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The Sun Gro'er *is a newsletter distributed two times yearly by Sun Gro's Technical Network Team for the purpose of communicating horticultural and Sun Gro product information.*

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E Value: A Single Value to Help You Pick the Best Mix to Match Your Production Needs

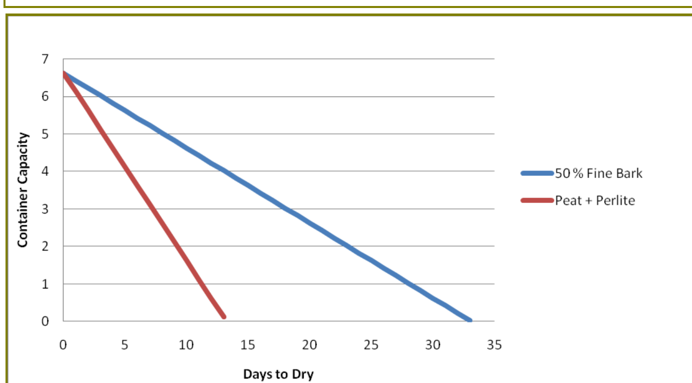
As Technical Specialists, one of the common questions we receive is "what is the best mix?" Of course everyone has unique wants, needs, and desires but we still do our best to recommend a mix that will best fit a particular situation. We have to consider mix performance, plant nutrition/ water quality, logistics, and cost. We literally have hundreds of mixes available so we can very likely meet anyone's needs, but sometimes those recommendations come with a bit of trepidation, especially when it comes to the "mix performance" issue.

Let me explain. When examining a potting mix's physical properties and attempting to characterize how it will perform in the greenhouse, we have quite a few and sometimes confusing metrics and terms: total porosity, air porosity, water holding capacity, infiltration rate, pore shape, pore size, unavailable water, plant available water, bulk density, compaction. What do all these things mean? How do we use them to explain how a particular mix will compare to the other? Even those of us that study potting mixes and soil physical properties sometimes struggle with offering you a simple measure or explanation of how a mix will perform in the greenhouse.

Further, with the wide variety of mix components available it can become mind boggling to figure out all the interactions of peat vs. bark vs. perlite vs. vermiculite. And then, you have to consider the size and shape of those components because fine peat will hold much more water that coarse peat. And that can be said for almost any component added to a potting mix. This is confusing!

With that concern, Sun Gro teamed up with researchers from the University of Arkansas in the U.S and University of Padova in Italy. This international team set out to find a single measure that would describe a mix's performance in the greenhouse over time. This value needed to be more indicative of a mix and not just when it is saturated and drained in a laboratory such as is done when porosity and water holding capacity are determined. Because in the greenhouse, it is unlikely that a mix ever truly gets saturated 'per se' since most containers have drainage holes.

FIGURE 1. Comparison of Mixes with the Same Container Capacities (water volume after saturation and drainage).



E Values

Further, even though porosity and water holding capacity give us some indication of the pore space in the mix and the initial water content, it doesn't do a good job of telling us how the mix will dry down over time relative to other mixes. This is what we usually want to know anyway – "How fast will the mix dry out?" or "How long will it say wet?". All the physical characteristics we typically measure to describe a particular mix, for the most part, attempt to translate into this one aspect!

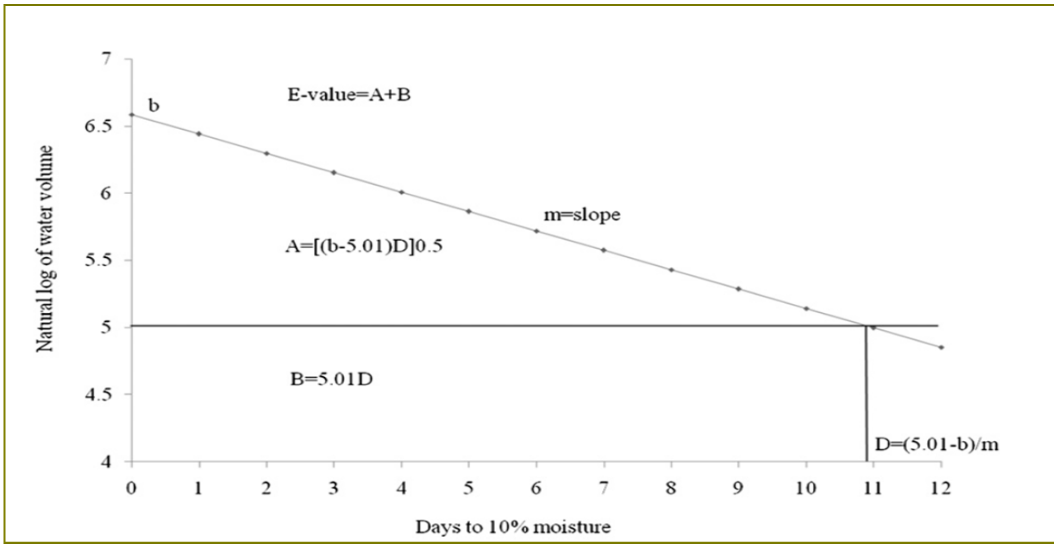


FIGURE 3. Example of an evaporation graph used to calculate E-values. The area under the evaporation line and up to 10% moisture equates to the total amount of water lost from that particular mix.

