myth, miracle or marketing?

Dust Mulches

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A soil management practice making the rounds on gardening Web sites is "dust mulching." Purported to improve water conservation, dust mulches are created by intensively hoeing the soil surface, creating a finely-textured layer of soil. According to proponents, dust mulching breaks the soil capillarity, reducing the evaporative loss of soil moisture. Furthermore, we're told that organic mulches aggravate water loss; in other words, no mulch is better for water conservation than organic material. With heightened government and public interest in reducing landscape water use, choosing effective mulches for water conservation is an increasingly important issue.

Soil moisture conservation

The earliest research on moisture conservation by dust mulches found, in fact, that water was not conserved (James, 1945; Ladewig, 1951; Robinson, 1966). In contrast to popular thinking, soil moisture does not move up from below to replace that lost through evaporation (Keen, 1942); therefore, "breaking soil capillarity" does not reduce water loss. Another early study found soil water levels at 6", 18" and 36" beneath the soil surface higher under an organic mulch (straw) to those under a dust mulch, with the greatest difference at 6" (James, 1945)—where most fine roots are found. At this depth, dust mulching was no more effective than bare soil in terms of water conservation.

Much of the recent research on dust mulching occurs in subtropical and tropical agricultural areas. And in some cases, dust mulches can be effective in improving soil moisture conservation (De and Giri, 1978; Sharma, 1991) and water use efficiency (Ali, 1985; Moitra and Ghosh, 1998; Raghavulu and Singh, 1982; Singh et al., 1999) when compared to bare soil conditions. But in the vast preponderance of studies, dust mulch was less effective in conserving water than organic mulches (Gargi and Gautam, 2003) derived from local crop residues, such as hay and straw (Ali and Prasad, 1972, 1974, 1975; Moitra et al., 1996; Raghavulu and Singh, 1982; Sarkar and Singh, 2007; Wooldridge, 1992), leaves (Mohan and Ali, 1969; Prasad and Singh, 1998; Sharma and Chakor, 1995;), and ground corn cobs (Benoit and Kirkham, 1963).

Soil temperature moderation

While organic mulches moderate the temperature of underlying soils, dust mulches do not possess the same ability. Organic mulches have been shown to decrease daytime temperatures of soils more effectively than dust mulches compared to unmulched conditions (James, 1945; Moitra and Ghosh, 1998; Sarkar and Singh, 2007; Wooldridge, 1992). This is not surprising, given the historic but unsuccessful use of dust mulches as thermal

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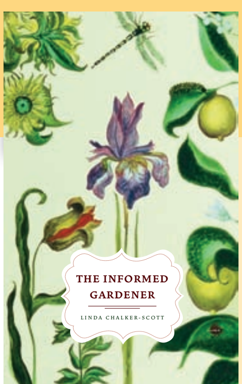

In this introduction to sustainable landscaping practices, Dr. Chalker-Scott addresses some of the common myths and misconceptions that plague home gardeners. The book is available from the University of Washington Press or directly from the author herself.

Comparative effects of dust and organic mulches upon crop yields

To read this table, simply look under the "crop of interest", then refer to the "ranking of mulches". In the first example under "wheat", organic mulching is better than dust mulching according to Ali. Codes for symbols are at end of table.

References (sources) are located in third column for your convenience and a bibliography is available from Linda Chalker-Scott's Web site.

Crop	Ranking of mulches	Reference
Wheat: (*Triticum* spp.)	OM > DM	Ali, 1976
	OM > DM (wet year)	De and Giri, 1978
	OM = DM (dry year)	De and Giri, 1978
	OM > DM > PM > C	Rao et al., 1997
	OM > DM > C	Sachan, 1976
	OM > DM	Sachan et al., 1977
	OM, DM > C	Sharma, 1991
	OM > DM	Sharma and Chakor, 1995
	OM > DM = C	Sharma and Thakur, 1992
Corn/maize: (*Zea mays*)	OM+DM > OM > C	Shivran and Rana, 2003
Barley: (*Hordeum vulgare*)	OM > DM	Ali and Prasad, 1972
	OM > DM	Ali and Prasad, 1974b
	OM > DM	Katiyar and Uttam, 2003
	OM > DM > C	Sarkar and Singh, 2007
	C > OM = DM	Warsi et al., 1980
Pearl millet: (*Pennisetum* spp.)	OM > DM	Ali and Prasad, 1974a
	OM1 > PE > OM2 > DM	Daulay et al., 1979
	OM > DM	Gargi and Gautam, 2003
	DM > OM	Singh et al., 1997
Sorghum spp.:	DM+OM > OM > DM > C	Prasad and Singh, 1998
	OM > DM = control	Raghavulu and Singh, 1982
Rapeseed: (*Brassica napus*)	OM > DM	Moitra et al., 1996, 1998
	OM > DM	Singh et al., 1989a and b
Safflower: (*Carthamus tinctorius*)	OM = DM > C	Chordia and Gaur, 1986
Mung (*Vigna radiata*)	OM > DM	De and Giri, 1978
Pigeon pea: (*Cajanus cajan*)	DM+OM > OM > DM > C	Prasad and Singh, 1998
Groundnut/peanut (*Arachis hypogaea*)	OM > DM	Mohan and Ali, 1969
Lettuce: (*Latuca sativa*)	DM = C	Bear, 1942
Mint oil : (*Mentha* spp.)	DM > C	Singh et al., 1999
Tobacco: (*Nicotiana tabacum*)	DM > C	Singh, 2006

