FERTIGATION IN BANANA AS A TOOL TO INCREASE WATER AND FERTILIZER USE EFFICIENCY: A REVIEW

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Abstract: Banana is one of the important fruit crop in the tropics. Banana is being an exhaustive crop, it is paramount to maintain high degree of soil fertility to ensure high yield. Adoption of modern techniques like fertigation is needed to be emphasised to increase water use efficiency and fertilizer use efficiency. Fertigation is the most effective way to supply water and nutrients to plants which not only saves water and fertilizer but increases yield and quality. As reported by different research workers of world, adoption of fertigation in banana results in saving of fertilizer up to 25-30 per cent and water saving up to 40 per cent and significant increase in yield and quality of banana.

Keywords: Banana, Fertigation, Fertilizer use efficiency, Water use efficiency.

Introduction: Banana contributes 37% to the total fruit production in India. India is the largest producer of banana in world and it ranks second in area and production next to mango. It is widely cultivated in varying agro-climatic regions under different systems of production. In India it occupies an area of 7.97 lakh ha with production of 284.6 lakh tonnes and with productivity of 35.7 t ha^{-1} [1]. Banana is a rich source of carbohydrate and is rich in vitamins particularly vitamin B. It is also a good source of potassium, phosphorus, calcium and magnesium.

Banana being a gross feeder requires high amount of water and nutrients. Water and nutrient are the two key factors in the growth and development of banana. To ensure high yield and superior quality in banana, adequate application of nutrients is of paramount importance besides other improved cultural practices. Under such conditions fertigation helps in increasing yield through higher water and fertilizer use efficiency and reducing the degradation of soil.

Fertigation is a method of application of water-soluble fertilizer through the 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 commonly practiced in fruit crops.

Fertigation is advantages over conventional fertilizer application method since it can enhance the fertilizer use efficiency, nutrient uptake, improves quality parameters substantial saving of fertilizer up to 30- 40 % [2] and thus, it resulted into significantly increase total mass of plant, improved phonological characteristics and bunch characteristics, higher fruit yield and quality of banana over conventional fertilizers application [3].

At present, the major hurdles in Indian agriculture is high fertilizer consumption and low fertilizer use efficiency, as the prices of fertilizers are increasing every year. So, today's perspective it is essential that apply the recommended doses of nutrients at appropriate growth stages by proper method of application in order to increase the productivity and farmer profitability. Therefore, literature relevant to the subject has been reviewed.

Review of literature: A review of drip irrigation effects on Banana is being presented under following sub heads:

1. Effect of fertigation on Soil organic carbon and Available Nutrient
2. Effect of Fertigation on Growth, yield parameters, yield and quality of Banana
3. Effect of Fertigation on quality of Banana
4. Effect of fertigation on nutrient uptake and water use efficiency by Banana
5. Economic viability of drip fertigation

1. Effect of fertigation on Soil organic carbon and Available Nutrient

The application of 100 per cent recommended dose of N and K (200 g N and 200 g K2O $plant^{-1}$) through drip in 44 splits up to 300 days and soil application of P_2O_5 (40 g $plant^{-1}$) at planting recorded significantly higher organic carbon (0.39 %), available N : P_2O_5 : K_2O (253 : 22.5 : 618 kg ha^{-1}, respectively) as compared to initial soil status (238 : 21.6 : 618 N : P_2O_5 : K_2O kg ha^{-1}, respectively) [4].

Effect of Fertigation on Growth, yield parameters, yield and quality of Banana

Reference [5] reported that application of 100 per cent recommended dose of fertilizer (200 g N : 50 g P : 300 g K) through drip recorded significantly higher plant height (189.8 cm), bunch length (115.4 cm), number of fruit per bunch (117), bunch weight (21.41 kg) and yield of banana (95.2 t $ha^{-1)}$ as compared to 100 per cent recommended dose of fertilizer through soil application (172.6 cm, 111.2 cm, 109, 17.2 kg and 76.4 t ha^{-1}.

Reference [6] reported that fertigation of nitrogen and potassium at 200 g $plant^{-1}$ has given higher plant height at 180 DAP (143.11 cm), no. of leaves per plant (10.91), total dry matter (4390.58 g $plant^{-1}$), hands per bunch (7.43), fingers per bunch (96.02) and yield (88.46t ha^{-1}) compared to control.

Reference [4] revealed that, 100 % N and K_2O through drip fertigation rewarded maximum plant height (185 cm), stem girth (73 cm), maximum no. of hands per bunch (8.7), no. of fingers per bunch (151), weight of bunch (20.6 kg plant^{-1}) and yield (91.4 t ha^{-1}) compared to 100 % N and K2O applied through conventional method. This is due to; the banana plants effectively utilized the accurate placement of fertilizer in solution form at the active root zone area resulting in vigorous growth and faster bunch development.