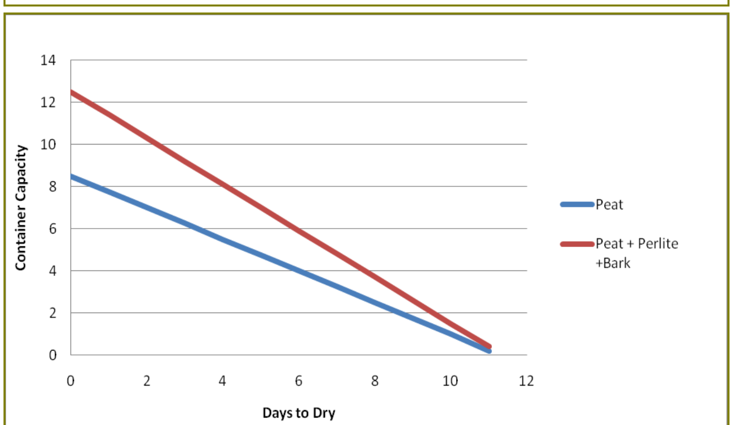
Look at **Figure 1** for an example. The two mixes that are represented on the graph have the exact same water holding capacity immediately after saturation and drainage (aka - container capacity). However, notice that the Peat + Perlite takes 14 days to dry while the 50% Fine Bark mix takes 33 days. So if we used conventional measures of water holding capacity and porosity, we would assume the mixes perform similarly but in reality they are very different in the amount of time it takes them to dry.

We understood that a common gauge when comparing potting mixes in the greenhouse is "how long between irrigations." We initially were going to conduct simple "dry down" trials of each mix and provide the number of days it took to dry down. But when explored further, we found we would be leaving out important information about the container capacity or total amount of water a mix would hold. As you might imagine we had some mixes that had different container capacities but took the same amount of time to dry down (**Figure 2**).

After some contemplation and quite of few trials and computations the ***E-value*** was developed. "E" stands for evaporation and this value takes into account the initial water holding capacity of the substrate and the time it takes to dry down to a given moisture content under highly controlled environment. The highly controlled environment is important so that we can repeatedly test mixes and continue developing further *E-values* with various mixes.

So, what is accomplished via a very rigorous procedure is to saturate several containers of a test mix with water and determine the container capacity once the water is drained. Thereafter, the containers are placed into a growth chamber where humidity, light intensity, wind speed, temperature, and numerous other parameters can be exactingly controlled. Each day the containers are weighed to determine how much water is lost. Those measurements continue until the moisture content of the mix reaches a very low level (10% by volume, which is below what is considered permanent wilting point for plants). After drying in the growth chamber, the containers are then removed

FIGURE 2. Comparison of Mixes with the Same Container Capacities (water volume after saturation and drainage).



and the mixes oven dried to find the absolute water content remaining in the containers and actual weight of the dried mix as well.

This is when things get a bit more scientific. Through various mathematical conversions, an linear *Evaporation* graph is drawn (**see Figure 3**). This graph allows us to plot the water evaporation over time starting from the "container capacity" down to 10% moisture by volume. We are then able to use geometry to calculate the total area under the slope or evaporation line. It is that area that takes into account several important physical property measurements and drying time that gives us the *E-value*.

Now all this jargon and math can be a lot to take in. But be assured you only need to refer to a single number, the *E-value*, to determine how much water a mix holds and how quickly it will dry. Will your greenhouse conditions exactly match those used in the growth chambers? Of course not, but since we are testing a wide variety of Sun Gro's most popular mixes (**Table 1**) you will be able to judge if a particular mix will be more suited to your liking based upon its *E-value*. Be sure to stay tuned for more information on this method of describing growing mixes.

Substrate	E- Value
Sunshine #4 or LA4	63
Sunshine #1 or LC1	73
Metro Mix 820	88
Sunshine #7 or LPG7	96
Metro Mix 840	107
Metro Mix 360	147

TABLE 1. E-Values of some common Sun Gro products. SS #4 mix has a high amount of perlite. MM 360 is fine textured with vermiculite.

Todd Cavins

Authors Note: For more details read:

HortScience 46 (4): 627-631, 2011.

