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
www.arctech.com

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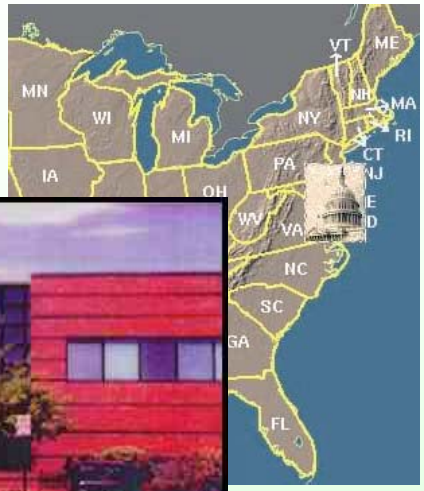
Preserving tomorrow's world... today

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)

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HUMIC ACID

- Carbon-rich highly functionalized organic molecule comprising of carboxlic, 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

C	carbon
H	hydrogen
O	oxygen

MACRO

N	nitrogen
P	phosphorus
K	potassium

SECONDARY

Ca	calcium
Mg	magnesium
S	sulphur

MICRO

B	boron
Cu	copper
Fe	Iron
Mn	Manganese
Mo	molybdenum
Zn	zinc
Cl	chloride
Co	cobalt

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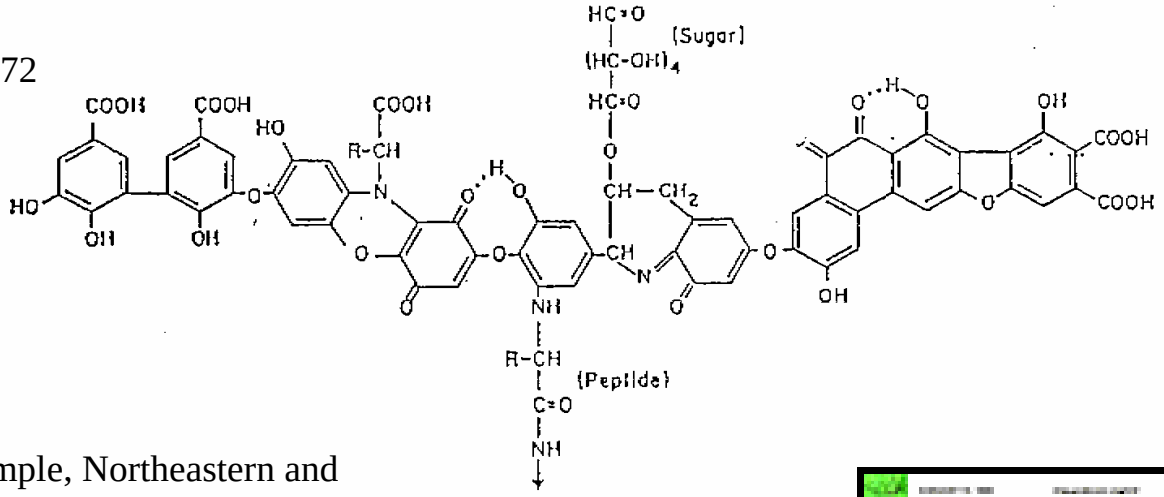
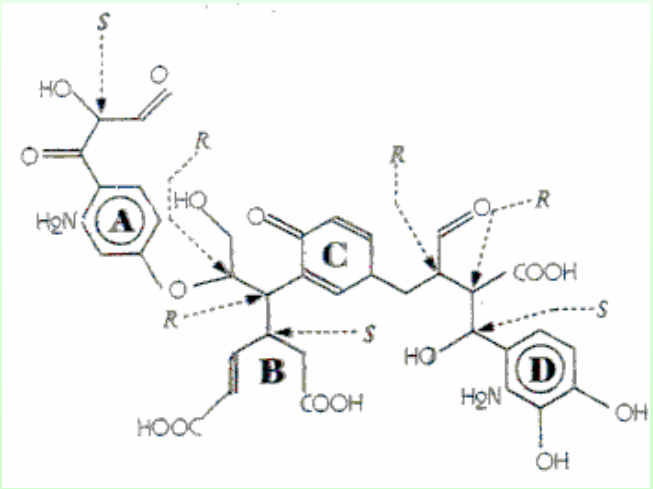
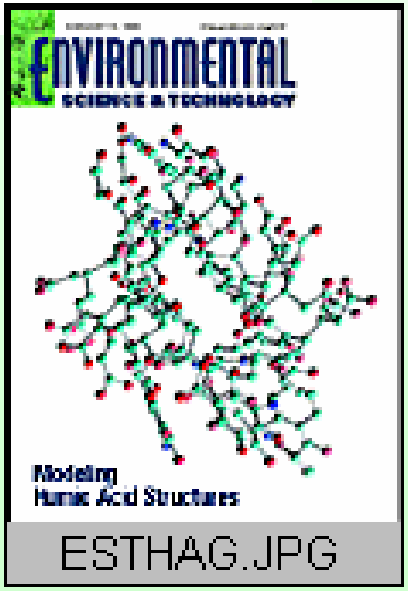
MODELS OF HUMIC ACID MOLECULE

A. Stevenson, 1972



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





ESTHAG.JPG

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

x=0-15

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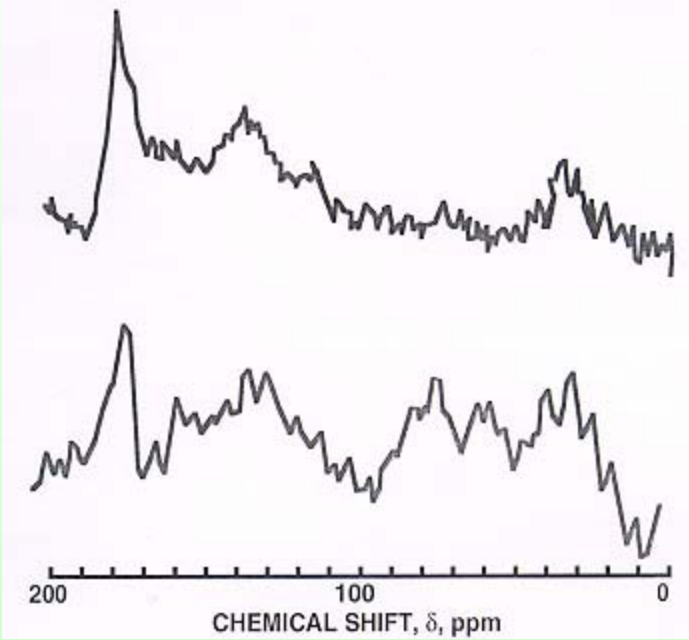
COMPARISON OF *actosol*® HUMIC ACIDS WITH SOIL HUMIC ACIDS

