USE OF HUMIC ACID IN POTATO PRODUCTION

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Use of humic acid in potato production is not new. Any grower that has incorporated residue from a preceding grain or alfalfa crop has affected the humic acid content of the soil. The benefits of high organic matter on soil physical and chemical properties are well documented. The question is -- can extracted humic acid derivatives sold as solid or liquid products provide the same benefits? Although there is limited research on humic acid effects on potatoes, the research that is available does provide some indications of how these products might be used.

To understand the reasoning associated with application of humic acid to soils, an understanding of the properties of soil organic matter is needed. Humus is a substance found in all fertile soils. It is a small fraction of the organic matter that results from breakdown of plant and animal remains. Humus can be further separated into a relatively stable and unreactive fraction (humin) and a soluble, reactive fraction (humic acid derivatives) by an acid-base solution. The active portion of humus is associated with many beneficial effects on soils and plants. These benefits can be categorized as:

Physical --	Improved soil tilth, aeration and water-holding capacity
Chemical --	Improved nutrient-holding capacity, buffering properites, and availability of phosphorus, iron, zinc, copper and other nutrients
Biological --	Increased root growth, plant uptake of nutrients, plant growth and yield

Intensive cultivation has been associated with a reduction of organic matter levels in soil. Some estimates indicate that 50% of humus is lost from soil within the first three years of cultivation. There are several ways to build soil organic matter and humus levels. Incorporation of manure, or addition of green manure and high residue crops to the rotation will help increase soil organic matter content. Application of concentrated humic acid solutions have been proposed to act in the same manner. However, humic acid derivatives do not necessarily have the same properaties as humus associated with breakdown of organic matter in soil. The properties and activities of humic acid derivatives are dependent on the type of organic material used as a source, the extraction procedure, and the conditions of storage.

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Many of the commercial humic acid solutions are derived from Leonardite shale. Other sources include peat and lignite coal. However, humic acids can also be extracted from almost any high carbon material that originated from organic matter, including crude oil and asphalt. Extracts from many of these materials do not closely resemble the humic acids in soil organic matter. The type of extractant solution used in processing affects the type and activity of the resulting humic acids. The pH of the solution during storage can also affect the activity and concentration of humic acids. Currently there is no one industry standard for determining the properties of humic acid solutions.

Adding to the confusion are the practices of applying humic acid in different forms, concentrations and timings. For example, a consultant in Idaho has reported its use with liquid and dry fertilizers, as a foliar spray with nutrient solutions, and as an additive to water applied by sprinkler. Humic acid is also applied in dry and liquid form as a broadcast prior to planting potatoes.

Another criticism of humic acid products is their relatively low application rates. An acre of soil with a 1% organic matter content contains 20,000 lbs of organic matter in the top six inches. Even if only a small portion of the organic matter fraction is humic acid, the soil will contain much more humic acid than could be applied in a one gallon per acre application of concentrated liquid.

Despite the questions about humic acid products, their use by growers in the Northwest U.S. has been increasing. A University of Idaho research project was established in 1988 to provide growers with information about humic acid. Mir Seyedbagheri, Elmore County Extension Agent, has cooperated with local fertilizer industry representatives to determine how humic acid products might be used in potato production. All research was conducted in commercial fields and conventional fertility and irrigation practices were used. In 1989 and 1990, rates of humic acid from 1 to 16 gallons per acre were applied to the seed furrow prior to planting of Russet Burbank potatoes. Observations of plants during the season indicated a tendency for more extensive root growth in plants treated with humic acid. Total yield generally increased with applications of humic acid up to 8 gal/acre (Figure 1). Yield increases were in the range of 40 to 60 cwt/acre in comparison to the check. Humic acid at the 16 gal/acre rate did not significantly affect yield. Combining yield data for the three sites showed that the best response to humic acid occurred when 4 to 8 gal/acre of humic acid was applied (Figure 2). Higher rates of application tended to reduce yield back to the same level as the check. Other trials in this region have not found any significant increase in yield when humic acid is applied by this method. With the current cost of many humic acid products it would be difficult to recover the expense of an 8 gal/acre application with the income generated by a 50 cwt/acre yield increase.

