

THE VALUE OF GREEN MANURES IN POTATO CROPPING SYSTEMS

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INTRODUCTION

Green manures are crops planted and grown during a normal cropping season or planted after a harvested crop and incorporated into the soil while still green. Benefits include: improved soil condition, increased organic matter, improved water penetration, reduction of some diseases, reduced nematode population, and increased availability of nutrients.

The principle of green manures have been known and used successfully by farmers for centuries. Modern agriculture is rediscovering the benefits of this practice. Adapting green manures into potato-cropping systems requires knowledgeable management of several crops. Producers generally do not want to devote an entire season for green manure production. Potatoes are a long-season crop and large potato growing areas have relatively short growing seasons (90-120 days). These problems have been largely overcome and potato producers can use a green manure either as a spring or fall planted crop to improve the soil, reduce diseases and increase profitability. UI Research and Extension have identified green manures and changes in cropping systems that improve potato production.

The most common or conventional rotation is wheat-potatoes or wheat-wheat-potatoes with fumigation during the potato-cropping year. Green manure crops of sufficient tonnage incorporated before potatoes, have shown to improve potato yields and quality without fumigation in the major potato production areas of southern Idaho.

EFFECTS OF GREEN MANURES IN A POTATO CROPPING SYSTEM

The following benefits have been seen in East Idaho when radish or other green manures have been incorporated ahead of a potato crop:

- reduction of Verticillium wilt (early die) following radish green manures
- oil radish suppressed nematode infections in potatoes
- increased quality of potatoes by increasing percent of U.S. No. 1's
- legume green manures provided fertilizer replacement values of 50 to 120 pounds of nitrogen per acre
- barley, wheat and corn incorporated as green manures reduced early die and increased yields
- green manures reduced weeds and need for some herbicide applications

- soil organic matter increased with benefits of better water infiltration, soil water holding capacity, and better availability of some soil nutrients, especially in white soils
- reduced the need for soil fumigation

CULTURAL PRACTICES FOR GREEN MANURE PRODUCTION

The ideal characteristics of a green manure crop are:

- a. Green manure crop should not serve as a good host for *Meloidogyne chitwoodi* (Columbia root knot nematode) or other nematodes.
- b. It should grow fast and produce abundant biomass. Good production is 10 to 20 tons per acre of green material.
- c. It should not be sensitive to frost so that early spring planting or late growth in the fall is less of a factor.
- d. It must not hamper operations needed to optimize the yields of the preceding or subsequent crops.
- e. It must not shed seed if this would lead to a weed or volunteer problem.
- f. It must be able to be planted as a second crop in late summer after the harvest of an earlier crop and incorporated as green manure in the fall.

Planting dates for green manure should be as soon in the fall as possible to allow enough time for good growth and tonnage to incorporate. Following winter wheat or barley, chop the stubble, till and seed as soon as practical.

Planting radish seed and other green manures is done with a regular grain drill set for the proper seed size. Drilling seed into a firm well-prepared seedbed is usually best to obtain seed-soil contact and gives the highest seed germination percentage. Some producers have successfully seeded radish, turnip or mustard by broadcasting the seed with dry fertilizer and harrowing in the seed.

Radish germinates very quickly compared to cereals or rapeseed. In warm soil, seed will germinate in three days and grow to 2 to 3 leaf stage (2 to 3 inches) in 2 weeks.

It is necessary to irrigate and fertilize the green manure for best results and growing large amounts of biomass necessary for amending the soil. One to two irrigations are usually required depending on soil type and fall weather conditions.

Green manures can be incorporated by chopping or disking, or disking alone. Plowing is least desirable because of less soil-plant material mixing.

COMPARISON OF COSTS OF PRODUCTION WITH GREEN MANURES

UI crop costs and returns budgets for potato production are available and provide a good overall perspective of the costs and returns of producing potatoes. Table 1 is a summary of an enterprise budget with green manure costs and estimates of changes in income and reductions of costs if a green manure is used in the cropping system. This table is a

compilation of the results of several trials and field demonstrations, which involved incorporating green manures and estimates of the crop increase as a result.

