



# NEWSLETTER

## INTERNATIONAL HUMIC SUBSTANCES SOCIETY

Number 20

May, 1998

### PRESIDENT'S MESSAGE

*Dear Colleagues,*

*The results of the recent IHSS elections have been completed and it is with great pleasure that I welcome on behalf of the IHSS membership Dr. Fritz Frimmel as Vice President/President Elect, Dr. Ed Clapp as Treasurer and Dr. Jean-Phillipe Croué as Board Member. Dr. Clapp has done a tremendous amount of work and given much of his time to IHSS matters and Drs. Frimmel and Croue are well known to all researchers in our field. I know that they will contribute significantly to the guidance of the Society during the next several years. I also wish to thank very much Dr. Kalevi Pihlaja and Dr. Jerzy Drozd for their willingness to run and serve the Society. The happiness associated with welcoming new officers of IHSS is always tempered with the sad knowledge that highly qualified individuals have offered their services and were not selected to contribute. It is the sign of a healthy Society that so many qualified individuals are willing to serve and I wish to thank all of the candidates for their dedication to the study of humic substances and the Society.*

*I also wish to welcome a new National Chapter into IHSS. An Indonesian Chapter has been approved by the Board of Directors and is formally in place. They have been very active and have approximately 25 members. I personally look forward to meeting as many as possible at the 9th International Meeting in Adelaide.*

*Response to the membership survey that was sent to you earlier this year has been good, with 175 responses to date and more arriving daily. While this is very good response, I must point out that the Society has over 700 members. This survey is a chance for individuals to make their thoughts on the Society known to the Board of Directors. Please send your responses to me. It is not too late. I will continue to tabulate the results and they will form a significant agenda item at the next Board of Directors meeting in Adelaide prior to the 9th Meeting. I hope to have the general results ready for inclusion in the next newsletter, but I can state that there is tremendous support for the Society. There were many very good comments that need to be considered. Some of the members mentioned issues that were not on the survey that they thought were important. I encourage any of you to send me those issues and I will pass them along to the Board at the meeting.*

*Finally, I have received approximately 20 applications for the IHSS Student Travel Bursaries. Dr. Nicola Senesi and Dr. Fritz Frimmel have agreed to act with me as reviewers of these applications. We will try to make announcement of the successful candidates by mid-June. Again, as with the elections, there are many fine applications and not all can be supported. However, it is a very good sign that so many fine, young scientists are involved in the study of humic substances. We must continue to support and encourage these young colleagues in their studies.*

*It has been a very busy 4 months for me in my office. Already there has been an extremely interesting and dynamic Symposium "Humic Substances II", which I had the privilege of attending. I believe that a more detailed report on this fine meeting will be found in the newsletter. Also, Dr. Geoff Davies, who organized the symposium, has agreed to act as chairperson for the IHSS Nominating Committee. He will be joined by Dr. Kaye Spark and Dr. Zdenek Filip. It is their duty to present a slate of candidates to the members for positions of officers and board members. You will be getting more information on the committee and how to contact them in another newsletter. For now, I wish to thank them for volunteering to serve.*

*During my first days in this office, I had some time to think about the Society and I wanted to share those thoughts with the membership. Please find some of those thoughts in a second message that also appears in this newsletter.*

*Sincerely,  
Jim Alberts  
President, IHSS*

# INTERNATIONAL HUMIC SUBSTANCES SOCIETY BOARD OF DIRECTORS

1998

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## International Humic Substances Society on the World Wide Web

!!!!!!! The Web page address has changed !!!!!!!

Visit our home page at:

<http://www.ihss.gatech.edu>

Prof. E.M. Perdue coordinates the development of the IHSS WEB page. Progresses toward this goal may be followed at the above WEB site which resides on a server located at the Georgia Institute of Technology, Atlanta, USA.

Suggestions and comments regarding the content and organization of the WEB pages are actively requested from all IHSS members.

E-mail Dr. E.M. Perdue at [michael.perdue@eas.gatech.edu](mailto:michael.perdue@eas.gatech.edu) for more information.