One possible explanation for the yield increase in these trials would be the nutrient-releasing capacity of humic acid. Phosphorus availability can be a problem in the high pH, high free lime soils of the area. Fertilizer phosphorus is rapidly tied up in slowly available forms when applied to these soils.

Humic acid applied in the seed furrow may have absorbed some of the fertilizer phosphorus, keeping it in a more available form for plant uptake. The more extensive potato-rooting observed in humic acid-treated soils may also have promoted uptake of nutrients, improving overall plant growth and yield.

Research and field trials have been conducted at AgriNorthwest in Washington to evaluate the efficacy and economic value, if any, that could be derived from the use of humic acid products on Russet Burbank potatoes. Research blocks were used in 1986 and paired full circles were used at McNary for 1987 and 1988 trials. Humic acids (both dry and liquid forms) were applied in conjunction with a balanced fertility program and standard management practices. The fields were monitored weekly for leaf petiole, soil nitrogen, moisture levels, and fertilizer inputs. At harvest, yields, quality, and total inputs were determined. Treated fields required 5.6% less nitrogen, 15.1% less phosphorus and 1.88 inches less water to produce yields that were on average 23 cwt/acre higher than the untreated fields (Figure 3). Humic acid treated fields had higher petiole nitrate and phosphorus levels than untreated fields on almost all sample dates, despite receiving lower amounts of N and P fertilizer (Figure 4 & 5). Potassium applications were not adjusted in humic acid treated fields, but petiole K levels were higher than in untreated fields on all but the first sample date (Figure 6). Fields that have been treated with dry leonardite products for several consecutive years have shown even more substantial decreases in water use.

There have also been claims that humic acid derivatives promote healthy, drought resistant plants that are less sensitive to stress. Although these claims have not been fully tested on potatoes, there has been some research conducted on early blight at Hancock, Wisconsin. Treatment of Russet Burbank with humic acid (preplant, sidedress, and foliar) did not significantly reduce early blight incidence (Figure 7). A conventional fungicide program (Dithane + Rovral) provided early blight control through most of the season, and also resulted in higher yields than the humic acid treatment (Figure 8).

SUMMARY

Humic acid products have shown positive results in limited tests on Russet Burbank potatoes in Idaho and Washington. Small yield increases and reduction of nutrient and water applications have been documented. Humic acid did not reduce early blight or affect yield when applied to Russet Burbank in Wisconsin.

It should be noted that the research reported here involved various brands of humic acid applied at various timings. Extrapolation of these results to other products, methods of application, timings or growing regions is not recommended.

Results from large-scale field trials in Washington indicate that changes in management practices may be needed to gain benefits from application of humic acid. Failure to adjust fertilizer or water inputs may explain the inconsistent results reported for humic acid trials in some locations.

Figure 1. Effect of humic acid on yield of Russet Burbank at three locations in Idaho.

