

# *actosol*®

*Humic/Fulvic Acid Fertilizer*

- **Increases yields of crops, vegetables and fruits**
- **Produces superior turf and deep roots**
- **Enhances uptake of fertilizers**
- **Replenishes depleted soils**
- **Promotes ecological balance**

**ARCTECH, Inc**

**14100 Park Meadow Drive • Chantilly, Virginia 20151 USA**

**Phone (703) 222-0280 • Fax (703) 222-0299**

**April, 2005**



*Preserving tomorrow's world... today*



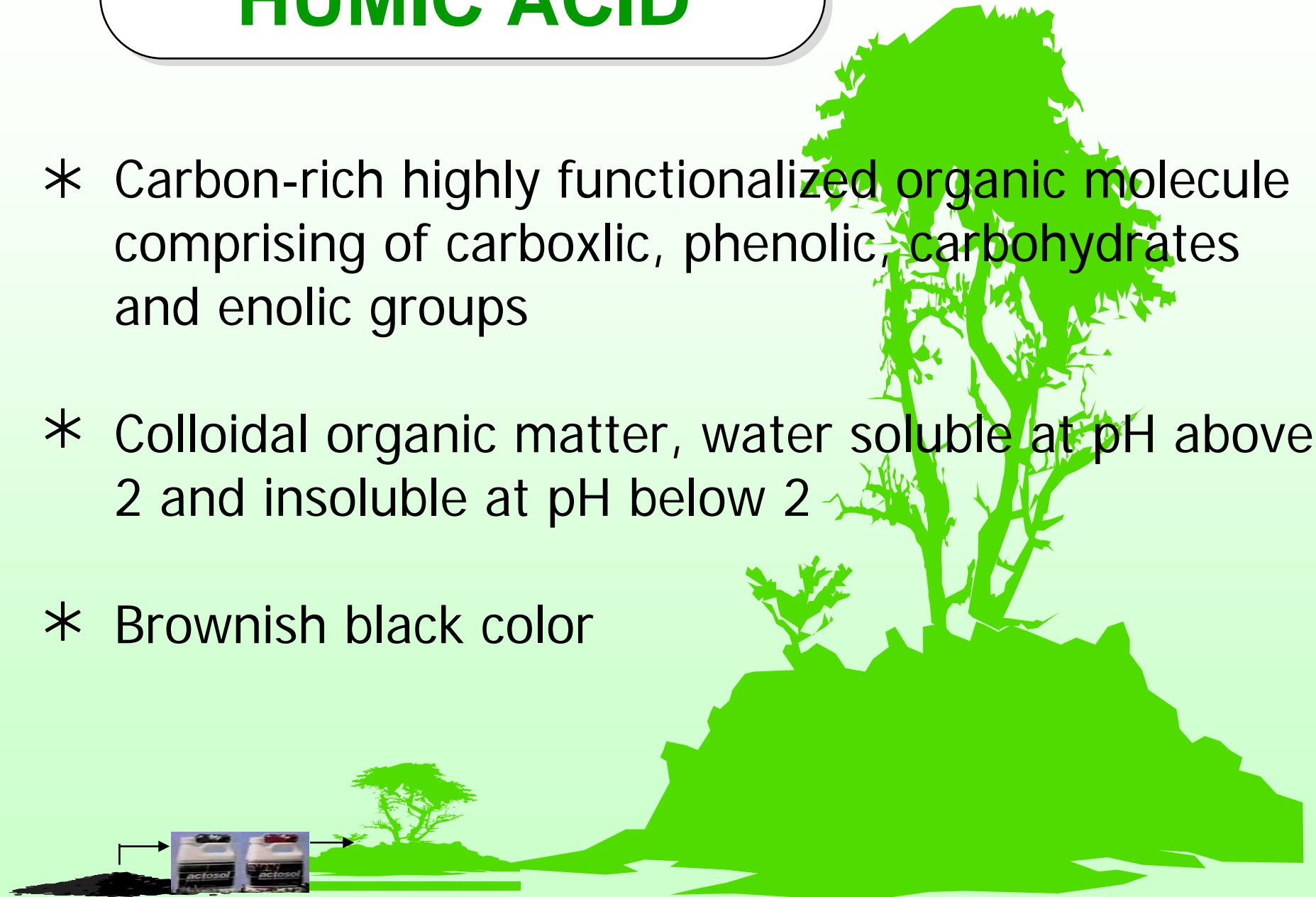
# ARCTECH CORPORATE PROFILE

- ❖ Established in 1988 as spin-off company from Atlantic Research Corp., an large U.S. Aerospace Company
- ❖ Headquarter and Technical Center – Chantilly, Virginia
- ❖ Manufacturing Plant – South Boston, Virginia
- ❖ Market Profile: Develops Innovative Solutions from Concept to Implementation for Energy, Environment and Agriculture markets
- ❖ Commercial Products Applications in U.S.A, Egypt, Gulf Countries and S.Korea
- ❖ Creating Biotechnology Solutions since Mid 1970's.
- ❖ Selected as one of the six top bioprocessing firms in the United States (Arthur Young, 1989)



# HUMIC ACID

- \* Carbon-rich highly functionalized organic molecule comprising of carboxylic, phenolic, carbohydrates and enolic groups
- \* Colloidal organic matter, water soluble at pH above 2 and insoluble at pH below 2
- \* Brownish black color



# ESSENTIAL ELEMENTS FOR PLANTS




[	<b>C</b>	carbon
	<b>H</b>	hydrogen
	<b>O</b>	oxygen

M A C R O	[	<b>N</b>	nitrogen	
		<b>P</b>	phosphorus	
		<b>K</b>	potassium	
	S E C O N D A R Y	[	<b>Ca</b>	calcium
			<b>Mg</b>	magnesium
			<b>S</b>	sulphur

M I C R O	[	<b>B</b>	boron
		<b>Cu</b>	copper
		<b>Fe</b>	Iron
		<b>Mn</b>	Manganese
		<b>Mo</b>	molybdenum
		<b>Zn</b>	zinc
		<b>Cl</b>	chloride
		<b>Co</b>	cobalt



