



# Potato Progress

Research and Extension for Washington's Potato Industry

Published by Washington State Potato Commission [www.potatoes.com](http://www.potatoes.com)

Andrew Jensen, Editor. Submit articles and comments to: [ajensen@potatoes.com](mailto:ajensen@potatoes.com)

108 Interlake Rd., Moses Lake, WA 98837; Fax: 509-765-4853; Phone: 509-765-8845.

Volume IV, Number 14

September 28, 2004

---

## 2004 Mustard Green Manure Field Day: October 26<sup>th</sup>

A recent issue of the journal *Science* contained a special section entitled "Soils-The Final Frontier." The series of articles and papers made the point that though the soil is "the most diverse and important ecosystem on the planet," it is also the most complicated and perhaps least understood. One author reported that one gram of soil, about 1/5 teaspoon, can contain between 5000 and 10,000 species of microorganisms. Hundreds of other species of nematodes, soil arthropods, insects, and earthworms can also affect a plant in the field.

It is in the midst of this complexity where the benefits of mustard green manure occur and where things can go wrong. Because of this complexity, a complete understanding of what happens when you grow and incorporate a mustard green manure, or apply compost or animal manure, may not be possible in the near or even distant future. However, we can observe the effects of what we do on some soil properties and on the yield and quality of following crops. That is what we have been doing with mustard green manures.

If you missed previous field days or have attended before but want to hear the basics again, come to this year's event. The 2004 mustard green manure field day will be held Tuesday, October 26th, 10 am at the Dale Gies farm, 1.5 miles west of Rd M on Rd. 5 SE. We will cover the potential benefits and the basics of mustard management, what we do and what we don't know. In addition, field plots of mustard varieties will be available for comparison. Contact the Grant/Adams Extension office 754-2011 ext. 413 if you need more information. Andy McGuire ([amcguire@wsu.edu](mailto:amcguire@wsu.edu)).

---

## Tuber Moth Numbers Continue to Climb

See the most recent tuber moth pheromone trap catch numbers in Oregon and Washington at the WSPC web site:

<http://www.potatoes.com/research.cfm>

## Why Did the Potato Become a Major World Crop After Being Transferred from the Andes?

C. R. Brown, USDA/ARS, Prosser, WA, (cbrown@pars.ars.usda.gov)

You may be amazed to realize that the potato originated in the Andes of South America, was taken to Europe as a botanical curiosity, and in slightly over a century became a major foodstuff of the Northern latitudes. Today China is first in potato production with Russia and Poland in second and third place. What are the attributes of potato that lead to its taking a major role as a crop outside its center of origin?

The short answer is that the potato is amazingly productive. The potato is second only to sweet potato in its ability to generate carbohydrate per area per day (See Table 1). Despite the fact that potato is about 80% water weight, its production of dry matter surpasses all the small grains.

The prodigious productivity of the potato was crucial in its early adoption in Europe. A family could grow enough potato to feed a family in small plots of infertile and rocky land. For the Irish people the potato supplied a food source that they themselves controlled. Most of the food produced in early nineteenth century Ireland belonged to the landlords. Potato from the family gardens belonged entirely to the family and became a mainstay of nutritional sustenance. Potato increased the sustainability of food production for the poor Irish agriculturalist to the point that from 1790 to 1845, the Irish population increased by four times. The Irish potato famine, caused by the late blight disease, was devastating just because the potato had become a mainstay of the Irish diet.

And what about protein? Potato is not known as a protein-rich food, producing about 3% protein by weight in fresh potato. However, if one considers the total protein produced per unit area per day, potato is fourth among the major crops. Adequate protein in the diet of infants is often a serious problem for the world's poor who cannot buy enough highly proteinaceous food, like milk, meat, and eggs to supplement an infant's diet. However, potato is often used to rehabilitate seriously malnourished children because of its palatability, digestibility, and the fact that the protein is a very high quality, 78% of egg protein value.

Table 1. Comparison of daily rates of production of dry matter, energy value, and protein in potato and other world crops.

Crop	Dry Matter kg / ha / day	Energy value from carbohydrate Mcal / ha / day	Protein Kg / ha / day
Potatoes	18	54	1.5
Tomatoes	8	25	1.3
Cabbage	12	29	1.6
Yams	14	47	1.0
Sweet Potatoes	22	70	1.0
Wheat	14	40	1.6
Rice	17	49	0.9

# Omega-3 Fatty Acids --- Benefits, Sources, and Production Techniques

Zhiyou Wen and Shulin Chen

Department of Biological Systems Engineering, Washington State University, Pullman, WA

If you ask people what food group they should avoid, most will probably answer “fats.” While it is true that, in large amounts, some types of fat are bad for your health (not to mention your waistline), there are some we simply cannot live without. Among them are the omega-3 fatty acids, including eicosapentaenic acid (EPA) and docosahexanoic acid (DHA).

Omega-3s can help reduce various heart diseases such as heart attack, arrhythmias, atherosclerosis, and thrombosis. Other benefits include reducing joint pain, rheumatoid arthritis, and symptoms of schizophrenia such as hypertension and depression. A recent study by UCLA neuroscientists has even shown that DHA can protect the brain against Alzheimer’s disease.