^{13}C Nuclear Magnetic Resonance

actosol® Humic Acids

Soil Humic Acids



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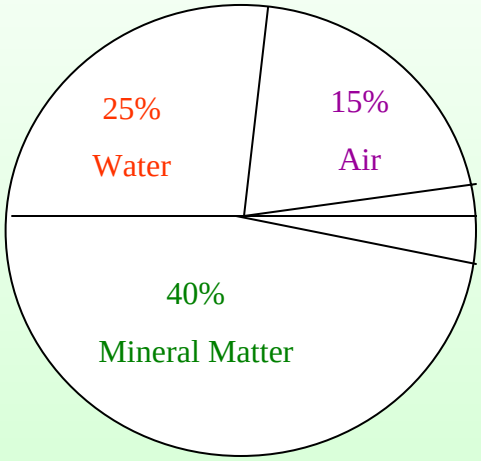
COMPONENTS OF OPTIMUM FERTILE SOIL

SOIL



Living Organisms 0.1%

Organic Matter 19.9%

MOST ACTIVE

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

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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

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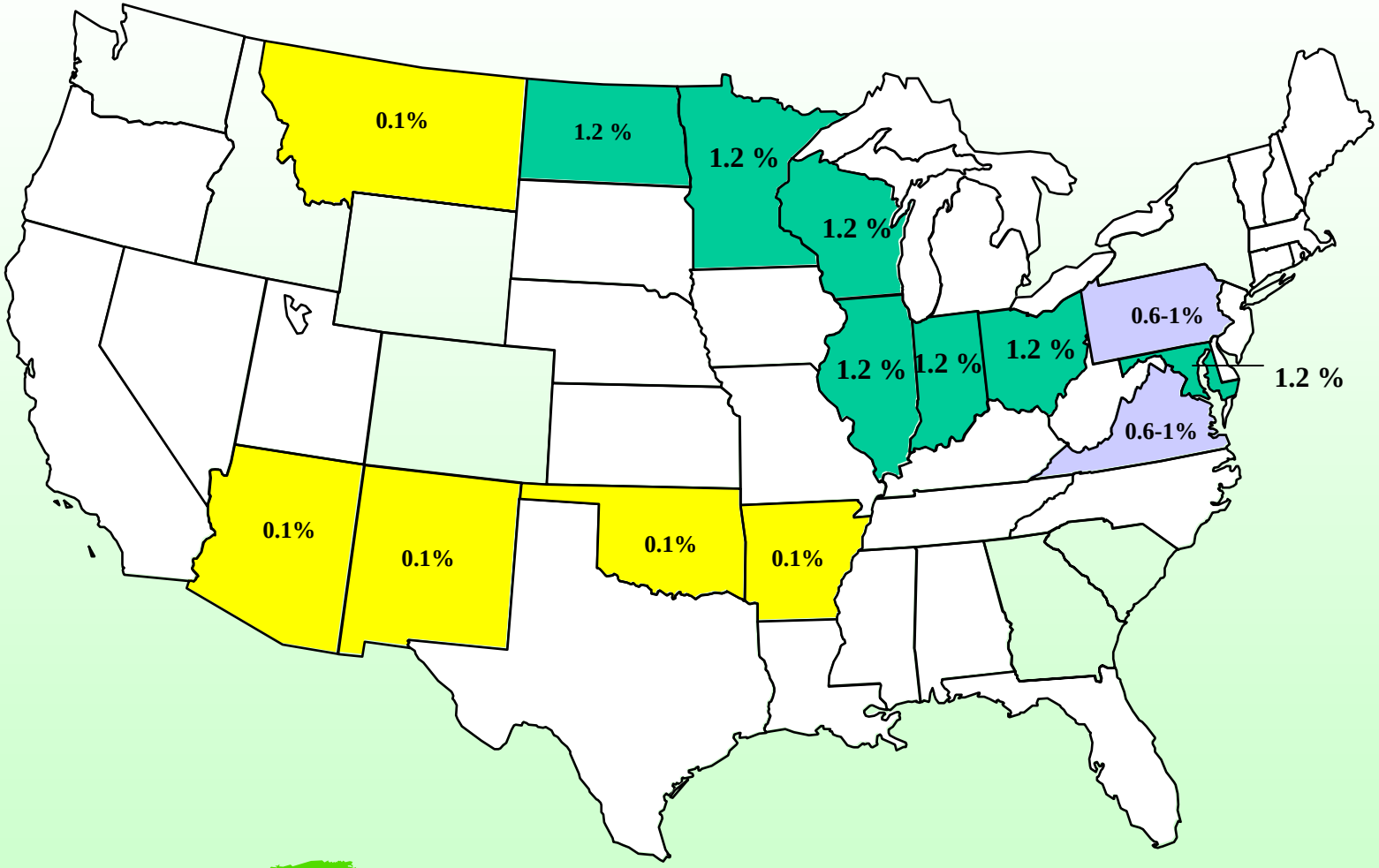
HUMIC ACID CONTENT OF VARIOUS SOILS IN THE U.S.



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

	SAMPLE ID	LOCATION	Organic Matter (%) *	Organic Matter (%) **	Organic Matter (%)***
A. Chad Francis Farm	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. Rosemary Dairy	04	Fescue Hay Field	3.2	2.0	0.00
	05	Clover Hay Field	5.4	5.0	0.606
C. Wayne Kendrick Farm	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
D. Bit By Bit Farm	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_2 in acid medium by Virginia Tech.

*** Humic Matter Analysis Method by Alkali Extraction per American Society of Soil Agronomy analysis

ARGTECH
Analyzing today's new's world... today

◦ 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

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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

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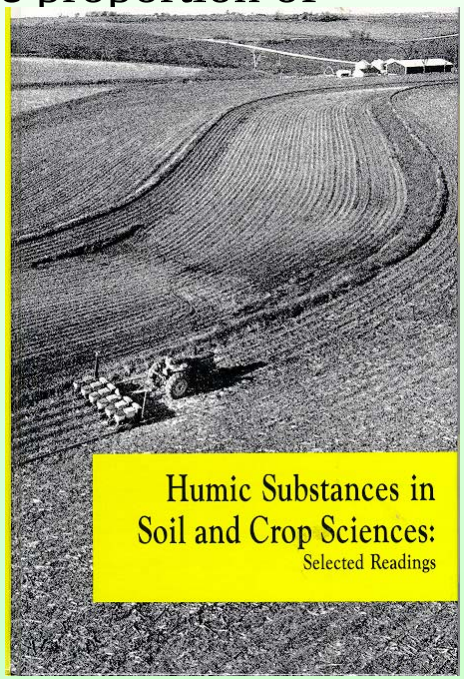
HOW DOES *actosol*® HUMIC ACID CREATE BENEFITS?