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## MEMBERSHIP DUES (1998)

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### 20 US \$ / year (10 US \$ for students):

- Argentina (10 US \$)
- Australia-New Zealand
- Brazil
- Canada
- European Union (including Norway)
- Indonesia
- Israel
- Japan
- Malaysia
- Mexico
- Philippines
- South Africa
- Switzerland
- United States
- Venezuela

### 1 US \$ / year:

- former USSR countries, including Baltic republics
- Bulgaria
- Romania
- Albania
- P.R. China

National Coordinators should collect the fees from members of their chapters in local currencies, deduct 20-25 % out of the fees (postage, copying, etc.), and then send the balance in US \$ to the Treasurer, Dr. C.E. Clapp, Univ. Minnesota, St. Paul, MN, USA.

### 5 US \$ / year (2 US \$ for students):

- Caribbean Countries
- Croatia
- Czech R.
- Hungary
- Poland
- Slovakia R.
- Slovenia
- Developing countries in Africa, Asia and Central and South America

Coordinators from 5\$-group chapters are invited to collect dues for two years (\$10, and save converting to US \$ not so often) and are allowed to keep up to 50% of the fee. Coordinators from 1\$-group chapters can keep the entire fee.

**IHSS Members are reminded that membership dues are payable at the beginning of each year directly to their National Coordinators.**

## IHSS VOLUMES (and related publications)

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### HUMIC SUBSTANCES IN TERRESTRIAL ECOSYSTEMS

Edited by Alessandro Piccolo. Elsevier, 1996 (675 pp). **ISBN 0-444-81516-3**

HUMIC SUBSTANCES IN SOIL AND WATER ENVIRONMENTS. *Characterization, Transformations and Interactions*. Proceedings 7th Int. Meeting of the IHSS. St. Augustine, Trinidad, 1994. 1996 (493 pp). Edited by C.E. Clapp, M.H.B. Hayes, N. Senesi, and S.M. Griffith and published by IHSS. **ISBN 1-889365-00-9**

HUMIC SUBSTANCES, PEATS AND SLUDGES: Health and Environmental Aspects. Edited by M.H.B. Hayes & W.S. Wilson. The Royal Society of Chemistry, Cambridge, 1997. Special Discount Price £38.68 (\$72.80). **ISBN 0-85404-699-2**

THE ROLE OF HUMIC SUBSTANCES IN THE ECOSYSTEMS AND IN ENVIRONMENTAL PROTECTION. Selected Papers of the 8th Int. Meeting of the IHSS. Wroclaw, Poland, 1996. (1002 pp.). Edited by J. Drozd, S. Gonet, N. Senesi, and J. Weber. PTSH & Polish Chapter of the IHSS, Wroclaw, 1997. **ISBN 83-906403-2-5**

## FROM THE PRESIDENT

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Dear Fellow IHSS Members:

During the past Christmas and New Years holidays, I had an opportunity to sit and reflect on the responsibilities and duties that faced me and the rest of the IHSS Board Members in the upcoming year. It was a very sobering period of reflection and I wanted to share with you some of my thoughts.

I realize that the Society has come a long way since its inception, and while it has had some growing pains, it still represents a much needed avenue for the discussion of research on a subject that is of critical importance to our global economy and quality of life. From its beginning by a relatively small group of intensely active and dynamic researchers, it has grown to reach out to scientists across the globe. Now, through the natural progression of science, the responsibility for continuing the mission of the IHSS has been placed in the hands of a new generation. I happen to be the most recent steward of that responsibility, but I sincerely believe that we must not underestimate the extremely difficult decisions and forward thinking that the two most recent Past-presidents have brought to the Society. Both Drs. Mike Hayes and Nicola Senesi have contributed enormously to the transition of the initial inspiration of the founders to a Society poised to truly represent a world-wide community of scholars. I can not thank either of these individuals enough for their efforts on behalf of the Society, many of which went unnoticed by the membership. Please believe me when I say that their efforts, along with those of the Board Members during their tenures as IHSS President, have made the Society the recognized focal point of international humic substances research.

It is at this point that the responsibility of my current position became so sobering. I, along with the Board Members, will continue to be called upon to make decisions which will direct the course of the Society. We accept that responsibility. Yet, it is you, the membership, that must give us guidance in our deliberations. The Society exists to promote research on humic substances in all facets of human and environmental arenas, to make certain that the research is of the highest scientific quality and to distribute those findings to the world community for its use. The membership, not the Board, will decide the strength and effectiveness of the Society. We on the Board are your representatives and need to know your thoughts and wishes for the Society. It is your duty to give us that input. Without it, we can only guess about the memberships' wishes.

