WELCOME

Irrigation System used in Protected Cultivation

UGE-321 Hi tech Horticulture

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❖ Protected cultivation is defined as a technique in which the microclimate around the plant is fully, partially or altered in order to protect the crop from adverse weather. It facilitates soil moisture conservation and the effective use of energy, primarily solar energy. It is required for higher returns, year-round farming, improved crop quality, off-season production, assured output, self-employment for educated rural youth in the agricultural sectors, lower residues of pesticides, managed pollination, weather vagaries, easier conservation of plants and free cultivation of weeds.

❖Protected cultivation of high-value crops has emerged as the leading most crucial technology to ensure high production, improved quality and financially viable returns as markets

Irrigation System used in Protected Cultivation

- The precise amount of irrigation required in each day throughout the year can be supplied efficiently by a well-designed irrigation system in greenhouse.
- The irrigation requirement depends on cultivated area, type of crop, weather condition, timing of cultivation, capacity of ventilation requirement, etc.
- The crop quality can be hampered by frequent application of water in greenhouse. Therefore, decision on irrigation scheduling should be taken by continuous inspection and understanding the requirement.
- The irrigation systems used in greenhouse are hand writing, perimeter watering, overhead sprinklers, boom watering, and drip irrigation

Hand watering: Hand watering is the most traditional method of irrigation and very tedious and takes considerable time to operate. The growers can afford hand watering for high density crop, irrigating specific pots and areas which dries earlier than others. The disadvantages of hand watering are