- 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.



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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.

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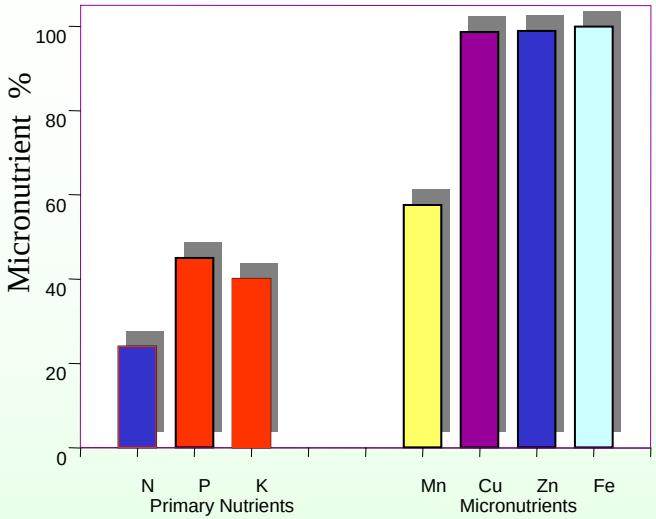
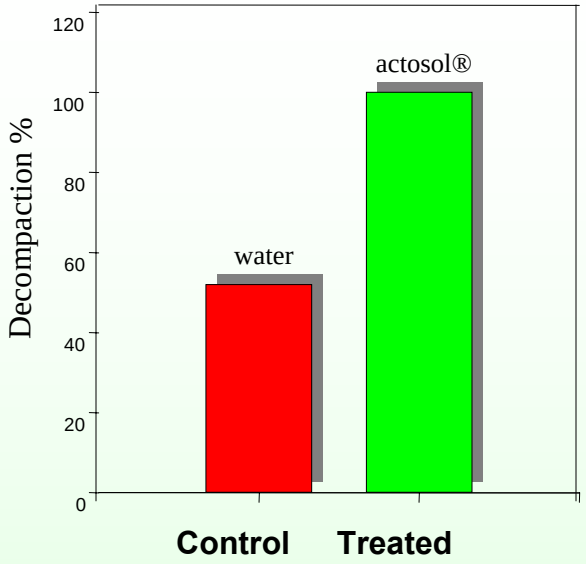
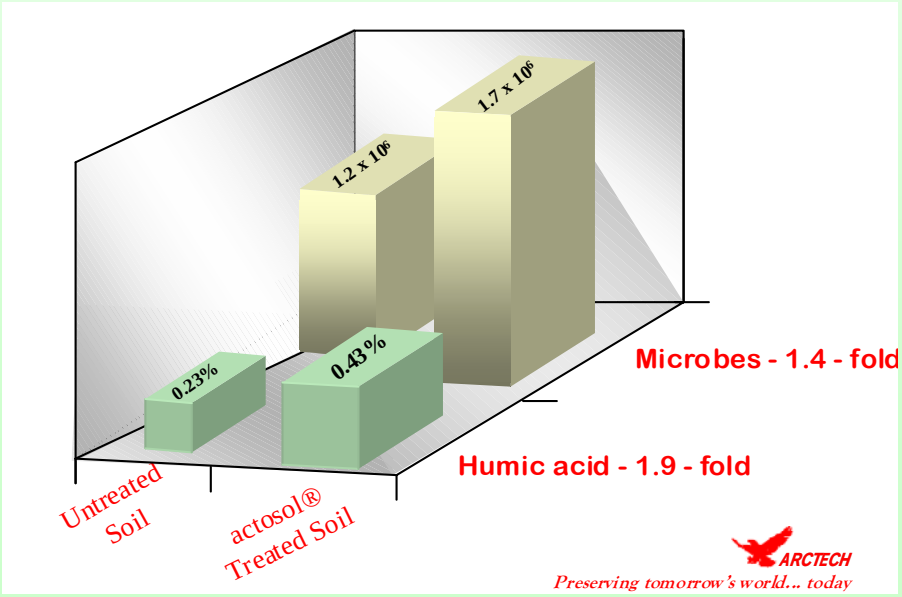
Primary and micronutrients bound to actosol® humic acid