During my Presidency, I hope to represent the membership as fully as possible within my abilities. There are many issues that will be addressed during the next year: needed changes in the Society's By-Laws; the venue for IHSS 10; and the all important election of new Board Members and Officers, who will continue to make this Society responsive to its members and dynamic in its pursuit of humic substances research. Your comments on these and other topics are wanted.

The two Past-Presidents and their Board Members accepted the challenge to preserve and better the IHSS. The current Board and I also accept that challenge to continue their work and to expand upon it. I call on you, the membership, to accept the challenge of assisting us in that goal and making certain that we on the Board make the best possible decisions for the Society.

Thank you for your confidence in me as your elected representative and voice of the IHSS. I look forward to an exciting time for the Society and hope to meet with as many of you as possible at IHSS 9 in Adelaide. However, just because we may not meet face-to-face does not mean that your voice is not important to me. I assure you that it is.

Jim Alberts  
President, IHSS

## FROM THE PAST PRESIDENT

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Dear IHSS Members,

in conclusion of my term as the President of IHSS I wish to express my deep gratitude and appreciation to all the IHSS fellows for having so enthusiastically supported the several and exciting activities of the Society in the past two years. I am convinced that the strength and efficiency of the Society are based on the vigorous activity and support of the membership which, I am sure, will continue unchanged in the future years. In this occasion I also wish to acknowledge the commitment and tremendous efforts that the entire Board has put on the service and on behalf of the Society.

These efforts have contributed to the achievement of a number of important issues addressed by IHSS in the last two years. Membership has continued to grow to reach a number close to 800, and new, active and strong National Chapters have been formed and joined the Society, including the French, Brazilian, Chinese and Venezuelan Chapters. Several well attended Meetings of National Chapters have been held in the last two years in Australia, Brazil, France, Italy, and several other Conferences, Congresses, Workshops and Symposia have been co-sponsored by IHSS throughout the world. Most of these meetings have produced proceedings volumes and/or books of high standard and interest to the "humic" community. The Proceedings of the 7<sup>th</sup> IHSS Meeting held in Trinidad in 1994 was published. The 8<sup>th</sup> Meeting of IHSS was held in Wroclaw in September 1996, and has been a great success for both the members attending and the quality of the science presented. In this occasion, the Society has experienced for the first time the assignment of Student Travel Bursaries to six successful applicants. A great effort has been devoted to the reorganization and replenishment of the IHSS Standard and Reference Collection, with its transfer to St. Paul and the appointment of the new Chairman, Dr. Paul R. Bloom, who has made a great job, together with Dr. C.E. Clapp, in the management of the Collection. The IHSS Newsletter has continued regularly its publication with the enthusiastic commitment of the new Editor, Prof. T.M. Miano, Secretary of IHSS. A WWW IHSS home page has been developed thanks to the efforts of Prof. E.M. Perdue, IHSS Board member.

It is a great pleasure and honor for me to heartily welcome on Board the newly elected IHSS officers, Prof. F. Frimmel, Vice President / President Elect, and Dr. J.-Ph. Croué, Board Member, and to express my great appreciation for the re-election of Prof. C.E. Clapp as the Treasurer of IHSS. Dr. Clapp has done an extremely important and large amount of work for the Society in these years. I wish also to thank Prof. K. Pihlaja and Prof. J. Drozd for having offered their candidatures for serving the Society, and to acknowledge the appreciated work done for the last elections by the members of the IHSS Nominating Committee, Prof. A. Piccolo, Prof. J.A. Rice and Dr. L. Martin-Neto. Finally, my warmest acknowledgments are due to the former Past President, Dr. M.H.B. Hayes, for his tireless, continuous and inspiring support and commitment on behalf of the Society.

I wish to conclude this message by assuring my continuous service to the Society in the office of Past President and as a Fellow Member to the new intriguing and exciting challenges that the Science of Humic Substances will open in the next years.

Nicola Senesi  
Past President, IHSS

## IHSS STANDARD AND REFERENCE COLLECTION

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### News Concerning the IHSS Collection of Humic Materials

Changes in Prices of IHSS Humic and Fulvic Acids.

