GREEN MANURE WEED CONTROL IN POTATO PRODUCTION
Presented during the workshop on
CROPPING SEQUENCE AND ROTATION:
IMPACT ON POTATO PRODUCTION AND SOIL CONDITION

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Including a green manure within the cropping system can reduce weed populations and associated costs of control. Studies to determine the effectiveness of green manures for weed control or suppression were discussed during the Cropping Sequence and Rotations Workshop as follows:

Boydston and Vaughn (2002) evaluated alternative weed management systems in potato, including green manures. This study was conducted in central Washington in 1994 and 1995 with five weed management systems utilizing a combination of green manure cover crops, herbicides, and cultivation compared with an untreated control.

TREATMENTS:

STD- Standard herbicide treatment of metribuzin at 0.38 lb ai/A applied preemergence and sprinkler or rain incorporated with approximately 0.25 inches water on the same day as application.
RYESTD - fall-planted rye green manure crop (rye crop was sprayed with glyphosate and rye residues were incorporated into the soil 2 to 3 days later with a rototiller prior to potato planting the following spring), followed by metribuzin (0.38 lb ai/A) applied in a band in the potato hill, followed by reservoir tillage at 6-inch potato height.
CULT - cultivation with tine-toothed harrow at weed emergence/before potato emergence, followed by hilling with shovels and rolling cultivators.
RPSD - fall-planted rapeseed green manure crop followed by reservoir tillage at 6-inch potato height. The rapeseed crop was sprayed with glyphosate in the spring before potato planting and incorporated into the soil 3 days later with a rototiller.
RESTIL - reservoir tillage alone at weed emergence, before potato emergence.
CHECK – no cover crop, cultivation, or herbicide weed management.

NOTE: reservoir tillage equipment is commonly called a Dammer-Diker, and consists of a ripping shank in the furrow followed by a rotating wheel with paddles that form pits (reservoirs) in the furrows between potato hills. This type of tillage is usually performed to decrease water runoff and improve water infiltration in irrigated potato fields.

Presented at the Idaho Potato Conference on January 22, 2004.

SUMMARY OF RESULTS:

Total tuber yield and U.S. No. 1 and U.S. No. 2 tuber yields were greatest in the RYESTD and STD systems both years of the study (Boydston and Vaughn Table). Although the CULT system reduced early-season weed densities in 1994, both total tuber and U.S. No. 1 and U.S. No 2 tuber yields were reduced 15% compared with the STD system. In 1995, U.S. No. 1 and U.S. No. 2 tuber yields were reduced 25% compared with the STD system. The RPSD system reduced early-season in-row weed densities from 60 to 70% compared with the CHECK treatment, however, U.S. No. 1 and U.S. No. 2 tuber yields were reduced 30% (1994) and 27% (1995), and total tuber yields were reduced 49% (1994) and 38% (1995) compared with the STD system. The researchers concluded that the RYESTD system was an effective alternative weed management system controlling weeds, decreasing preemergence-applied herbicide inputs 66%, and maintaining tuber yields.

Adapted from Table 3 in Boydston and Vaughn (2002).
Potato tuber yield and tuber size distribution of potato grown under six weed management systems near Paterson, WA, in 1994 and 1995.

	Tuber yields[a]			
	U.S. No. 1 + U.S. No. 2		Total	
Treatment	1994	1995	1994	1995
	---------- cwt/A----------			
STD	549 a	556 a	435 a	468 a
RYESTD	531 a	562 a	415 a	461 a
CULT	466 b	504 a	372 a	350 b
RPSD	383 c	408 b	222 b	291 bc
RESTIL	126 d	332 b	25 c	204 c
CHECK	79 d	204 c	8 c	79 d

[a] Means within a column followed by the same letter were not significantly different ($\alpha = 0.05$) as determined by Fisher's protected LSD test.

Information from another study by Boydston and Hang (1995) about research determining if rapeseed (*Brassica napus*) green manure crops suppress weeds in potato also was given as follows:

Rapeseed ('Jupiter') was planted in the fall then rototilled or sprayed with glyphosate, then strip-tilled the spring prior to potato planting. Sudangrass ('Trudan 8') was planted in the fall, then strip-tilled in the fall after winter-kill. Fallow controls were strip-tilled in the spring similar to rapeseed plots. Main plots were divided into sub-plots (1/2 the plot), and sub-plots were treated with pendimethalin + metribuzin (0.9 + 0.5 lb ai/A).

