• 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
Established in 1988 as spin-off company from Atlantic Research Corp., a 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 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
- Ca calcium
- Mg magnesium
- S sulphur

MICRO

- B boron
- Cu copper
- Fe Iron
- Mn Manganese
- Mo molybdenum
- Zn zinc
- Cl chloride
- Co cobalt
MODELS OF HUMIC ACID MOLECULE

A. Stevenson, 1972

Empirical Formula: \( C_{36}H_{36}O_{18}N_2 \cdot xH_2O \)

\[ x = 0 - 15 \]

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

Environmental Science & Technology

Preserving tomorrow’s world… today
COMPARISON OF actosol® HUMIC ACIDS WITH SOIL HUMIC ACIDS

13C Nuclear Magnetic Resonance

actosol® Humic Acids

Soil Humic Acids
COMPONENTS OF OPTIMUM FERTILE SOIL

SOIL

COMPONENTS:

- Mineral Matter: 40%
- Air: 15%
- Water: 25%
- Organic Matter: 19.9%
- Living Organisms: 0.1%

MOST ACTIVE:

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

Preserving tomorrow’s world... today
<table>
<thead>
<tr>
<th>Textural Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>Soil that contains 85% or more of sand; % silt + 1.5 times % clay shall not exceed 15</td>
</tr>
<tr>
<td>Loam</td>
<td>Soil contains 7-27% clay; 28-50% silt &amp; 52% sand</td>
</tr>
<tr>
<td>Clay</td>
<td>Soil that contains 40% or more clay; 45% sand and 40% silt</td>
</tr>
</tbody>
</table>
HUMIC ACID CONTENT OF VARIOUS SOILS IN THE U.S.
### COMPARISON OF ANALYSIS OF SOIL ORGANIC MATTER OF HALIFAX COUNTY, VIRGINIA FARM SOIL

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

*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 CO₂ in acid medium by Virginia Tech.**

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

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.
Microbes - 1.4 - fold
Humic acid - 1.9 - fold

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

Primary and micronutrients bound to actosol® humic acid

Primary and micronutrients bound to actosol® humic acid

actosol® improves soil structure

actosol® humic acid increases water holding capacity
actosol Humic Chelated Micronutrients Increases Uptake by the Plants

Micro-Nutrient Solution (Control)

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

- Without actosol®: N: 30, P: 70, K: 100
- With actosol®: N: 30, P: 35, K: 50
IMPORTANCE OF HUMUS, A KEY COMPONENT IN actosol®
DISCOVERED DURING ALASKAN CRUISE

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

|                        | N   | P (P₂O₅) | K (K₂O) | 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% P₂O₅ and 50% K₂O.
Optimum Dilution Rates for actosol®

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

3% humic acid

<800 ppm 1:40 Dilution
<1500 ppm 1:20 Dilution

<800 ppm 1:150 Dilution
<1500 ppm 1:40 Dilution

Base actosol®
6% humic acid

Preserving tomorrow’s world… today
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
**actosol® Organic Fertilization Program for Turf Management and Plant Health Care**

---

**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.

---

### Lbs per 90,000 sq. ft Application

<table>
<thead>
<tr>
<th>Time</th>
<th>Application</th>
<th>actosol® Product in 200 gallon tank</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Ca</th>
<th>Fe</th>
<th>S</th>
<th>Fulvic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late Feb- Early March</td>
<td>Pre-Emergent – Restart</td>
<td>6gal Turf Booster</td>
<td>12</td>
<td>3</td>
<td>3</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2gal Fe Chelated</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late May</td>
<td>Emergent – Lush greening</td>
<td>5gal Turf Booster</td>
<td>10</td>
<td>2.5</td>
<td>2.5</td>
<td>0.4</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2gal Ca actosol</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1gal Fe Chelated</td>
<td></td>
<td>2.5</td>
<td>2.5</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early to Mid June</td>
<td>Pre-Summer – Maintenance</td>
<td>6gal Garden</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2gal Fe Chelated</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late July to August</td>
<td>Summer – Stress free Green</td>
<td>8gal Turf Booster</td>
<td>16</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept. – Oct.</td>
<td>Fall – Sustained Beauty</td>
<td>6gal Ca actosol</td>
<td>1.2</td>
<td></td>
<td></td>
<td>1.2</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2gal Fe Chelated</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov. – Dec.</td>
<td>Winterizer – Prepare</td>
<td>4gal Turf Booster</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4gal Horticultural actosol</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td></td>
<td></td>
<td>239.6</td>
<td>21.5</td>
<td>2.5</td>
<td>1.6</td>
<td>1.4</td>
<td>0.5</td>
<td>15</td>
</tr>
</tbody>
</table>

Contains non-plant food ingredients, 2.9% * If needed mix fungicide in the tank. However perform jar test for compatibility. May reduce fungicide use by as much as 50%.

Humic/Fulvic Acid derived from Lignite. Quick and sustained release with 30% Nitrogen, 50% P₂O₅ and 50% K₂O bound to humic/fulvic components.

USDA ALLOWED/EPA APPROVED
actosol® CREATES VEGETATION IN SAND DUNES

HYDROSEED MIX

HYDROSEED MIX PLUS actosol®

Ocean City, MD

6 weeks growth, Virginia Tech., Testing

Preserving tomorrow’s world... today
actosol®
Organic Biostimulant

WITH & WITHOUT

Increase stress tolerance
actosol®
Organic Biostimulant

WITH & WITHOUT

Enhance root growth & yield

Preserving tomorrow’s world... today
actosol® Hydroteching Effective for Reclamation Site in Northern Alabama

Before Treatment

actosol® Treated

Control

After Treatment
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.
Vigorous growth of bitter panicum (*Panicum amarum*) when a fertilization regime was coupled with a Humic Acid application of 100 ml per m². 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).
Floriculture

actosol® BRIGHTENS FLOWERS

Horticulture

actosol® MIRACLE ON VEGETABLES

Control

Actosol

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

Preserving tomorrow’s world... today
actosol® vs. Miracle-Gro

AUGUST 2003

Preserving tomorrow’s world... today
Actosol®
Organic Biostimulant

With & Without

Improve nutrient uptake

Arctech
Preserving tomorrow's world... today
actosol®
Organic Biostimulant

WITH & WITHOUT

Improve nutrient uptake

ARCTECH
Preserving tomorrow’s world… today
WITH & WITHOUT

Begonia’s tests results

Innovations by ARCTECH

Preserving tomorrow’s world... today
actosol®
Organic Biostimulant
WITH & WITHOUT
Palm test results
Innovations by ARCTECH
Preserving tomorrow’s world... today
Agriculture

60% INCREASE IN SOYBEAN YIELD USING actosol®

EFFECT OF actosol® ON CORN PLANTS

King William Co., VA 1997

Bushels per acre

actosol® no actosol®

Treatment

Preserving tomorrow’s world... today
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 for superior turf
- Creates vegetation in saline and poor soils
- Proportioned releases for maximum efficiency

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

Distributors & Sales Reps Wanted
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 叶学良
            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**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield (Tons/fed for total of 5 Fresh Cuts)</th>
<th>% Yield Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated</td>
<td>75.7</td>
<td>12.65</td>
</tr>
<tr>
<td>Untreated</td>
<td>67.2</td>
<td></td>
</tr>
</tbody>
</table>

**Untreated**

**Treated**
Foliar & Soil Applications
Similar Trends were Also Observed in the Above Mentioned Parameters in Apricot Seedlings
Pears

Treated

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

Untreated

Treated