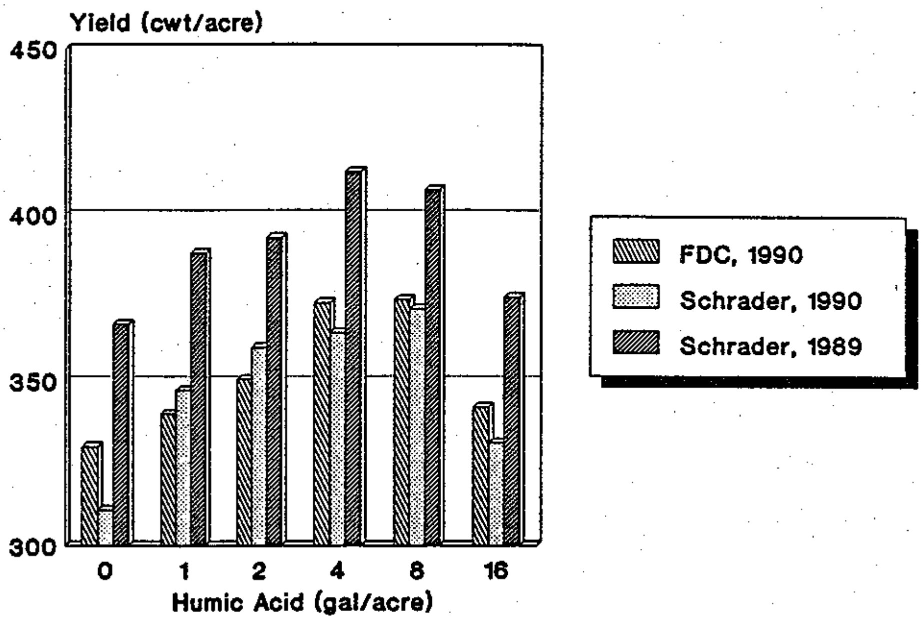


Figure 2. Average yield of Russet Burbank treated with 6 rates of humic acid. Values are means of three locations.

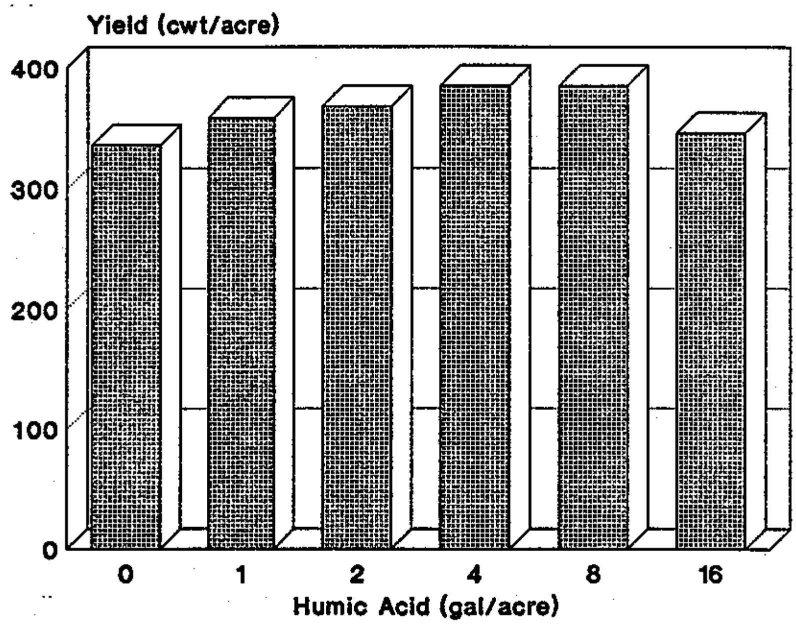


Figure 3. Effect of humic acid on yield of Russet Burbank at three locations in Idaho.

