FERTIGATION IN VEGETABLES CROPS

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I. INTRODUCTION

India is the brick of a Golden Revolution in Horticulture with a total annual production of 149 Million tonnes. Vegetables are important constituents of Indian agriculture and nutritional security due to their short duration, high yield, nutritional richness, economic viability and ability to generate on-farm and off-farm employment. Our country is blessed with diverse agro-climates with distinct seasons, making it possible to grow wide array of vegetables. Today, India is the second largest producer of the vegetables (90.8 Million tonnes) in the world, contributing 14.45 per cent of the total world production (NHB, 2013). The concept of Horticulture is shifting from maximizing yield to maximizing value with water management assumes paramount importance to reduce the wastage of water to increase the water use efficiency and also ensures evenly distribution. Moisture is maintained in the medium through application of water at critical stage of crop. The main point which considered is that changing from single product to creating value added product through a balanced, crop specific plant nutrition concept. The crop competence for nutrients will become more and more crucial, but even more relevant to transmit the superior knowledge to the end user is essential. Thus, fertigation is an important concept and the key focus of this article is on assisting the horticulturist in general and vegetable crops in particular.

II. FERTILIZERS

Fertilizers are chemical compounds (liquid or granular) which provides essential plant nutrients to the plants to promote growth. They are either applied through the soil or irrigation water.

III. FERTIGATION

Fertigation is a method of applying fertilizers, soil amendments and other water soluble products required by the plant during its growth stages through drip or sprinkler irrigation system. In this system fertilizer solution is distributed evenly in irrigation. The availability of nutrients is very high therefore the efficiency is more. In this method liquid fertilizer as well as water soluble fertilizers are used.

Table 1: Nutrient content of common fertilizers suited for fertigation

<table>
<thead>
<tr>
<th>Nutrient (N)</th>
<th>Compound</th>
<th>Nutrient content in solid fertilizers (N:P\textsubscript{2}O\textsubscript{5}:K\textsubscript{2}O)</th>
<th>Nutrient content in saturated liquid fertilizers (25\textdegree C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>Urea</td>
<td>46: 0: 0</td>
<td>21: 0: 0</td>
</tr>
<tr>
<td></td>
<td>Ammonium Nitrate</td>
<td>33: 0: 0</td>
<td>21: 0: 0</td>
</tr>
<tr>
<td></td>
<td>Ammonium Sulphate</td>
<td>21: 0: 0</td>
<td>10 : 0: 0</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Phosphoric acid</td>
<td>0: 51: 0</td>
<td>4: 18: 0</td>
</tr>
<tr>
<td></td>
<td>Mono Ammonium Phosphate</td>
<td>12: 61: 0</td>
<td>4: 18: 0</td>
</tr>
<tr>
<td></td>
<td>Di Ammonium Phosphate</td>
<td>18: 46: 0</td>
<td>4: 18: 0</td>
</tr>
</tbody>
</table>

IV. CHARACTERISTICS OF FERTILIZERS USED IN FERTIGATION
1. Full solubility.
2. Quick dissolution in water.
3. Fine grained product.
4. High nutrient content in the saturated solution.
5. Compatibility with other fertilizers.
6. Absence of chemical interaction with irrigation water.
7. Minimum content of conditioning agents.
8. No clogging of filters and emitters.
9. Low content of insoluble (< 0.02 per cent).
10. No drastic change of water pH (3.5 < pH > 9.0).
11. Low corrosives for control and head system.

V. TYPES OF WATER SOLUBLE FERTILIZERS
1. Liquid/Fluid fertilizers: Fluid or liquid in which the plant nutrients are in true solution. These are solutions which contain one or more plant nutrients.
2. Suspension fertilizers: Fluid fertilizers that have solid nutrients dispersed throughout the fluid.
3. Water soluble solid fertilizers: Fertilizers that are in solid state plant nutrients are fully water soluble.