Prices of some samples will be changed effective 1 June, 1998 to better reflect their value to IHSS. The prices of the Suwannee River Humic Acid Standard will *increase* from \$150 to \$175 for 100 mg lots. For the Nordic Aquatic Humic Acid Reference the price will *increase* from \$100 to \$125. For the Suwannee River Fulvic Acid Standard the price will *decrease* from \$150 to \$125 and for the Suwannee River Fulvic acid Reference the price will *decrease* from \$100 to \$75 for 100 mg lots.

The Leonardite Humic Acid Standard will continue to be sold at \$5 for 100 mg lots but in addition we are offering 5 g lots at \$100. We have a large reserve of this material and want to offer it to soil, water, and plant scientists and engineers at a price that makes it attractive for conducting research or preliminary studies.

Suwannee River Humic Acid Reference Sample is No Longer Available. The supply of Suwannee River Humic Acid Reference was recently exhausted. This material will not be replaced.

**New E-mail Address.** Effective 1 June the e-mail address for communication concerning the collection will be IHSS@soils.umn.edu. E-mail is the preferred method of communication for ordering from the IHSS collection. For more details see the IHSS web site at [www.ihss.gatech.edu](http://www.ihss.gatech.edu).

## MEETINGS

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9<sup>th</sup> International Meeting of IHSS “**Humic Substances Downunder. Understanding and managing organic matter in soils, sediments and waters**”, Adelaide, Australia, 21-25 September 1998. The conference will be held at the University of Adelaide, Adelaide, Australia. This venue is in the city centre and offers modern conference facilities, surrounded by parklands and is close to all amenities. Adelaide is on the southern coast of Australia, and in September the average temperature is in the range 17-20 °C. The city is serviced by international airlines and has a wide range of interests for both national and international visitors. These include beautiful beaches, wineries, national parks, and cosmopolitan attractions.



The aim of this international conference is to advance the field of humic substance and organic matter research by providing a forum for the sharing of current expertise between researchers in these disciplines and to enhance the communication and collaboration of researchers in Australia with those from other parts of the world. Topics: 1. *Characterisation* - Size, structure and functional group content; 2. *Origin and fate* - Bio-markers, C-cycling, degradation, adsorption; 3. *Aquatic systems* -Transport, pollutants, transformation, sediments; 4. *Soil systems* - Interactions, amelioration, pollutants and transport; 5. *Geochemical systems* - Coal and petroleum industry, mineral processing; 6. *Water treatment* - Removal or transformation, disinfection products

The Conference Organization is being carried under the direction of the National Chapter of the IHSS in Australia. The chairman of this committee is **Dr Roger Swift**, a Past President of the IHSS. If you are interested in receiving further information about the conference, please contact Dr Kaye Spark, IHSS-9 Conference Secretary, CRC for Water Quality and Treatment, PMB 3, Salisbury, SA 5108, AUSTRALIA. Ph: +61 8 8259 0347. Fax: +61 8 82590228.

**E-mail:** [IHSS-9@sawater.sa.gov.au](mailto:IHSS-9@sawater.sa.gov.au). **internet:** <http://www.clw.csiro.au/conferences/ihss9/>

## NOMINATIONS INVITED FOR IHSS BOARD POSITIONS

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### Nominations invited for Secretary and Board Member

Nominations are invited for two Society offices: **Secretary** and one **Board Member**. Both are for four-year terms, starting January 1, 1999. Potential nominees must agree to your nomination. Please, send the nominee's vita, your nominating letter and other pertinent information with questions you may have to the following address by July 1, 1998. Thank you.

Geoffrey Davies, Chair, Nominating Committee IHSS, c/o The Barnett Institute, 341 Mugar Hall, Northeastern University, Boston, MA 02115, USA. Phone (+1).617.373.3877. E-mail: gdavies@lynx.neu.edu

## MISCELLANEOUS

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### Successful Humic Substances Seminar II Held at Northeastern University

*A note by Elham A. Ghabbour and Phyllis Albert-Mitzman*

On March 27, 1998, the Humic Substances Group at Northeastern University hosted the second Humic Substances Seminar. The Group, headed by Dr. Geoffrey Davies, Associate Director of Northeastern's Barnett Institute and Professor of Chemistry, initiated the Seminars last year and plans to hold this popular meeting annually. Over 100 scientists and researchers attended from ten countries.