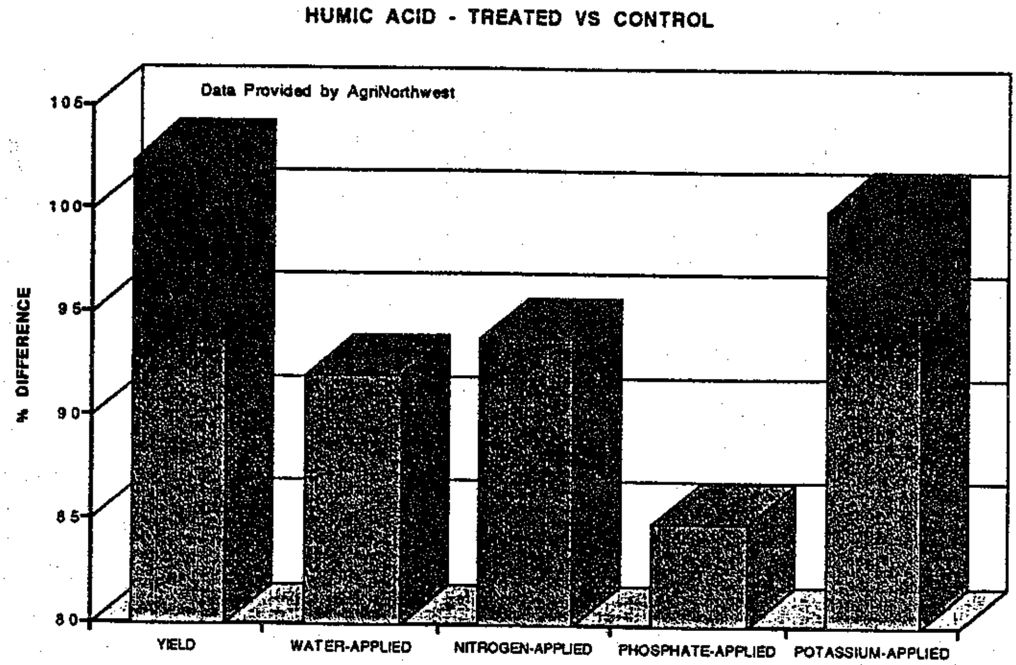


Figure 4. Average yield of Russet Burbank treated with 6 rates of humic acid. Values are means of three locations.

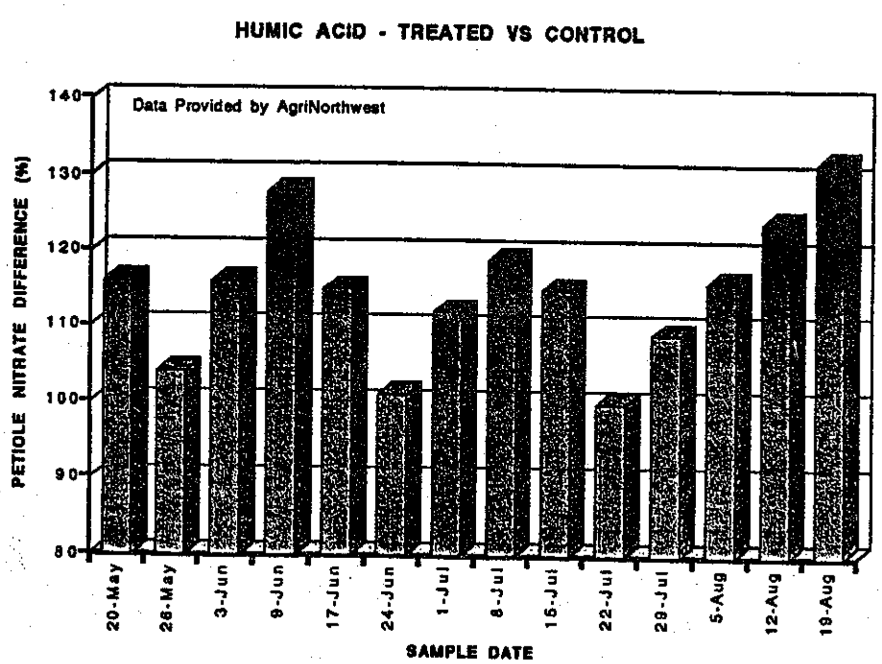


Figure 5. Effect of humic acid on yield of Russet Burbank at three locations in Idaho.

