The Plant Doctor's LANDSCAPE TIPS

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TMS = TOXIC MULCH SYNDROME (SOUR MULCH)

Photo 1: When planting herbaceous annuals and perennials, be very careful when applying mulch around these TM-sensitive plants. Herbaceous plants are the most susceptible plants to the horror of encountering TMS.

Photo 2: Large, undisturbed piles of mulch such as this one are more likely to develop toxic organic acids and gases, which may lead to TMS.

Photo 3: The shrubs in this landscape died not from TMS, but from applications of herbicide to the mulch before the mulch was distributed. If this was TMS, the shrubs would likely have lived while the sweet woodruff would have died.

INTRODUCTION (THE HORROR!)

Most of us are running ragged during the spring and summer when our clients demand immediate (last week) landscaping attention. Imagine installing 350 flats of annuals and perennials at a corporate world headquarters at the CEO's residence according to the contract you proposed and signed (Photo 1). The contract also called for the installation of mulch, which you picked up from the mulch yard and piled for immediate distribution (Photo 2) after planting the flats of flowers. Then, you frantically hurry off to the next site to appease another client who expected you there "yesterday". The next day you receive a call from the corporate world headquarters manager telling you that all 350 flats of the herbaceous plants are dying. What happened?

WHAT IS TMS & TM?

Toxic Mulch Syndrome, aka sour mulch, is not a human disorder, per se . . . even though it is caused by human activity. When wood chips, bark, leaves and other organic matter are stored in piles, it begins to "oxidize," which is another term used to describe "ferment." Burning firewood or gasoline is an oxidative process that occurs very rapidly, resulting in a variety of components (carbon dioxide, carbon monoxide, etc.) and lots of water (or steam). Making beer is another fermentation process that occurs rather slowly with the formation of ethanol from the incomplete breakdown of sugars and other carbohydrates. Fermentation of biomass products proceeds by naturally occurring microbes, which utilize the organic matter as nutrition and is an all-natural process without which the organic matter would accumulate on earth many miles into space over time. Fermentation may proceed in an oxygen-rich environment (aerobic) or in a low-non-oxygen environment (anaerobic). Anaerobic fermentation (aka partial pyrolysis) results in incomplete oxidation of various chemicals during the breakdown of wood and other organic matter products. With anaerobic fermentation, organic acids and gases are typically formed that can be very toxic to plants. Organic acids and gases such as formic acid, acetic acid (vinegar-like), methanol, ammonia and hydrogen sulfide among others may accumulate in mulch if anaerobic fermentation or partial pyrolysis occurs. Mulch with these accumulated chemicals are referred to as Toxic Mulch (TM), at least by me.

SYMPTOMS OF TMS

Damage from TMS may occur in a relatively short period of time, say within 24 hours after the application of TM, especially on herbaceous plants. Symptoms may include whitening or bleached foliage, scorched foliage, defoliation, twisting and curling of herbaceous stems and in some cases, plant death. Newly planted trees, shrubs and herbaceous plants are most often affected (Photo 3). Turfgrass and established plants that

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are low-lying or near the mulch may also be affected (Photos 4 & 5). Woody shrubs may be affected but it is likely that the lower skirt of the shrub will be affected first.

MANAGING TMS & TM

Remember, if you are involved in a TM situation, it will be very difficult to prove who is responsible. It is very unlikely that the mulch yard will admit responsibility; perhaps rightly so (or not), they have no control over when and how the mulch is being used. And the nursery/greenhouse where you purchased the plants will probably not assume guilt because they had nothing to do with TMS if it is indeed TMS. It is very likely that the landscaper will have to replace those 350 flats of annuals and perennials at his/her own expense. That expense should garner your attention, particularly when all that labor is involved.

TMS can be managed by two methods: 1) Avoidance (Photo 6) **and 2) Amelioration.**

Avoidance by Detection of Toxic Mulch (TM): Toxic Mulch can be detected rather easily by the following procedures.

1. **Large Mulch Piles:** Beware of mulch in large piles (Photo 7). Large piles are more likely than small piles to become anaerobic and produce toxic acids and gases. When picking up mulch from a yard, pay attention to where the mulch is loaded from. A large pile? Does the mulch possess some characteristics as described below.

Photo 4: The toxic organic acids from the mulch distributed beneath these conifer trees leached out into the lawn during irrigation/rain and killed the turf.

Photo 5: Perhaps mistaken for TMS is an application of glyphosate (Roundup, etc.) at the border of this bed to keep the turfgrass from encroaching into the bed.

Photo 6: Avoiding TMS by installing stone mulches is an easy way out but not very natural or organic according to many of the fine professionals in our industry.

Photo 7: Note the gases (including steam) volatilizing from this large pile of mulch during the loading operation. Obvious gas emissions not only suggest a "hot pile" but incomplete oxidation known as anaerobic fermentation; this load of mulch may cause TMS, which is not something most of us ever want to experience.

2. **Hot Mulch Piles:** Mulch that is very warm or hot to touch is likely in a state of partial oxidation where toxic organic acids and gases are typically found.

3. **Stinkin' Mulch:** TM can often be detected using our sniffer. TM typically exudes a pungent odor similar to ammonia, rotten eggs or vinegar. For us boys and girls who grew up on the farm, TM may smell like silage, the fermentation product of sorghum, corn or other field crops. Non-toxic mulch will smell like freshly created wood chips, freshly sawn wood or exhibit an earthy smell.

4. **Mulch pH Test:** Because of the organic acids formed in TM, the pH of the mulch will approach 2.0 or even lower from the normal pH of 4.5-6 found in "healthy" mulch (Photo 8).

5. **Soluble Salts Test:** Because organic acids tend to be charged chemicals, much like fertilizers and deicing salts, a quick soluble salts test can be performed by mixing one part mulch with one part distilled water and testing the solution with a solubridge. TM will usually result in a conductivity of electricity that is much higher than that found in healthy soils or healthy mulch (Photo 8).

6. **TMS Bioassay:** Recall that when we apply new facial products or dye our hair, we are advised to do a small allergen test first. The same can be done with mulch. If you're not in too much of a hurry, simply set an herbaceous potted plant in the suspect mulch and watch for TMS symptom development for a day or two.

7. **Know the Supplier:** Many suppliers of mulch are very busy creating mulch and filling orders. Reliable suppliers are aware of TMS and will make efforts to avoid it by making smaller mulch piles and turning them frequently to aid aerobic oxidation.

Photo 8: These two pocket sized instruments, a pH meter and solubridge, can help us determine whether we have the potential for TMS. TM will exhibit low pH (2-3) and high conductivity, similar to over-fertilization and deicing salts.

Photo 9: When turning and irrigating TM to lessen the potential for TMS, be careful where the leachates of toxic organic acids from the mulch may travel.

AMELIORATION OF TMS AND TM

Mulch that is suspect for TMS should be piled shallowly and allowed to air out for a day or two before application to a landscape. Turning the mulch frequently will aid in the escape of toxic gases. Where suspect TM is piled shallowly, occasionally "irrigating" the mulch will help to leach out the toxic organic acids. Be mindful of where the irrigation leachates move (Photo 9)! If you're still uncertain about the mulch, test the mulch according to some of the recommendations above. Whatever the case, don't let your plants down by exposing them to TMS!

The author, MSU and MGIA do not endorse any particular products. If using pesticides, be sure to read and follow label directions.

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