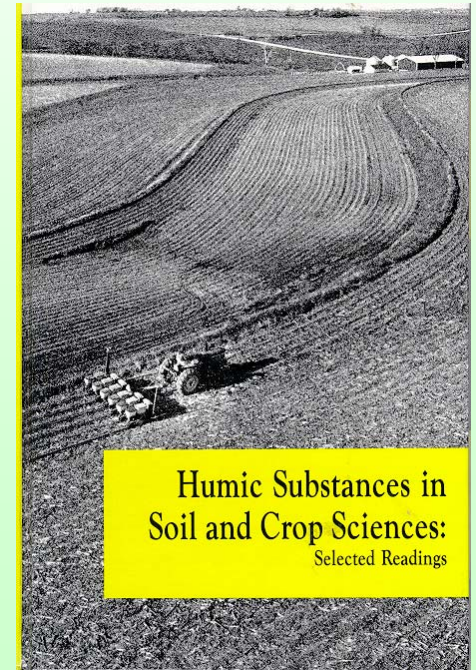
# THE actosol® HUMIC ACID ADVANTAGE

-  Enhances yield and quality of crops, vegetables, and fruits
-  Produces healthy and deeper root mass for superior turf
-  Creates vegetation in saline and poor soils



# HOW DOES actosol® HUMIC ACID CREATE BENEFITS?

- ✿ By enhancing soil structure and fertility through the addition of vital organic matter in the soil;
- ✿ By efficient transfer of fertilizer nutrients and micronutrients because of the high chelation and cation exchange proportion of the active humic acid component of actosol®;
- ✿ By increasing moisture holding capacity of soil;
- ✿ By increasing microbial activity in the soil; and
- ✿ By enhancing plant cell biomass.



# APPLICATIONS OF actosol® HUMIC ACID

- ✓ Agriculture
- ✓ Horticulture
- ✓ Floriculture
- ✓ Turf Management/Maintenance
- ✓ Mine/Landfill Reclamation
- ✓ Dune Stabilization
- ✓ Road/Highway Erosion Control
- ✓ Hydroseeding
- ✓ Pasture Land, Conservation of Natural Resources



# **actosol® HUMIC ACID BEING APPLIED SUCCESSFULLY IN VARIOUS APPLICATIONS**

## **UNITED STATES**

- Landscaping
- Erosion Control
- Landfill Closure
- Golf Courses
- Sod Farms
- Nurseries-Tomatoes
- Sand Dunes
- Floriculture
- Agriculture
- Horticulture

## **GULF COUNTRIES**

- Rhodes Grass
- Water Melon
- Cucumber
- Alfalfa
- Orange Groves
- Grapes
- Onion
- Date Trees

## **MAURITIUS**

- Sugar Cane
- Horticulture

## **S. KOREA**

- Golf Courses
- Greenhouses



# IMPORTANCE OF HUMUS, A KEY COMPONENT IN actosol® DISCOVERED DURING ALASKAN CRUISE



Sitka, Alaska



Preserving tomorrow's world... today



# ACTION OF HUMIC SUBSTANCES ON PLANT GROWTH

## Physical

- Increases water holding capacity
- Increases aeration of soils
- Improves soil workability
- Helps resist drought
- Improves seed bed
- Makes soil more friable or crumbly
- Reduces soil erosion.

## Chemical

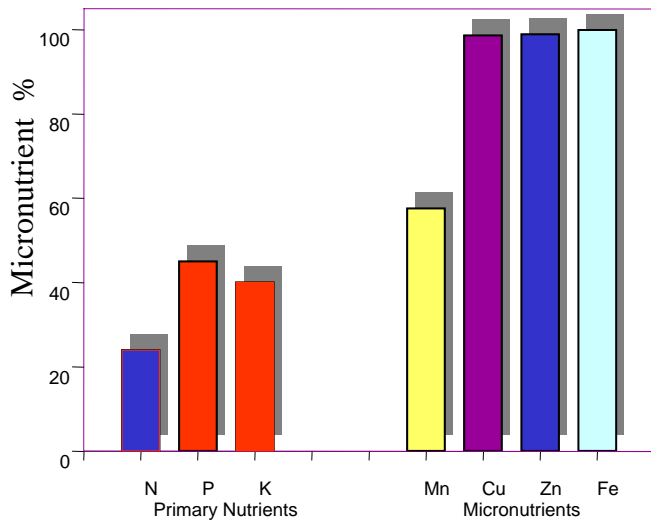
- Chelates nutrients for uptake by plants
- Possesses high ion-exchange capacity.
- Increases buffering properties of soils
- Increases percentage of total Nitrogen in soils.

## Biological

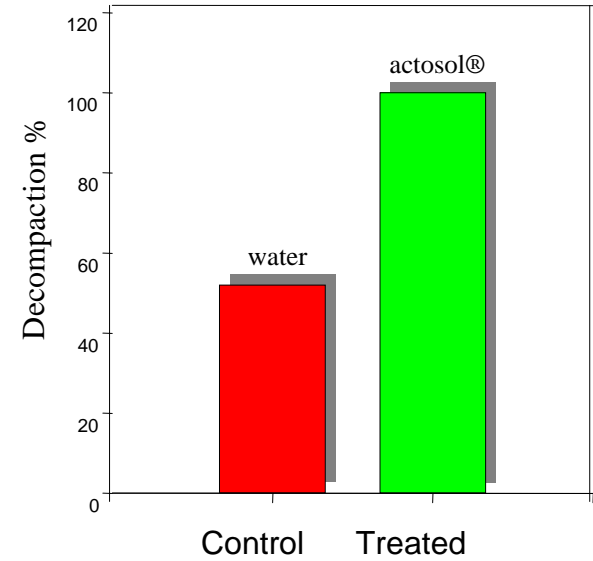
- Accelerates plant cell division and promotes growth
- Increases germination of seeds and viability
- Increases root respiration and formation
- Stimulates growth & proliferation of soil microorganisms.
- Aids in photosynthesis.