"Dirt and Fert " for Basket Production

Editors note: *This article originally appeared in GM Pro Magazine in June 2004.*

Interesting how some things don't change - Hanging baskets are still big business! When you think about it, hanging basket culture is in a league of it's own and deserves special attention. The entire objective of growing a hanging basket crop is different than a pack or a small pot. The objective is usually to grow big, full and "overflowing" plants that typically remain in the container. While the objectives for packs and small pots is to grow colorful, compact plants that are proportioned to the pot . When it comes to growing media for hanging baskets, the initial challenges are to avoid keeping the growing medium too wet, depending on the production program employed. Thereafter, when plants are full and "sized up", the major challenges are always moisture supply and weight.

... The objective of growing hanging baskets is to grow, big full and "overflowing" plants that remain in the container.

Hanging basket containers are available in all kinds of types, shapes and sizes. To name a few there are plastic baskets, coconut fiber baskets, paper fiber baskets, sphagnum baskets. Sizes range from 6 inch round to over 16 inches. Some have saucers externally and some internally. The volume of mix that a hanging basket will hold ranges "all over the board". This determines two things, weight and the amount of mix that you will need.

The first and most obvious factor is weight. Growing mixes vary in their weight in and of themselves. Mix suppliers will often provide information about the bulk density of a mix. Bulk density is the weight per volume expressed as pounds per cubic foot or grams per liter and is highly contingent on the moisture of the mix. From a practical standpoint, the wet weight of a mix is the critical factor. Generally speaking, bark mixes will be heavier than peat-lite mixes, but not all the time. Consider Table One. Logically as container diameter increases, the wet weight of a basket will increase. Mixes containing a high amount of bark or peat will be heaviest. Mixtures containing a high amount of perlite are lightest. Growers using a mid to heavy weight bark mix (30 to 50% bark) may wish to use a lighter growing medium product when growing larger baskets – Perhaps 12 inch and up. Data shown in Table One shows roughly a 25% increase in weight comparing a standard bark mix to a typical peat-lite mix. On the other hand,

TABLE 1. Wet weight of various Sun Gro growing media products in four different containers. Data presented in pounds per pot. Weight of pots included without hangers to provide a total weight.

Mix Type	BD (lbs. / CF)	Wet weight / 8" HB	Wet weight / 10" HB	Wet weight / 12" HB	Wet weight / 14" HB
Peat mixes					
LA4, 60% peat, 40% perlite	9 – 10	3.75	6.30	10.15	15.05
LC1, 75% peat, 25% perlite	9.5 – 10.5	3.90	6.60	10.65	15.40
LC10, 90% peat, 10% perlite	10 – 11.5	4.60	7.75	13.05	18.70
Bark mixes					
MM820, 20% bark	12.5 – 14.0	4.40	7.35	11.70	17.00
MM830, 30% bark	15 – 16.0	4.65	7.60	11.95	16.95
MM840, 40% bark	15.5 – 16.5	4.55	8.25	12.55	19.40
MM900, 50% bark	17.5 – 19.0	5.05	8.15	12.85	18.35

high peat mixes (90% peat) tend to hold a great amount of water resulting in significant weight.

The weight of a particular size hanging basket will be somewhat contingent on the actual volume of mix and the amount of packing that occurs. Bear in mind that saucer-less pots have a reservoir for water on the bottom of the pot adding weight. This may be a good thing for keeping the growing medium moist during later stages of production.

… Packing the mix will always decrease air pore space and lead to the mix holding more water…

Are you packing?

Packing the mix will always decrease air pore space and lead to the mix holding more water. We're talking about growers who REALLY pack the mix in, or stack baskets to store or transport for future use. Tamping the pot to settle mix around plant roots and the like is "OK" since it helps with initial root contact and avoids excessive shrinkage of the mix (following initial wet out). However, any significant degree of packing leads to problems with poor root growth at the start of production. And since it causes the mix to hold more water, it makes the mix wetter and heavier. Packing the mix can cause a mix to contain 10 - 25% more mix and add up to 25% more weight (data not shown). The third thing that packing does (depending on the packer) is to cause variable water retention throughout the crop – So some baskets dry out faster than others.

Propagule size makes the difference!

As noted earlier, there is always this dynamic. "I need something to try to keep the baskets dry in the beginning of a program but I need more water holding at the tail end of a program."

This is an interesting topic to bring up with growers because you always get some really lively discussion. The philosophy is the larger the plug size the less shrinkage and increased uniformity you will get. For growing straight varieties, this may not be as much as an advantage but for ultimate flexibility with combination planters, we see that larger transplants -- Materials from 2.5 to 3.5 inch pots or cell packs – "get the nod".

From the mix standpoint, when using larger transplants, you can then utilize a growing medium that is more appropriate when starting with small propagule sizes / plant types versus mixes for the baskets. For example, use a more open mix in the small pots and then use a mix that holds more water for the finished baskets. Whatever the case, you then avoid the issue of keeping the mix too wet at the start of a program. Added benefits when using larger plants are that they are "sized up" better before going into the final planter, less guess work on plant growth rates, production times in the final container are significantly shortened and plant loss is decreased (See Table 2).

