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Judicious Use of Water in Horticultural Crops (Micro Irrigation and Mulching)

(*Sampatti Yadav, Dr. Vinod Kumar Yadav, Jyoti Meena, Manish Verma and Gursharan Singh)
College of Agriculture, Ummedganj (Kota) Pin- 324001
*Corresponding Author's email: yadavsampatti@gmail.com

Abstract
Horticultural production in India will be boosted in order to improve the people's nutritional security and economy. The implementation of current technologies such as micro-irrigation, fertigation, and mulching, which increase water use efficiency (WUE) and fertiliser use efficiency, can increase production by a factor of ten (FUE). Most horticulture crops, such as bananas, grapes, citrus, pomegranate, and apple, can benefit from drip irrigation. Drip irrigation is the most effective method of supplying water and nutrients to plants, as it not only saves water but also boosts fruit crop production while reducing labour costs.
Mulching is a horticultural and agricultural practise that involves the use of organic materials. Mulch is applied to the soil surface surrounding plants to produce a favourable environment for growth. This could involve temperature management, salinity reduction, and weed control. In agriculture, black plastic mulch is most typically utilised. Because of its increased soil warming properties, clear plastic mulch is employed in some places. As a result, mulching can be a useful tool for enhancing horticultural crop yield in water-scarce areas.

Introduction
Micro irrigation is the slow delivery of water above or below the soil surface in the form of drips, tiny streams, or miniature sprays. When compared to traditional surface irrigation, the micro irrigation system is more effective in conserving water and increasing water usage efficiency. It also aids in the reduction of water usage, undesirable plant growth (weeds), soil erosion, and cultivation costs. A field is inundated with water in the flooding method of irrigation. As a result, there is a lot of run-off, anaerobic conditions in the soil and surrounding the root zone, and deep irrigation below the root zone, which doesn't give the plants enough water. As a result, it is one of the least efficient surface watering systems.
Mulch is most likely derived from the German word "molsch," which meaning "soft to decay," and reportedly refers to gardeners spreading straw and leaves over the ground as mulch (Jacks *et al*., 1955). Mulches are employed in agriculture for a variety of reasons, but the most essential goals are water saving and erosion control, especially in dry and semi-arid areas. Mulching helps to avoid soil deterioration by preventing runoff and soil loss, as well as weed infestation and water evaporation. As a result, it aids in the retention of soil moisture and aids in the control of temperature changes, as well as improving the physical, chemical, and biological aspects of soil. It also provides nutrients to the soil, which increases crop development and production (Dilip Kumar *et al*., 1990). Mulch also helps to reduce water vapour loss, soil erosion, weed issues, and nutrient loss (Van Derwerken and Wilcox, 1988).

Features of Micro Irrigation System

• In a drip irrigation system, water is applied drop by drop over a long period of time.
• Water is delivered at a low rate to maintain the ideal air–water balance inside the root zone.
• The moisture content of the soil is always kept at the 'field capacity' of the soil.

Types of Micro Irrigation

1. Surface drip irrigation
2. Subsurface drip irrigation
3. Bubbler irrigation
4. Micro sprinkler irrigation
5. Sprinkler irrigation

Surface drip irrigation: This is the most adopted micro-irrigation system in India. In this system water from the source carried in PVC main and submain lines are delivered to lateral lines made up of linear low-density poly ethylene laid on the soil surface and through emitters water is delivered to the plant near its root zone. Surface drip irrigation based on the placement of emitters on lateral is classified as Inline drippers and online drippers. Inline drippers are generally used for vegetable crops or closely spaced crops and are supplied by manufacturers/distributing companies on demand on specifying the spacing between emitter to emitter. Whereas online drippers are adopted in wider spaced crops such as orchards in which plain lateral and emitters are supplied separately, depending upon the crop water requirement or stage of the crop the number of drippers to be fixed on the surface of the lateral pipes.

On line dripper

In line dripper

Subsurface drip irrigation: In subsurface drip irrigation, water is applied slowly below the soil surface through buried inline type of emitters. This irrigation system can be adopted in small fruit and vegetable crops as well as in close spaced field crops.

Bubbler irrigation: This type of irrigation system is extensively used in land scape irrigation; however, it is particularly used in levelled fields covering orchards or perennial crops. In this system water is applied to the soil surface from an emitter with a point source discharge rate.

Micro sprinkler irrigation: - In micro sprinkler irrigation water is sprinkled or sprayed around the root zone of the trees with small sprinklers that work under low pressure. Micro sprinkler irrigation systems can be installed on 12-20 mm LLDPE lateral pipes.

Sprinkler irrigation: It is an important method of agricultural irrigation even under undulating topography. This system should be capable of applying maximum crop water need including the application losses if any. The sprinkler nozzles, which deliver water should cover the entire field and store the water in the soil without causing loss of water through surface runoff or deep percolation. Sprinklers, laterals, submains, and mainlines are the primary components of a sprinkler irrigation system. Sprinklers which are fixed on raisers riser pipe, which in turn is attached to laterals spread water as rain droplets over the land surface. Laterals get water from the main lines and submains convey to the sprinklers.

Features of mulching: Mulches help to maintain soil moisture, increase soil nutrition, reduce erosion, prevent weed growth in agricultural plants, and remove pesticide, fertiliser, and heavy metal residues. Mulches improve the appearance of landscapes while also enhancing the value of crops.

Types of Mulching Materials

Organic mulches: Organic mulches are made from plant and animal resources such as straw, hay, peanut hulls, leaf mould, compost, sawdust, wood chips, shavings, and animal manures.