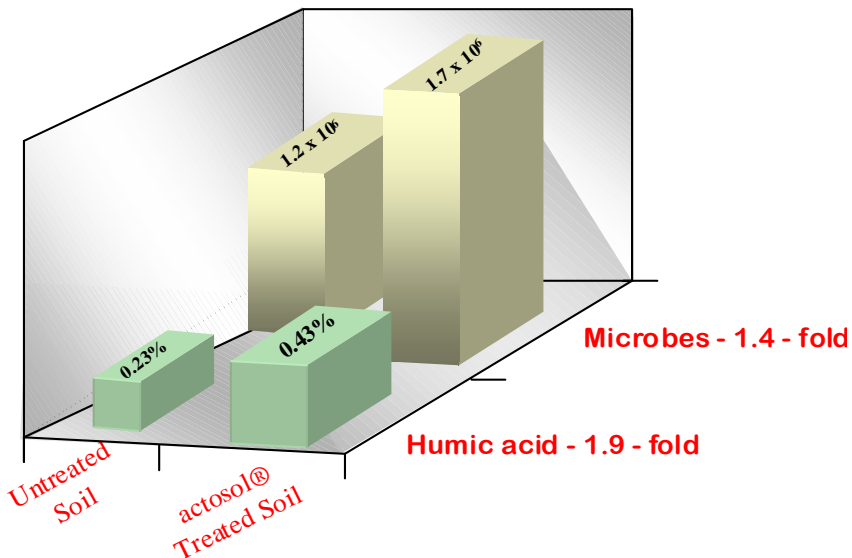
## Primary and micronutrients bound to actosol® humic acid



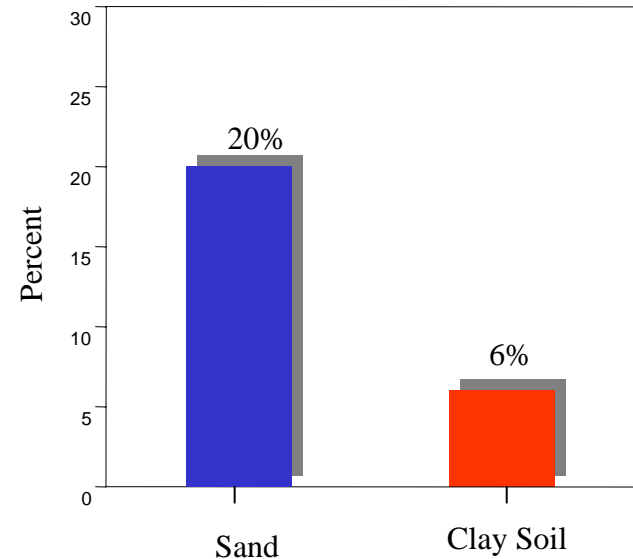
## actosol® improves soil structure



## Microbial counts and humic acid content are higher in actosol® treated soils



## actosol® humic acid increases water holding capacity



# Approval of actosol<sup>®</sup> Humic Acid

- A. USDA National Organic Food Production Program  
October 21, 2002**



**Allows use of Humic Acid for Growing Organic Foods**

**Additional Info : [www.ams.usda.gov/nop](http://www.ams.usda.gov/nop)**

- B. US Environmental Protection Agency  
June 13, 2003**



**Approves humic acid as environmentally safe and exempts from Tolerance requirement when used as an ingredient ( adjuvant, UV protectant ) in pesticide formulations**

**Additional Info : [www.epa.gov/fedregstr](http://www.epa.gov/fedregstr)**

- C. OMRI Listed (Organic Materials Review Institute)  
February 18, 2005**

**Additional Info : [www.omri.org](http://www.omri.org)**



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# actosol®

ORGANIC MIRACLE FERTILIZER  
Enhance Quality and Yield  
Crops, Fruits, Vegetables, Trees, Shrubs, Flowers and Turf

## TYPICAL ANALYSIS OF actosol® PRODUCTS (w/v%)

	<u>HUMIC</u>	<u>MACRO</u>			<u>SECONDARY</u>			<u>MICRO</u>					
	<u>ACID</u>	<u>N</u>	<u>P (P<sub>2</sub>O<sub>5</sub>)</u>	<u>K (K<sub>2</sub>O)</u>	<u>Ca</u>	<u>Mg</u>	<u>S</u>	<u>B</u>	<u>Cl</u>	<u>Cu</u>	<u>Fe</u>	<u>Mn</u>	<u>Zn</u>
<b>Turf Booster actosol®</b>	3	20	5	5	0.08	0.07	.10	0.007	0.5	0.01	0.1	0.01	0.01
<b>Garden actosol®</b>	3	10	10	10	0.08	0.07	.10	0.007	0.5	0.01	0.1	0.01	0.01
<b>Calcium actosol®</b>	3	2	-	-	2.00	0.07	.10	0.007	0.5	0.01	0.1	0.01	0.01
<b>Micronutrient actosol®</b>	3	0.4	0.08	.5	0.08	0.07	.10	0.007	0.5	0.5	0.5	0.5	0.5
<b>Base actosol®</b>	12	0.4	0.08	1.5	0.08	0.07	.10	0.007	0.5	0.01	0.5	0.01	0.01
<b>Bio-Activated- granular actosol®</b>	70	-	-	-	0.08	0.07	.10	0.007	0.5	0.01	0.01	0.01	0.01

### Notes:

1. All actosol® products are water soluble liquid except granular actosol®
2. Analysis of Humic components in liquid actosol® products is based on acid precipitation method as specified by the Soil Science Society of America and California Dept. of Food and Agriculture other methods such as BaCl<sub>2</sub> precipitation and absorption result into analysis well over 3% to as high as 20%. Acid precipitation gives scientifically sound and uniform humic component analysis
3. All the actosol® products contain humic and fulvic components, however no quantification because of lack of any acceptable analytical method
4. All actosol® liquid products formulated with NPK contain slow release bound 35% N, 50% P<sub>2</sub>O<sub>5</sub> and 50% K<sub>2</sub>O.
5. Granular solid actosol® 70% as extractable insoluble humic component.