VI. SALIENT FEATURES OF WATER SOLUBLE FERTILIZERS
1. Nutrients are 100 per cent water soluble.
2. Acidic in nature.
3. They correct and maintain the soil pH.
4. Nutrients are applicable in smaller quantity.
5. Nutrients are in readily available form.
6. Free from Na and Cl salts.
7. Apply in precise and uniform form.
8. Correct placement in root zone.
9. There are no chances of fixation of P and K.
10. No soil deterioration.
11. Application as per physiological stages of crop.
12. Improve up take of nutrients present in soil.
13. Efficiency is more than 90 per cent.
14. Improve and fasten the uptake of nutrients in soil.

VII. NEED OF FERTIGATION
➢ Rapid increase in area under micro irrigation, now fertigation is getting momentum in number of the countries. The concept of fertigation is new to the Indian subcontinent growing popularity to accept of this concept making it easy to adopt ‘Fertigation’. Fertigation is the technique to apply water soluble solids or liquid fertilizers through the drip irrigation on weekly or monthly basis so as to reach each and every plant regularly and uniformly. It is the most effective and convenient means of maintaining optimum fertility level and water supply according to the specific requirement (Shirgure, 2000).
➢ Fertigation permits application of a nutrient directly at the site of a high concentration of active roots and as needed by the crop. Scheduling fertilizer applications on the basis of need offers the possibility of reducing nutrient element losses associated with conventional application. Methods that depend on the soil as a reservoir of nutrients thereby increasing nutrient use efficiency. Fertilizer savings through fertigation can be to the tune of 25 - 50 per cent (Haynes, 1985).
➢ Fertilizers and pesticides applied through a drip irrigation system can improve efficiency, save labour and increase flexibility in scheduling of applications to fit crop needs (Rolston et al., 1979). However, all chemicals must meet the following criteria for the successful maintenance of the drip irrigation system (Bucks and Nakayama, 1980).
➢ However, increasing water scarcity and value crops and green houses to ensure higher escalating fertilizer prices may lead to greater efficiency of the two most critical inputs in crop adoption of the technology especially in high production. We should be conscious about that ‘per drop more crop.

VIII. RULES OF FERTIGATION
A few rules should be followed, to achieve maximum benefits of fertigation by Marr, 1993.
1. Type and amount of fertilizers used must be soluble enough to dissolve completely in the fertilizer tank water.
2. Completely charged or pressurized drip irrigation system is required before fertigation begin.
3. The fertilizers should be injected ahead of the filters to ensure that any undissolved particles are filtered out before fertilizer enters the drip tape.

4. The period of time in which fertilizer is injected into the system must be at least as long as that required to bring the entire drip irrigation system up to full pressure. This will allow each dispensing orifice in the drip line to have the same contact time with the fertilizer solution as it passes through the system.

5. All fertigation units should be wired to the pump switch control or a flow control switch in the main line to prevent the unit from running when no water flows in the line.

IX. PRE-REQUISITE FOR SUCCESSFUL FERTIGATION

1. Scientifically designed and well installed drip irrigation system.

2. Drip system material should be free from residues/deposits and fertilizers must not cause excessive corrosion of irrigation system components.

3. Irrigation system operating pressure variation should be minimum.

4. Selection of most appropriately fertilizer according to soil condition, plant requirement and costs.

X. FERTIGATION EQUIPMENTS

Fertiliser can be injected into drip irrigation system by selecting appropriate equipment. Commonly used fertigation equipments are:

1. Venturi pumps

2. Fertilizer tank

3. Fertiliser injection pump

4. External energy driven injector pumps

5. Automatic fertigation controller

**Venturi Injector**

This is a very simple and low cost device. Venture consists of a converging section, a throat, a diverging section. A partial vacuum is created in the system which allows suction of the fertilisers into the irrigation system through venturi action. The vacuum is created by diverting a percentage of water flow from the main and pass it through a constriction which increases the velocity of flow thus creating a drop in pressure. When the pressure drops the fertilisers solution is sucked into the venturi through a suction pipe from the tank and from there enters into irrigation stream. Although simple and with greater uniformity of dosing the fertilisers tank the venturi cause a high pressure loss in the system which may results in uneven water and fertiliser distribution in the field. The suction rate of venturi is 30-120 litre per hour.