Starting plants in small pots or large cell packs also allow plants to have more light initially and take up less space (saving fuel) which is often an issue during Winter months.

What are the downsides of using larger transplants? Utilizing space on a bench rather than putting the material up and out of the way may be an issue for some. Adding cost by "planting twice" is often a negative but if you bought the materials in then it's a non-issue except for cost of the material.

A suggestion for the experimenters… you can be creative and more flexible with nutrition on the front end of the production. For example, if you have plants for combo's that need more micronutrients or total

TABLE 2. Advantages and disadvantages of using small vs. large plug sizes.

Large plugs (100 – 72)	Small pots (3.5 ")
Less expensive	More expensive
Longer basket time	Shorter basket time
Less time on bench	More time on bench (pots)
More shrinkage	Less shrinkage
Harder to keep combo baskets sized well	Easier to keep combo baskets sized well
Combos have more "wild" look	Combos have more "defined" look
Media in basket geared to meet short and long term needs	Media in basket geared more to long term needs
Root zone and nutritional creativity	Match treat everything the same

nutrition or whatever the special need is, you may consider treating the mix (in small pots) **BEFORE** going into the final basket. When you use small propagules (plugs) this is often not possible but it is possible if using small pots / packs.

Other additives to enhance water management - gels.

There are various gel products on the market that can absorb a great deal of water. And there are growers who believe gels are a benefit for supplying water to plants. The key when using products containing gels is that the amount of mix that is put into the pots needs to be less than non-gel products since the gels expand when absorbing moisture. Filling the container to the top may cause the mix to swell above the rim of the pot when the gel expands, thus making future watering more difficult and creating a mess. Growing media with gels often require 2 to 3 thorough irrigations to assure the gel is fully expanded. Avoid packing mixes with gels since the gel particles will tend to displace air pore space.

Wetting agents with baskets.

While most reputable mix manufacturers provide a wetting agent in their products, wetting agents can be used during or near the end of production to assure maximum and uniform wetting of the mix components after sale. The thinking here is that optimizing wettability will ensure you get the maximum water holding capacity from a particular mix formulation for the retailer and consumer as well. This is theoretically true and growers can always use this technique as "insurance". This is going to be important especially for smaller diameter baskets. Suppliers of wetting agents have long promoted this technique. Always follow label recommendations and cautions for this use of wetting agents.

Interestingly enough, in an article by Erik Runkle and Deadre Craig, "Watering Bedding Plants Before Shipping" (p. 70, GPN Magazine, August 2011), they state that watering of plants upon arrival at their retail destination is of great importance to maximize postharvest marketability. One would conclude then, that assuring maximum wettability of the growing medium at the retail site is of paramount importance.

Necessity is the mother of invention and diapers are not just for babies.

We're serious. We heard this at Town & Country Garden Center in Racine, WI. They take pride in their quality baskets and they use diapers on the bottom of the baskets to hold more water. Don't ask us about the brand or if it really works but someone out there gets an "A+" for creativity. We don't believe growers will find mix suppliers adding diapers any time soon.

How much mix will I need?

Good question. As shown in Table 3, even if pot diameter is marketed as the same, the pot volume will differ. Growing media manufacturers often provide charts showing pot count per cubic foot or per bag but this is an approximation AT BEST. So Table 3 provides an "idea" of the amount of mix needed for various pot sizes and brands but it depends not so much on mix type but on the pot size and the amount of moisture content and packing of the mix. As noted earlier, you can reduce the amount of pots filled 10 to 25% by light packing of the mix.

Nutrition, out of sight and out of mind?

Should we treat baskets the same way we treat flats/ packs? Of course not.

Nutrition for plants grown in hanging baskets (just like any other crop) should be based on the quality of the water they receive. So all the concepts learned for any other crop still apply. The only difference is that the pot size is larger so nutritional changes may not be as fast as in smaller pots and the general fertility (i.e. nitrogen) requirements are often greater (Remember the objective?). But many times this creates a dilemma since the fertilizer injection equipment the grower has in place does not allow for it. Or since baskets are placed overhead, they just don't receive the same amount of care the flats receive down below. Well, not to worry. With the advent of controlled release fertilizers (CRF), the grower has a tool that can help the fertility management of growing hanging baskets.

The key thoughts when using CRFs are longevity, rate and timing of application.

CRF products are sold based on longevity.

Products may be rated as month release (i.e. 3-4 month, 5-6 month, 8-9 month) or day release (70 day, 100 day, 140 day). These longevities are based on the soil temperature. Commonly sold products on the market are rated at soil temperatures of 70 or 77F. If soil temperatures during production are greater than the CRFs benchmarked temperature, then the actual longevity may be less than what is stated on the bag. Be aware that soil temperatures in the greenhouse most likely will be greater than the outdoor temperatures. So if you're thinking that a Spring application of a 70 day product gives you what you need because its Spring and its not hot yet, think of what is happening in the mix in the pots in the greenhouse. Also remember that if baskets are already hung, the root zone temperatures most likely will be greater than at "bench level" (i.e. hot air rises).