Corporate  
ARCTECH, INC.  
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Phone (703) 222-0280 • Fax (703) 222-0299

Manufacturing Plant  
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P.O. Box 832, S. Boston, VA 24592  
Phone (434) 575-7200 • Fax (434) 575-7230



Preserving tomorrow's world...today!

# Turf

**actosol®** CREATES VEGETATION IN SAND DUNES



Ocean City, MD



**HYDROSEED MIX**



6 weeks growth, Virginia Tech., Testing

**HYDROSEED MIX  
PLUS actosol®**



# actosol<sup>®</sup> Hydroseeding Effective for Reclamation Site in Northern Alabama



**before treatment**



**actosol<sup>®</sup>  
treated**



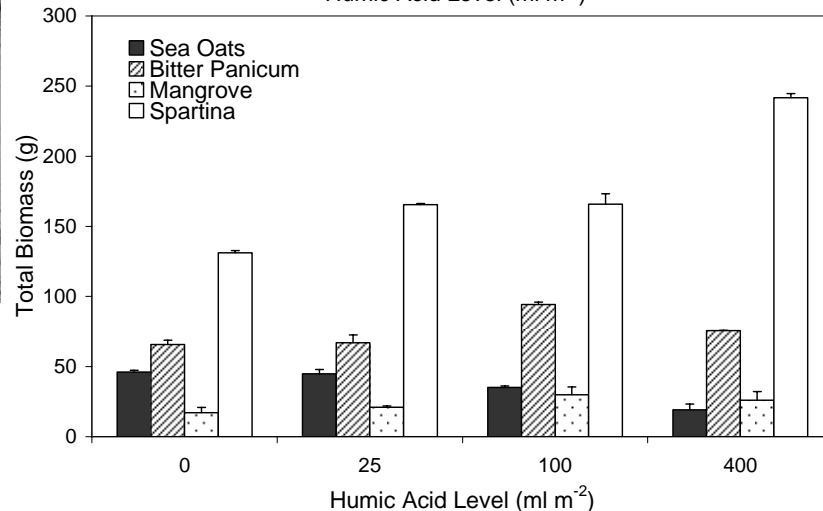
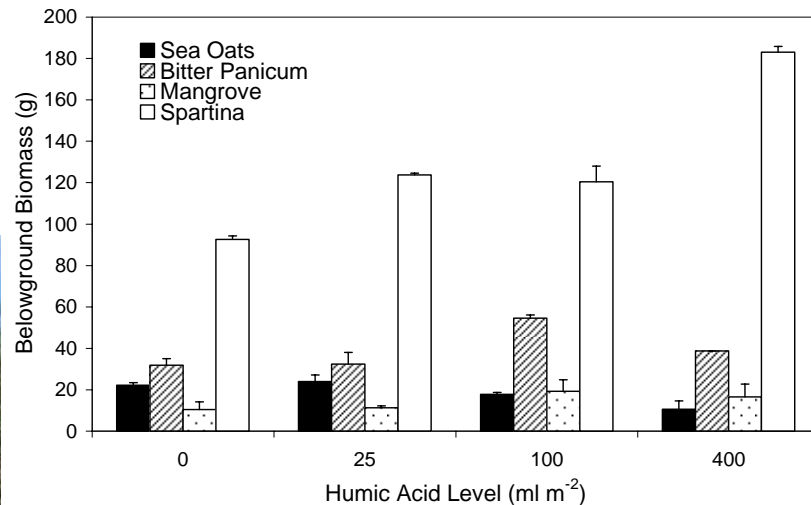
**control**

**after treatment**

# actosol® Humic Acid Application Increased Roots, Top Biomass, and Vigorous Growth of Dune Grasses for Restoration of Louisiana Coastal Lands. (Tests by Prof. Mark Hester of University of New Orleans)



Vigorous growth of bitter panicum (*Panicum amarum*) when a fertilization regime was coupled with a Humic Acid application of 100 ml per m<sup>2</sup>. Note extensive amount of vegetative spread (tillering) and flowering within only 5 months after planting (photo taken September 2004).



The effect of humic acid (applied as Actosol 3% humic acid solution) on biomass production by two widespread dune grass species (sea oats and bitter panicum) and salt marsh species (black mangrove and smooth cordgrass). *Spartina alterniflora* (smooth cordgrass) biomass production was substantially increased by addition of humic acid, especially the 400 ml m<sup>-2</sup> level. Mangrove and Bitter Panicum both demonstrated greater biomass production at the 100 ml m<sup>-2</sup> humic acid level. It is anticipated that Sea Oats will demonstrate elevated productivity at some more moderate level of humic acid (<25 ml m<sup>-2</sup>).



# actosol® Astonished Results for Vegetation of Landfill Cap in Pennsylvania

REGIONAL EQUIPMENT CENTER  
WEST KIRMAR PARKWAY  
WANAMIE, PA. 18634  
(717) 735-0355 OR 735-0373  
FAX (717) 735-3233

August 14, 1995

Mr. Tom Sikand  
Arctech, Inc.  
14100 Park Meadow Drive  
Chantilly, Va. 22021

RE: "ACTOSOL" Results on East Side Landfill Project

Dear Mr. Sikand:

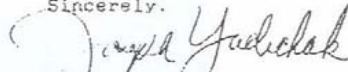
During the closure of the East Side Landfill site in Luzerne County, Pennsylvania, Regional Equipment Center used a topsoil/cellulose mix for the top six (6) inches of cover over a one hundred ten (110) acre prior landfill.

The contractors used a conventional method of hydro-seeding with fertilization. The grass germinated and quickly died.

Regional Equipment Center then contacted the experts at Arctech. Following the recommendations of those experts and applying "ACTOSOL", Regional Equipment Center was able to provide rich, lush grass. The results were astounding.

Thanks to the staff and the "ACTOSOL" the final cover on the East Side Landfill site was most successful.

