

Fully Biodegradable Mulches

Objectives: Students should know

The advantages and disadvantages of using biodegradable mulches.

Mechanism of weed control.

The characteristics of each type and examples.

Advantages	Disadvantages
Annual weed control	Large quantities per unit area
Biodegradable – no disposal costs	Biodegradable – replenishing needed
Soil moisture conservation	High transportation costs
Reduction in runoff and soil erosion	Some materials susceptible to wind removal
Reduction in rain-splashed soil <ul style="list-style-type: none"> • Less foliar diseases • Less fruit and vegetable spoilage 	Can contain weed propagules Can promote moist conditions that favor plant pathogens
Moderation of soil temperature in hot climates and seasons	Cool soil temperatures in cool climates and seasons delays crop development. Frost damage in organic orchards.
Habitat for weed seed predators	Harbor pest insects and small mammals
Aesthetics for landscaping	Difficult to apply
Addition of organic matter	May be difficult to plant through
Addition of nutrients, modification of pH	High C:N ratios; fertility may have to be adjusted to avoid crop nitrogen deficiency.

Mechanism of Control

- Provide a physical barrier to weed growth.
- Eliminate some germination cues: exclude light and by moderate the amplitude of soil temperature fluctuation. To be effective, mulch depth should usually be more than 2 in (5 cm)-thick depending on the material.
- Allelopathy

Organic particle mulches:

- Naturally occurring agricultural and forestry waste materials such as straw, leaves, sawdust, pine bark and wood chips, pine needles, hulls, and ground corn cobs can be used for weed suppression.
- On-farm or locally available materials should be used since the cost of trucking the materials can be costly even if the mulch itself is inexpensive.
- Mulch can be produced in situ by growing cover crops. Larger size material that results from rolling or undercutting the crop persists longer than mowed cover crops. Organic mulches should not contain genetically modified plant material and should not be infested with weed seeds and vegetative propagules.

Apply mulch based on the texture and density of the mulch.

- Fine particles mulches should not be more than 2 to 3 inches deep after settling.

- Excessive amounts of these fine-textured mulches around shallow-rooted plants can suffocate their roots causing chlorosis and poor growth.
- Course-textured mulches such as pine needles and pine bark nuggets, which allow good air movement through them, can be maintained as deep as 4 inches.
- Mulches of shredded leaves, small leaves (oak leaves), or grass clippings should never exceed a 2-inch depth. The flat surfaces allow matting, which restricts water and air supply to plant roots.

Hutchinson and McGiffen (2000)

Table 1. Cowpea mulch biomass in 1997 and 1998 and the percent reduction in biomass over the season.

Year	Dry wt of mulch (kg·ha ⁻¹)		Reduction (%)
	At pepper transplanting	At pepper harvest	
1997	8227	3885	52.8
1998	9618	2441	74.6

Table 2. Effects of cowpea mulch on noncumulative weed emergence in nonweeded plots.

Soil treatment	Time after transplanting (weeks)						Harvest	
	3		5		9		1997	1998
	1997	1998	1997	1998	1997	1998	1997	1998
	<i>weeds per meter of bed</i>							
Cowpea mulch	14 a [*]	8 a	26 a	8 a	16 a	8 a	48 a	10 a
Bare ground	299 b	142 b	211 b	121 b	200 b	85 b	244 b	111 b

^{*}Mean separation within columns by LSD, $P < 0.05$.

Table 3. Effect of cowpea mulch on total weed dry weight and mean weight per weed at harvest in nonweeded plots.

Soil treatment	Total dry wt (g·m ⁻² bed)		Mean wt per weed (g/plant)	
	1997	1998	1997	1998
Cowpea mulch	12.2 a [*]	7.0 a	0.39 a	0.45 a
Bare ground	37.1 b	72.1 b	0.17 a	1.01 a

^{*}Mean separation within columns by LSD, $P < 0.05$.

Recycled paper mulch

- Can be applied to raised beds using the same equipment used for polyethylene mulches.
- Effective for suppressing weed growth; however, microbial decomposition of the paper where it is embedded in the soil reduces its longevity.
 - The application of a resin made from epoxidized soybean oil and citric acid resulted in a more durable but fully biodegradable mulch (Shogren and David, 2006). Certifying agencies will have to determine whether use of this material is permitted.
- Paper is more bulky and thus more expensive to ship than the same surface area of polyethylene mulch.
- OMRI-listed biodegradable paper mulch is marketed under the following brands: Rhimax™, LandMaster™, and Weed Block®.
- Newspaper: applied as sheets, shredded or chopped.

Monks et al. 1997. Weed Technology 11:561-566.

Effect of mulches on weed control in West Virginia, 1993 and 1994

Treatment	Depth	Grass		Broadleaf
		1993	1994	
	in	%		
Control	-	0	0	0
Shredded newspaper	1	40	20	53
Shredded newspaper	3	88	68	82
Shredded newspaper	5	88	70	83
Shredded newspaper	7	100	80	94
Chopped newspaper	1	89	45	79
Chopped newspaper	3	100	90	94
Wheat straw	6	86	34	77
Black plastic	-	99	70	91
Landscape fabric	-	100	60	86
LSD (0.05)		14	19	14

Sprayable mulch

These products are not yet commercially available.

Hydramulch

- Slurry composed of shredded newspaper, cotton byproducts, gypsum, adhesive and water can be sprayed onto the soil surface where it dries to form a mulch the consistency of paper egg cartons.
- When applied at 0.16 in (4 mm) thick hydramulch persists season long and suppresses broadleaf and grassy weeds, but is penetrated by nutsedges (Warnick et al., 2006).
 - Must be free of genetically modified cotton byproducts in order to be used for organic production systems.

Foam mulch

- Recycled cotton and cellulose fibers, gums and starches, surfactants and saponins, pigments, fertilizers and buffers have been formulated to produce a foam that solidifies into a mulch with season-long persistence (Masiunas et al., 2003).

Biodegradable starch mulch:

- Made from plant starches such as corn or wheat.
- Decompose during the cropping season and the remnants can either be tilled into the soil at the end of the cropping season or it can be removed and fed to livestock in some cases or composted.
- Two products available in North America are:

- Garden Bio-Film (BioBag USA; <http://biobagusa.com/>), and
 - Biodegradable Bio Telo Mulch Film (Dubois Agrinovation; <http://www.duboisag.com/>).
- Manufactured with Mater-Bi a GMO-free cornstarch. The mulch suppresses weeds as well as promotes soil warming. Comparable yields of been obtained with starch and polyethylene mulches (Miles et al. 2007).

Important Tips for Success with Biodegradable Mulches

(<http://www.hort.cornell.edu/extension/commercial/Vegetables/online/2005veg/PDF/Important%20Tips%20for%20Success%20with%20Biodegradable%20Mulches.pdf>)

Storage

- Cool and dry- this product will start to degrade if stored warm and moist!
- Buy what needed each year
- Store upright, on ends avoids getting holes in the roll

Application

- Do not stretch as tight as standard black plastic
 - Stretching starts the degradation
 - Will increase rate of breakdown
- Apply right before planting
 - Sunlight and moisture will start breakdown