The Concept of Fluid Fertilizers May Well Date Back to 1808

An Englishman by the name of Humphry Davy successfully used dilute ammonium acetate in a field of wheat.

Did you know?

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Shortly after 1799 when Sir Joseph Banks and American-born Count Rumford founded, what became a year later, the Royal Institution in London, they appointed Humphry Davy as their first resident lecturer. He proved to be an outstanding researcher, always fulfilling his responsibilities.

In 1802, early in his lectureship, he was requested by the Board of Agriculture to direct his attention to agricultural subjects. The following year he instituted a course of eight lectures that he repeated over the next decade.

In 1810, his sponsors invited him to publish the text of his lectures as a monograph entitled "The Elements of Agricultural Chemistry."

In general, his lectures tended to be oriented toward arable farming systems and dealt largely with the nature of crops and soils. Conventional crop husbandry and the associated environmental factors were mentioned but the main emphasis was on the chemistry of available plant nutrients. One complete lecture would be devoted to animal and vegetable manures and another to mineral or fossil additions.

Enter fluids

Davy referred to the different organic manures already in regular use and the way they were transformed by fermentation and putrefaction. He discussed how they could be mixed and the most appropriate way they should be handled and applied. He noted that there was a considerable risk of losing both liquid and gaseous components, which he referred to as "potential nourishment of plants." To demonstrate this, he placed hot cattle manure in a retort and collected the condensable fluids in a receiver during a period of three days. When he analyzed the content of the receiver, he detected ammonium acetate and carbonate. He repeated this experiment with a slight variation, describing it as follows:

"I introduced the beak of another retort filled with similar dung, very hot at the time, into the soil amongst the roots of some grass in the border of a garden. In less than a week a very distinct effect was produced on the grass upon the spot exposed to the influence of the matter disengaged in fermentation. It grew with much more luxuriance than the grass in any other part of the garden."

"Davy's work contributed much to the world of fluid fertilizers."

There seems little doubt that the experiment is probably one of the very earliest recorded instances of the injection of gaseous ammonia into the soil supporting a growing crop--well over a century before its adoption in the United States in the 1930s.

Fine tuning. Although the application of organic manures, including urine, had been a well-established practice since the Middle Ages and even earlier, Davy seems to have been one of the first to offer a rational explanation of the nature of the "nourishment" they contained. He was also conscious that such "nourishment" was taken up by plants in

the aqueous phase, so this led him to a series of experiments to determine the effect on plants of a range of dissolved substances, including many inorganic compounds derived from mineral sources.

Although in the 17th century Sir Kenelm Digby had watered barley with a dilute solution of nitre and reported luxuriant growth, he did not appear to have appreciated its potential significance. Consequently, Davy tried on both grass and corn the effect of a range of solutions containing sodium, potassium, and ammonia as sulphates, nitrates, carbonates, chlorides, and acetates. He found that in all cases:

"...when the quantity of salt equaled one thirtieth part of the weight of water, the effects were injurious, but least so in the instances of carbonate, sulphate, and muriate of ammonia."

Further dilution by a factor of ten made all the difference and he concluded:

"Plants watered with the solutions of sulphates grew just in the same manner as similar plants watered with rain water. Those acted on by the solution of nitre, acetate, and super-carbonate of potassa, and muriate of ammonia grew rather better. Those treated with the solution of carbonate of ammonia grew most luxuriantly of all."

Davy was somewhat puzzled by the results from ammonium nitrate solution as the growth was similar to that of plants treated with rainwater, but when he found that the solution was very acidic he concluded that the free acidity may have interfered with the result.

Subsequently, in 1801, he scaled up the more successful of his experiments when he was able to assist growth in a field of wheat by applying a dilute solution of ammonium acetate. He also made the point that soot, long known for its fertilizing properties, contained ammonium salts and deduced that the liquor arising as a byproduct from the destructive distillation of coal could be an abundant source of ammonia that could be used for agricultural purposes. Significant quantities of this so-called gas liquor were applied on a local basis. However, it was many decades before it was officially recognized as a nitrogenous fertilizer.

Gifted insight

Humphry Davy was an extraordinary individual with intuitive experimental skills, coupled with a flair for communicating his findings to his audiences in his Royal Institution lectures and elsewhere. Sir John Russell considered that one of Davy's major contributions was to establish Agricultural Science as a coherent subject. Russell claimed that Davy's "Elements of Agricultural Chemistry" reigned as the standard text of its field for over 50 years and that its contents were cited in 1840 by Justus Liebig in his well-known work in the same field. It was my privilege in 1974 to draw attention to Davy's remarkable insight into the way nutrients in fluid form were taken up by crops and the crucial role of nutrient concentration in optimizing crop response. It is further my privilege to be able to author this article in celebration of the 200th Anniversary of Davy's seminal work that contributed so much to the world of fluid fertilizers as we know it today.

Derek Palgrave, author, joined J.W. Chafer, Ltd. of Doncaster, England, in 1964 as its chief chemist and technical director. He is now involved in a program of public lecturing on a wide range of topics, including science and technology.