After the welcoming address by Dr. Ronald D. Hedlund, Northeastern Vice Provost for Research and Graduate Education, Dr. James Alberts (U. of Georgia) opened the first session, which was on the structure of humic substances. Dr. Michael Hayes (Birmingham U.) delivered the first paper on "Emerging Concepts of Humic Structures Based on Evidence from Spectroscopy and Chemical Analysis." Focusing on the gross mixture of macromolecular humic substances, Dr. Hayes believes that any study of humic composition and structure must begin by isolating and fractionating these substances. Jingdong Mao (UMass, Amherst) followed with a paper on "Structure and Elemental Composition of Humic Acids: Comparison between Solid-state  $^{13}\text{C}$  NMR and Chemical Analysis". This research compared CP-MAS and DP-MAS to obtain NMR spectra and ratios of  $\text{sp}^3\text{C}$  to  $\text{sp}^2\text{C}$ . He reported that the structure of humic acids are closely related to their origin, and suggested a fruitful line of research would be to measure the water content of these substances because it is part of their structure.

The second session, chaired by Dr Joseph Budnick (UConn), opened with a paper by Dr. Leonid Akim (NRC/EPA, Athens, GA) on "A Computational Chemistry Approach to Studies of the Interaction of Humic Substances with Mineral Surfaces." Using a computational chemistry approach on mica, Dr. Akim found that ionized polymers are more strongly sorbed onto charged mineral surfaces than unionized ones by a cation bridge between HA and minerals. Dr. Maria De Nobili (U.of Udine, Italy) presented a paper on "The Relative Importance of Molecular Size and Charge Differences in Capillary Electrophoresis of Humic Substances of Different Origin." Through acid base titration at ionic strength corresponding to the electrophoretic buffer, Dr. De Nobili has found that CE has the ability to characterize low molecular weight humic substances and good positive linear correlations between the mobility and log Mw of fractions extracted from the same origin.

The third session, chaired by Dr. Gordon Wallace (UMass, Boston), began with a paper on "Fractionation and Analysis of Heavy Metal Bound Soil Humic Acid Species by Size Exclusion Chromatography and Inductively Coupled Plasma-Mass Spectrometry," delivered by undergraduate Peter Ruiz-Haas of Hampshire College, Amherst. He used high performance SEC (HPSEC) interfaced with an ICP-MS to identify and quantify heavy metals (Pb, As, Cu, Mn, Ni, and Zn) bound to different humic acid fractions. Dr De Nobili presented a paper on "Formation and Voltammetric Characterization of Iron-Humate Complexes of Different Molecular Weight." She found that both  $\text{Fe}^{\text{II}}$  and  $\text{Fe}^{\text{III}}$ -humate complexes exhibit greater stability of low molecular weight  $\text{Fe}$ -



humate complexes, and a larger complexation capacity of low molecular weight HS fractions and particularly of the 1-10 kDa fraction.

The next session was chaired by Dr. Daman Walia (Arctech, Inc., Chantilly, VA). Dr. Geoff Davies presented a paper on "Adsorption of Humic Acids on Clays and Minerals: 1. Kaolinite." The adsorption data fit the Langmuir model with sequential monolayer formation and then adsorption of HA on HA. The adsorption enthalpies and entropies fit a single linear correlation, indicating a common underlying mechanism with dehydration of the kaolinite surface and the HAs as important steps. The next paper was on "Isotherm Nonlinearity and Competitive Sorption in Humic Substances," delivered by Dr. Baoshan Xing (UMass, Amherst). He discussed experimental evidence inconsistent with partitioning, testing a number of HOC and some pesticides with peat and soil HAs. He found that nonlinearity increased with contact time: strong competition occurs for compounds with comparable molecular structure and size.

Following the lunch break, Dr. Xing chaired the next session. Research on "The Ability of Microorganisms to Reduce Quinone Groups in Humic Substances" was presented by Durelle Scott (U. of Colorado, Boulder). He discovered that quinone moieties in humic molecules are the primary electron accepting group, and that humic substances in any anoxic environment can participate in microbial reduction of organic molecules. "Humic Acid as a Reactive Substrate for Alkylation" was delivered by Santha Kolla (Temple U.). Her research demonstrated that NMR shows how CH<sub>3</sub>I methylates HAs. Dr. Alberts then presented a paper on "Effect of pH and Water Chemistry on Natural Organic Matter (NOM) in a Norwegian Lake." He focused on the effect of adding lime to several Norwegian lakes. This process increased the pH of lake waters to levels that could sustain living organisms; it also increased the nitrogen levels of the NOM, which enhances their utilization by microbial communities.