Sincerely,

  
Joseph Yudichak,  
Executive Director



*Preserving tomorrow's world... today*

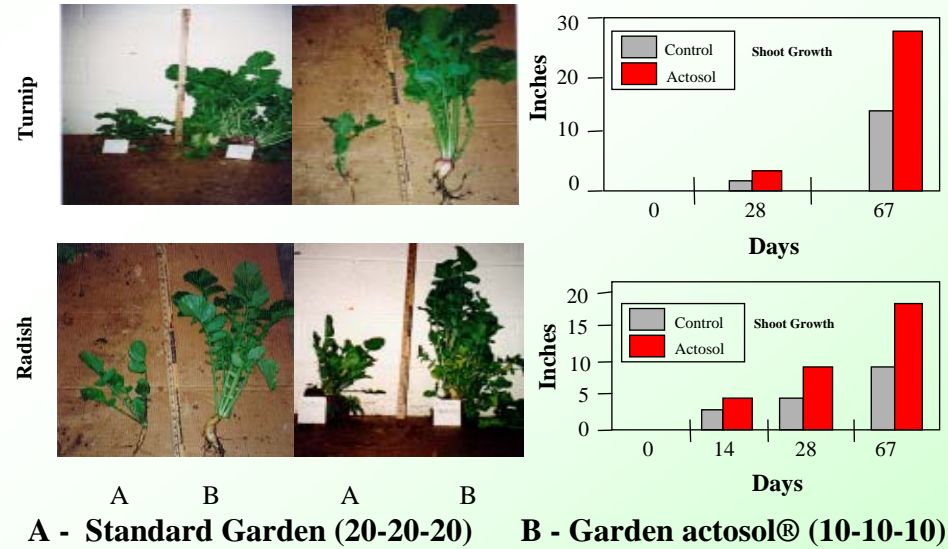
# Floriculture

**actosol® BRIGHTENS FLOWERS**



# Horticulture

**actosol® MIRACLE ON VEGETABLES**



# actosol® vs. Miracle-Gro

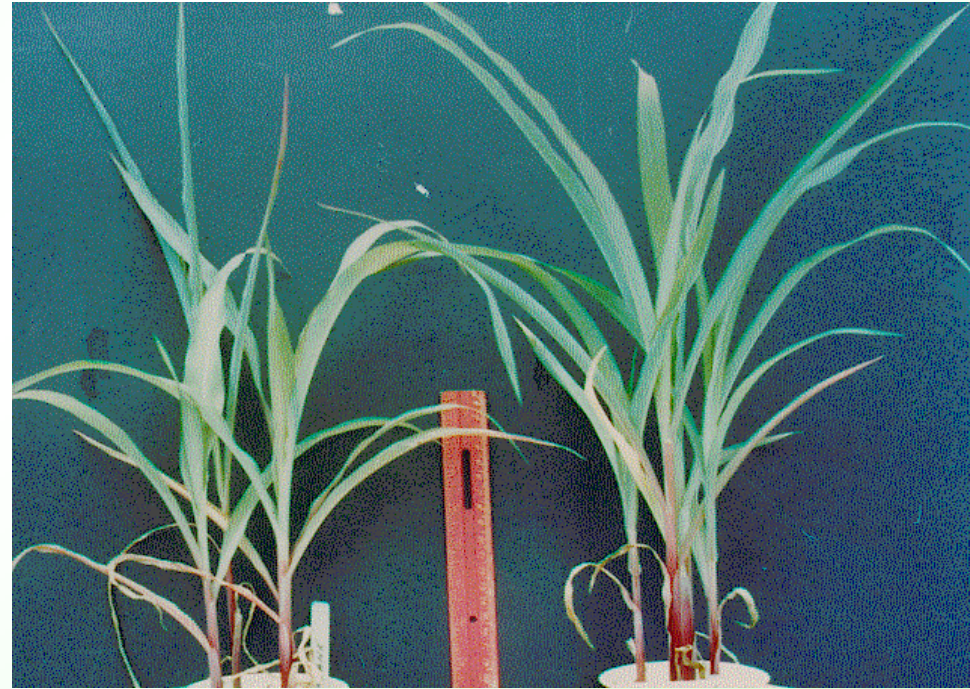
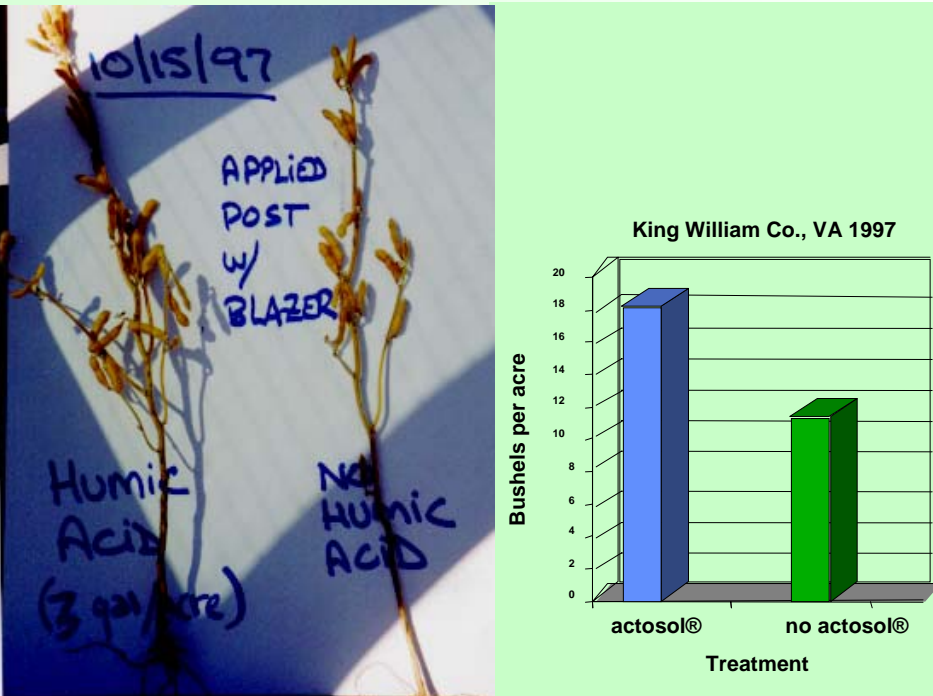