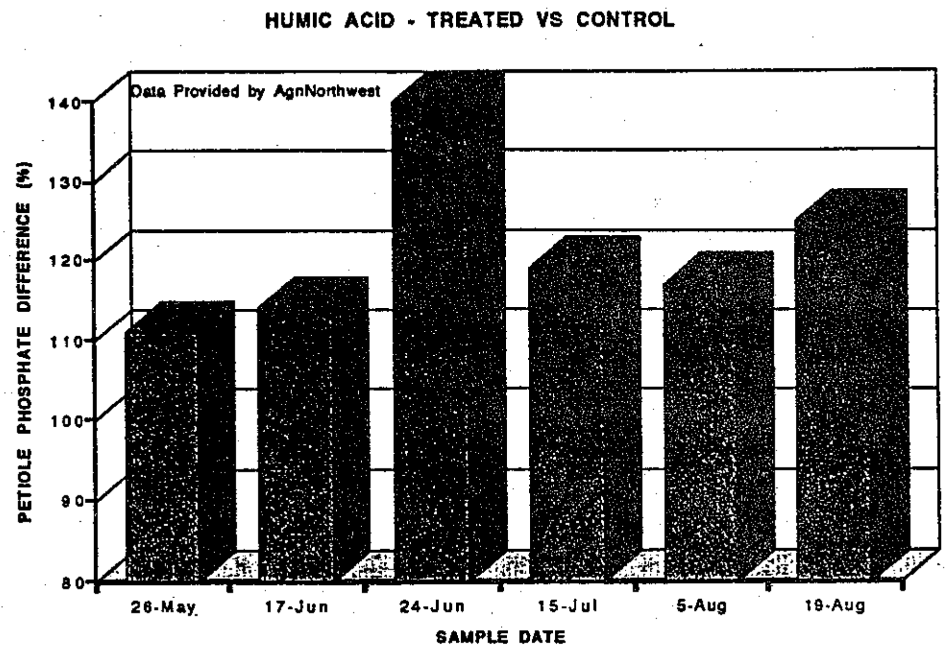


Figure 6. Average yield of Russet Burbank treated with 6 rates of humic acid. Values are means of three locations.