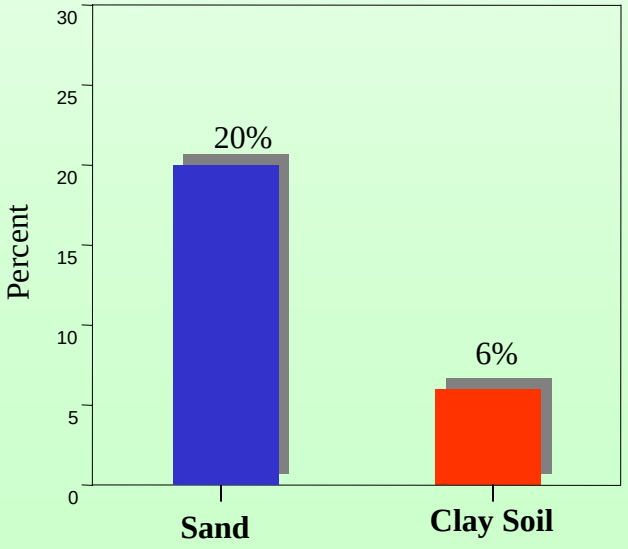
actosol® improves soil structure



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



actosol® humic acid increases water holding capacity



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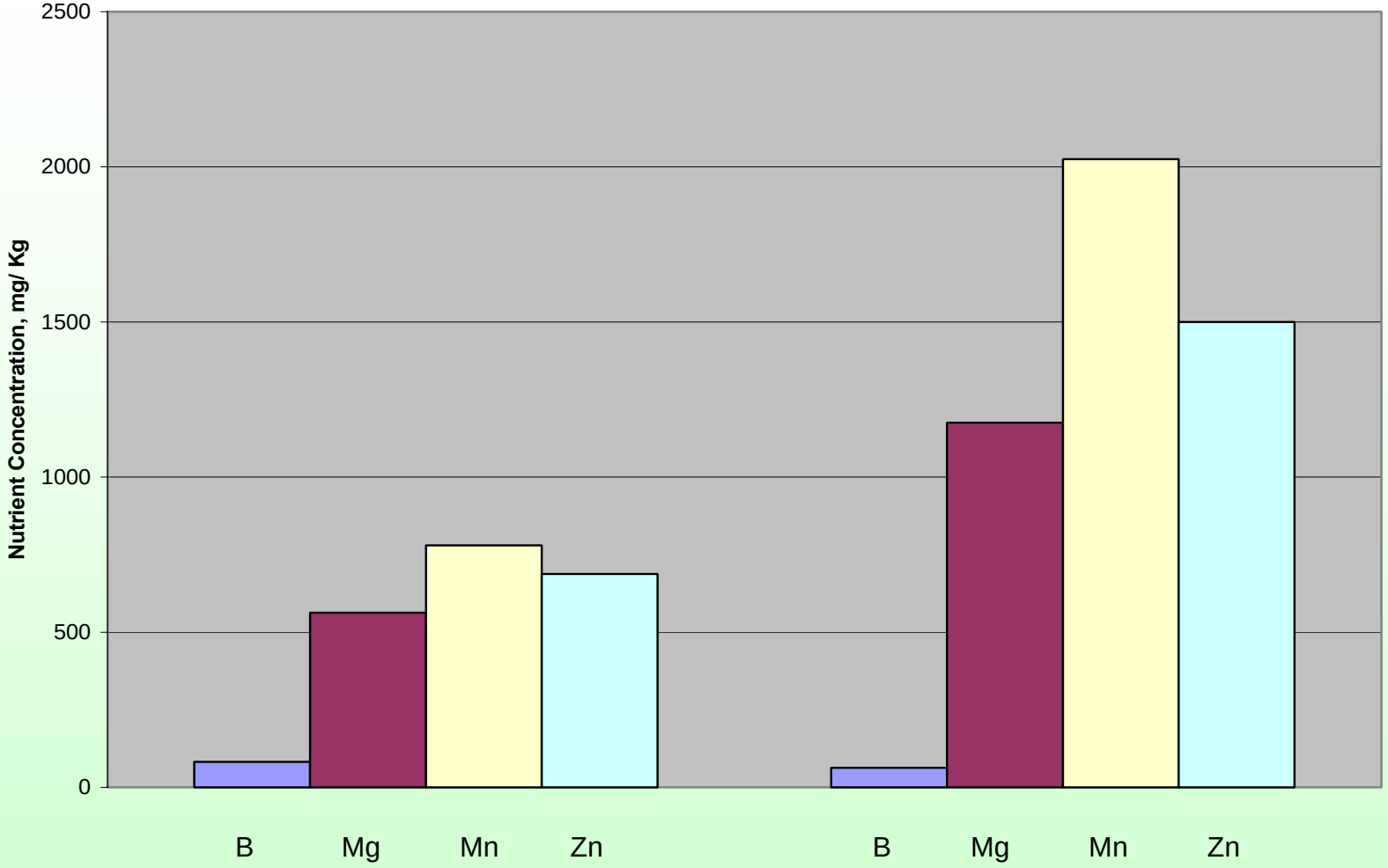
actosol Humic Chelated Micronutrients Increases Uptake by the Plants



Micro-Nutrient Solution (Control)

Micro-Nutrient Chelated actosol®

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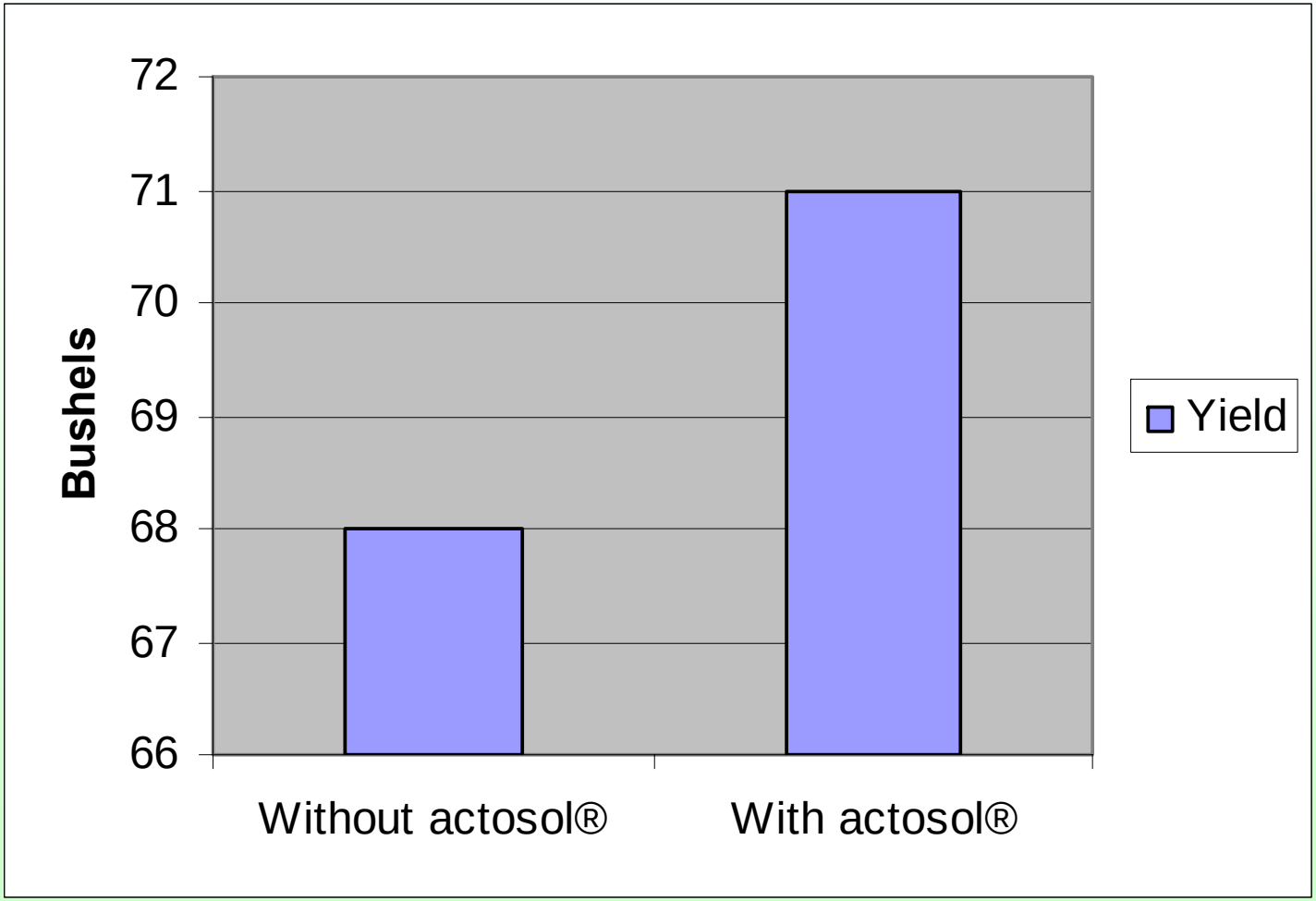
actosol® Humic Acid Application Will Reduce Nutrient Input and Increase Wheat Yield