**Fertiliser Tank (Flow by pass system)**

Operational principle is water flow because of pressure gradient between the entrance and exit of the fertilizer tank created by a pressure reducing valve. In this systems part of irrigation water is diverted from the main line to flow through a tank containing the fertiliser in a fluid or soluble solid form, before returning to the main line, the pressure in the tank and the main line is the same but a slight drop in pressure is created between the off take and return pipes for the tank by means of a pressure reducing valve. This causes water from main line to flow through the tank causing dilution and flow of the diluted fertiliser into the irrigation stream. With this system the concentration of the fertiliser entering the irrigation water charges continuously with the time, starting a high concentration. As a result uniformity of fertiliser distribution can be a problem. Fertiliser tanks are available in 90, 120, 160 liters capacity.
**Fertigation Pump**

These are piston or diaphragm pumps which are driven by the water pressure of the irrigation systems and such as the injection rate is proportional to the flow of water in the system. This injection rate of fertilizer solution is proportional to the flow of water in the system and adjusted to attain the desired level of fertilizer application. A high degree of control over the fertiliser injection rate is possible, no serious head losses are incurred and operating cost is low. Another advantage is that if the flow of water stops, fertiliser injection also automatically stops. This is perfect equipment for accurate fertigation. Suction rates of pumps varies from 40 to 160 litre per hour.

**XI. ADVANTAGES OF FERTIGATION**

1. In drip fertigation, the amount and form of nutrient supply is regulated as per the need of the critical stages of plant growth.
2. Saving of fertiliser applied, due to better fertiliser use efficiency and reduction in leaching.
3. Optimisation of nutrient balance in soils by supplying the nutrients directly to the effective root zones as per the requirement.
4. Reduction in labour and energy cost by making use of water distribution systems for nutrient application.
5. Better yield and quality of products obtained.
6. Timely application of precise amounts of fertilisers directly to the roots zone, this improves fertiliser use efficiency and reduces nutrient leaching below the root zone.
7. Ensures a uniform flow of water and nutrients.
8. Improves availability of nutrients and their uptake by crop.
9. Safer application method, as it eliminates the danger affecting roots due to higher dose.
10. Soil and water erosion are prevented.

**XII. DISADVANTAGES OF FERTIGATION**

1. Both the components (drip and water soluble fertiliser) are very costly.
2. Maintenance of drip irrigation is difficult. There is possibility of theft and rat infestation.
3. Good quality water is very essential.
4. Clogging of emitters may cause a serious problem.
5. It needs water soluble fertilisers, the availability of these types of fertilisers is limited.
6. Adjustment of fertilisers to suit the need is not easy.
7. Infestation of insect pest and diseases increases.
8. Area under micro irrigation is now increasing mainly because of subsidy in microirrigation, if subsidy is withdrawn, the area under micronutrient may also reduce.
9. Due to fear of yield loss, because of relatively lower dose of fertilisers in fertigation, farmers have the tendency to add additional fertilisers and irrigation water by traditional methods too. This may result in crop lodging (Sugar cane) lower yield and lower profits.

**XIII. CONCLUSION**

Drip fertigation technology is beneficial to the farmers for higher production and quality vegetable production. Achieving maximum fertigation efficiency requires knowledge of crop nutrient requirements, soil nutrient supply, fertilizer injection technology, irrigation scheduling, crop and soil monitoring techniques. Thus, success in using this system will depend on a sound fertility programme based on soil testing and a drip irrigation system that is designed and operated properly.

**REFERENCES**