AUGUST 2003

# Agriculture

60% INCREASE IN SOYBEAN  
YIELD USING **actosol®**

EFFECT OF **actosol®** ON CORN PLANTS



# SUCSESSES OF actosol<sup>®</sup> HUMIC ACID FERTILIZER



Amazingly, the growth rate of the alfalfa and wheatgrass was significantly better – thicker, taller and a much darker green color - in the plot where the Actosol-Z<sup>™</sup> was added, even though only about 25% of the prescribed 100 ppm concentration of Actosol-Z<sup>®</sup> was actually applied. This is also evident in the photos below, where the agricultural consultant is shown collecting alfalfa and wheatgrass samples for analysis.



*Preserving tomorrow's world... today*

# actosol<sup>®</sup> APPLICATION INCREASED NUMBER OF HARVESTS AND COLOR OF CLOVER IN KAFR EL SHEIK, EGYPT



**Untreated**

**Treated**

**Yield (Tons/fed for total of 5 Fresh Cuts)**

---

**Treated**

**75.7**

**Untreated**

**67.2**

---

**% Yield Increase**

**12.65**



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## ◦ PRESS RELEASE ◦

FOOD AND AGRICULTURAL ORGANIZATION OF THE UNITED NATIONS  
VIA DELLE TERME DI CARACALLA - 00100·ROME, ITALY  
LIAISON OFFICE FOR THE AMERICAS·1001-22nd St.NW·WASHINGTON,DC 20437

### SOIL LOSS ACCELERATING WORLDWIDE Hinders Effort to Feed Earth's Growing Population

- 25 billion tons per year of topsoil lost worldwide
- 6 billion tons per year lost in U.S. alone
- Critical need exists to enhance soil fertility to feed world's growing population





**COMPARISION OF ANALYSIS OF SOIL ORGANIC MATTER OF HALIFAX COUNTY,  
VIRGINIA FARM SOIL**

	<b>SAMPLE ID</b>	<b>LOCATION</b>	<b>Organic Matter (%) *</b>	<b>Organic Matter (%) **</b>	<b>Organic Matter (%) ***</b>
<b>A. Chad Francis Farm</b>	01	Alpha Hay Field	2.2	2.1	0.04
	02	Sweet Corn Field	2.3	1.5	0.39
	03	Fescue Pasture	2.1	1.6	0.12
<b>B. Rosemary Dairy</b>	04	Fescue Hay Field	3.2	2.0	0.00
	05	Clover Hay Field	5.4	5.0	0.606
<b>C. Wayne Kendrick Farm</b>	06	Flue Cured Tobacco	2.3	1.7	0.17
	07	Burly Tobacco Field	2.2	1.4	0.39
	08	Soybean Field	2.5	1.8	0.14
	09	Corn Field	4.6	3.1	0.20
<b>D. Bit By Bit Farm</b>	10	Soybean Field	2.9	1.7	0.79
	11	Produce Field Tomato/ pumpkin	3.2	1.9	0.15
	12	Cornfield	1.1	0.8	0.00

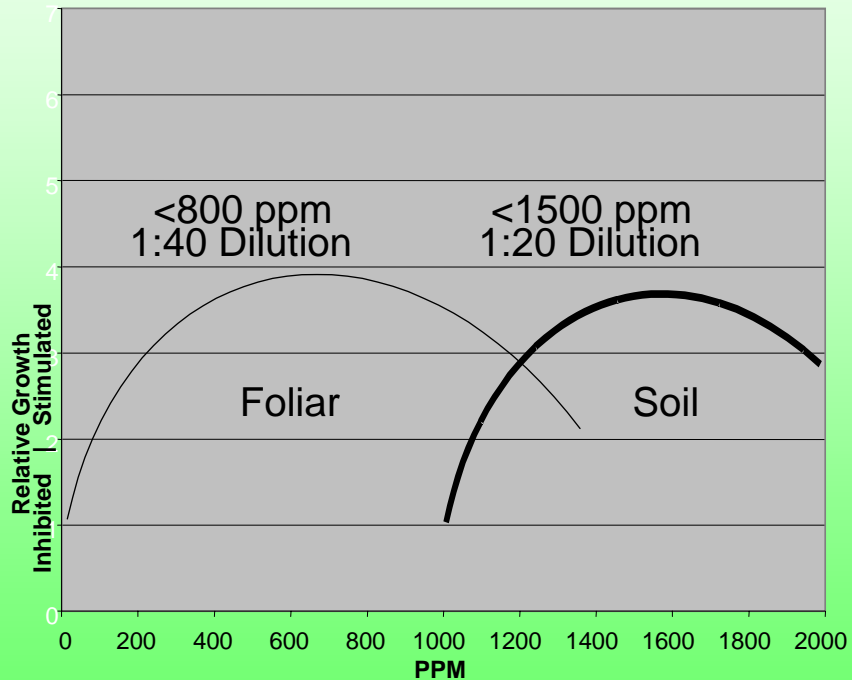
\*Loss-On-Ignition (LOI), a gravimetric, dry oxidation method, was used to estimate the percentage Soil Organic Matter by Virginia Tech.

\*\* A modified Walkley-Black method was used, where dichromate solution oxidizes organic C to CO<sub>2</sub> in acid medium by Virginia Tech.