How do omega-3s perform so many health "miracles" in people? One way is by balancing the ratio of omega 3s with another group of essential fatty acids known as the omega-6s, and thus, reducing the negative impact caused by an over-balance of omega-6s. Omega-6s are commonly found in eggs, poultry, cereals, vegetable oils, baked goods, and margarine, and are in part responsible for skin health, lower cholesterol, and blood clotting. But when omega-6s are not balanced with sufficient amounts of omega-3s, problems arise. For example, when blood is too proficient at clotting, clots form; increasing the risk of heart attack and stroke. Once omega-3s are added to the mix, the risk of heart problems goes down.

The latest research shows that the most desired ratio of omega-3s to omega-6s is roughly 4 to 1. However, the typical American diet has this ratio drastically reversed with a ratio of around 20 omega-6s to every omega-3! While reducing the intake of omega-6s can help, getting more omega-3s from food is an even better way to go.

Omega-3 fatty acids are commonly found in wild coldwater fish such as cod, salmon, herring, mackerel, sturgeon, anchovies, and tuna with about 1.5 ounces of fish containing 1 gram of omega-3s. However, as ocean fish catch decreases and concerns of contamination over freshwater wild fish arises, as well as a general absence of fish in the preferred diet of many Americans, the typical American diet is often deficient in seafood and consequently even more deficient and disproportionately lacking in omega-3s.

An alternative to eating fish is to purchase and take fish oil capsules that are widely available on grocery shelves. However, most people do not like the peculiar taste and fishy flavor of the fish oil. In addition to the omega-3s, though, fish oil also contains some unwanted saturated fatty acids which will offset the beneficial effects of omega-3s when people eat the fish oil capsules.

Another, new and intriguing alternative exists in the fact that fish, like humans, are not capable of synthesizing omega-3 fatty acids. Much of their omega-3s are derived by eating the algae in the oceanic environment that are the primary producers of the omega-3 fatty acids. Thus, the new alternative approach to supplying people with a sufficient amount and proportion of omega-3s is to culture and introduce this algae source into the American diet.

When algae culturing is mentioned, the most common perception is the growth of algae in a large open-air pond where the algae is exposed to the necessary photosynthetic light source it needs to grow. This culture mode is called photoautotrophy. The photoautotrophic culture mode, however, cannot grow very much algae because the growing conditions are difficult to control. Plus, the algae growing in the

bottom of the pond cannot get enough light because of light penetration problems. All of these factors lead to a very low algae concentration in the pond and thus, a very low level of omega-3s produced.

Instead of being cultured in ponds, algae can be grown in a well controlled fermentor without the requirement of light. This heterotrophic culture mode can significantly increase the algal concentration and the omega-3 production. However, this process requires sugar sources (such as glucose) as a feedstock for the algal growth and because of the high cost of pure sugar used the process is usually considered un-economical. In addition, the commercialization of algal omega-3 fatty acids production is also limited by the high cost of purification of these omega-3s from the complex algae biomass.

Reducing the cost of producing heterotrophic algae-derived omega-3 fatty acids is a challenge for both the scientific and industrial communities. The research groups at the Departments of Biological Systems Engineering and Animal Science at Washington State University are proposing to develop an omega-3 fatty acids production process by growing algae using starch from cull potatoes. As some algae can utilize potato starch as their sugar source, the high cost of pure glucose used in algal culture can be reduced significantly, by replacing it with an inexpensive source of starch from under-valued culls. Also, the limit imposed by the high cost of purification is being resolved by directly feeding the omega 3-rich algae to dairy cows to make omega-3 fatty acids in the form of milk. By using cows as “omega-3s extractors” to isolate the fatty acids from the complex algal biomass into milk, the purification cost is avoided. Preliminary research findings reported elsewhere have shown that: (1) the cows will tolerate a fraction of their diet being comprised of algae biomass; (2) there is no subsequent loss to milk yield; and (3) upon digestion a considerable fraction of the omega 3 fatty acids survive intact from the rumen process due to their enclosure within the algae cell walls. Research is on-going to optimize the algal production and feed ‘extractor’ parameters, with a final goal towards developing an on-farm process by which producers can convert their under-valued cull potatoes into healthy, marketable and saleable omega 3 dairy products; thereby bringing added sustainability and improved economics to our potato and dairy producers.

---

## Mustard Green Manure Incorporation Methods and Timing

Andy McGuire, WSU Extension, Grant-Adams Area

Just as it is important to pay attention to details when planting and growing a mustard green manure crop, finishing well with the right incorporation methods and timing will help you to reap the most benefits from the crop

Given our current knowledge of the mechanisms at work with mustard green manures, I recommend that the mustard be flail chopped and then disked into the soil. Minimize the time between chopping and disking as much as possible. Letting the crop dry and turn brown after chopping will probably decrease any disease suppression benefits.

Previously, timing of incorporation was based on 1) labor and equipment availability, 2) fumigation schedules, and 3) balancing crop growth with risk of setting viable seed. This usually led to incorporation taking place sometime between the second and last week of October. However, recent observations from farmers using mustard green manures suggest a correlation between realizing a high level of benefits from the mustard and incorporation in the last week of October or even November. While there is no scientific data to support this, it may be beneficial to aim for a later incorporation date where it will not hinder other goals.