



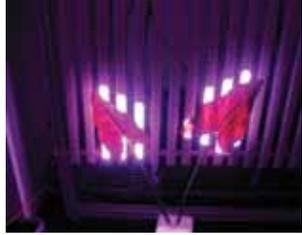
# Agriculture Spinoffs



Through everything from remote sensing to robotics to global positioning systems and technologies for growing crops in space, NASA's space exploration and Earth science efforts have yielded remarkable benefits for farmers and agricultural industries, including more than 60 documented spinoff technologies. These spinoffs now help farmers keep produce fresh on the way to market, enable robotic systems for mass harvesting fruit, and even guide tractors to improve efficiency and reduce fuel costs.

## Chlorophyll Meters Aid Plant Nutrient Management

Licensed NASA technology developed from satellite sensors now forms the basis for a hand-held chlorophyll meter. Growers and agricultural researchers use the meter to determine the nutrient needs of crops such as wheat, rice, cotton, and corn. The meter reveals indications of disease 2 weeks before visible signs appear.



## LED Systems Target Plant Growth

To help develop technologies for growing food crops in space, one company invented a lighting system, now used in agricultural greenhouses, that can be adapted to allow maximum efficiency in light absorption by all available photosynthetic tissues.



## Aeroponic Gardens Help Plants Grow Faster and Healthier

A soil-less plant-growth experiment that enabled plants to grow healthy without the use of pesticides has enabled the development of a commercial aeroponic system. The sterile environment allows plants to grow disease-free, with 98 percent less water, and no pesticides.



## Toolkits Control Robotics for Fruit Harvesting

With NASA funding, a company developed design and control software that enables the effective operation of robots, including a robotic system for citrus fruit harvesting. The system has multiple cameras and disposable picking mechanisms to mass harvest fruit for juice processing.



## Remote Sensing Influences Crop Services for Farmers

NASA's geospatial satellite information assisted in the creation of a crop prescription service that allows farmers to generate prescriptions and crop scouting maps. It also contributed to the development of an educational service for young farmers to familiarize them with geospatial technology.



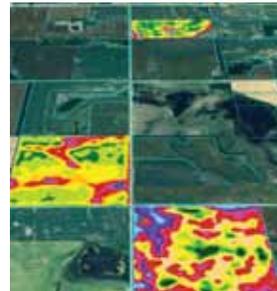
## Navigation System Drives Automated Tractor Steering

NASA's Gravity Probe B program led to a surprising outcome: a GPS auto-steering technology for guiding automated agricultural equipment. The technology helps farmers reduce fuel costs, decrease driver fatigue, and eliminate overlap on fields.



## Image Processing Software Informs Farming Practices

NASA's Earth Resources Laboratory Applications software was adapted and used in a program to provide data for prescription farming. Data about soil content and rainfall levels informs farmers' decisions about soil nutrient additives, irrigation, and pest control.



## Data Delivery Methods Enhance Satellite Images for Agriculture

When a company wanted to improve its technology for analyzing satellite imagery of farmland and agricultural fields, it turned to NASA. Today, the company provides imagery and data analysis for agri-business and the crop insurance industry.



## Feature Detection Systems Enable Maps of Crop Fields

NASA SBIR contracts supported the development of satellite image refinement software that helps researchers study the effects of population and climate on crop field acreage. The system produces detailed maps of crop fields, which can provide useful information on agricultural production.



## Air Purifiers Eliminate Pathogens, Preserve Produce

NASA researchers developed a technology that removes a chemical from the air responsible for speeding the decay of fruits and vegetables. Today, the device helps preserve produce on its way to and at the market, helping farmers protect their harvests at an operating cost as little as \$1 a day.

For more information about NASA spinoffs, please visit [spinoff.nasa.gov](http://spinoff.nasa.gov).