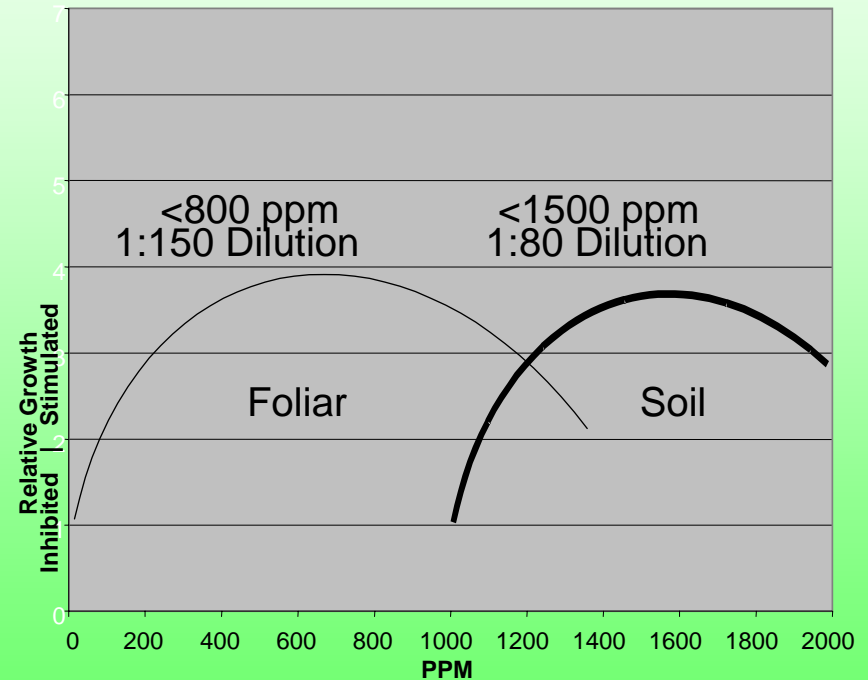
\*\*\* Humic Matter Analysis Method by Alkali Extraction per American Society of Soil Agronomy by Arctech, Inc.

# Optimum Dilution Rates for actosol®

Turf actosol®, Garden actosol®, Calcium actosol®,  
Micronutrient actosol®  
3% humic acid



Base actosol®  
12% humic acid



# actosol® Organic Fertilization Program for Turf Management and Plant Health Care

With **ORGANIC MIRACLE** for Sustained Greening

## Why **actosol**®?

**actosol**® is an organic nutrient activator which enhances soil fertility and stimulates the growth and development of plants. It is formulated with natural humic and fulvic acids, the active components of rich soil humus. Today soils have become highly depleted in organic humus and even with high nutrient inputs, the yields are suffering. The American Society of Agronomy publication, Humic Substances in Soil and Crop Sciences (1990) states that by additions of organic humic the health and growth of plants can be significantly increased.

## Benefits of **actosol**®

### Physical Benefits

- Increases water holding capacity
- Increases aeration of soils
- Improves soil workability
- Helps resist drought
- Improves seed bed
- Makes soil more friable or crumbly
- Reduces soil erosion.

### Chemical Benefits

- Chelates nutrients for uptake by plants
- Possesses high ion-exchange capacity.
- Increases buffering properties of soils
- Increases percentage of total Nitrogen in soils.

### Biological Benefits

- Accelerates plant cell division and promotes growth
- Increases germination of seeds and viability
- Increases root respiration and formation
- Stimulates growth & proliferation of soil microorganisms.
- Aids in photosynthesis.

Time	Application	actosol® Product in 200 gallon tank*	Lbs per 90,000 sq. ft Application						Humic/ Fulvic
			N	P	K	Ca	Fe	S	
Late Feb- Early March	Pre-Emergent – Restart	6gal Turf Booster 2gal Fe Chelated	12	3	3		0.4		
Late May	Emergent – Lush greening	5gal Turf Booster 2gal Ca actosol 1gal Fe Chelated	10 0.4	2.5	2.5	0.4	0.2		
Early to Mid June	Pre-Summer – Maintenance	6gal Garden 2gal Fe Chelated	6	6	6		0.4		
Late July to August	Summer – Stress free Green	8gal Turf Booster	16	4	4				
Sept. – Oct.	Fall – Sustained Beauty	6gal Ca actosol 2gal Fe Chelated	1.2			1.2	0.4		
Nov. – Dec.	Winterizer – Prepare	4gal Turf Booster 4gal Garden actosol	8 4	2 4	2 4				
Total: 48gal			55.60	21.5	2.5	1.6	1.4	0.5	15

Contains non-plant food ingredients, 2.9% \* If needed mix fungicide in the tank. However perform jar test for Humic/Fulvic Acid derived from Lignite. Quick and sustained release with 30% Nitrogen, 50% P<sub>2</sub>O<sub>5</sub> and 50% K<sub>2</sub>O bound to humic/fulvic components

