### Special Feature 3

### **Beneficial Aspects of ALA Put to Work for the Environment**

-Cosmo Oil succeeds in mass production of ALA for commercialization as liquid manure



# ALA—the Starting Material Essential to Living Organisms

While the world's population is increasing, arable land is decreasing as the result of urbanization and climate change. As this situation could lead to a global food crisis, the human race now faces the urgent task of raising agricultural productivity. The Cosmo Oil Group has succeeded in mass producing 5-aminolevulinic acid (ALA), a substance that could play a major role in boosting productivity.

ALA is an amino acid present in all living organisms, and is believed to have originated with life itself 3.6 billion years ago. This substance is a building block of the chemical compounds that play important roles in living bodies, such as the hemoglobin in the blood that moves oxygen through an animal's body and the chlorophyll so essential to plant photosynthesis. Even when applied externally, ALA can be expected to have a wide variety of effects. It can be applied in diverse fields, such as medical treatment and diagnosis, enzyme production and the culture of microorganisms, growth induction for plants and enhanced photonic synthesis.

As part of efforts to become a cutting-edge company in the environmental field, Cosmo Oil is involved in research and

#### ALA Products

Cosmo Oil developed the Pentakeep series, an agricultural fertilizer offering new applications, and Penta Garden series, a fertilizer for home gardeners.



development in many areas, including the development of more sophisticated oil production technology, environmental cleanup technology and numerous new technologies. ALA has been one of the focuses of its research since the late 1980s.

### Mass Production Allows ALA to be Applied in Many Fields

Previously, ALA could only be produced in small quantities through chemical synthesis, and consequently, only small amounts were used as research applications. Production of ALA in large quantities at low costs means that it can be applied in a wide variety of areas, and its impressive effects can benefit more people. It was this idea that inspired the Cosmo Oil Group to begin mass production of ALA through a fermentation process using photosynthesis bacterium. When this photosynthesis bacterium was initially examined, ALA production volume peaked when a large number of bacteria were present. Resolving this problem led to a major turning point: tens of thousands of variant strains were produced before breeding the current strain in use.

In production, glucose sugar is used as the raw material and no animal ingredients are used in cultivating the bacteria, thereby

#### Effects of Pentakeep

Example with fruit cultivation in Slovakia Crop: Wine grapes Effect: Pentakeep not only increased the yield of the grapes, which are naturally sensitive, but also raised the sugar content, resulting in a clear improvement in the flavor of wine.



preventing risks such as Bovine Spongiform Encephalopathy (BSE) and ensuring safety. The Cosmo Oil Group continued to develop high-purity refining techniques and succeeded in extracting ALA crystals with over 99% purity. The Group was first



ALA crystals with 99% purity

in the world to succeed in using fermentation in its industrial production technique for ALA, and was recognized with the Technical Award of the Society for Biotechnology, Japan, in 1999.

## Extraordinary Effect on Plants Harnessed for Use as Fertilizer

Along with its development of mass-production methods, the Cosmo Oil Group conducted research into ALA applications, which demonstrated particularly notable effects on plants.

Increase in chlorophyll

Chlorophyll increases when administering moderate amounts of ALA to plants, enhancing photosynthetic capacity and  $\rm CO_2$  sequestration.

- Produce is large and sweet Increasing photosynthetic capacity results in larger and sweeter fruits and vegetables.
- Plants strengthen in low-sunlight environments Plants prosper even in environments with little sunlight.
- Improved resistance to cold and salinity tolerance

The large amount of sugar produced through photonic synthesis makes plants resistant to cold and tolerant to soil with high salinity, even alkaline soil.

• More efficient nutrient absorption ALA accelerates the speed at which nutrients are absorbed from the roots.

To take advantage of the unique properties of ALA, the Cosmo Oil Group joined with Seiwa Co., Ltd. to commercialize the Pentakeep series of liquid fertilizer. Currently, Seiwa is selling the fertilizer to domestic agricultural producers, and Cosmo Oil's subsidiary Cosmo Seiwa Agriculture Co., Ltd. is selling the home gardening variety to general consumers.

The Cosmo Oil Group is particularly focused on marketing Pentakeep outside Japan to fulfill its role in raising global agricultural production. Tests conducted in the Netherlands, Poland, the Czech Republic, and Hungary demonstrated increased yields and higher quality in many plants, garnering high praise from agricultural producers. The product is now widely sold in Italy, Germany, Greece and Spain. In 2003, Pentakeep was demonstrated at Horti Fair in the Netherlands,

the world's largest agricultural exhibit. Cosmo Oil's fertilizer won the theme prize, and attracted a stream of business inquiries from agricultural companies from all over the world. Looking ahead, the Cosmo Oil Group plans to expand into the U.S. and Chinese markets.



Horti Fair agricultural exhibit in the Netherlands

## Pursuing ALA's Potential to Contribute to a More Prosperous Life

ALA is demonstrating impressive results in raising crop yields and inducing growth, thereby contributing to agricultural production without harming living organisms or contaminating soil. ALA is currently marketed as the liquid fertilizer Pentakeep, but in a solid form it could be applied to larger land areas and be effective in grain production and other agricultural pursuits. Moreover, as land areas of many regions in the world have been damaged by salt and alkali, making desertification a major problem, ALA's effectiveness in improving the salinity tolerance and alkalinity tolerance of plants makes it a landmark substance that could herald a turning point for the environment in these areas. Cosmo Oil is also moving ahead with research into afforestation and agriculture using ALA.

In addition, the Company expects ALA to have applications in animal feed, hair growth formulas, and tumor diagnosis and treatment. The Cosmo Oil Group will continue to commercialize ALA for applications that can contribute to a wide variety of fields, such as agriculture, the environment and health. As with petroleum, ALA takes its origins from the earth's riches that have been with us since time immemorial. The Cosmo Oil Group will continue to take up the challenge of seeking ALA's potential to pursue better lives for humankind.

#### Effects of Pentakeep

Example with vegetable cultivation in Italy Crop: Lettuce (grown in tunnels)

Application method:

500g/ha of Pentakeep Super was applied to leaves one time every eight days for a total of four applications.

Effect:

The mass of lettuce above the ground increased significantly in proportion to the roots, resulting in increased yield.



### Fields where Cosmo Oil Applies ALA

