

A REVIEW OF THE FERTIGATION ON THE FRUIT TREES

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Abstract:

Advances in micro-irrigation techniques have facilitated greater adoption of the application of fertilizers to crops through irrigation water; the technique is termed as fertigation. It is used extensively in commercial agriculture and horticulture. High fertilizer uptake efficiency provided by this nutrition method (about 67%) ensures minor environment pollution. The benefits of irrigation and fertigation only become evident if the correct irrigation design is employed to meet plant requirements and to distribute water and fertilizer constantly. The selection of the correct injection equipment is just as important as the selection of the correct nutrient. Incorrect selection of equipment can damage parts of the irrigation equipment or reduce the effectiveness of the nutrients. Climatic conditions, particularly chilling accumulation in winter and temperature and relative humidity in spring, affect shoot growth, flowering and fruit set, as well as the fruit growth and ripening rate. The paper proposes some concepts relative to fertigation of the fruit trees.

Keywords: fertilizer, fruit quality, micro-irrigation, yield

1. INTRODUCTION

The practice of supplying crops with fertilizers via the irrigation water is called fertigation (Bar-Yosef, 1992). Fertigation is a modern technique and provides an excellent opportunity to maximize yield and minimize environmental pollution (Hagin et al., 2002). This is provided by increasing fertilizer use efficiency, minimizing fertilizer application and increasing return on the fertilizer invested.

Fertigation is one techniques of applying fertilizers through irrigation systems, mainly in drip and other micro irrigation systems; the refers to application of fertilizers to an area of soil, where most of the active roots are present and also matches the timing of nutritional demand of the tree. Many authors have argued that a highly accurate application, both for water and fertilizers, can be achieved by simultaneous administration by fertigation. Thus we obtain the advantage of simultaneous supply of mineral elements in accordance with the trees needs (Nielsen et al., 2001; Weinbaum et al., 1992). The foliar application of fertilizer associated with fert-irrigations, insure in great measure the fruit trees needs for supplies, the soil fertilization is reducing and the fertilizers consumption as well (Marangoni et al., 2001). On the other hand, if is applied constantly, the localized irrigation provide into the plants a sustained sap circuit, with the capacities to uptake the minerals especially by the roots developed in the soil volume supplied with water by irrigation. Fertigation eliminates fluctuation of humidity in soil, which results in enhanced plant development and higher yields (Bar-Yosef, 1999; Tojanko and Čmelik, 2004; Kipp, 2005).

Over the past years, fertigation has been a regular agro-technical measure, given its superiority over the other forms of fruit plant nutrition. According to Miller et al. (1982), fertigation is based on its pronounced capacity to supply plants with actually available nutrients whose availability is independent of chemical processes in soil. High fertilizer uptake efficiency provided by this nutrition method (about 67%) ensures minor environment pollution, which conforms to the trends of modern agricultural production (Hagin and Lovngart, 1996; Fukuda et al., 1999).

The fertilizers applied through irrigation systems saves 29-78% in application costs due to the improvement in efficiency of fertilizer application. Also it results in low fertilizer leaching, precise nutrient application (right- amount and right- time) (Alva et al., 2005).

Nitrogen (N) is one of the major plant nutrients, which of ten applied to obtain optimum crop production. Besides tree growth, it is also involved in a number of physiological functions (Singh et al., 2002). Delivery of nitrogen through fertigation reduces nitrogen losses in the soil tree system by ammonia volatilization and nitrate leaching (Smith, 2001).

The current paper presents a review of the research on fertigation of the fruit trees.

2. ADVANTAGES AND DISADVANTAGES

- Advantages (<https://www.smart-fertilizer.com/articles/fertigation-fertilizer-compatibility-chart>):
 - Fertilizer application is uniform and more accurate;
 - Nutrient are immediately available to plants;
 - Reduce environmental contamination.
- Disadvantages (<http://agropedia.iitk.ac.in/content/fertigation>):
 - Initial investment is high;
 - Chemical reaction in drip system leading to corrosion and precipitation of fertilizer;
 - Clogging of emitter.