CRF rate

Rate is usually expressed as pounds per cubic yard when incorporated or grams per pot or teaspoons/tablespoons per pot when top-dressed. Rate is based on the longevity of the product, level of fertility desired and the application method (incorporation vs top-dressing). Companies selling CRF products provide information to guide the grower to the correct rate. When using CRF, our recommendation is to employ a "combination program". When using a combination of liquid fertilization and CRF, use half of the full CRF rate or more conservatively, the suppliers "low rate".

Application timing

For ultimate ease and performance, CRFs can be incorporated into a mix. Growing media manufacturers often provide this option. However, once a CRF is added to the mix, it needs to be used in a reasonable amount of time after incorporation. This is because most CRF products are "activated" by soil moisture (vs. "free water"). Once water vapor enters the CRF prill, the fertilizer inside the coating starts to dissolve. There is always moisture in a mix. Most growing media ranges from 40% to 60% moisture by weight. It may look or even feel dry but there will be water vapor present. The extent of the moisture level will determine the relative speed the CRF prills are "activated". Generally speaking, the greater the temperature, the more water vapor present. Obviously, when temperatures are low, as in Winter months (depending on location) this may not be concern. As a general guideline, our recommendation is to use a mix with CRF incorporated within 10-14 days following manufacture and to always water thoroughly following planting.

CRFs can be "top-dressed" after planting if you prefer not to blend a CRF into the growing medium. It is

TABLE 3. Examples of commonly sold hanging baskets and growing medium volume requirements. All baskets filled to top edge. Very light "packing" was employed. Some of these models may no longer be available as of this posting, however the concepts still hold true.

MODEL	MARKETED DIAMETER	ACTUAL DIAMETER	CUBIC FEET / BASKET	BASKETS / 3 CUBIC FEET
Euro w/saucer	6	5 7/8	0.053	56.35
Euro saucerless	6	5 7/8	0.053	56.35
Euro w/saucer	8	7 15/16	0.117	25.60
Euro saucerless	8	7 3/8	0.106	28.17
E8SL	8	7 3/8	0.102	29.45
Belden HB	8	8.0	0.117	25.60
Euro w/saucer	10	9 5/16	0.200	15.00
Euro saucerless	10	9 5/16	0.192	15.65
Belden HB	10	10.0	0.183	16.36
Traditional HB	10	10.0	0.234	12.80
Traditional HB Saucer-less	10	10.0	0.224	13.40
Super Traditional	10	10 9/16	0.250	12.00
Super Bowl	12	10 13/16	0.299	10.05
Euro w/saucer	12	11 1/16	0.333	9.00
Euro saucerless	12	11 1/8	0.306	9.82
Listo M1200HB	12	11 1/2	0.285	10.54
Belden HB	12	11 3/4	0.333	9.00
Listo M1400HB	14	13 7/16	0.444	6.75
Belden HB	14	14.0	0.563	5.33

It may be a better choice to use a lighter growing media in large baskets like the one on the left. This 16 inch basket is filled with Sunshine LA4 mix which is one of Sun Gro's light weight mixes. The smaller baskets on the right are filled with Sun Gro's Metro Mix 902 mix, a heavy bark mix.

often thought that watering method needs to be appropriate for top-dressing (drip irrigation may not be best with top-dressing) although studies have shown this is not always true. Uniformity of application and longevity are usually decreased when top-dressing although top-dressing gives the grower much more flexibility.

For ultimate value to the end user, applying CRFs shortly before sale is best. While incorporating CRFs before the start of production may have some value to the end-user, it is usually not applied at a rate to provide significant nutrition for the remainder of the season. For example, if you apply a low to medium rate of an 8 –9 month longevity product to hanging baskets in January in Texas, you cannot expect the product to provide adequate nutrients through the season (i.e. into September) especially since the average temperature in Texas is higher than 70F.

Final Thoughts.

Consider if hanging baskets are the primary crop you grow. The objectives of growing top notch baskets suddenly takes priority and the choices you make changes. From choosing your soil mix to the varieties you are going to grow to the pots types you are going to use. Giving a second thought to the mix you will use and the nutritional program employed will help in growing trouble free hanging baskets for you and your customer. Consider the weight, water holding capabilities at the start and end of production and the nutritional options available. Be creative and have fun!

Rick Vetanovetz, Dan Jacques, Mark Thomas and Ron Walden

This article originally appeared in GMPro Magazine in June 2004.

Plants placed above may not receive as much attention as those placed below. Using CRFs may be a strategy to help avoid nutritional issues.

