Humic Products–Potential or Presumption for Agriculture. Do Humic Products Have a Place in Australian Grazing Enterprises?

Kim L. Billingham
Department of Primary Industries, Australia

The 22nd International Grassland Congress (Revitalising Grasslands to Sustain Our Communities) took place in Sydney, Australia from September 15 through September 19, 2013.

Proceedings Editors: David L. Michalk, Geoffrey D. Millar, Warwick B. Badgery, and Kim M. Broadfoot

Publisher: New South Wales Department of Primary Industry, Kite St., Orange New South Wales, Australia

Humic products – potential or presumption for agriculture. Do humic products have a place in Australian grazing enterprises?

Kim L Billingham

NSW Department of Primary Industries, Taree District Office, 1 Macquarie St Taree, NSW 2430 Australia
www.dpi.nsw.gov.au
Contact email: kim.billingham@dpi.nsw.gov.au

Keywords: Humic products, soil remediation.

Introduction

Australian soils are inherently low in organic matter. Agricultural practices have compounded this problem. As farmers look for more sustainable farming methods a commercial niche has opened for a range of alternative products including the humic products. More than 200 humic products are manufactured and sold by Australian companies (Billingham 2012). Many more can be purchased *via* overseas websites.

The term 'humic products' denotes a range of materials derived from lignites (brown coals), peats, lignins, composts and other organic wastes. Most are manufactured by alkali and acid extraction of the source material. Humic products are usually sold as soil amendments or foliar sprays under a wide range of trade names and product descriptions in an unregulated market with no standardisation requirements (Billingham 2012). Common groupings are the solid humic acids or humates, the liquid fulvic acids or fulvates and the natural, organic or 'raw' humates that have not been extracted with an alkali. The humates and fulvates are often blended with macro and/or micronutrients with the broad claim of increased fertiliser use efficiency. Most application rates range from 5 kg/ha to 1 t/ha for solid products and 1-50 L/ha for liquid products with dilution rates up to 1:200. In 2012 available prices ranged from AU$35 per 5 L drum to more than AU$2500/t (Billingham 2012).

Humic products are marketed with a myriad of claims, but little evidence, of improved soil properties and plant growth. These claims closely resemble the properties of soil organic matter and, especially, the humic substances that occur naturally in soils and are responsible for many of its functions. Very little research into humic products has been conducted in Australia. To determine their efficacy, the peer-reviewed literature was searched and the claims investigated against the evidence found in the literature.

Method

A world wide literature review was carried out comparing manufactured humic products with humic substances, which occur naturally in soils. Particular attention was paid to the role humic products may play in the physical, chemical and biological properties of soils and subsequent plant growth. In addition, fifteen Australian companies were chosen for their promotion of humic products for broadacre cropping and pasture production. Information from their websites was collated in February 2012 and analysed in the light of evidence from the literature review. Two main questions were posed; (1) given our current understanding of the mechanisms that interact in soil-plant ecosystems, can we explain how the products work?; and (2) is there sufficient evidence from independent trials that the products will work under field conditions?

Results

Most research into humic products has taken place in the laboratory and glasshouse. Although germination and shoot/root growth showed a positive response to the addition of humic extracts (Chen and Aviad 1990), many of these trials used hydroponics or soil-less media. Very few field trials have been conducted across the world and most of those tested a range of products at different application rates on a variety of horticultural crops in different soil types and environments. There has been no repeatability.

The application rates and cost of humic products pose a major problem. Possibly due to their high price relative to other amendments, recommended rates are often below those that have shown to provide benefit in glasshouse trials (Karr 2001). Australian soils contain between 13 to 21 t/ha of natural humic substances with pasture soils at the higher end of this range (Billingham 2012). The question must be asked – at AU$2500/t, why buy and add more humic products?

Other issues arise from the claims that humic products are effective due to their presumed similarity to natural humic substances:

- Products manufactured from lignites and peats do contain varying proportions of humic substances (Hayes and Clapp 2001). However, products sourced from composts and lignins have not undergone the lengthy biological transformations inherent in the humification process. Treating an organic material with an alkali and acid may produce something that looks like a humate, but not behave like one.
- Humic materials must be recalcitrant in soils, resisting microbial degradation, to function effectively. Naturally occurring humic substances have an average age from months to thousands of years (Kastner and Hofrichter 2001). It is not known whether humic products can survive microbial degradation long

enough to carry out the many functions for which they were applied.

- There is a wide variation in product quality due to differing source materials and manufacturing processes. Fataftah *et al.* (2001) found that the humic acid content of 10 commercial humic products varied by more than 800% depending on the analytical method used. Quality is also related to the number of functional groups available on humic molecules to take part in chemical reactions in the soil and is reported as total acidity. None of the companies surveyed provided functional group analyses of products on their websites (Billingham 2012).

A mode of action was established for most of the soil properties being investigated, though trial results with humic products were mixed (Billingham 2012):

- Humic products may have a role in improving soil structure and reducing erosion. However, using the low recommended application rates there have been no significant results in the field.
- Water holding capacity could potentially increase or decrease depending on how the applied humic products react with the mineral component of soils.
- Any nitrogen (N) bound into humic products or added during manufacture is largely unavailable to plants. There may be a synergistic effect of humic material on plant N uptake.
- Humic and fulvic acids can increase phosphorus availability in both calcareous and acid soils but there have been mixed results with plant yields.
- Virtually no studies have been conducted on the effect of humic products on cation exchange capacity.
- It is not possible to predict how a certain humic product will affect the pH of a particular soil given competing chemical reactions for the available functional sites on the humic molecules.

There is sufficient evidence for the role of humic molecules in the sorption and transport of metal ions to roots. However, this is equally so for both trace elements and toxic heavy metals.

- There is potential for humic products in the remediation of both heavy metals and organic pollutants in soils but their activity in any situation cannot be predicted.
- The direct effect of humic products on plant growth has been established in the laboratory but the mechanism is not yet known.

Conclusion

Humic products do show some potential for agriculture, especially in terms of phosphorus and micronutrient availability and soil remediation. However, sufficient field evidence does not yet exist to recommend them for cropping or pasture systems. Given the volume of natural humic substances that already occur in many pasture soils, any presumed benefit from adding humic products should be evaluated accordingly.

References

Billingham K (2012) 'Humic products - Potential or presumption for agriculture.' (NSW Department of Primary Industries: Orange, NSW).

Chen CR, Aviad T (1990) Effects of humic substances on plant growth. In 'Humic substances in soil and crop sciences: Selected readings'. (Eds P MacCarthy, CE Clapp, RL Malcolm, PR Bloom) pp. 161 - 186. (Americal Society of Agronomy, Inc. Soil Science Society of America, Inc.: Madison).

Fataftah AK, Walia DS, Gains B, Kotob SI (2001) A comparative evaluation of known liquid humic acid analysis methods. In 'Humic substances - Structures, models and functions'. (Eds EA Ghabbour, G Davies) pp. 337-342. (The Royal Society of Chemistry: Cambridge).

Hayes MHB, Clapp CE (2001) Humic substances: Considerations of compositions, aspects of structure, and environmental influences. *Soil Science* **166**, 723-737.

Karr M (2001) Oxidized lignites and extracts from oxidized lignites in agriculture. http://humates.com/Humates in Agriculture-Karr.pdf. Accessed 15 Oct 2010

Kastner M, Hofrichter M (2001) Biodegradation of humic substances. In 'Biopolymers. Lignin, humic substances and coal'. (Eds M Hofrichter, A Steinbuchel) pp. 349-378. (Wiley-VCH: Weinheim: Germany).