

Sprayable Paper Mulch for Organic Row Crop Production



D. Granatstein¹, A. McErlich², and E. Hogue³

¹Washington State University, Wenatchee, WA; ²Small Planet Foods, Sedro-Woolley, WA; ³Agriculture and Agrifood Canada, Summerland, BC



Introduction

Mulching has long been used as a nonchemical weed control practice suitable for organic farms. Plastic mulches produce large amounts of waste, and bulky materials such as straw can be prohibitively expensive to use. Dr. Gene Hogue of Agriculture and Agrifood Canada in Summerland, BC, developed a sprayable paper mulch that could potentially overcome these drawbacks. His initial tests (Fig. 1) in orchards showed promise, and we explored the potential to use this approach in organic row crop production.



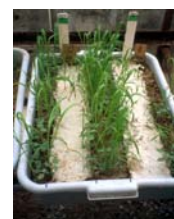
Prototype applicator for sprayable paper mulch in orchards, developed by Dr. Gene Hogue. Using reject fiber from paper recycling.



Existing perennial weeds are not smothered and can push through the mulch.



Better corn growth and fewer weeds in V2 mulch (L) than control (R).



Excellent broadleaf, grass suppression with pre-emerge 2 cm mulch (L) and 8d post-emerge 1 cm mulch (R).



Double nozzle applicator used at 4 d post-emerge in corn.

Methods

The mulch material was donated by Keyes Fibre Co. in Wenatchee, WA. Keyes Fibre makes apple packing trays and other products from a pulp (4% solids) made of 75% newsprint and 25% corrugated cardboard. This pulp, with no other additives than recycled fiber and water, is acceptable under the National Organic Standards, according to the Washington State Dept. of Agriculture Organic Food Program.

Four greenhouse trials and one field trial were conducted with sweet corn in 2002. Two greenhouse trials were conducted with onion in 2003. Initial trials evaluated whether the mulch would impact crop development, including stand establishment, biomass, and rate of plant development. Subsequent trials evaluated the weed control potential of the mulch, looking at different thickness of application, different application dates, and combination with flame weeding.

Plant Growth

Sprayable paper mulch applied post-emergence did not retard sweet corn or onion development, and in fact appeared to enhance growth in the greenhouse trials (Tables 1-3). Given the exact scheduling of harvest for processing sweet corn, delayed maturity was an initial concern that does not appear to be a problem. However, pre-emergent use of the mulch limited corn emergence (some plants did come through) and stunted growth. Onion stand was not impacted if the mulch was applied after the cotyledons had lifted from the soil.

Table 1. Corn growth in greenhouse (Trial 2).

Treatment	Mulch Timing	Final Ht. (cm)	Biomass (g/plant dry)	No. days to V3
A	no mulch	12.4	0.6	15.5
B	VE early (coleoptile up)	13.7	0.7	14.5
C	VE mid (1/2-3/4")	15	0.9	14.5
D	VE late	15.8	1.0	14.5
E	V1 (complete 1st leaf)	14	0.9	15
F	V2 (complete 2nd leaf)	16.4	1.0	14

Table 2. Corn growth in field trial, 2002.

Treatment	Mulch Timing (post-emerge)	Biomass (dry) at 5 wks (g/plant)	Growth rate at 5 wks (% plants)	
			V5	V8
A	No mulch	21.3	13	7
B	4 days	14.3	10	9
C	7 days	21.6	14	7
D	10 days	15	11	7

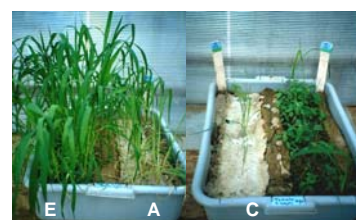
Table 3. Onion growth in greenhouse (Trial 1).

Treatment	Stage	Height (cm)	Fresh wt. (g/plant)	Dry wt. (g/plant)	
A	no mulch	19.2 a	27.0 a	2.11 a	0.28 a
B	1 cm, 14 d	20.5 b	32.7 bc	3.89 b	0.56 a
C	2 cm, 14 d	21.1 b	37.3 c	5.29 c	0.75 a
D	1 cm, 21 d	20.1 ab	29.2 ab	2.61 ab	0.28 a
E	1 cm, 14 d + weeds	17.0	20.7	0.95	0.08 a
F	2 cm, 14 d + weeds	18.0	24.8	1.25	0.11 a

Mulch treatments: cm= depth of wet material; d=days post-plant for application;

Trt. A-D replicated 3x; Trt. E & F were observational.

Means followed by the same letter are not significantly different (p<0.05).



Onion weed control (L to R): E (no mulch, no flame); A (no flame, 2 cm mulch); C (flame, 2 cm mulch); D (flame, no mulch)



Apparatus for applying spray-on mulch.

Weed Control

Mulch applied at both 1 cm and 2 cm thickness (wet) effectively suppressed weeds in sweet corn, both in the greenhouse and in the field. The 2 cm mulch was somewhat more effective, particularly for smothering already emerged weeds (Fig. 1). The effect was similar for both broadleaf and grass weeds. In the greenhouse, later applications appeared to provide more effective control than early post-emergent applications. A post-planting pre-emergent flame weeding in combination with a post-emergence sprayable mulch provided excellent weed control in onions (Fig. 2). Later-emerging weeds (e.g. lambsquarter) that were missed by the flaming were effectively suppressed by the mulch.

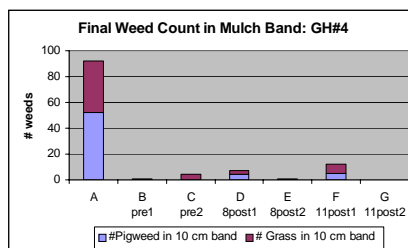


Fig. 1. Weed suppression of planted weed seeds (pigweed, barnyardgrass, lambsquarters) in greenhouse. pre=1 cm mulch before weed emergence; pre2=2 cm mulch; 8post1=1 cm mulch 8 days after weed emergence, etc.

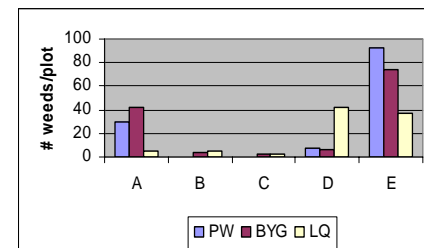


Fig. 2. Weed suppression in onion with spray-on mulch and flaming (before onion emergence). A=no flame, 2 cm mulch; B=flame, 1 cm mulch; C=flame, 2 cm mulch; D=flame, no mulch; E= no flame, no mulch. Replicated 3 times.

Practicality

The major barrier to commercial use of this technology is the logistics of procurement, handling and application of the large volumes of pulp needed in a field setting. In the field trial, the 4% pulp was diluted to 2% for better flow, effectively doubling the volume to be applied. To make one pass down the longest row of a center-pivot corn field (quarter-section, row length 2640 ft), it would require about 264 gallons for a band 4" wide and 1 cm thick (wet). Pulping equipment does exist that would allow production of the slurry in the field from newsprint and cardboard gathered locally, thus reducing the hauling of water. A trash pump worked well to move the slurry and commercial hydroseeding equipment would be suitable. In the field, the mulch maintained its integrity for 40 days through 8 sprinkler irrigations. It did not crack with the wet/dry cycles. Very little mulch was apparent the following spring after the field had been disked. The sprayable mulch can also be a carrier for other materials, such as colorants for insect control or nutrients.

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