



## Nano Irrigation

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Today we are witnessing the changes of technology which influence our day to day life and we also know not only technology but also agriculture influences our life. If we combine both technology and agriculture we can solve many problems. In our country regarding agriculture, the major concern is water. As we know water is depleting day by day. Irrigation is one of the important practice in agriculture. Now a days traditional irrigation practices are not being that efficient. In this situation a unique and advanced technology has been introduced i.e nano irrigation. Nano irrigation which has gained popularity in recent years. It involves the application of small amount of water and nutrients directly to the plant root zones through nano sized droplets or particles. It results in increasing the water use efficiency reduces the water wastage improves the crop yield. The main thought to introduce this technology is to minimize the water loss, deliver water directly to the plant's roots in a small quantity and to increase the efficiency by delivering it in a controlled manner.

### Introduction

It is also named as moisture technology. It is a precise irrigation technique. Here in this process we use sensors which will monitor the soil moisture and it will deliver the data to central control unit which analyzes and examines the data to determine the level of water required by the plant, then the data is analyzed according to that, water will be delivered through a network of nanotubes straight to the roots, it also has the ability to improve crop yield and quality as it is providing required amount of water and nutrients, they will grow more effectively. It can also reduce the effect of soil salinization caused due to the excessive water usage.

### Principle of nano irrigation

The main principle of nano irrigation is based upon the fact that the plants mainly utilizes most of the nutrients and water from their root zone. With this technology it will help us to deliver the water in a slow and steady manner through the root system with the help of an emitter. This helps the plant to become more efficient in absorption of water.

### Main techniques and technologies used in nano irrigation

Nano irrigation technology introduces many important and useful techniques and technologies through which irrigation can be applicable in more efficient way

- **Drip irrigation** : It is the most efficient and effective technique to deliver water directly to the root zones through the network of pipes and emitters. It is one of the most precise technique
- **Soil moisture sensor** : these sensors used to monitor. It monitors the soil health. These can recognize the soil dryness and trigger the irrigation system to deliver water

- **Weather stations** : it monitors the weather conditions I.e temperature, humidity, rainfall etc. According to that, the irrigation system can analyze the water requirement for the plant .
- **Nano sensors** : these are the miniature sensors. they are placed on plants or in soil which can detect the soil moisture, temperature and nutrient levels and trigger the system according to that
- **Precise agriculture software** : It collects the data from various sensors and analyzes it according to that it will give command to the irrigation system to deliver water. It helps farmers to optimize their irrigation practices and make plants grow more efficiently.
- **Nanotechnology based irrigation system** : this utilizes the nano particles to enhance the efficiency of the irrigation system. For example nano particles added to water to increase its absorption by plants , reduce water loss through evaporation .

### Advantages

This newly emerging technology have several advantages:

It reduces water usage by precise usage of water as it delivers water directly to the root zone. It mainly helps in areas where water availability is scarce as it allows more efficient use of water . It also has another advantage , it has the potential to bring down the use of fertilizers and pesticides . As it is supplying the water straight to the roots according to the requirement of the plant which will ensure that there will be no wastage . This will decrease the use of fertilizers and pesticides and lessen the environmental effect . It will indirectly result in cost saving .

### Challenges of nano irrigation

There are many challenges to be faced which are associated with its use.

One of the main changes is the potential of nano particles to accumulate within the soil and water which leads to environmental effects and risks. It is disadvantageous for small scale farmers to implement this system the cost will be high initially as it requires specialized equipment and materials .

However the benefits of nano irrigation can often outweigh the cost .Mainly in areas where water is scarce.

### Future prospects of nano-irrigation

- **Integration with other Precision agriculture technologies** : this nano irrigation technology is integrated with many other integrated Precision technologies like GPS , drone, and remote sensing . It helps farmers in efficient management of crops.
- **Increase use of urban and indoor farming** : As urban and indoor farming systems become more common, the use of nano irrigation is likely to increase, as it provides a precise and efficient way to deliver water and nutrients to crops grown in these environments.
- **Improve efficiency and sustainability** : as it has the potential to reduce the water usage and nutrients wastage it improves the growth of plant and soil health.
- **Development of new nano particles** : with the technologies there have been many new nano particles are being developed which can increase the nano irrigation efficiency and performance.
- **Expansion into new crops and regions** : As the benefits of nano irrigation become more widely known, it is likely to be adopted in new crops and regions, particularly in areas where water is scarce or expensive.

## Research and experiments on nano irrigation

Many research experiments have been conducted during recent years on Nano irrigation . The experimental studies have shown clear results of increasing the yield and quality of plants while conserving the water resources .

A study which was published in **2020** , Journal of cleaner production , here the researcher tested the effectiveness of nano irrigation on tomato plants .They found that using nanoparticles in the irrigation water improved water uptake and increased the yield by **18%** when compared to traditional irrigation methods . It consists of the pores which have the leakage rate according to the requirement of particular plant results in increase in efficiency

In **2020** another experiment was conducted at khalidiya by the regional center of Agriculture research agriculture agadir (Iraq) They compared the drip system and nano irrigation . They conducted the experiments on two plants that use “ *Quinoa*” and blue panicum. This experiment resulted that moisture system in nano irrigation is more effective for more spacing with multiple grown cycle crops . They have also noticed the increase of grain yield in Nano irrigation .

In **2021** a report on field study "*Nano-enhanced irrigation for improving water use efficiency and crop productivity in arid regions*" by Al-Ashwal et al. This study has evaluated the effect of water use efficiency and crop productivity in arid areas . It resulted that nano irrigation increases the crop yields and reduce water consumption.

**2019** a study published in the journal of agriculture and food chemistry. They tested the zinc oxide nano particles on rice crops . It showed a result of an increase of **25 %** more yield than conventional agriculture and also helps in growth improvement and photosynthetic activity.

Another study in **2017** published in the journal of environmental management , they tested the nano particles of silver on wheat plants . It rests in improvement of water use efficiency , increase of yield and biomass.

## Conclusion

Finally , in conclusion , nano irrigation is a promising technology which Has the ability of creating a healthier and more robust crop , it has the Ability to increase the quality and yield , and decrease the usage of fertilizers and pesticides . However further research is needed to Evaluate the long term effects of these technologies on soil health , and environment. It is also important to ensure that the nanoparticles used in nano irrigation do not pose any risks to human health or the environment .