**compatibility. May reduce fungicide use by as much as 50%.**

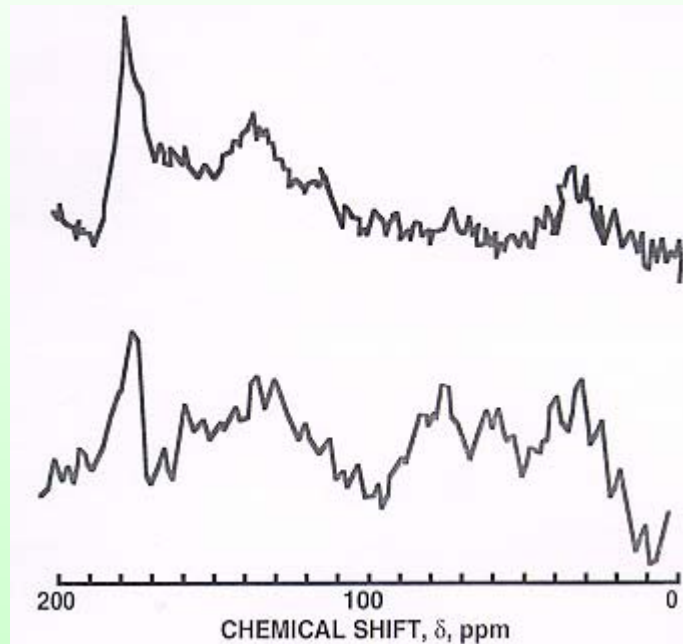
USDA ALLOWED/EPA APPROVED



# COMPARISON OF ACTOSOL® HUMIC ACIDS WITH SOIL HUMIC ACIDS

## $^{13}\text{C}$ Nuclear Magnetic Resonance

actosol® Humic Acids



soil Humic Acids



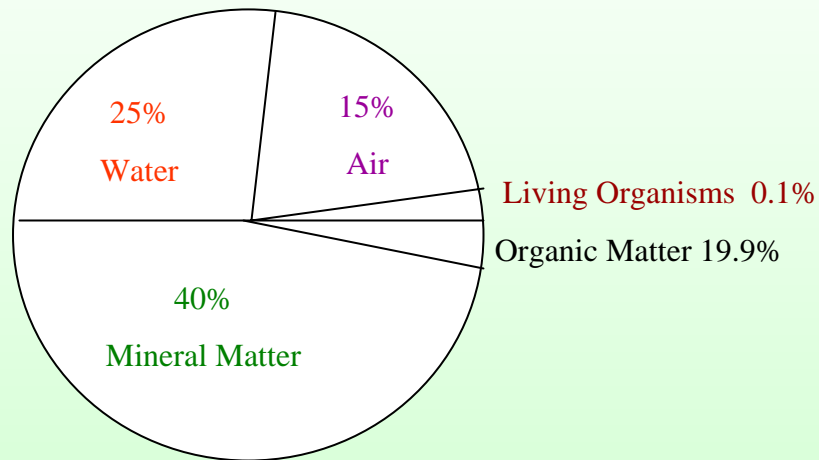
## AVERAGE ELEMENT COMPOSITION OF SOIL HUMIC SUBSTANCE

Element	Humic Acid %	Fulvic Acid %
Carbon	53.8-58.7	40.7-50.6
Hydrogen	3.2-6.2	3.8-7.0
Oxygen	32.8	39.7-49.8
Nitrogen	0.8-4.3	0.9-3.3
Sulfur	0.1-1.5	0.1-3.6



# COMPONENTS OF FERTILE SOIL

SOIL



## MOST ACTIVE

- Humic Acid (Soluble at high pH)
- Fulvic Acid (Soluble at all pH)
- Humic (Insoluble)



*Preserving tomorrow's world... today*

## COMPONENT PARTS OF SOIL TEXTURAL CLASS

***Sand:*** Soil that contains 85% or more of sand; % silt + 1.5 times % clay shall not exceed 15

***Loam:*** Soil contains 7-27% clay; 28-50% silt & 52% sand

***Clay:*** Soil that contains 40% or more clay; 45% sand and 40% silt



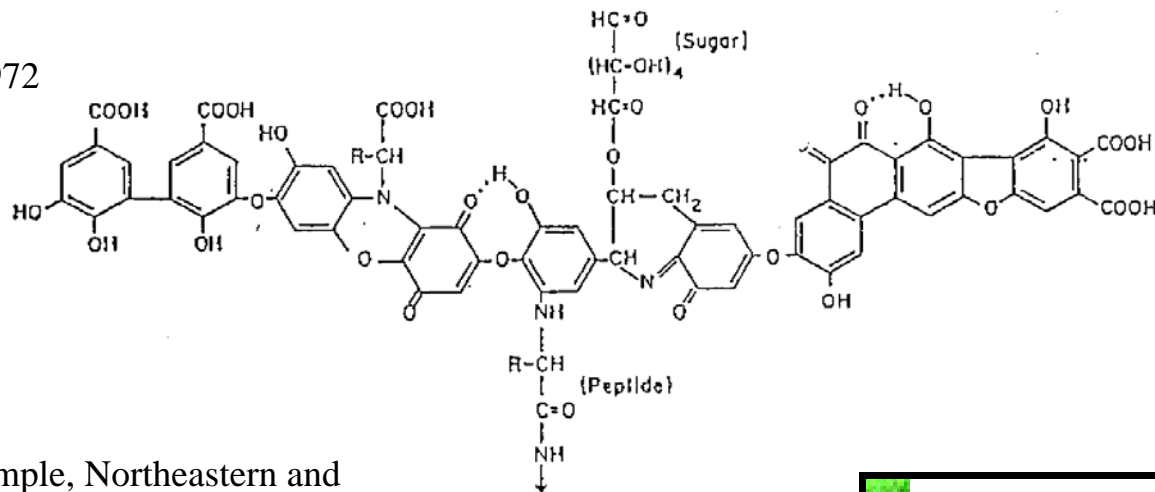
## SOIL TEXTURE CLASSES

- Sand
- Loamy sand
- Sandy loam
- Loam
- Silt loam
- Silt
- Sandy clay loam
- Clay loam
- Silty clay loam
- Sandy clay
- Silty clay
- Clay

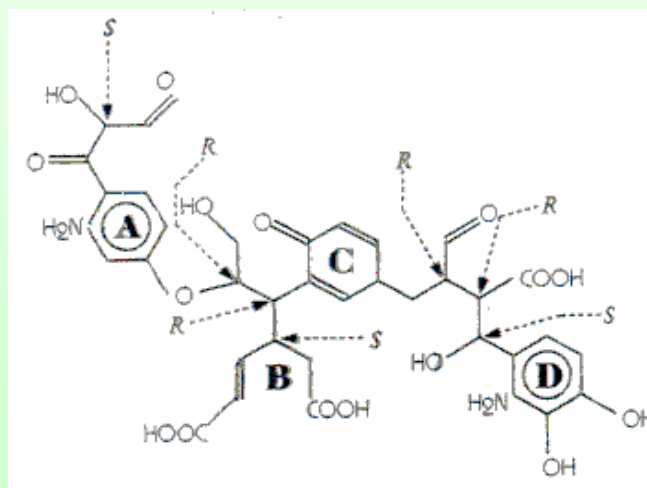


# MODELS OF HUMIC ACID MOLECULE

A. Stevenson, 1972



B. TNB, 1998 (Temple, Northeastern and Birmingham)



Empirical Formula:  $C_{36}H_{30}O_{15}N_2 \cdot xH_2O$

$x=0-15$