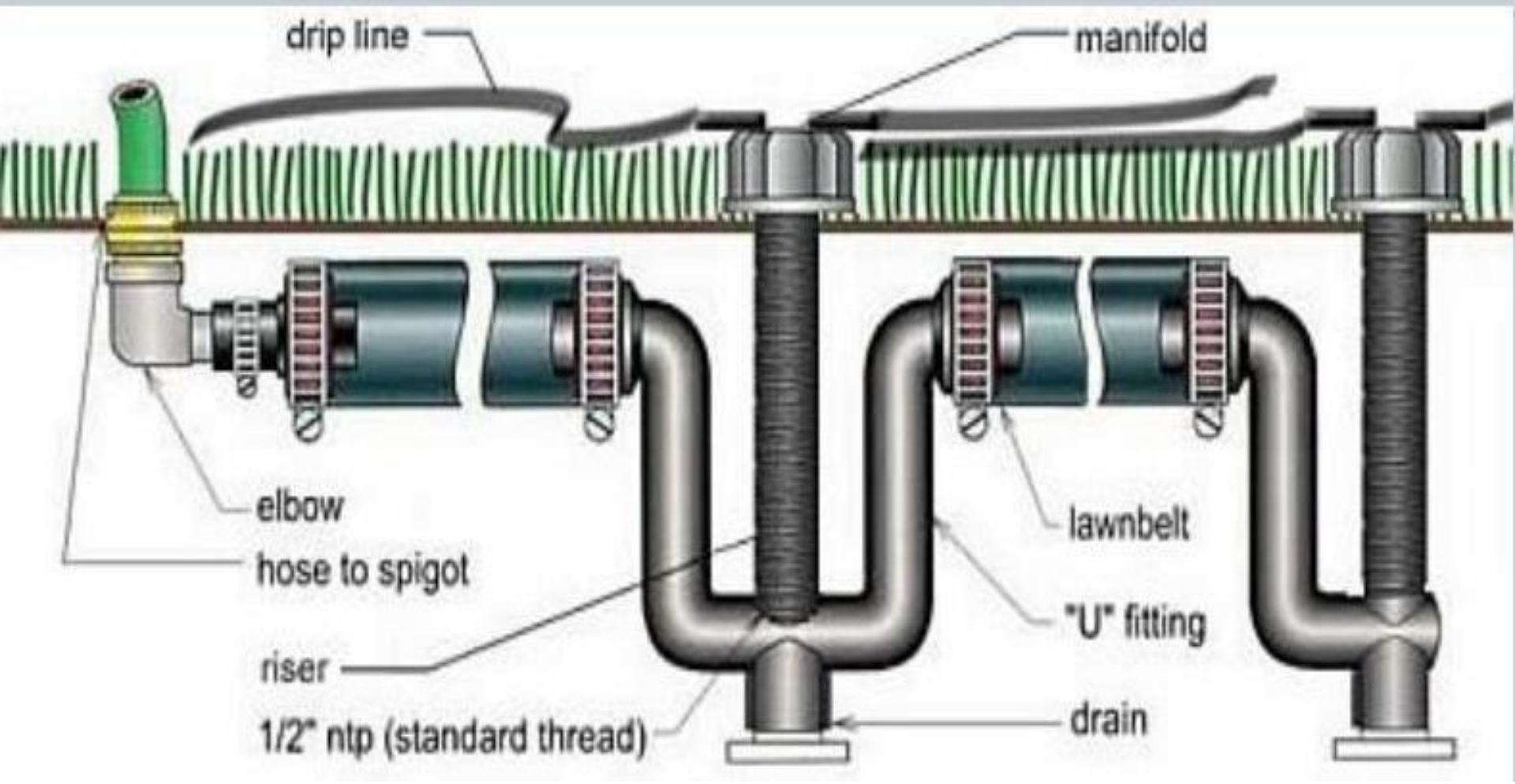
(i) Operation cost is too high and

(ii) Higher risk is associated with applying too smaller amount of water or waiting for long duration between two successive watering.

Hand watering

Perimeter watering: The perimeter watering system may be used on benches or beds for crop production. A standard device consists of a plastic pipe with nozzles spraying water over the surface of the substrate below the vegetation across the circumference of a bench. It is possible to use either polythene or PVC piping.

- Being PVC pipe stationary, the polythene pipe tends to roll if it is not tightly fixed to the side of the bench. It makes nozzles to move from the correct direction to the surface of the substrate.
- Nozzles are constructed by using nylon or hard plastic material and a spray arc of 180°, 90° or 45° can be applied. They are staggered around the benches, irrespective of the types of nozzles used, so that each nozzle projects between two other nozzles on the opposite side.
- A 30.5 cm valve is required in 180° nozzles of Perimeter watering systems for benches.



Overhead sprinklers

Overhead sprinklers: A pipe is mounted around a bed's middle. Riser pipes are mounted frequently to a height just above the crop height. The height of 0.6 m and 1.8 m is sufficient for flat bedding plants and fresh flowers, respectively.

- There is a nozzle installed at the top of each riser. Nozzles vary from those that cast a 360° pattern continuously to forms that spin around a 360° globe.
- To capture water that may fall between pots and waste on the bottom, trays are placed under pots.
- Every single tray is square, and the neighboring tray faces it. Almost all water loss is minimized in this manner.
- Drainage of excess water is passed through drain holes of the trays and certain quantity of water is stored in the tray, which is subsequently absorbed by the substratum.

Overhead sprinklers

Boom watering: Boom watering used to produce seedlings grown in plug trays.