Inorganic mulches: Inorganic mulch, such as plastic mulch, accounts for the vast bulk of mulch used in commercial crop cultivation. Mulch is made of plastics such as polyvinyl chloride or polyethylene films. The things used were LDPE, HDPE, and elastic PVC, and while there were some mechanical modifications between them, they were minor.

Effect of Micro Irrigation

Effect of drip irrigation on water saving and water use efficiency : The higher water uptake by crop as a result of direct application of small amounts of water in several splits into the root zone without wetting the entire area and higher water distribution efficiencies in the soil profile under drip irrigation as compared to surface irrigation was due to higher water uptake by crop as a result of direct application of small amounts of water in several splits into root zone without wetting the entire area and higher water distribution efficiencies in the soil profile (Bangar and Chaudhary, 2004).

Effect of drip irrigation on yield features: According to Hedge and Srinivas (1990), shallow drip irrigation improved banana fruit yield by 6 to 10% compared to overflow irrigation.

Effect of drip and fertigation on growth parameters: Compared to soil fertilisation under rainfed situations, Raina *et al*. (2005) create that fertigation with 100 and 80 percent of recommended dosage and soil fertilisation under irrigated situations resulted in significantly higher growth parameters (annual shoot growth, tree growth, and canopy volume).

Effect of drip and fertigation on quality parameters: The rise in yield was attributed to higher development, larger size, and more liquid content in the fruits under drip-irrigated plants, according to Patel and Patel (1998).

Effect of drip and fertigation on fruit cracking and sun burning: Sprinkler irrigation to change 100 percent evapo-transpiration (ET) resulted in the extreme production and minimum fruit breaking in litchi, according to Ray *et al*. (2005).

Effect of Mulching on Soil and Plants

Reduced fertilizer leaching: Fertilizer loss due to leaching is decreased as surplus rainfall is discharged drained the root zone. In sandy soils, this is especially true. This permits the grower to apply additional fertiliser to the row before planting the crop.

Maintain soil temperature: Mulching lowers the temperature of the soil in the summer, raises it in the winter, and prevents temperature extremes. The capacity of the mulching material to reflect and transmit solar radiation affects the influence of mulching on the temperature regime of the soil in general.

Conserve soil moisture: When organic mulch is applied to the soil surface, it helps to minimise weed growing, decrease evaporation, and encourage rainwater penetration throughout the growing period. In accumulation, during periods of heavy rain, plastic mulch assists in draining extra water away from the crop root zone.

Reduced infiltration rate: Crop residue mulch, when current at the soil-atmosphere interface, has a direct effect on rainwater penetration and evaporation. Mulch reductions surface runoff and retains rainfall at the soil surface, allowing it more time to soak into the soil (Khurshid *et al*., 2006).

Add organic matter: After decay, carbon-based mulches provide organic matter and plant nutrients to the soil while also improving the physical, chemical, and biotic qualities of the soil, increasing crop output. Under the mulch, the soil stays loose and friable, providing an ideal condition for root infiltration. Organic mulches not only save soil humidity, but they also add nutrients to the soil by addition organic matter (Dilip Kumar *et al*., 1990).

Plant growth and development: Mulching produces a favourable atmosphere for growth, resulting in plants that are more vigorous, better, and possibly pest-resistant. Root growth is stimulated by improved soil temperature and moisture content, which leads to increased plant growth. Mulched plants, on the other hand, tend to grow and mature more regularly than unmulched plants (Bhardwaj *et al*., 2011; Sarolia and Bhardwaj 2012).

Promote early harvest: Mulching warm-season plants like cucumbers, muskmelons, watermelons, eggplant, and peppers results in earlier maturity and larger yields.

Improvement quality and yield: Mulch helps keep fruits clean by preventing them from touching the ground and, in many circumstances, decreases soil rot, fruit cracking, and blossom end rot. Fruits are flatter and have fewer scars.

Reduce weed growth and clean crop: Mulching lowers the sprouting and nutrition of many unwanted plants by creating a physical barricade. Mulching aids in the decrease of wild plant seed germination, weed growth, and wild plant control (Vander Zaag *et al*., 1986).

Effect of covering on pest and micro-flora Insect pest control: Transparent plastic mulch reduced whitefly populations, helped catch aphids in yellow traps, and reduced the prevalence of viral illnesses when compared to bare soil. Transparent mulch reduced the incidence of virus disease and delayed the onset of virus symptoms by two weeks when compared to bare soil (Nameth et al., 1986).

Conclusion

Water applied uniformly to the root zone of the plant helps to maintain optimum hydration in the root zone while also allowing for proper soil aeration. Drip fertigation increases productivity while simultaneously ensuring excellent profit margins and high-quality fruits.

Mulching is a viable option for enhancing horticulture crop output in water-scarce areas. The high initial investment and comparatively low technical expertise of regular Indian farmers are two main roadblocks to the country's widespread adoption of drip fertigation technology. However, rising water scarcity in high-value crops, protected cultivation, and improved efficiency of the two most important inputs (water and fertiliser) in agricultural production drive adoption of these technologies.

Transparent plastic mulch reduces whitefly populations, aids in the capture of aphids in yellow traps, and lowers the risk of virus disease. Mulching, it is concluded, has a variety of beneficial effects on horticultural crop production in arid and semi-arid regions, including an increase in soil moisture (4.70-12.50 percent), a reduction in water infiltration rate (15.35-18.40 percent), a reduction in runoff (30.0- 70.50 percent) and soil erosion (70.0-85.0 percent), a reduction in weed growth (90.0-95.0 percent), pest control (15.0- 27.35 percent), a reduction in Furthermore, organic mulch adds organic matter (3 – 5 t ha-1), stimulates soil microflora, participates in the nutrient cycle, and boosts soil biological activity.

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