C= control (no mulch) DM = dust mulch OM = organic mulch PM = polyethylene mulch

"The value of hoeing lies in reducing weed competition."

generators in insect control (Hagen, 1918; Reeves et al., 1916; Reeves, 1917).

Early in the 20th century researchers explored the possibility that dust mulches might control insect pests. Alfalfa weevil (Hypera postica Gyllenhal.) can have a devastating impact on alfalfa fields. Hagan (1918) speculated that a "fine dust mulch, heated by the hot sun, would burn and suffocate the larvae dragged into it from the crowns." Likewise, Reeves (1917; et al., 1916) suggested that temperatures of 120° F could be generated in a dust mulch, thus destroying all stages of the weevil. However, later research (Gillette and List, 1920), found that dust mulching was not effective in controlling the weevil and recommended against its use. Though a few other studies in the 1940s explored the relationship of dust mulches to insect pest control (Guyton, 1940; Horsfall, 1942), so little benefit is apparently derived from the practice of dust mulching that research was discontinued.

Regardless of their inconsequential impact on insect control, dust mulches do have the ability to heat the soil under warm climate conditions. Not only can this increase soil evaporative loss, it can also damage or kill fine roots found near the surface.

Soil erosion

Any soil management practice that creates fine particles will inherently be more susceptible to erosion by wind, rain, or other physical disturbances. Many decades ago Palmer (1945), Russell (1947) and Ladewig (1951) identified dust mulching as one of the primary causes of agricultural erosion. Additionally, water runoff will also increase under such management compared to other mulching treatments (Wooldridge, 1992).

More recently, researchers have investigated dust mulching as a major contributor to particulate air pollution. Thorne et al. (2003) found low-rainfall, winter fallow fields covered in dust mulches to be a major source of airborne particulates; no-till spring cropping was recommended instead. Similarly, Kjelgaard et al. (2004) found such fields to be continuous emitters of PM10 (particles less than 10 µm mean diameter), substances associated with human health and global climate concerns.

Crop yields

Much of the research on dust mulching has been directed towards increasing crop yields in Africa and Asia. In theory, any mulch could increase crop yields through improving soil conditions, especially water retention. Indeed, in several studies, crop yields were found to increase in dust-mulched fields compared to those with no mulch added. However, in nearly every instance where dust mulching was compared to organic mulching, organic mulches were found to be superior in enhancing crop yields. The "Comparative effects" table summarizes these studies.

As the evidence shows, dust mulches are usually less effective than organic mulches for improving yields of a variety of different crop species.

Economic impacts

The economics of dust mulching have been examined recently; only one study found dust mulching to deliver the highest rate of return (Singh et al., 1997) and this result was inconsistent between years. In contrast, mulches made from sugar cane (Sharma and Chakor, 1995), rice straw (Katiyar and Uttan, 2003), and other local crop residues (Prasad and Singh, 1998) consistently deliver the highest rates of gross and net returns. This analysis agrees with the information in Table 1: obviously, organic mulch treatments that improve crop yield will have a greater economic benefit. Coupled with the other indirect benefits including reduced erosion, the economic value of organic mulches far exceeds those of dust mulching.

It's unclear why the myth of dust mulching persists in spite of the strong evidence against its use. One researcher noted that the value of hoeing lies in reducing weed competition—not in the formation of a dust mulch. In fact, he warns readers that creation of dust mulches through hoeing can actually reduce crop yields. Is this a recent finding? No, it was reported over 60 years ago (Keen, 1942). As sustainable gardeners, we need to find, read, and apply the accumulated scientific knowledge that is out there, rather than relying on fable and folklore. ■

References are available at: www.theinformedgardener.com. *Simply click on "horticultural myths" and navigate to references.*