N: 30
P: 70
K: 100

N: 30
P: 35
K: 50

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

Sitka, Alaska

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Approval of *actosol*® 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

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

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

Additional Info : 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%)

	HUMIC ACID	N	P (P_2O_5)	K (K_2O)	Ca	Mg	S	B	Cl	Cu	Fe	Mn	Zn
Turf Booster actosol®	3	20	5	5	0.08	0.07	.10	0.007	0.5	0.01	0.1	0.01	0.01
Horticultural actosol®	3	10	10	10	0.08	0.07	.10	0.007	0.5	0.01	0.1	0.01	0.01
Calcium actosol®	3	2	-	-	2.00	0.07	.10	0.007	0.5	0.01	0.1	0.01	0.01
Micronutrient actosol®	3	0.4	0.08	.5	0.08	0.07	.10	0.007	0.5	0.5	0.5	0.5	0.5
Bio-Activated Base actosol®	6	0.4	0.08	1.5	0.08	0.07	.10	0.007	0.5	0.01	0.5	0.01	0.01

Notes:

1. All actosol® products are water soluble liquid

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 BaCl2 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 are formulated with USDA ALLOWED/EPA APPROVED/OMRI LISTED humic matter extracted from naturally occurring organic matter.

4. All actosol® liquid products formulated with NPK contain slow release bound 35% N, 50% P_20_5 and 50% K_20.

Corporate
ARCTECH, INC.
14100 Park Meadow Drive • Chantilly, Virginia 20151
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Manufacturing Plant
ARCTECH, INC.
P.O. Box 323, S. Boston, VA 24592
Phone (434) 575-7200 • Fax (434) 575-7230

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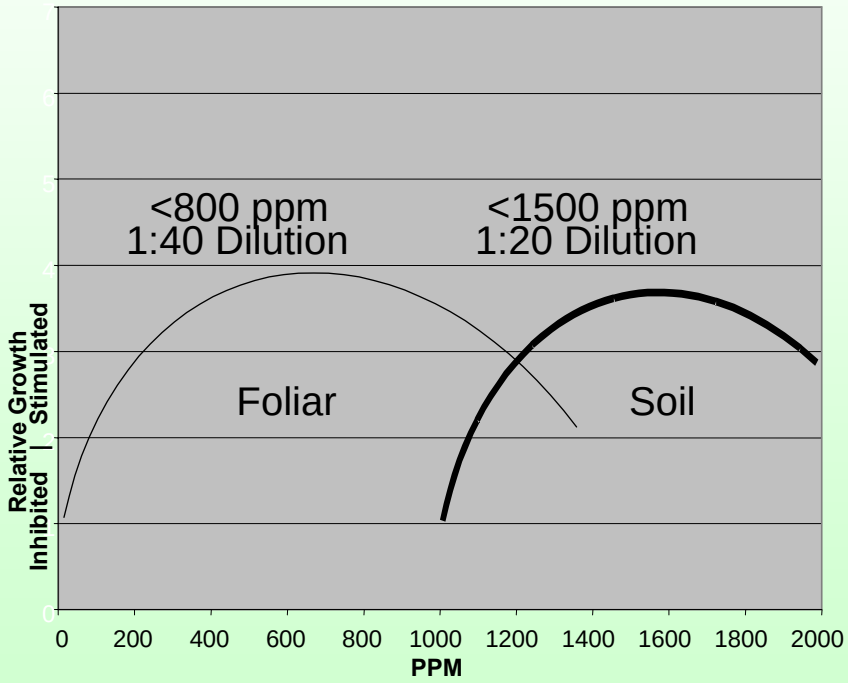
Optimum Dilution Rates for *actosol*®

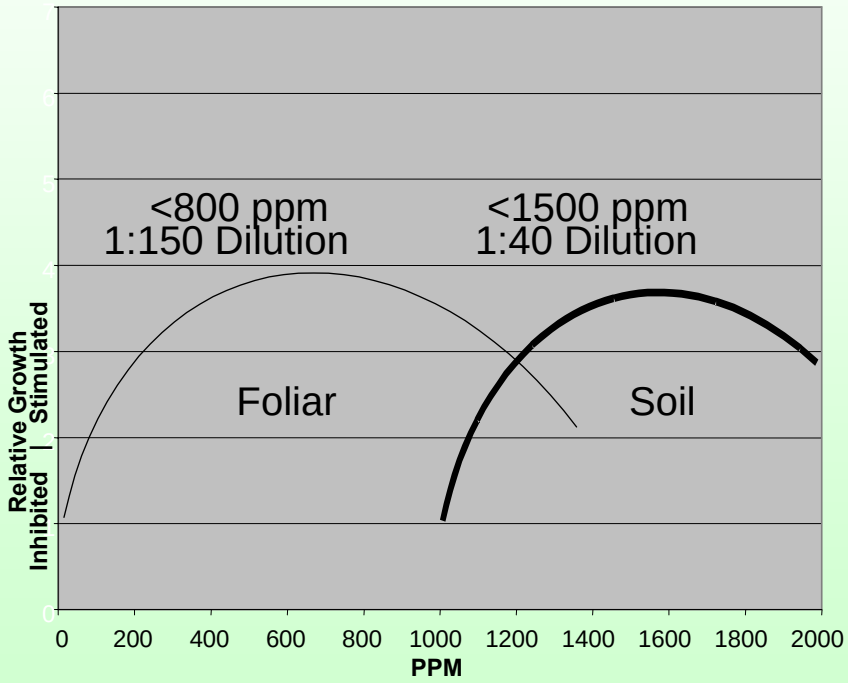
Turf actosol®, Horticultural actosol®,
Calcium actosol®, Micronutrient actosol®