Got Fiber? A Critical Look at Using Digested Dairy Fiber

Does this growing media product from cows do plants good?

A material that is emerging as a growing media for plants is a byproduct from dairy farms. This material is called by various names using words connecting dairy manure + digestion or compost + fiber or solids — For example, digested dairy fiber. There are also a couple of trade names used for this material based on the way it is processed, and in some cases, in proprietary ways.

Growers naturally have questions on this new material. Here is an overview of answers to those questions to help growers assess how this material fits in their production programs. There will, of course, be more research, more knowledge, better answers on this material in future.

To be sure, the digestion technology mentioned here may also be applied to wastes other than dairy manure, like food wastes, slaughterhouse wastes, horse, sheep, pig, chicken or even human manure, but their end product characteristics obviously differ from that of dairy fiber, so it is important to know the source of material.

What is dairy fiber?

Dairy fiber is essentially undigested solids in cow manure. It has been found that processing manure can generate energy though the generation of methane. Cow manure is run through different kinds of machines to separate different fractions in it. The gas fraction is captured as methane gas for use as energy. The liquid fraction is collected for use as a fertilizer. The solid fraction is the dairy fiber. Using the fiber is very important because the economics of the energy conversion process often hinges on income from the fiber. This also leads to marketing programs to promote the use of fiber promoting it's "sustainability" and organic origin.

Dairy fiber looks like growing media, feels like growing media— can it be growing media?

Why dairy fiber is coming into the market now?

Traditionally, farmers spread cow manure as such in the fields. Later, some farmers started pumping a slurry of dairy manure onto the fields. A few tried to *process* and produce fiber from dairy manure for use as a container growing media back in early 1980s (vs. use a composted manure)

Now, more and more dairy farmers are processing dairy manure due to limited land to spread manure, pollution regulations, suburbanization, complaints of manure smell, etc. Plus, governments are also promoting and supporting projects such as manure to energy, reduce greenhouse gas (methane) emission, etc. Thus, more dairy fiber is becoming available.

How is dairy fiber produced?

There are different types of systems that process dairy manure in different ways. Some systems separate solid and liquid fractions by mechanical separators, without any methane gas production. The separated solids are then run through a long, horizontal, rotating, drum-like vessel, where the solids are composted in an accelerated way.

Some systems run dairy manure through anaerobic digesters, where the manure is decomposed in tanks by anaerobic bacteria to generate methane gas, which is used on the farm or sold as electricity. The remaining liquid and solid fractions are then collected and separated.

Some of these systems operate on a continuous basis while others process a set quantity of material as a batch.

Some processes also include a "curing period" where the fiber is place in piles or windrows outside the mechanical process and out in the open to allow the biological activity to stabilize.

How long the manure is processed, how long the manure resides in a composting vessel, to what temperature the manure is exposed, etc. depend on the technology used. Because of these processing variations, the resulting characteristics of dairy fiber vary from farm to farm.

Does dairy fiber smell?

Dairy fiber doesn't have the same unpleasant smell as fresh dairy manure, nor does it attract flies. That does not mean all processes produce odorless or "low odor" fiber.

Is dairy fiber hygienic?

Since dairy fiber is derived from manure, *Escherichia coli* (E. coli) outbreaks come to mind. E. coli is a type of fecal coliform bacteria. Although fresh raw manure has fecal coliform bacteria, dairy fiber has gone through an accelerated composting during which fecal coliform and other microorganisms are reduced generally by up to 99%. The actual level of reduction in microbial population depends upon the temperature and duration the dairy fiber underwent during its processing. The type of process dictates the temperatures and duration.

Temperatures during aerobic drum composting (without anaerobic digestion) can vary from 140 to 160^{0}F for 4 hours to 7 days. Anaerobic digestion temperatures can be ambient (mesophilic) or hot (thermophilic) for 4 to 30 days, depending on the system. Though these temperatures do not *sterilize* (meaning all living things are killed) the material, because of the conditions and time, the microorganism load in dairy fiber is reduced substantially.

Whether the microbes that survive this processing regrow and multiply depend on whether there is any food left for them in the dairy fiber. There is also a chance of microbial contamination from fresh manure. For example, dairy fiber contacts fresh manure when being stored in the same barn or if the same farm equipment used for fresh manure is used with the dairy fiber.

Generally one can expect no significant microbial hazard from dairy fiber. However, one should be prudent when using dairy fiber for growing food crops such as vegetable crops or herbs and test dairy fiber samples for safety.

Are there any plant pathogens and weed seeds in dairy fiber?

Because of the temperatures and processing conditions described above, one would expect a reduction in plant pathogens and weed seeds, if any, that could come from straw or hay used in dairy production.

