FERTIGATION TECHNIQUE AS A TOOL FOR BETTER COTTON PRODUCTION

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Abstract: Cotton is the most important fibre and oil yielding crop grown under diverse agro-climatic conditions. It is also an important commercial crops playing key role in economic and social affair of the world. India is one of the major producers of cotton in the world with largest acreage of 11.7 M ha with a production of 398 lakh bales and productivity of 577 kg lint hectare^{-1}. Cotton being a long duration crop demanding higher water and nutrients, the major factor limiting growth, yield and quality of cotton are improper water and nutrient management.As quoted by Sir. C. V. Raman, *water is the ELIXIR of life that makes wonders in earth if it is used properly, efficiently, optimally, equitably and judicially*. Thus fertigation in cotton helps in increasing yield besides improving quality, water and Nutrient Use Efficiency.

Keywords: Cotton, Fertigation, Nutrient use efficiency, Quality

Introduction: Fertigation is a new concept gained popularity in developing countries and being now extensively implemented in developing countries. It is a method of application of water soluble fertilizer through the drip irrigation system. It is most effective and convenient means of maintaining optimum fertility level as well as water supply according to the specific requirements of the plants and is most is also practiced in cotton for better utilization of nutrients and water.

Fertigation is the judicious application of fertilizers by combining with irrigation water. It offers accurately and timely nutrition to the crop, thereby reducing the losses of nutrients associated with conventional fertilizer application methods. Since indiscriminate use of water through conventional type with 60 per cent application efficiency is causing serious threat to available ground water resources on the other hand drip-fertigation, where fertilizer is also applied through an efficient (drip) irrigation system, Nutrients Use Efficiency could reach as high as 90 per cent besides achieving > 95 per cent application efficiency compared to 40-60% in conventional methods. Therefore, the amount of fertilizer lost through leaching could be as low as 10% in drip fertigation as compared to 50% in the traditional one.Since cotton is one of the identified crops for adoption of drip fertigation commonly known for its response, accommodating of higher plant population (associated with annual crops) warrant effective water distribution and delivery.

Cotton, often referred as "White gold" is being cultivated in India for more than five thousand years. Cotton deserves the prime position in India constituting more than 70% of the total fibre consumption in the textile sector [1]. India is one of the major producers of cotton in the world with largest acreage of 11.7 M ha with a production of 398 lakh bales and productivity of 577 kg lint hectare^{-1}[2] and provides livelihood for over 4 million farming families.Though there is significant rise in the yield over the years, India's productivity is low when compared with the other countries. In India, more than 75% of the cotton is cultivated either without suitable irrigation facilities or under rainfed conditions. Cotton being a long duration crop demanding higher water and nutrients, the major factor limiting growth, yield and quality of cotton are improper water and nutrient management.Thus fertigation in cotton helps in increasing yield besides improving quality, water and Nutrient Use Efficiency.

Present situation and need for fertigation:

- Cotton is an important fibre and agro-industrial crop
- Climatic change & water scarcity concerns
- Increasing fertilizer & labour costs
- Leaching and washing away of nutrients by runoff
- Low water & fertilizer use efficiency
- Low seed cotton productivity/ha
- Favourable cotton prices and employment generation
- Economic importance of cotton in meeting fibre for textile industry
- To conserve water, increase water & fertilizer use efficiency and optimize cotton yields

Advantages of fertigation:

- **Uniform application of fertilizer:** In fertigation, fertilizer is applied along with irrigation water, i.e. through dripper. Normally, uniformity in drip irrigation system is above 95 per cent and thus fertilizer application also achieves higher uniformity.
- **Placement in root zone:**Fertigation provides the opportunity to apply fertilizers/chemicals in the root zone only as it is possible to have a control through drip irrigation system.
- **Quick and convenient method:** The fertigation is quick and convenient as it provides management of time and quality at control unit of drip irrigation.
- **Improved FUE:** The nutrients supplied through fertigation increases their availability, limit the wastage of their being leached out below rooting

depth and consequently improve fertilizer-use efficiency. It enables reduction in fertilizer requirement (25-50%) thus saving fertilizer.

- **Frequent application is possible:**Fertigation provides an opportunity to apply fertilizer more frequently than conventional methods. However, a mechanical spreader is costly, causes soil compaction, may damage the growing crop and always not accurate.
- **Possibility of application in different grades to suit the stage of crop:** The soil and plant system requires different types of fertilizer material during the crop cycle, can be supplied through fertigation more effectively compared to conventional methods.
- **Micronutrients application along with NPK:** Fertigation provides an opportunity to mix the required micronutrients along with conventional NPK and can be applied to soil/plant systems.
- **Save groundwater pollution:** The excessive use of fertilizer through conventional methods lead to the leaching of fertilizer material beyond the root zone depth. At a number of locations it has been observed that it pollutes the groundwater of the area. The fertigation provides an opportunity to prevent these environmental hazards.
- **Improves nutrient movement of P and K in root zone**

Case studies:

