Despite fears of its dangers... **Nanotechnology is making major transformations in the field of food and agriculture.**

Global population growth is expected to reach an estimated 8 billion people by 2025 and 9 billion by 2050, to raise global agricultural production to feed a rapidly growing world population. Therefore, experts believe that it has become necessary to use modern technologies such as nanotechnology and nanobiotechnology in agricultural and food sciences. This technology has enormous potential to revolutionize agriculture and its related fields. Currently, nano-agriculture is focused on targeted agriculture, which involves the use of nanoparticles with unique properties to enhance the productivity of crops and livestock.

In a new scientific paper issued in the journal Science of the total Environment, researchers from the University of Hail, Saudi Arabia, reviewed the most important applications of new nanomaterials in the food and agricultural industries, focusing on their importance in providing complete food solutions from farm to spoon; Including nutritious and functional foods, and their role in improving the efficiency and diversity of these products through nano-additives, changing colour, taste and packaging.

The agricultural sector has also, according to the researchers, witnessed many products based on nano-technologies, such as nano-fertilizers, nano-pesticides, nano-growth stimulators and many more for the development of sustainable agriculture and crop improvement. But they point out that despite the many advantages of nanotechnology, there are still toxicity challenges and safety concerns that need to be addressed and that require shifts in regulatory policy. They expect the rapid development to lead to a major transformation in the food and agricultural sectors, with a rapid increase in market share and investment.

## Nano Fertilizer

Replacing conventional fertilizers with nano-fertilizers is a way to release nutrients into the soil gradually and in a controlled manner, avoiding waste and pollution of water resources. Studies have proven the significant effect of titanium dioxide (TiO2) nanoparticles on plant growth through light absorption and transmission of light energy. Nano-

fertilizers have unique properties such as super absorption, increased production, higher photosynthesis, and increased leaf size.

One study conducted on the tomato plant, for example, found that carbon nanotubes, which were used as a super fertilizer, penetrated the thick seed layer of the plant and supported water absorption inside the seeds, which positively affected their germination and growth rates.

## Nanotechnology in food production:

Opportunities for nanobiotechnology include food, agricultural, and energy applications. In the food processing industries, the most common uses of nanobiotechnology in food product quality control are the provision of nanosensors for the detection of bacteria. When used, nano-sensors have high accuracy in detecting the presence of insects or fungi within the grain mass stored in storage rooms.

Nanotechnology has provided the industry with new tools to modify plant genes, enabling the development of new plant species thanks to the use of synthetic biology, a new branch of science based on genetic engineering techniques, nanotechnology and informatics.

Nanotechnology has the potential to increase agricultural productivity through the genetic improvement of plants and animals as well as providing materials for delivering genes and drug molecules at the cellular level to specific sites in plants and animals.