Reference [7] reported that application of 100% recommended dose of water soluble fertilizer through fertigation as per the growth stages has recorded higher finger length (23 cm), finger girth (13.17 cm), number of hands per bunch (8.33), number of fingers per bunch (147.6), bunch weight (18.66) and yield (82.94 t ha^{-1}) compared to conventional method of fertilizer application. Fertigation as per the growth stages proved superior as compared to uniform splits because of the availability of nutrient during growth stages and nutrients are utilized efficiently by the growing plants.

Effect of Fertigation on quality of Banana:

Reference [8] revealed that subsurface drip fertigation of 100 per cent recommended dose of fertilizers (Urea, 13:40:13, KNO_3) + liquid bio fertilizers recorded the highest bunch yield (44.51 t ha^{-1}) which accounted to 115 per cent yield increase over surface irrigation with soil application of recommended dose of fertilizers. The fruit quality parameters like total soluble solids (TSS), ascorbic acid and sugar content are also maximum. Higher fruit quality especially higher sugar content can be explained by the role of potassium which is involved in carbohydrate synthesis, breakdown and translocation and synthesis of protein and neutralization of physiologically important organic acids.

Reference [9] reported that fertigation with 100% RDF (200:300g N&K /plant) and application of 15 L /day /plant have recorded higher TSS (23.28% brix). Fertigation with high levels of fertilizer and low levels of water could produce better TSS. Application of K might have contributed to quality improvements under high levels of fertigation. K is involved in carbohydrate synthesis and its absolute requirement for starch synthatase activity

Effect of fertigation on nutrient uptake and water use efficiency by Banana: Water use efficiency was observed to be about 20 % higher in drip irrigated area in comparison to check basin method used for crop cultivation. The nitrogen, phosphorus and potassium use efficiency was 25-60 % higher in fertigation than the conventional method of fertilizer application. The maximum increase was in treatment T_3 (59.5 %) followed by treatments T_2 (43.25 %) and T_1 (24.5 %). The overall fertilizer use efficiency (NPK) was found maximum for treatment T_3 (53.8) followed by T_2 (48.32), T_1 (41.97) and T_4 (33.71). The higher fertilizer use efficiency for the treatment T_3 was mainly attributed to lower dose fertilizer application. The treatments $T_1$and T_4 with 100 % recommended dose of fertilizer indicated that the fertilizer use efficiency was increased by about 25 % when the fertilizer was applied through drip [5].

Reference [4] reported that application of 100% recommended dose of N and K through drip increased uptake of N, P and K (685, 127, 1275 kg ha^{-1} respectively) .In general 7.63 kg N, 1.40 kg P and 14.0 kg K were required to produce one tonne of banana. The uptake of NPK kg ha^{-1} and kg t^{-1} was reduced with the reduced level of fertilizer dose. However, uptake of nutrients was increased in fertigation treatments as compared to conventional method of fertilizer application

Reference [10] reported that application of 100 % recommended dose of fertilizer (RDF) in which 50 percent of P and K was applied as basal and the remaining NPK as water soluble fertilizers through drip irrigation along with sulphur @ 25 kg ha^{-1} as soil application registered increased water use efficiency (44.4 kg ha^{-1} mm) higher net income (Rs. 416968 ha^{-1}) and B: C ratio (6.2). The increased water use efficiency and water productivity recorded under subsurface drip fertigation system was mainly due to better performance of the crop and increased yield by effective utilization of available water and nutrients that were supplied at regular intervals throughout the crop period to meet the crop demand.

Economic viability of drip fertigation: Reference [9] reported that fertigation treatment W1F3 has given highest B: C ratio (1.78) and reduced cost of production per kg of Banana (Rs. 1.26). Fertigation has proved to economise water and fertilizer level with a corresponding lower expenditure in cost of production with labour saving towards weeding, fertilization and water application.

Application of 100 per cent recommended dose of N (200 g plant^{-1}) and K (200 g plant^{-1}) through drip at weekly interval in 44 splits and basal dose of P_2O_5 (40 g plant^{-1}) as soil application recorded higher monetary returns (Rs.3,19,900 ha^{-1}), net profit (Rs.1,49,896 ha^{-1}), increase over control (Rs.26, 950 ha^{-1}) and B:C ratio 1.88 [4].

Conclusion: Considerable work has been carried out on fertigation for banana production during the past several years. However, still lot of work remains to be done which is summarised below and needs to be investigated: (a)Fertigation time and number of splits need to be standardized for tissue culture banana and other banana varieties for higher yield and fertilizer use efficiency. (b) Fertigation needs to be evaluated under different banana growing agro-climatic zones and soil types for various types of banana varieties.

(c) Evaluation of emitter clogging problem in fertigation in Banana. (d) Economic viability of drip fertigated banana under different agro-climatic zones.

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