In the final session, chaired by Dr. Elham Ghabbour (Northeastern U., MA), Dr. Ed Clapp (U. Minnesota) delivered a paper on "The Role of Humic Substances in Plant Growth." He studied the effect of HAs on root, shoot, and flowering growth, and found that compared to fertilizer controls, they resulted in significant increases. The final seminar paper, presented by Dr. Daman Walia, was on the "Greenhouse Gas Dilemma and Humic Acid Solution." Dr. Walia's work focuses on applications of HA research to help detoxify the environment. His company, ARCTECH, has developed a process to convert coal into HAs and clean fuels as alternatives to coal combustion, which reduces CO<sub>2</sub> emissions by 50% and promotes economic growth.

The seminar closed with a summary of the proceedings that included Drs. Alberts, Hayes, Clapp, Walia, and Davies. Conference participants agreed enthusiastically that the seminars are invaluable and they should become a permanent annual event. Humic Substances Seminar II Proceedings will be published by the Royal Society of Chemistry in late 1998. Dr. Davies announced that Humic Substances Seminar III will be held at Northeastern University March 26 and 27, 1999.

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## **Agricultural Uses of Humic Acids is on the Rise**

**By Ken Day**

Farms in the Western United States are utilizing humic acids (HA) products to a much greater degree than ever before. Agricultural use in this part of the U.S. has been growing at an annual rate of about 20% per year for the last ten years. In these states, the total use of agricultural HA products approached a value of about 5 million U.S. dollars last year.

Several factors are propelling growers to this move to HA products. Among these is the simultaneous improvement in the quality of agricultural HAs and the reduction in purchasing costs due to economies of scale in manufacturing.

Second, and perhaps more important, has been the tremendous advances in scientific research that have enabled agriculturalists to better understand humic chemistry and the modes of action of HA products. Most of the progress in HA research in the last 15 years can be attributed to scientists who belong to the International Humic Substances Society (IHSS).

Horizon Ag Products, based in Kennewick, Washington, has been a leader in developing higher quality and more affordable HA products for growers. They have also taken the lead in conducting research on the agronomic aspects of HA use. Because of their low-key approach to sales and

their commitment to research and development, they have become probably the largest manufacturer and distributor of agricultural HA products in the Western U.S. This article summarizes some of the more important conclusions from field research conducted on their behalf in recent years.

A number of large scale replicated field trials have been sponsored by Horizon Ag Products in California, Washington, and Idaho. These trials have demonstrated conclusively that HA products can be used profitably by growers in various farm production systems. The soils in all of these trials vary in texture from loamy fine sands to clay loams. However, all are desert soils with less than 2% organic matter, and most have soil pH levels from 7.0 to 8.5. The soils in most of these studies were calcareous (having high lime) in nature. The irrigation methods used varied from surface irrigation, to center-pivot sprinklers, to buried drip systems.

Numerous trials have resulted in positive yield and quality on several crops, including alfalfa hay, apples, cherries, cotton, garlic, mint, onions, peaches, potatoes, processing and fresh market tomatoes, and wheat. Improved tissue analysis levels have been consistently measured for nitrogen, phosphorus, potassium, and zinc when HA products have accompanied standard fertilizer programs. In some studies there were measurable improvements in soil structure, water infiltration, and reductions in applied water. Because of a lack of space only a few of the studies that were carried out will be summarised here

### **Potatoes in the Columbia Basin of Washington State**

In the late 1980s, experiments with Horizon Ag-Products HAs were commenced on one of the largest irrigated farms in the Columbia Basin. Over 40,000 acres of irrigated crops are harvested on the farm and extensive research facilities are available. The initial research was conducted in replicated blocks at this facility. The results were sufficiently positive to justify expansion, and the experiments were moved to the production farm.

The trials were conducted with potatoes under center-pivot irrigation on calcareous loamy sands and sandy loam soils. A solid, granular leonardite called Agri-Plus (70% HA) was applied pre-plant at a rate of 40 lbs per acre. Then a 3% HA liquid product (Quantum-H) was applied. The Quantum-H was mixed with liquid fertilizers and applied through the center pivot irrigation system in  $\Omega$  to 1 gallon per acre increments during the season. A total of 2,400 acres of carefully paired fields were divided between treated and non-treated fields.