3% humic acid



Base actosol®

6% humic acid



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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

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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

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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						
			N	P	K	Ca	Fe	S	Humic/ Fulvic
Late Feb-Early March	Pre-Emergent – Restart	6gal Turf Booster 2gal Fe Chelated 100 lbs. Urea	12 46	3	3		0.4		
Late May	Emergent – Lush greening	5gal Turf Booster 2gal Ca actosol 1gal Fe Chelated 100 lbs. Urea	10 0.4 46	2.5	2.5	0.4	0.2		
Early to Mid June	Pre-Summer – Maintenance	6gal Garden 2gal Fe Chelated 100 lbs. Urea	6 46	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 100 lbs. Urea	1.2 46			1.2	0.4		
Nov. – Dec.	Winterizer – Prepare	4gal Turf Booster 4gal Horticultural actosol	8 4	2 4	2 4				
Total:			239.6	21.5	2.5	1.6	1.4	0.5	15

Contains non-plant food ingredients, 2.9% Humic/Fulvic Acid derived from Lignite. Quick and sustained release with 30% Nitrogen, 50% P_2O_5 and 50% K_2O bound to humic/fulvic components

USDA ALLOWED/EPA APPROVED

*** If needed mix fungicide in the tank. However perform jar test for compatibility. May reduce fungicide use by as much as 50%.**

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Turf

actosol® CREATES VEGETATION IN SAND DUNES

Ocean City, MD

HYDROSEED MIX

HYDROSEED MIX PLUS actosol®

6 weeks growth, Virginia Tech., Testing

ARGTECH

Preserving tomorrow's world... today

actosol®

Organic **Biostimulant**

WITH & WITHOUT

Increase stress tolerance

ARGTECH

Preserving tomorrow's world... today

actosol®

Organic **Biostimulant**

WITH & WITHOUT

Enhance root growth & yield

ARGTECH

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actosol® Hydroseeding Effective for Reclamation Site in Northern Alabama

actosol®

Treated

Before Treatment

Control

After Treatment

ARGTECH

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SUCCESSES OF
actosol® 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™ was added, even though only about 25% of the prescribed 100 ppm concentration of Actosol-Z® was actually applied. This is also evident in the photos below, where the agricultural consultant is shown collecting alfalfa and wheatgrass samples for analysis.

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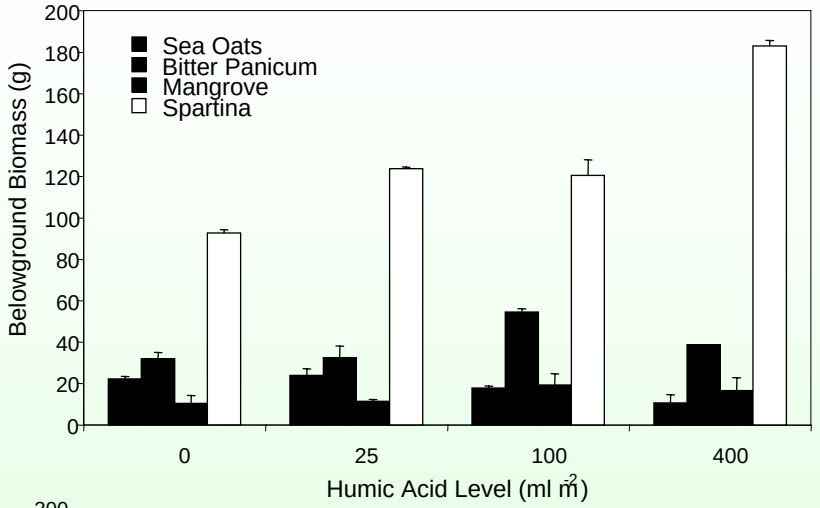
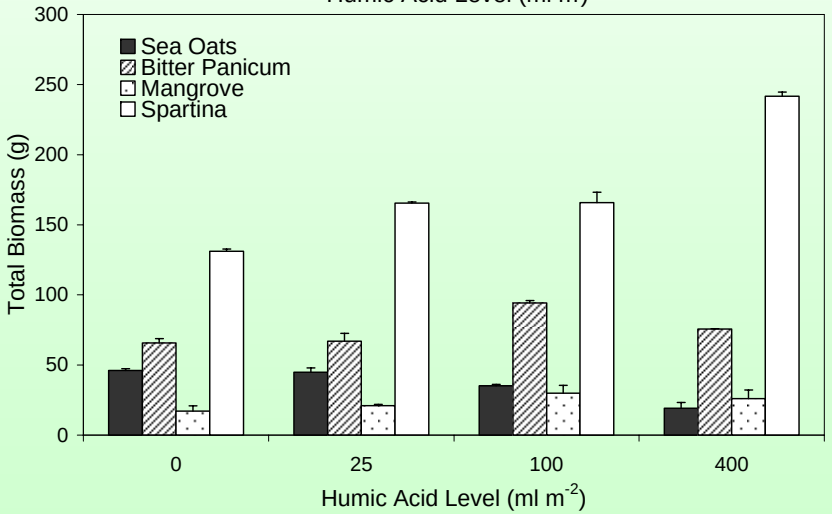
actosol® Humic Acid Application Increased Roots, Top Biomass, and Vigorous Growth of Dune Grasses for Restoration of Louisiana Coastal Lands. (Tests by Prof. Mark Hester of University of New Orleans)

Vigorous growth of bitter panicum (*Panicum amarum*) when a fertilization regime was coupled with a Humic Acid application of 100 ml per m^{-2}. 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^{-2} level. Mangrove and Bitter Panicum both demonstrated greater biomass production at the 100 ml m^{-2} humic acid level. It is anticipated that Sea Oats will demonstrate elevated productivity at some more moderate level of humic acid (<25 ml m^{-2}).