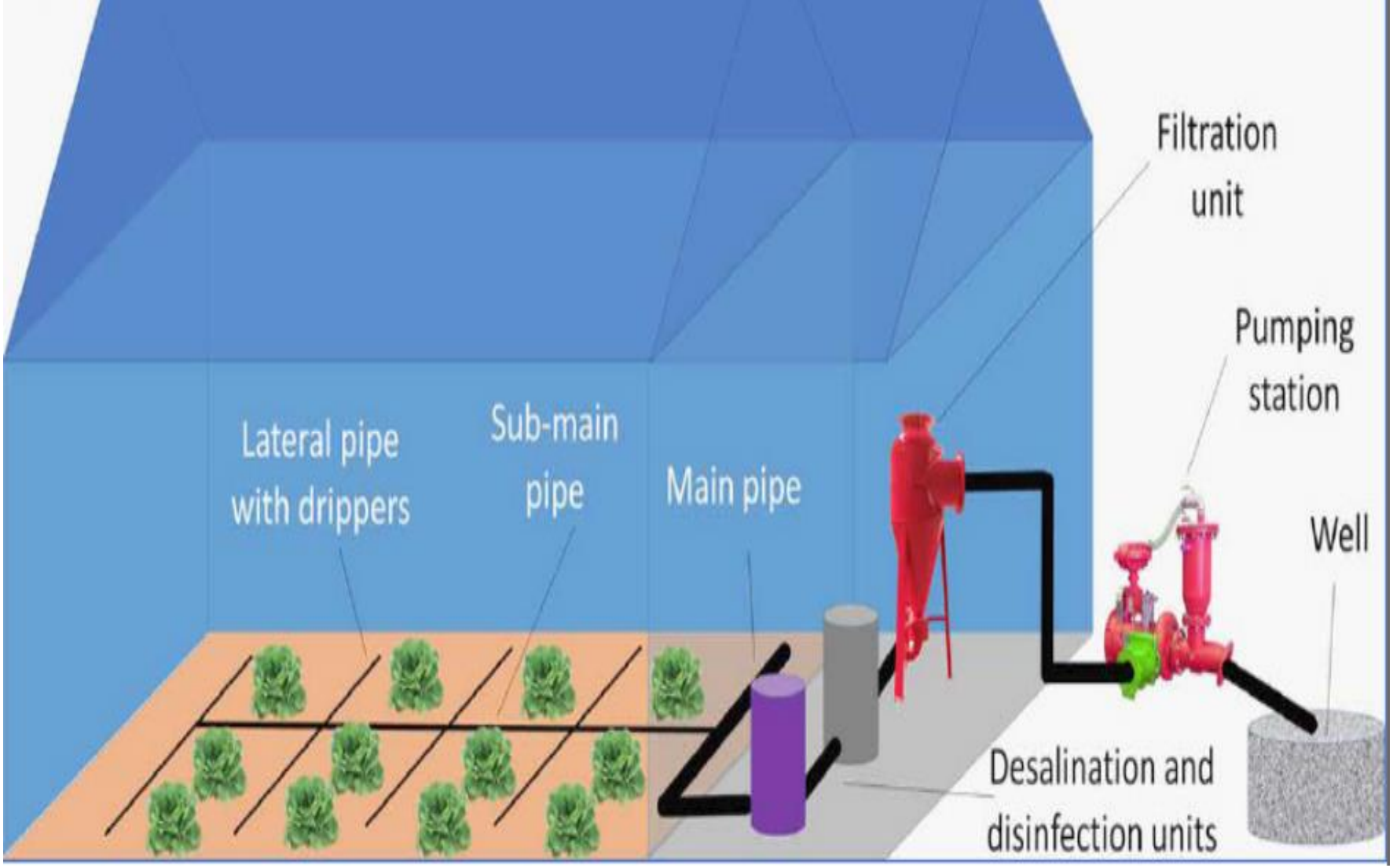
- Plug trays are constructed by plastic material with dimension of approximately 30 × 61 cm and depth of 13-38 mm, and contain around 100 to 800 cells.
- Each seedling is produced in its own individual cell. The precision of watering is very important during the 2 to 8 weeks development cycle of plug seedlings.
- The pipe is fitted with nozzles that can either spray water or fertilizer solution down on the crop.
- The boom is propelled by an electric motor.
- The amount of water delivered per area of the plant unit is adjusted by the speed at which the boom is moving.

Boom watering

Drip Irrigation: Drip irrigation, also known as trickle irrigation, consists of the lying on the surface or subsurface of the greenhouse of small-diameter plastic tubes beside or below the plants.

- Water is supplied at regular intervals to the plants through small holes or emitters located along the tube.
- Drip irrigation systems are commonly used in conjunction with protected agriculture, as an important and significant part of the comprehensive design.
- Drip irrigation is the only way to add standardized water and fertilizer to the plants in greenhouses.
- The application efficiency is usually 90 to 95 percent, compared with 70 percent sprinkler and 60 to 80 percent furrow irrigation.

- Basic irrigation equipment consists of a pump's laterals or emitters, main line, distribution pipes, laterals of manifold, and drip tape.
- The head is typically made up of control levers, couplings, filters, time clocks, fertilizer injectors, pressure controls, flow meters, and gauges between the pump and the pipeline network.
- Water passes through very small emitter outlets, it is absolutely necessary to screen, filter, or both before it is distributed in the tube system.
- The initial field positioning and layout of a drip system is affected by the land topography and the expense of different configurations of the system.



Drip Irrigation

Yield increase and water savings under drip irrigation

Crop	Yield increase (%)	Water saving (%)
Tomato	50	39
Watermelons	88	36
Cabbage	2	60
Radish	2	77
Beet	7	79
Chilies	44	62
Chilies	39	60

Design and Layout of Drip Irrigation

Steps in designing drip irrigation

Daily water consumption of the plant: Evaporation from the USDA class-A pan during the hottest day in the crop period of the plant or year in the case of the tree crop is taken consideration for estimating daily water consumption of the plant. It is calculated as follows:

Daily water use of each plant/ tree (q) = Evaporation (mm) × pan coefficient × crop coefficient × plant spacing (cm) × row width (cm)