Incorporation type had no effect on subsequent weed control, weed biomass, or tuber yields (Boydston and Hang Table). In the no-herbicide sub-plots, the rapeseed green manure treatment reduced mid-season weed density by 85 and 83% compared with fallow or sudangrass treatments, respectively, in 1992. The dominant weed that year was

common lambsquarters (*Chenopodium album*), with lesser amounts of redroot pigweed (*Amaranthus retroflexus*), and grasses present. Final weed biomass was reduced 96 and 98% by rapeseed treatment compared to fallow and sudangrass, respectively. The herbicide treated sub-plots were virtually weed-free regardless of green manure treatment.

In 1993, redroot pigweed was the major weed present. In the no-herbicide sub-plots, the rapeseed green manure treatment reduced weed density 73% and final biomass 50% compared with the fall or sudangrass treatments. Rapeseed biomass was greater in 1992 compared with 1993, a possible reason for weed density and biomass reduction differences between the two years in this study. Having redroot pigweed versus common lambsquarters as the dominant weed, also may have made a difference in weed reduction between the two years.

Adapted from Table 1 in Boydston and Hang (1995).
Total mid-season weed density above the potato canopy and final weed biomass in potato following fallow, sudangrass, or rapeseed in 1992 and 1993 near Prosser, WA.

	Weed density [a]		Weed biomas	
Green manure treatment	No herbicide	Herbicide treated	No herbicide	Herbicide treated
	--- no./100 m^2 ---		------ g/m^2 ------	
1992				
None (fallow)	61 a	1 a	386 a	0 a
Sudangrass	54 a	3 a	560 a	0 a
Rapeseed	9 b	0 a	14 b	0 a
1993				
None	62 a	0 a	529 a	1 a
Sudangrass	61 a	0 a	504 a	0 a
Rapeseed	17 b	0 a	263 b	0 a

[a] Means within a year and column followed by the same letter were not significantly different ($\alpha = 0.05$) as determined by the LSD test.

A greenhouse study with rapeseed or white mustard tissue amended soils – results presented at the workshop:
Hairy nightshade seeds were planted into pots of soil that had been amended with rapeseed, white mustard, or potato tissue. Hairy nightshade seedlings emerging in rapeseed or white mustard tissue-amended soils were stunted and chlorotic compared with seedlings growing in non-amended soils. Rapeseed, white mustard, or potato tissue added to soils reduced hairy nightshade emergence and biomass. Potato tissue did not cause the same symptoms or similar biomass reduction as the rapeseed or white mustard amendments.

Adapted from Table 4 and 5 in Boydston and Hang (1995).
Hairy nightshade fresh weight and number of seedlings at 3 wk after emergence after adding 20 g rapeseed or potato fresh tissue, or white mustard fresh tissue to 400 g dry loamy sand soil in the greenhouse.

	Hairy nightshade	
Soil ammendmnet	Weight	No. seedlings
Rapeseed study		
	g/pot	no./pot
Rapeseed	0.7 c	6.4 c
Potato	4.0 b	13.3 b
None	6.8 a	25.1 a
White mustard study		
White mustard	0.9 b	7.2 b
None	5.4 a	15.8 a

[a] Means within a study and column followed by the same letter were not significantly different ($\alpha = 0.05$) as determined by the LSD test.

Trade names are provided for clarity and do not constitute an endorsement of the product.

REFERENCES:

Boydston, R.A. and S.F. Vaughn (2002) Alternative weed management systems control weeds in potato (*Solanum tuberosum*). Weed Technol.16:23-28.

Boydston, R.A. and A. Hang. 1995. Rapeseed (*Brassica napus*) green manure crop suppresses weeds in potato (*Solanum tuberosum*). Weed Technol. 9:669-675.

Additional suggested reading:

Eberlein, C.V., M.J. Morra, M.J. Guttieri, P.D. Brown, and J. Brown. 1998. Glucosinolate production by five field grown *Brassica napus* cultivars used as green manures. Weed Technol. 12:712-718.