Table 1: Costs and returns in potato production with and without green manure. (Southeast Idaho Russet Burbank No Storage. Crop costs and returns budget #EBB4-Po1-99)

	Conventional system cost/acre	Green manure system cost/acre
Gross returns	\$1485 (330 cwt @ \$4.50)	\$1665 (370 cwt @ \$4.50)
Irrigation	\$55.52	\$55.52
Custom	\$57.05	\$57.05
Fertilizer	\$147.00	\$79.00 (no micros or late P)
Green manure costs	0	\$77.37
Other costs	\$69	\$69
Seed costs	\$151	\$151
Pesticide costs	\$292	\$162 (no fumigation)
Labor, fuel, repair, interest	\$207	\$207
Total operating costs/acre	\$979	\$858
Net Returns	\$506	\$807

For best results, green manures should be treated as a crop and not neglected. Just letting volunteer grain grow without fertilizer and irrigation does not produce the needed biomass to effect good results that can be produced from a green manure crop. Table 2 summarizes the inputs and costs of raising a green manure crop.

Table 2: Costs of green manure production

	Quantity per Acre	Unit	Cost per Unit	Cost per Acre
Seed (radish)	25	pound	2.00 ¹	\$50
Planting		acre	4.00	\$4
Irrigation	1-2 inch	acre	0.65	\$1.30
Incorporation		acre	4.57	\$4.57
Nitrogen	50	pound	0.35	\$17.5
TOTAL				\$77.37

¹ Radish seed has varied greatly in price. As demand goes up, price should be less. Barley seed cost would be about \$10 per acre reducing total costs to \$37.37.

SUMMARY OF EFFECTS OF GREEN MANURES ON POTATO PRODUCTION

Figure 1 shows a comparison of input costs, yield, and net returns with and without green manure in a cropping system. This graph has been compiled from observations of field demonstrations and research findings and not from a single experiment; however, it summarizes the potential benefits that can be expected. Green manures can reduce costs by reducing the need for fumigation and other soil-applied pesticides. It is well documented green manures reduce the requirement for some nutrients and make others, such as phosphate and iron, more available others.

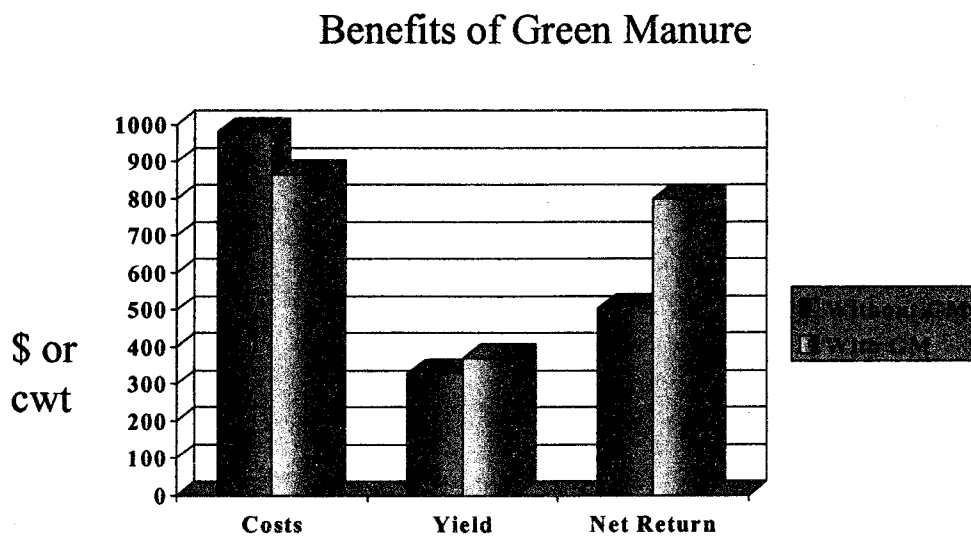


Figure 1: Comparison of input costs, potato yield and net returns with and without green manure, example benefit here of \$260.

UI Extension and industry have ongoing field demonstrations and research involving green manures. The adaptation of these cropping systems needs more refinement because of the diversity of potato-growing areas and the rotations used in potato production in Idaho. The benefits demonstrated so far and the potential should give producers encouragement to implement this practice.