Design application rate (DAR): Design application rate is calculated as:

$$DAR = CU \times A \times K$$

Where, CU = Peak consumptive use during the crop period/day

A = plant space area;

K = coverage factor of plant

Number of emitters required for each plant: Number of emitters required for each plant depends on area of wetting and radius of wetted area of single emitter. It is calculated as:

Number of emitters per plant = $2\ A/r^2$

Where, A = total area to be wetted,

r = radius of wetted area of single emitter

Rate of flow of each emitter (E): The rate of flow of each emitter (E) is calculated as:

$$E = q/n \times t$$

Where, q = daily water requirement (mm),

n = number of emitters,

t = time of operation (hr/day)

Irrigation interval: Irrigation interval (Ii) is depends on the net quantity of water applied in each irrigation and total plant water requirement per day. It is calculated as:

$$Ii = NDI/WR$$

Where, Ii = irrigation interval (hr),

NDI = net depth of each irrigation (mm),

WR = water requirement per day (mm)

Time of operation of each emitter:

Irrigation time or time of operation of each emitter is calculated as:

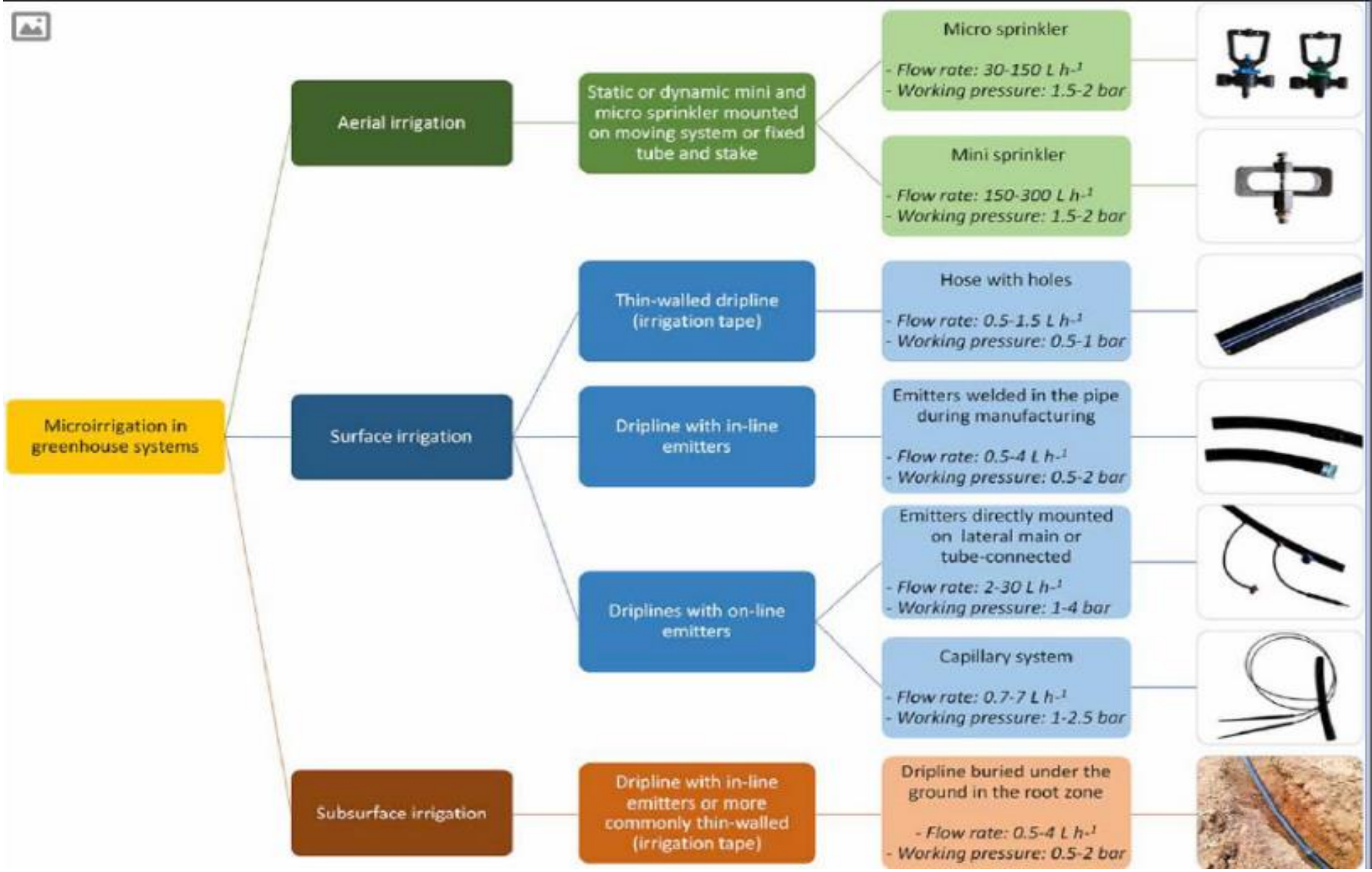
$$\text{Irrigation time (h)} = \frac{\text{Volume of water to be applied (m)}}{\text{emiter discharge rate (l/h)}}$$