Unlike a general compost which is generally a product formed slowly from heaps in the open, dairy fiber is generally a product of rapid and closed composting system. Thus, which microbes colonize it, what competition they provide to suppress plant pathogens, whether they form any molds during storage, etc. are not known yet. The curing process conducted in the open may introduce and build microbial populations in a cured dairy fiber.

Is dairy fiber stable?

Dairy fiber is basically undigested plant material. Other materials like sand or wood chips, when used as bedding for cows, can and do carry into dairy fiber. But generally, dairy fibers are structural components of forage grasses, clover, feed grain, etc. In a way, they are like composted plant residues. Just like how plant residues degrade during composting outside, these plant materials degraded inside a cows rumen, in an accelerated process, at the most in 3-4 days. These materials were even masticated twice.

These plant materials generally go through another digestion outside the cow during the processing of dairy manure. By this stage, almost all easily degradable compounds in these materials would have degraded. The remaining matter would be mainly lignin and cellulose. Lignin in one dairy fiber sample tested by Sun Gro was about 30% and at such lignin content, there would be hardly any biodegradable content. Lignin by itself resists microbial breakdown. Therefore, dairy fiber may not be much prone to microbial nitrogen lockup and the consequent nitrogen deficiency in plants.

Post-digestion, dairy fiber is sometimes stored in piles. If these piles are moist, they might compost a little more. This aerobic storing and curing may give even a much more stabilized dairy fiber.

Some dairy fibers shrink a little during plant growing. This shrinkage may be due to settling rather than decomposition. In general, dairy fiber is physically stable. Pots made from dairy fiber remained intact for the duration of growing a transplant.

How are air and water holding capacities of dairy fiber?

Dairy fiber is usually fibrous and/or crumbly. The volume of air space in a diary fiber sample, just after watering and drainage, was about 30%— very high and more than air needs of most crops. This high air space is due to large sized particles in that dairy fiber sample. Majority of particles in that sample were larger than 1/16 inch.

Dairy fiber, like most organic materials, on becoming too dry, becomes hydrophobic and does not wet easily and may require the use of wetting agent to improve its wettability.

In one manufacturing technology, solids in dairy manure are separated and run through a drum to accelerate composting and produce dairy fiber.

Photo courtesy of Rolland Kessler.

A gallon of one dairy fiber sample held about half gallon water— just after watering and drainage. However, the water content decreased rapidly over time, just in hours. This decrease might be related to large particles in the sample, which when together form large pores, which do not hold water firmly. But it is also likely due to the basic fibrous nature of the material. This low water holding characteristic would have implications for irrigation: dairy fiber would require more frequent irrigations, especially if one wants high growth rates of plants. The low ability to maintain water for a longer time would have implication in the shelf life of plants at stores too.

Since the size of particles in a growing media influences its air and water holding characteristics and since particle sizes in dairy fiber vary in nature, dairy fiber can be sieved so as to alter its particle size distributions for a desired air and water holding capacity.

What is the pH of dairy fiber?

Cow manure has high pH— in high 6's or 7's. So it follows, dairy fiber has high pH— in high 7's. Anaerobic digestion increases pH even further: dairy fiber from anaerobic digestion has pHs in high 8's. But some of these high pHs could even be due to "barn lime" sometimes used in dairy operations getting mixed with the manure.

Such high pH's in a growing media are not desirable for growing plants. High pHs reduce availability of micronutrients such as iron, which in turn limits plant growth and causes yellowing of plants. One can manage high growing media pHs to some extent by fertilizing with chelated micronutrients. Another solution to high media pH is to reduce its pH at the start itself by adding sulfur, iron sulfate or phosphoric acid. The lowering of pH by sulfur takes weeks, increases EC (i.e. soluble salts) and is variable in it's reactivity.

What about salt levels and ammonia in dairy fiber?

Though fresh dairy manure by itself has consistently very high salt levels, dairy fiber salt levels vary. Some dairy fibers have an EC of 1 mmho/cm (using a saturated medium extract procedure) while other dairy fibers have an EC of 4 mmhos/cm. This variation is related to how the manure was processed and the dairy fiber was obtained.

High EC levels in dairy fiber are generally due to high levels of potassium, phosphorus, calcium, magnesium, sulfur, sodium. However, particular salts and their levels depend on the diet of dairy cows that produced the particular fiber. Similarly, the impact on plant growth from any residues of medical compounds depends on the medicines given to cows.

Sometimes there is carryover of ammonia from fresh manure to dairy fiber. If this happens, it would be harmful to plants, especially at high pH, where free ammonia can harm plants, especially seedlings.

When salt levels in a dairy fiber are low, it is easier to manage fertilization during crop production. When salt levels are high, salts have to be leached as high salt levels reduce plant growth, especially that of salt sensitive crops. Leaching also causes a runoff concern.

If salts in a diary fiber are at medium levels, it is possible to make use of the nutrients by adjusting the fertilization. However, how the nutrients bound in dairy fiber are released due to exchange during fertilization and how significantly these nutrients contribute to plant nutrition are not known.

