore space. Finally, the sum of these two measures is the “**Total Porosity**,” a useful measure for comparisons.

Some published numbers for porosity is also shown in the table. Clearly, the greater percentage of fine particles, the lower the total porosity. BUT: if a mix has a high percent of fine particles and a high percent of coarse particles, perhaps because there is a lot of bark or perlite, this effect can be countered. But then think about how dramatically these fine and coarse particles will separate from each other: the lowest density particles rise to the top and the finest ones get carried to the bottom.



**Pop Bottles Porometers draining by force of gravity**

Component	Air space	Dry-out rate	Nutrients provided	pH	Wettability
Bark	High	Fast	Few	Acidic	Poor
Coir	Moderate	Moderate	Moderate (Cl, K & Na)	Slightly acidic	Good
Compost	Very low	Slow	High	Slightly acidic to alkaline	Poor
Peat moss	Moderate	Moderate	None	Very acidic	Very poor
Perlite	Very high	Fast	None	Alkaline	Good
Sand	Low	Moderate	Few	Slightly acidic to alkaline	Good
Vermiculite	High	Moderate	Few	Alkaline	Good

to a more desired range (5.5 to 6.0). Finished compost that has been properly aged is usually neutral (7.0) or slightly higher. Combining compost with peat moss can certainly raise the pH of the overall mix, but it should be checked before using and additional lime should be added if necessary. Cation exchange capacity (CEC) is probably unchanged, regardless of the volume per-

Measurement of these porosities is not an exact science. The reason for that is when you go to fill a vessel of a known volume with the media that you are measuring, how full is full? It is very easy to pack a vessel very tightly, but is this how the media exists in the containers that we grow in? Probably not. Over-packing containers drives the air out, which inhibits drainage. So, we have a standardized procedure for filling vessels which involves gently filling to the top, briskly tapping the counter-top with the bottom of the vessel about three times, and then refilling to the top without any more tapping.

**“Bulk Density”** is the weight of a known volume of air-dried media. In the lab, we measure this as grams per cubic centimeter ( $\text{g}/\text{cm}^3$ ), but industrially, it can be expressed as kilograms per cubic meter ( $\text{kg}/\text{m}^3$ ), pounds per cubic foot ( $\text{lbs}/\text{ft}^3$ ), or pounds per cubic yard ( $\text{lbs}/\text{yd}^3$ ). Bulk density is affected by two primary factors: how the material is handled and the densities of the various ingredients themselves. Media that is packed tightly into a space is denser than if loosely packed. Media that contains lots of high-density particles like rock or sand makes the entire mixture denser. While denser media in larger outdoor containers makes each container heavier, the height and structure of the plant affects the wind’s ability to blow over pots more than does the weight of the pots themselves. For most of the plants we grow in greenhouses, it is much preferable to use low bulk density media.

Chemical Properties can be affected by compost content. Peat moss is a naturally acidic material (3.0 to 4.5) and media made from it needs to be limed to raise the pH up

percentage of peat, coir, or compost. Published values of the CECs for these materials range widely, but all are typically over 100 meq/100 g. Electrical conductivity (EC) can be affected by compost content if the compost is not mature. Otherwise, it is not an issue. However, added fertilizers can affect EC, depending on the forms used (soluble or insoluble). Fertilizers used in organic production are usually less soluble or insoluble, requiring microbial degradation in the latter case. Organic fertilizer can work very well in media containing compost, but a mix of rapidly soluble and insoluble materials should be used in order to feed plants both immediately and up to four or five weeks later. Beyond that time, you should not expect your media to feed your plants much and supplemental fertilizer would be needed, particularly since the plants are large and demand more nutrients.

Finally, an important question: How much compost is too much? In 2019, we were able to determine that at least up to 36% compost by volume can work very well, in combination with the commonly used ingredients. While a higher percentage may also work, beware of The Law of Diminishing Returns. Also remember that in general, peat, coir, perlite, and vermiculite are pretty uniform and consistent materials. The higher volume percent compost you use, the more variability you are introducing, along with increasing bulk density and reducing total porosity.

If you have constructed media using compost and you’d like to have it tested, please contact Andy. We have our methods down, thanks to the steady hands of Gabriel Torphy. A small fee will be charged.