3. EFFECT OF FERTIGATION ON GROWTH AND YIELD OF FRUIT TREES

The nutrient requirements of young cherry trees (*Prunus avium* L.) increase during the period of fruit formation, and they continue to increase annually until the trees reach full production (Salgado et al., 2012). The nutrient requirements can vary according to training systems, planting density, soil type, climatic conditions and other factors. The availability of nitrogen (N) is one of the crucial aspects of orchard management. The estimated requirements in the first six years range from 8.8 to 44 kg N ha⁻¹year⁻¹ for pommies and stone fruit trees (Nielsen et al., 2002; Dierend, 2006), while for adult trees, they range from 39 to 65 kg N ha⁻¹ year⁻¹ (Roversiet al., 2006).

For most crops, the amount of available water results in differential effects on both vegetative and reproductive growth. The expansion of the shoots and young branches increases with the amount of water applied. Conversely, while vegetative growth decreases, foliar abscission increases when the water deficit reaches 50% of ETc (Livellara et al., 2011). Yield is not affected by moderate water deficit (0.75 ETc), although the fruit size decreases (Nielsen et al., 2004; Dehghanisanij et al., 2007). Previous studies on cherry fertigation show that the optimisation of water and nutrient applications is possible. The highest efficiency is obtained with low N applications (50 mg-N L⁻¹) between 0 and 8 weeks after flowering together with irrigation programmed according to the evaporative demand (Hanson and Proebsting, 1996).

The studies show that the trees grew more vigorously when fertigated with ammonium nitrate at the beginning of cultivation, whereas fertigation with a complete (NPK) fertilizer resulted in stronger growth in the subsequent years (Treder, 2006). NPK fertilization is responsible for highest yield and fruit length, however, phosphorus fertilization results in improved fruit diameter (Bybord, 2013).

The importance of fertigation and its influence on better apple tree growth has been confirmed by many authors (Hipps, 1992; Dencker and Hansen, 1994; Widmer and Krebs, 1999; Neilsen et al. 2000)

Nitrogen fertigation increased yield and average fruit weight of peach fruits (Bussi et al., 1994). Layne et al. (1996) found linear increase in total yield of high density peach orchard.

Fertigation with full dose of recommended dose of fertilizers resulted in significant increase in physical parameters including fruit yield, fruit weight, fruit length and fruit diameter when compared with direct fertilizer application in cherry, peach, plum and nectarine (Ahmad et al., 2010; Banyal et al., 2014; Singh et al., 2015 and Verma et al., 2017).

Southwick et al. (1999) observed that 0.11 and 0.23 kg nitrogen per tree is sufficient dose of nitrogen for optimum dry yield. Drip fertigation improved fruit size and yields (9-22 per cent) at peach tree (Bryla et al., 2003, 2005). Koumanov et al. (2016) studied the effect of continuous and interrupted fertilizer application (both drip and sprinkler irrigation) through fertigation on fruit yield and yield attributing components of 'Burlat'/'Mazzard' and 'Lapins'/'Gisela 5' of cherry. The variant shows no significant differences, with and without interruption of the nitrogen supply before fruit harvesting and hence, nitrogen fertigation, may be applied continuously without negative effects on the cherry fruit yield.

Fertigation significantly affects fruit quality attributes in terms of total soluble solids, acidity and total sugars content in cherry, nectarine and peach (Ahmad et al., 2010; Singh et al., 2015 and Verma et al., 2017). Fertilizer application through fertigation improves water and nutrient availability in soil therefore, it is readily available to trees and facilitates positive effects on several aspects of fruit quality.

4. CONCLUSIONS

- Fertigation was first developed for field and horticultural crops, and later used on tree plantations. Fertigation today is used in any system, small or large scale, all over the world.

- The topic on the combined use of nutrients with irrigation will be of benefit to growers all over the world for the efficient use of water and fertilizers in production systems.

- In terms of generative potential of fruits, fertigation is considered an influential factor which is to a great extent governed by selected fertilizer.

- Fertigation presents number of advantage such as saving of labour and fertilizer, higher efficiency of the two factors of production (water and fertilizers) and reduction of ground water pollution.

- Fertigation holds a great potential since it effects and improves the growth, yield and quality parameters of the stone fruits.

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