Does dairy fiber inhibit seed germination?

Fresh dairy manure inhibits germination of some seeds, probably due to phenols or high salt levels. However, well composted dairy fiber doesn't affect seed germination.

Herbicides used in the production of forages used to feed cows are often passed through the digestion process and may not be readily degraded during the mechanical digestion and/or curing processes. This is an issue that needs more consideration.

Is enough of dairy fiber available?

Cows excrete 24/7/365, so input material is always there. A cow can generate 3-4 gallons of fiber per day.

But converting manure to fiber requires capital. A drum type composter costs a couple of hundred thousand dollars. An anaerobic digester averages a million dollars. So a farm has to have hundreds of cows to be economical to build a digester. But subsidies and other incentives are available and more farmers are looking into building digesters. Some farmers may even form a co-op and establish a central site for manure collection and digestion. Makes sense, right?

Dairy fiber is light in weight (less than 10 pounds per cubic foot) and is bulky to handle and transport. Thus, one would expect more dairy fiber to be available less expensively in dairy states like Wisconsin, Pennsylvania, New York, California. And projections show that this is indeed the case.

Some farmers use all or some of the dairy fiber they produce as bedding for their animals or for field application. Thus, availability of dairy fiber depends on many such factors.

What you can do?

As was pointed out, the quality of dairy fiber depends on the quality of "inputs" as well as the processing technology and methods. To optimize all these variables, obtain dairy fiber from a growing media company. A growing media company treats the material not like a waste but applies the principles of using it to grow high quality plants. They adjust the variables based on their technical knowledge, so the product is more uniform and gives reproducible results from batch to batch. To ameliorate any unfavorable effects and bring in the favorable effects of dairy fiber, growing medium companies can combine dairy fiber with other components available to them. Of course, consider whether its price is attractive enough to adjust your growing practices to accommodate the change. And, as always, trial before implementing the change for the entire operation.

Shiv Reddy

(A version of this article appeared in GrowerTalks January 2011 issue.)

Editor's Note: *It is the position of Sun Gro that names for digested dairy fiber that imply that it is the same as sphagnum peat moss or peat is practically, technically and legally incorrect.*

Information that suggests it is the same as sphagnum peat is equally incorrect since even after additional treatment does not demonstrate the same physical and chemical characteristics as sphagnum peat moss.

Restoration of Peat Bogs - Canadian Ingenuity at its Best

Many horticulturists have little knowledge about the way that peat is harvested. Less so how peat bogs are restored after harvesting has ceased. For years the Canadian peat moss industry has supported and promoted the study of peat ecosystems and best management procedures to restore a harvested peat bog back to a functioning peatland. A little known "secret" has been taking shape under the direction of Dr. Line Rochefort since 1992. Dr. Rochefort is the Industrial Chair for Peatland Management and founded the Peatland Ecology Research Group (PERG) at the University of Laval in Quebec, Canada. This function is supported from Canadian governmental agencies and also the Canadian Sphagnum Peat Moss Association (CSPMA). Up to the early '90s, the sphagnum peat moss industry tried to work out best management practices to restore bogs but it was found that they needed to take the project to a "new level". The main objective of PERG is to develop a knowledge base that would contribute to the responsible management of Canadian peatlands.

Dr. Rochefort and her associates have applied their knowledge of sphagnum peat ecosystems to show that harvested peatlands can indeed be restored successfully. Rochefort was provided a harvested bog and uses it as an "outdoor laboratory" and example of how successful restoration can be accomplished. At the Bois des Bel research station, Dr. Rochefort's team shows that their knowledge is derived and applied on a large scale — At the ***ecosystem level***. Their work shows not only that sphagnum peat moss has established, is growing and accumulating but the ***diversity*** of flora and fauna is gradually being restored. It's not enough to simply grow plants on a restored bog and "make it look nice" but it is to bring it back as close as possible to a functioning state of productivity and biodiversity similar to other regional bogs — That's the ideal. The Bois des Bel project shows that restoration can be achieved in as little as 10 years and is becoming a world-wide "model" for peatland restoration.

Out of this work governmental agencies and the peat moss industry have adopted guidelines for restoration. In fact, a restoration plan needs to be in place for all bogs and if new peatlands are to be opened for harvest, a restoration plan is mandatory as well as finances to support the restoration. This is in addition to the required engineering and environmental review of opening up a peatland for harvest.

Many industries cannot achieve restoration quite like this. Nevertheless, there is still a lot to learn and improvements to be made but it looks like the collaboration between Canadian researchers and the Canadian peat moss industry is on its way to achieving the ideal.

Rick Vetanovetz

For more information:
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LEFT: Dr. Line Rochefort showing the amount of sphagnum moss grown in 10 years after initiation of bog restoration. It was evident that sphagnum moss had established and was growing well!

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