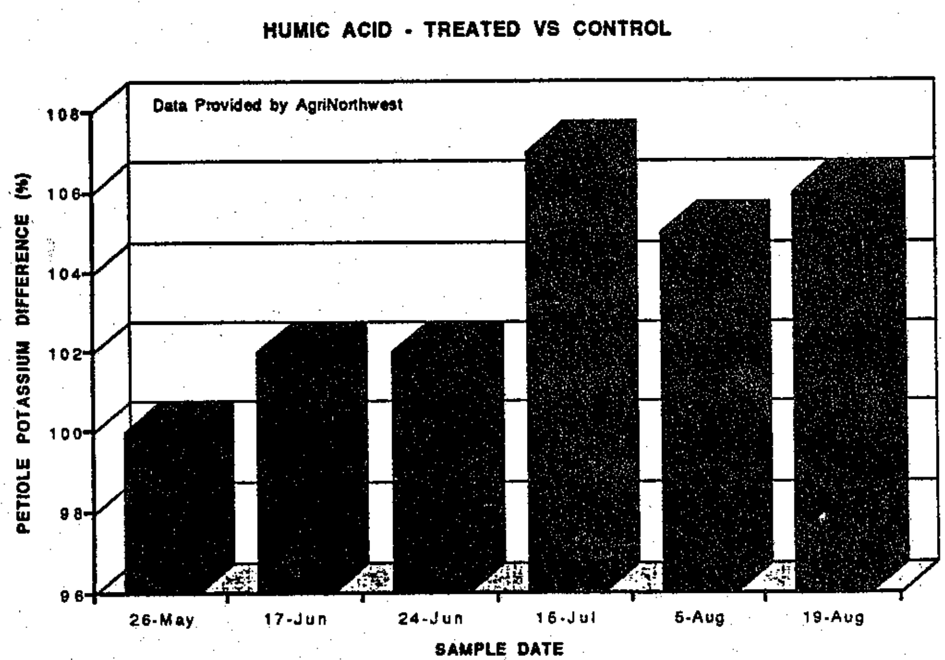
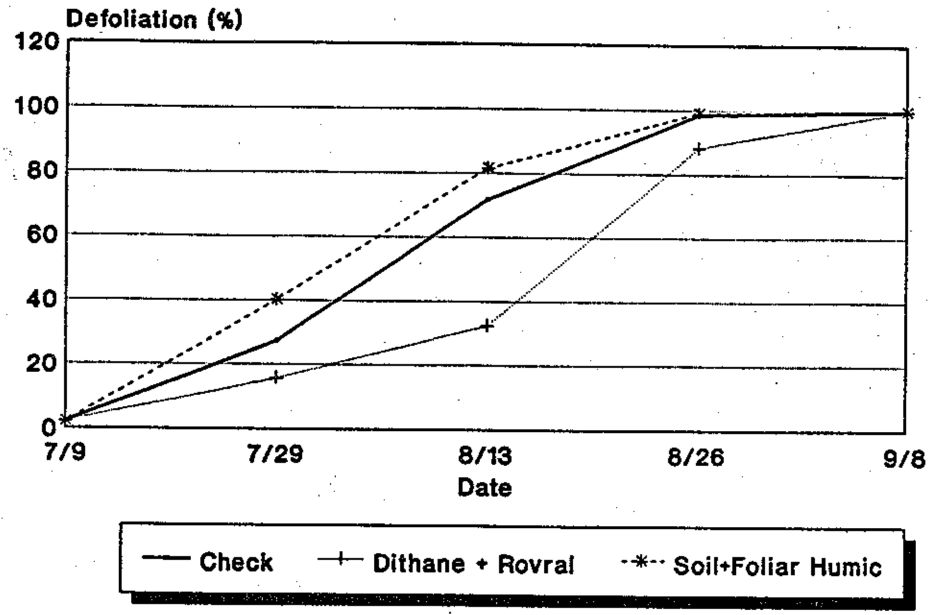
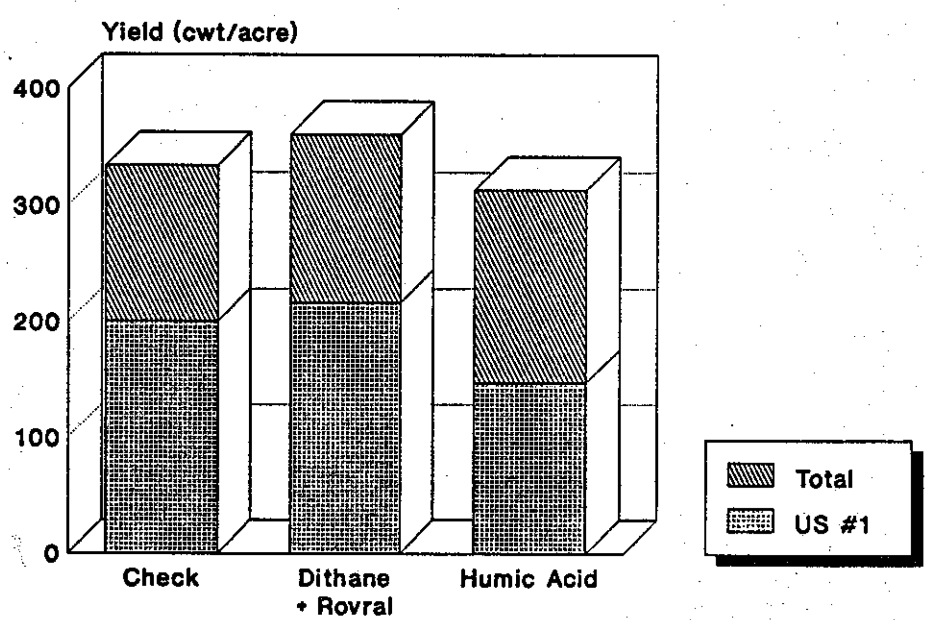


Figure 7. Comparison of early blight control by conventional fungicides and humic acid at Hancock, Wisconsin.



Source: W. Stevenson (1991)

Figure 8. Effect of conventional fungicides and humic acid on yield of Russet Burbank at Hancock, Wisconsin.



Source: W. Stevenson (1991)