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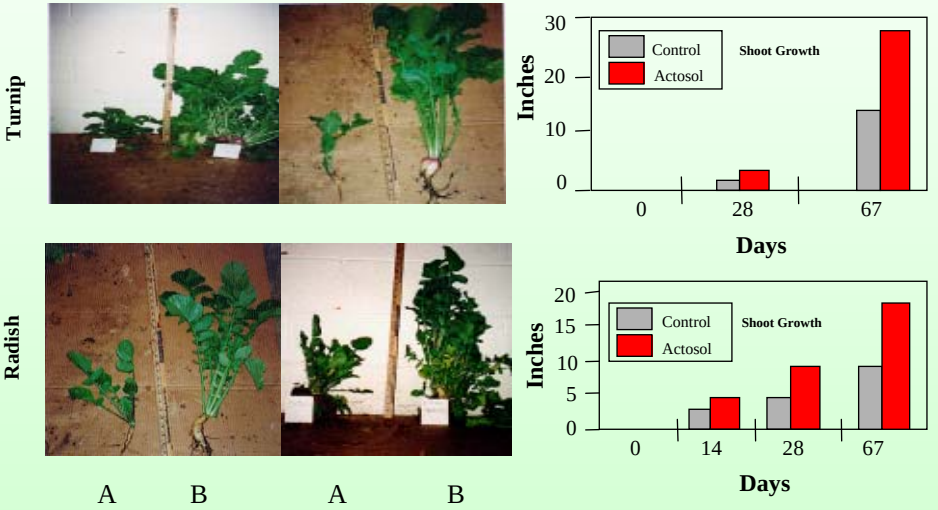
Preserving tomorrow's world...today

Floriculture

actosol® BRIGHTENS FLOWERS

Horticulture

actosol® MIRACLE ON VEGETABLES



A - Standard Garden (20-20-20) **B - Garden actosol® (10-10-10)**

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actosol® vs. Miracle-Gro

AUGUST 2003

ARGTECH

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actosol®

Organic **Biostimulant**

WITH & WITHOUT

Improve nutrient uptake

ARGTECH

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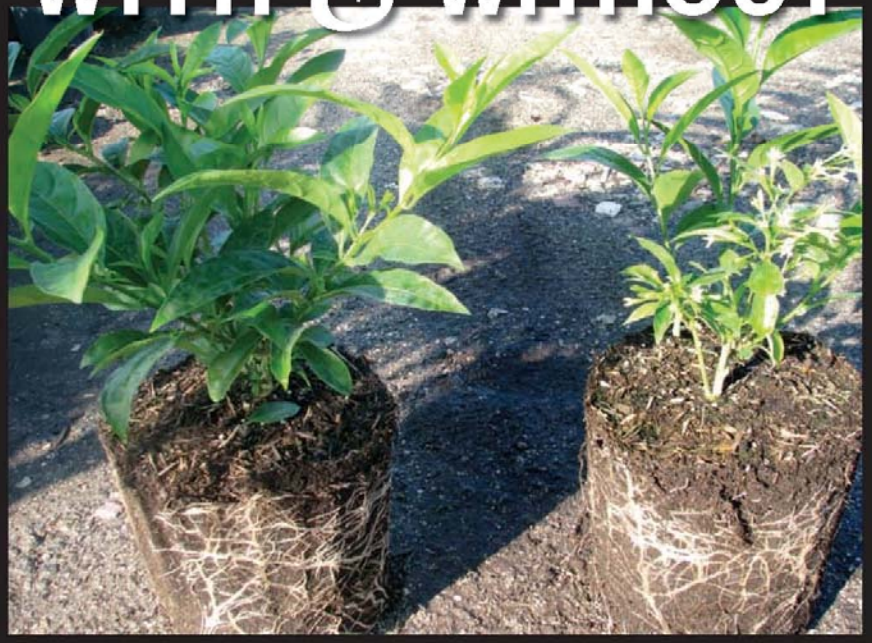
actosol®

Organic **Biostimulant**

WITH & WITHOUT



Improve nutrient uptake

ARGTECH

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actosol®

Organic **Biostimulant**

WITH & WITHOUT

Begonia's tests results

Innovations by **ARCTECH**

ARCTECH

Preserving tomorrow's world... today

actosol®

Organic **Biostimulant**

WITH & WITHOUT

Palm test results

Innovations by ARCTECH

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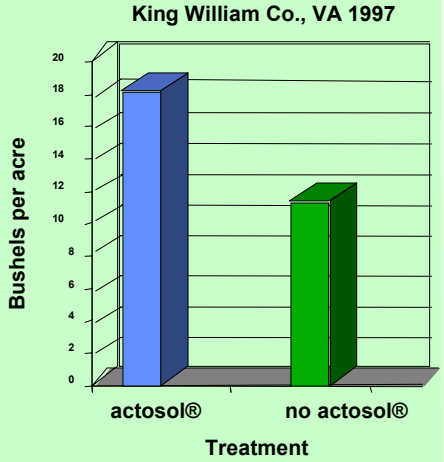
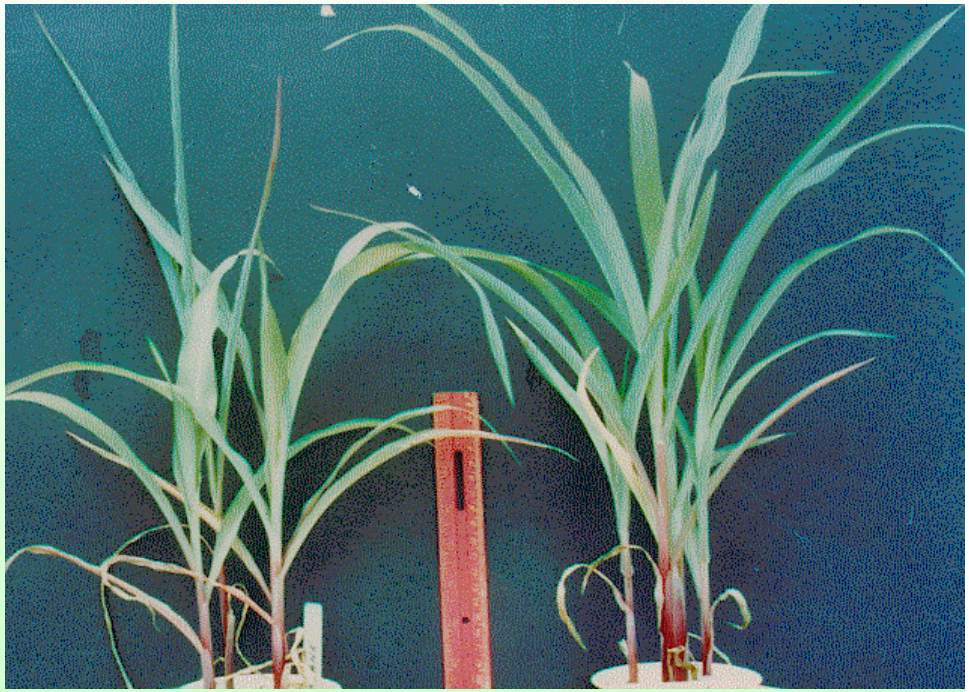
Agriculture