- Reference [3] conducted field investigation at agronomy field unit, UAS, GKVK, Bangalore during *kharif* 2012 with 7 treatments and 3 replications involving treatment combinations of 3 splits (T_2 and T_3), 4 splits (T_4 and T_5) and 5 splits (T_6 and T_7) at 75 and 100 per cent dosages of RDF as compared to RDF through soil application.
- Surface fertigation treatments resulted in 16-46 per cent higher seed cotton yield over RDF through soil application. Among fertigation treatments, 100 per cent RDF in 5 splits recorded highest seed cotton yield (3397 kg ha^{-1}). The higher seed cotton yield in surface fertigation treatments was attributed to yield parameters like more number of squares, flowers and bolls. Significantly higher N, P and K uptake (160.99, 28.57 and 134.87 kg ha^{-1}) was recorded in 100 per cent RDF with fertigation in 5 splits. The higher nutrient uptake in fertigation treatments was attributed to uniform nutrient distribution and higher nutrient availability in the soil as compared to RDF through soil application
- A field experiment was conducted during summer, 2007 to study the optimization of the critical inputs such as irrigation water and fertilizer for cotton through drip fertigation in coastal deltaic region of Karaikal. The treatment consisted of three different levels of soil moisture (I_1 - 0.4 and 0.6 ETc, I_2 - 0.5 and 0.7 ETc and I_3 - 0.6 and 0.8 ETc, during before and after flowering stages, respectively) and four different doses of nutrients (N_0 - 0, N_1 - 50%, N_2 - 75% and N_3 - 100% RDF through fertigation) were taken up in combination with farmers practice as control. The experiment was conducted in factorial randomized block design with three replications.
- Supply of irrigation water through drip to a tune of 0.5 and 0.7 Etc (I_2) and 0.6 and 0.8 Etc (I_3) was at par and proved significantly superior to a tune of 0.4 and 0.6 Etc (I_1) during before and after flowering stages of the crop in influencing seed cotton yield. Similarly, fertilizers applied at recommended dose (100% RDF) had registered the highest seed cotton yield (2635 kg ha^{-1}) but were at on par with each other [4].
- Drip fertigation is a core technology in precision farming system. However the economic viability in close spaced crops like cotton has to be ascertained. Hence an experiment was conducted in Tamil Nadu Agricultural University, Coimbatore during winter 2010 to compute the economics of drip fertigation with Water Soluble Fertilizers (WSF) and Conventional Fertilizers (CF) over conventional methods in Bt cotton (Mallika Bollgard II) and Non Bt Cotton hybrid. Three drip irrigation levels at 75%,100% and 125% and three fertigation levels at 75%,100% and 125% of RDF of NPK through WSF (150:75:75 NPK Kg /ha). These were compared with drip fertigation with conventional fertilizers and farmers practice of furrow irrigation (5cm depth) and soil application of CF at 100% Recommended Dose of Fertilizer (RDF) [5].
- They reported that drip fertigation of RDF with water soluble fertilizers has recorded higher yield (39.6 q ha^{-1}) and net income (1,42,246 Rs. ha^{-1}) compared to control (25.71 q ha^{-1} and 1,14,246 Rs. ha^{-1} respectively). But B:C ratio is highest in control (5.51), followed by Drip fertigation of RDF with CF (4.13) and the least among is RDF with water soluble fertilizers (3.23). Inspite of higher yield and gross income from WSF, the high cost of WSF has resulted lower net seasonal income and B: C ratio. Hence considering the B: C ratio, drip fertigation with conventional fertilizers in Bt Cotton has outweighed the WSF in obtaining higher income per rupee invested.
- Reference [6] conducted field experiment for three years during *kharif* season (2005-2006 to 2007-2008) to study the effect of nitrogen and potassium at 75, 100 and 125 per cent recommended doses and in 4, 6 and 9 split applications through fertigation under drip irrigation on Bt cotton (BG-1) at Nandyal, Andhra Pradesh in vertisols. They reported that

treatments with fertigation of N and K through different splits recorded higher oil content compared to control with recommended method of fertilizer application. Fiber strength was found to be highest in 75% of N & K applied basal with 9 splits (22.2 g tex^{-1}) but uniformity, Micronaire and *kapas* yield were found to be higher in 125% of N & K applied basal with 9 splits (43.7 %, 4.6 and 1.8 t ha^{-1} respectively) over control with rec. method of fertilizer application (21.3 g tex^{-1}, 43.2 %, 4.5 and 1.47 t ha^{-1} respectively).

Conclusion:

"More Crop Per Drop": It is clear that fertigation have many advantages like higher WUE and FUE, minimum losses of N, better availability and mobility of P and K, optimization of the nutrient balance by supplies nutrients directly to root zone, control of nutrient concentration in soil solution and saves application cost. It increases the yield and economics of cotton under drip system and also surface fertigation. Even though high initial investment and comparatively low technical skill of average Indian farmers are some of the major constraints limiting the large scale adoption as drip fertigation technology in the country drip irrigation and fertigation is very essential for efficient management of two very important inputs i.e. water and fertilizer for sustainable production and self sufficiency.

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