Layout of drip irrigation

- Drip irrigation system for a greenhouse contains Mainlines, sub mains, and laterals provide water into the fields from the control head.
- Typically made of PVC or polyethylene hose and should be buried under the ground because, when exposed to direct solar radiation, they degrade quickly.
- Lateral pipes normally have a diameter of 13-32 mm.
- Emitters or drippers are devices that are used to monitor water discharge from the side of the plant.
- One or more emitters used for a single plant, such as a tree, they are normally spaced more than 1 meter apart.

Operating drip systems

- A system is called permanent when it stays in place for more than one season.
- Pressures as low as 0.15-0.2 kg / cm2 and as high as 1 to 1.75 kg / cm2 can work with the laterals.
- It is almost at the ambient pressure that water falls out of the emitters.
- If desirable, a fertilizer tank can be connected to the system to supply the crop with irrigation with various nutrients.
- Drip irrigation only wets part of the soil root region, unlike surface and sprinkler irrigation.
- The wetting patterns that form from dripping water onto the soil rely on the rate of discharge of the emitter and the type of soil.



Different components of micro-irrigation used in greenhouse systems

Area under Micro Irrigation: Form 1st April, 2014, NMMI (National Mission on Micro Irrigation) was merged under National Mission on Sustainable Agriculture (NMSA) and implemented as "On Farm Water Management" (OFWM) during the financial year 2014-15.

- From 1st April 2015, Micro Irrigation component of OFWM has been merged under Pradhan Mantri Krishi Sinchayee Yojana. It will be implemented as Centrally Sponsored Scheme on Micro Irrigation during the financial year 2015-16 as per the same pattern of assistance and cost norms as were prevailing under OFWM, until revised.

- The Government is making all efforts to enhance water use efficiency at farm level through adoption of micro irrigation in all the States of the Country and so far an area of 137.80 lakh ha has been covered under Micro Irrigation.
- The Department of Agriculture and Farmers Welfare (DA&FW) is implementing “Per Drop More Crop” component of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY-PDMC) from 2015-16 in all the States of the Country. The PDMC scheme focuses on enhancing water use efficiency at farm level through Micro Irrigation viz. Drip and Sprinkler irrigation systems.

- The objective of facilitating the States in mobilising resources for expanding coverage of micro irrigation, Micro Irrigation Fund (MIF) has been created with National Bank for Agriculture and Rural Development (NABARD).
- The fund is to facilitate the States in mobilizing the resources for expanding coverage of Micro Irrigation by taking up special and innovative projects and also for incentivizing micro irrigation beyond the provisions available under PDMC scheme to encourage farmers to install Micro Irrigation systems.

- In addition, Indian Council of Agricultural Research (ICAR) imparts training and organizes field demonstrations through Krishi Vigyan Kendras (KVKs) to educate farmers for promotion of efficient irrigation techniques/ Micro Irrigation for various crops.
- The Government provides financial assistance/subsidy @ 55% of the indicative unit cost to Small & Marginal farmers and @45% to Other farmers for encouraging them to install Drip and Sprinkler Irrigation systems under the PDMC scheme to enhance the coverage.
- Beside some States provide additional incentives/top up subsidy to reduce farmers' share for adoption of Micro Irrigation.

Conclusion

Micro irrigation helps in proper utilization of, water, fertilizers, saves labour and increases the productivity of horticultural crops. Apart from higher yield, higher resource use efficiency, higher benefit cost ratio is also obtained in Micro irrigation. Drip irrigation cum fertigation increases the yield due to higher nutrient uptake and thereby improves water and fertilizer use efficiency. In turn fertilizer could be saved to the tune of 25 to 50 per cent through drip Irrigation.

THANKS