Each field was tissue sampled weekly to determine nitrate-N, phosphate-P, and potassium levels. Fertilizer applications of nitrogen and phosphorus were made through the irrigation systems based upon the need determined by the results of petiole analyses. Irrigations were applied as required, based on the results of neutron probe sites in each field. In summary, after one year the treated fields yielded 3.5% more produce (representing increased revenues of \$70 per acre). The retail cost of such a program would be about \$35 per acre. Just as interesting was the fact that treated fields required 5.6% less nitrogen fertilizer and 15% less phosphate fertilizer. In spite of this reduction in applied fertilizer, the petioles were higher in N and P in the HA-treated fields more than 90% of the time. Potassium fertilizer was applied pre-plant at the same rates for treated and untreated fields. However, the petiole potassium levels for the treated fields averaged 6% higher throughout the season.

A surprising result of the study was that treated fields required 1.88 inches per acre (9.5%) less irrigation water, yet maintained superior moisture levels than untreated fields. This trial was continued and expanded to more acres with similar results. In fact, water savings improved each year for each of the 3 years of the study. By the third year, water savings reached 3.5 acre-inches per acre or 15% of the total water use of the crops. Farm managers attributed these savings to substantial reductions in surface water runoff. Mid-way into the second year of the trial the entire farm adopted the liquid HA program, and within four years had implemented a complete HA program, liquid and granular. This farm today continues to use Horizon Ag Product HA on the majority of its acreage.

### **Potatoes and Alfalfa in Idaho**

Two private research consultants in Idaho conducted replicated field trials in 1997 using Agri-Plus and Quantum-H. Stukenholtz Labs did a carefully replicated trial on alfalfa hay grown on loam soils at two different locations, and obtained significant yield responses. The first trial yielded 1.5 tons per acre more over the course of the season (the increase was worth \$135 per acre). The

second trial yielded 1.95 tons per acre more. The HA treatments included addition of 40 lb. per acre Agri-Plus (Dry leonardite 70% HA) pre-plant, with subsequent applications of 4 gallons per acre of Quantum-H (6% liquid HA) applied through the sprinklers. The first application of 2 gallons per acre was made early in the season. A second application of 2 gallons per acre was made after the first cutting. There were no measurable differences in hay quality between the treated and non-treated areas.

Kelly Hurst Consulting did a replicated trial on potatoes in eastern Idaho on loamy soils. The treatments included the 40 lbs/acre of Agri-Plus followed by 2 gallons of Quantum-H in the phosphate starter band. Another 6 gallons per acre were applied through the center pivot system evenly spaced through the season. The yield was 17% greater in the treated plots (worth over \$300 per acre), with a 7% increase in quality.

### **Processing Tomatoes in California**

Many growers in California have used the Agri-Plus product by itself. Agri-Plus is a unique dry leonardite product mined in New Mexico. It has a high percentage of low and mid range molecular size humic and fulvic acids that release into the soil at neutral pH ranges. The standard application rate for the Agri-Plus is 40 lbs per acre per season. Two applications are sometimes made per season in intensive farming areas or on problem soils.

At the Cox and Perez Ranches in Westley, California, 14 processing tomato fields were split with either a half or a third of each field receiving 40 lbs of Agri-Plus prior to planting. Most of the fields had loam or clay loam soils. Two areas of the field in each treatment area were harvested separately and yields were determined (leaving 28 total replicates). Treated fields consistently yielded more than untreated fields. In fact, the average yield increase was 3.24 tons per acre (an 8.6% yield increase) representing increased revenues to the grower of about \$160 per acre. A similar experiment was done on fresh market tomato fields. The 6 fields that were split realized a 16.4% average yield (by weight) increase from treatments of Agri-Plus.

In 1997 the Farming Dî Ranch in Fresno County split seven fields with three harvest observations on each different treatment. Agronomy Associates, Inc. set up and monitored this trial. The areas of the fields treated with 40 lbs per acre of Agri-Plus averaged 4.0 tons per acre more (11% increase) bringing the grower \$200 per acre in increased returns. Three of the fields had significant yield responses within the replicates at the 90% confidence level.