60% INCREASE IN SOYBEAN YIELD USING actosol®



EFFECT OF actosol® ON CORN PLANTS



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Preserving tomorrow's world... today

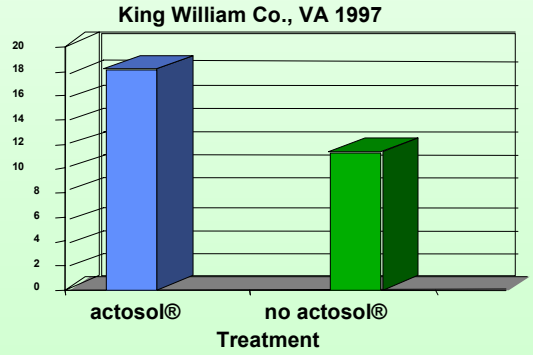
actosol®

Humic Acid Fertilizer

Derivatives of naturally occurring humus matter in soil, humic acids are the key ingredient in all actosol® products. Humic acids are active elements in organic soils and are important for the conversion of fertilizer into plant available nutrients.

60% Increase In Soybean Yield Using actosol®

Using Humic Acids Corn Yield Winner Gleans 334 bu/acre



- ***actosol®*** Increased Wheat Yield By 2.52 bu/Acre In Controlled Tests!
- Foliar Application of ***actosol®*** Increased Barley Yields by 5.2 bu/Acre

THE actosol® ADVANTAGE

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

Distributors & Sales Reps Wanted

Contact: Daman Walia at actosol plant, South Boston, VA. 1 (800) 471-8494

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actosol® in Peoples Republic of China

腐殖酸液体肥 ACTOSOL®

生物试验报告

研究单位：西南农业大学资源环境学院

研究人员：王正银　徐卫红　叶学见

李光耀　廖琼仙

资助单位：香港民生实业有限公司

中国·重庆

一九九九年三月～一九九九年五月

actosol® 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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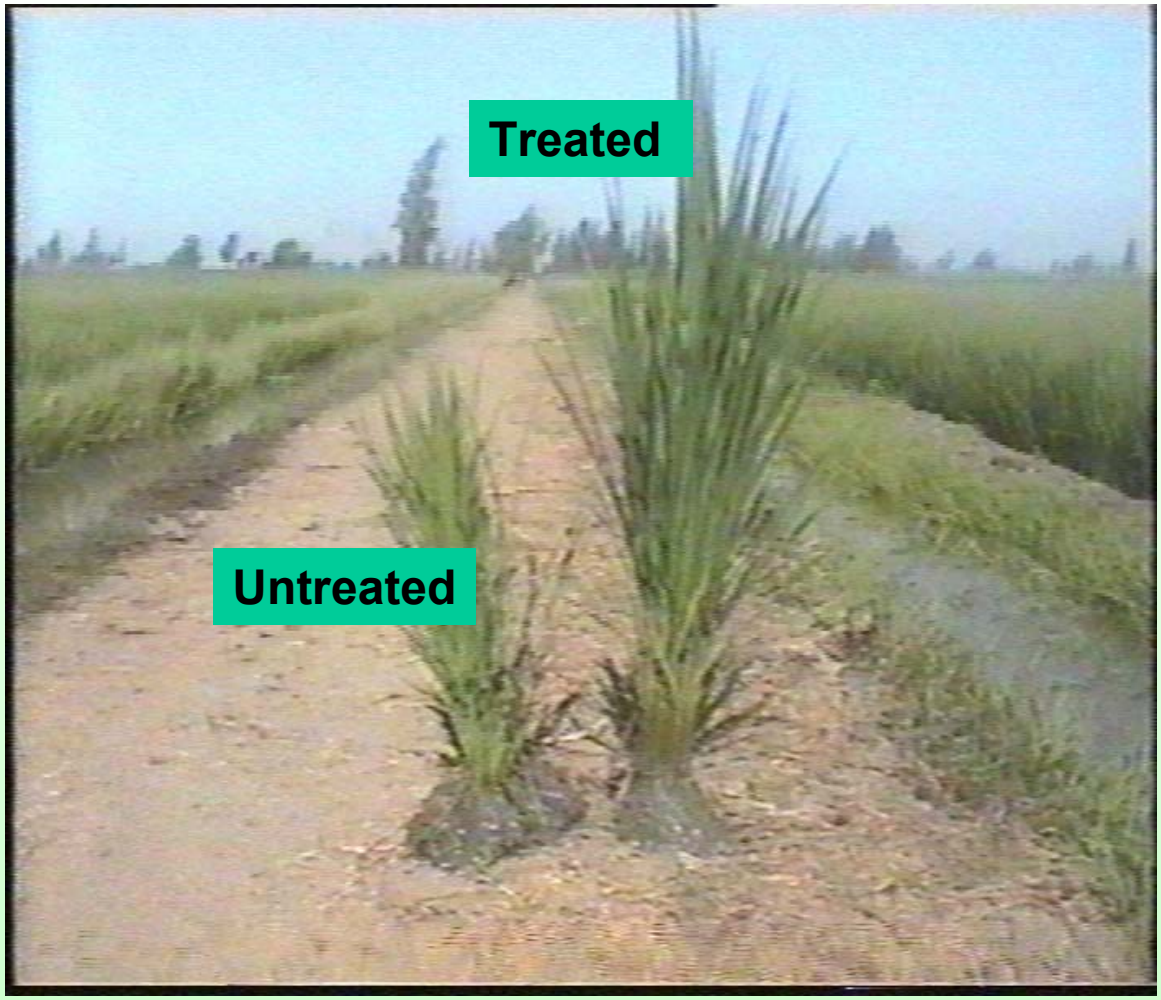
Control-Mango

Foliar & Soil Applications

Rice



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Similar Trends were Also Observed in the Above Mentioned Parameters in Apricot Seedlings

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Pears

Treated

Untreated

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Peach

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actosol® Application Enhances Growth of Strawberry Plants in West Tahrer, Egypt

Untreated

Treated

ARGTECH

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