

FERTILIZER AND TOFU

BY T.W. BRUULSEMA

Tofu is just one of the many kinds of foods made from soybeans. It's an excellent source of protein, and is often included in vegetarian diets. It's an example of the type of food being sought out more and more by people concerned about how diet affects their health. And like nearly all plant products, it benefits from fertilizer.

Science is discovering important health benefits to eating foods such as tofu. Reviewing such science has led the U.S. Food and Drug Administration (FDA) to authorize health claims on foods. The claim "...foods that include 25 grams of soy protein a day may reduce the risk of heart disease" is an example. It applies to tofu and other soy products.

Oilseeds, grains, fruits, and vegetables contain complex compounds made by plants. These compounds—phytochemicals including lycopene, isoflavones, and antioxidants—help prevent many of today's most common health problems, including heart disease and cancer. The compounds are called nutraceuticals, and the foods that contain them are called functional foods—foods that have a specific health function.

Soybeans contain isoflavones as one of their nutraceutical ingredients. They also contain potassium, an ingredient which supports another health claim. Foods that are low in sodium and contain good sources of potassium may contribute to reduced risk of stroke (by lowering blood pressure). **Table 1** shows that tofu and a range of soy foods provide substantial amounts of protein, isoflavones, and potassium. Truly functional foods.

So what's tofu got to do with commercial fertilizers? Recent research has shown that fertilizing soybeans with potassium increases their isoflavone levels. At a site where potassium fertilizer boosted the yield of soybeans by 10%, it increased their isoflavone level by 16%.

Soybeans grown on soils of varying fertility showed a link between the levels of potassium and isoflavones in the seed (**Figure 1**). Results varied by year, but the link was positive in both.

Scientists are increasingly interested in the connection between plant mineral nutrition and the nutritive value of foods—nourishing the soil to nourish people. The American Society

Consumers increasingly search out foods for health benefits. The healthfulness of foods owes a lot to commercial fertilizers. Farmers optimize both yield and quality when they apply fertilizers in accordance with science-based nutrient management. For nutritional quality of food, it does not matter whether the nutrient source for plants is organic or inorganic.

TABLE 1. Soy foods and their protein, isoflavone, and potassium content per serving.

Soy foods	Serving size	Protein, g	Isoflavones, mg	Potassium, mg
Tofu, firm	1/2 cup	20	25	300
Tempeh	1/2 cup	17	53	340
Miso	1 tablespoon	2	7	28
Soymilk, plain	1 cup	7	24	345
Soybeans, roasted	1/4 cup	17	55	59

Nutrient Database Laboratory, USDA.

Note: FDA Daily Reference Values (DRVs) are generally 3,500 mg of potassium and 50 g of protein, with adjustments for certain conditions.

of Agronomy recently featured the symposium “Fertilizing Crops for Functional Food.” It highlighted research on a wide range of crops and nutrient elements.

For example, at the University of Wisconsin, Dr. Irwin Goldman found that fertilizing with sulfur influenced the selenium uptake of onions and cole crops. And conversely, fertilizing with selenium influenced their production of sulfur compounds. He concluded that balance of these two nutrients—and all essential nutrients—was important. Both sulfur and selenium affected health functionality.

The symposium also featured recent research on nitrogen, phosphorus, and potassium fertilizers affecting:

- Apple and tomato functional food ingredients
- Citrus functional components
- Echinacea phytochemicals
- Flaxseed lignans
- Soybean isoflavones
- Watermelon antioxidants

The recent findings agree with what has long been known about the impact of fertilizers on nutritional quality. Generally, supplying the plant with an appropriate balance of nutrients, avoiding excesses and deficiencies, produces good quality. It does not matter whether their source is organic or inorganic. However, it's usually easier to achieve the right balance when commercial fertilizers are part of the mix—they supplement and correct the fixed ratios of nutrients in soils, crop residues, and manures.

Specific effects of each nutrient are not always consistent, but a few are worth remembering. Nitrogen increases protein and carotenes, but can reduce vitamin C if applied in excess. Potassium can boost vitamin C in vegetables, and also carotenes, especially lycopene. Potassium and chloride have both been shown to suppress many plant diseases that reduce food quality.

Health concerns lead many people to buy organic food. They seek food that has been grown as naturally as possible. But there is a limitation. Natural conditions lead to deficiencies in plant nutrients in the soil where crops are grown. The nutrients taken away need to be replenished. **Returning crop residues and animal manures puts back some—but not all—of the nutrients removed. So to grow optimally, and to have the greatest nutritional value, crops need commercial fertilizers.**

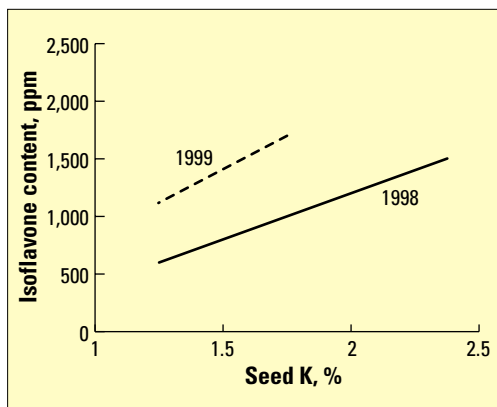


Figure 1. Isoflavone content of Ontario soybeans increases with higher seed potassium, but results vary by year. (ppm=parts per million)



The health benefits of apples, tomatoes, potatoes, citrus, and other foods are receiving more recognition. However, there is no evidence that foods produced with organic methods are healthier or safer than conventional products.



Tofu, is a healthy, high protein food made from soybeans. Research indicates that potassium may benefit isoflavone content of soybeans.

Both organic and conventional farmers use a combination of organic and mineral sources of nutrients. However, regulations for organic farming prohibit or limit the use of soluble inorganic forms of plant nutrients—the very forms that plants take up, and the forms that are most effective in correcting imbalances within the natural mineral and organic sources. **Nutritional scientists have concluded that organic foods are neither healthier nor safer than conventional products.**

Science-based nutrient management includes use of soil testing to determine the fertility of the soil. It includes the use of plant analysis to determine the nutrient status of the plant and the nutritional quality of its product. It includes using the best available technology for precision application and placement of fertilizers, specific to the characteristics of the soil and landscape. And it includes integrating the use of manures and other available nutrient sources with commercial fertilizers for optimum nutrient use efficiency.

Plants are the original source of all organic matter. Their role in capturing sunlight to convert carbon dioxide in the air to carbohydrates is fundamental to the nutrition of all human and animal life on earth. Mineral nutrients are essential to plants in filling this role. When farmers use science-based nutrient management to guide the application of commercial fertilizers, they are optimizing both the yield and the quality of the food that plants produce. BC

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Acknowledgment: Soybean photo at top of page 18 courtesy of USDA-ARS. Small photo (in circle) at top of page 18 courtesy Indiana Soybean Board. Tofu photo at top left, page 20, courtesy www.outofthefryingpan.com. Tofu photo at top right, page 20, courtesy www.everydayvegan.com.