### **Cotton in Fresno County, California**

Two separate field trials on cotton grown in saline-sodic fine sandy loam soils were conducted in 1997 by Agronomy Associates, Inc. After four years in a row of Agri-Plus applications on the first farm, the treated parts of the field had a 33% greater plant population, a 200 lb per acre lint yield increase (based on boll counts and boll weight measurements), 30% higher nitrate nitrogen levels in the petioles, and 45% higher potassium tissue levels.

Trials on a similar soil but at a different farm had almost duplicate yield results when 4 gallons per acre of Quantum-H was applied with nitrogen fertilizer and through the water early in the season. Agronomy Associates have conducted many trials on different ranches and in association with other private research and consulting companies. Consistent remarkable improvements in nitrate-nitrogen petiole levels have been observed when the Quantum-H was applied in combination with fertilizer nitrogen. Improvements in potassium levels have consistently been observed for tomatoes and cotton when liquid HA products were water run in furrow irrigations or through drip systems. These improvements came even where no additional fertilizer potash was applied. Zinc tissue levels have also been consistently higher in the treated portions of fields receiving liquid humic acid water runs.

### **Crucial Considerations for Success**

By trial and error, and by careful interpretations of the research we have discovered several keys to obtaining consistent results with HA products. Some of these principles are outlined as follows:

1. Insist on high quality HA products that have the following quality parameters:
  - a) high active ingredient content; b) consistent analyses; c) low sludge content for ease of handling; d) HAs with low molecular weight and high oxygen contents (high in carboxyl, hydroxyl, and quinone functional groups).

2. Humic acids must be applied in high enough quantities, and/or concentrated in the plant root zone to reach soil solution concentrations of 20 to 50 ppm. Most of the HAs should be applied early in the growing season and concentrated around the seedling root zone. For grass and turf crops 10 to 20 ppm is adequate.
3. Intimate association of liquid HA products with phosphorus fertilizers are essential for improved phosphate uptake. Applications of liquid HAs with nitrogen can either be made with the fertilizer, or with irrigation water immediately following fertilization.
4. Foliar feeds with fulvic acid containing liquid products are helpful, especially on tree crops. Fulvic acid products formulated with micronutrients can help resolve temporary micronutrient deficiencies through chelation.
5. To be economically viable for the grower, the HA products must be inexpensive and available in bulk quantities.
6. Care should be taken not to mix HA products with herbicides, insecticides or fungicides unless previous experience demonstrates compatibility.

### About the Author

Kenneth Day has BS and MS degrees in Plant and Soil Science from California State Univ., Fresno. He has over 17 years of experience as an agronomic consultant providing irrigation, fertility and pest management services to growers in California. His knowledge and experience with organic soil amendments and humic acid products is extensive. His first exposure to the organic chemistry of soils and HAs was during the completion of his thesis on manures and composts in 1984. Although he was initially doubtful about the economic benefits of HA products, he has gradually come to believe in their economic value to agriculture. In more recent years he has extracted from the scientific literature a large body of research concerning HAs. He has also helped conduct over 11 field trials with HA products. The majority of the successful trials have been with Horizon Ag Products, which he recommends to his agricultural clients.

### Plant-Derived Humic Acid Samples Available

A note by Geoffrey Davies

Finding humic acids (HA) in plants<sup>1-5</sup> raises new questions about HA structures, functions and origins. Solid HA samples isolated with a very thorough procedure from the richest known free-living source, the alga *Pilayella littoralis*, are now available for research as follows:

**PLS** (cleaned, washed, air dried fresh *Pilayella littoralis* source): 50 g / \$35.00;

**PLV**, vacuum oven (40 °C) dried HA: 100 mg / \$60.00, 250 mg / \$120.00;

**PLF**, freeze dried HA: 100 mg / \$75.00, 250 mg / \$150.00;

**PLSF**, supercritical fluid CO<sub>2</sub> dried HA: 100 mg / \$150.00.

All HAs isolated from *Pilayella littoralis* and packed under N<sub>2</sub>. Prices include packing, mailing and lot analytical data. Please enquire for bulk or special orders. Prepaid orders only by certified \$\$ bank check made out to "Humic Acid Group" at Barnett Institute, 341 Mugar Hall, Northeastern University, Boston, MA 02115, USA.

Phone (+1).617.373.3877; Fax: (+1).617.373.2855; e-mail: [gdavies@lynx.neu.edu](mailto:gdavies@lynx.neu.edu).

Refund gladly given for unused samples returned within 30 days.

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