



SOME EMERGING AND IMPROVISED MATERIALS FOR TRICKLE IRRIGATION: A REVIEW

SANI I. A.

Department of Agricultural and Bioenvironmental, Federal Polytechnic Bali, Taraba State, Nigeria.

Abstract

Trickle irrigation is an environmentally friendly process that utilised a range of improvised materials in combination with series of techniques to irrigate crops. This has however remained in pilot scale studies as far as the application of these techniques in the field realities are

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concerned, hence the need for compilation of research on the subject. This review found that the use of improvised materials should be done after a pilot study

INTRODUCTION

In the industrialised countries several irrigation methods such as sprinkler, trickle, bubbler, pitcher and sub irrigation are now in practice, which have high irrigation application efficiencies thus save water and produce high yields. Among them trickle irrigation is one of the most suitable technologies in modern irrigated agriculture with great potential. It is a system of supplying filtered water and fertilizer directly on or into the soil and also water is allowed to disperse under low pressure in an exact and predetermined pattern (Mirjat, 2010, Zakari, et al., 2013,). In the past, surface irrigation.

confirmed the incur unnecessary and materials are critical to feasibility of using the avoidable cost. the success of trickle technique. Otherwise, Selection of suitable irrigation system. the technique may and cost - effective

(SI) methods such as basins, borders and furrows have been used to irrigate crop in Nigeria. Under these irrigation methods, water flows over the entire field or along furrows by gravity (Gunarathna, et al., 2017). Ponding of water on the surface, deep percolation, evaporation losses are common features of these traditional methods. Application efficiency of these methods is not more than 40 - 45% (Satpute, 2011). Trickle irrigation offers unique agronomical, agro technical and economic advantages for efficient use of water. The main disadvantages of trickle irrigation systems are sensitivity to clogging, salinity build up and poor soil moisture distribution. With water scarcity and climate change, management of water have become increasingly important issues in crop production globally. Irrigated agriculture is being called on to produce more food using less water without degrading soil and water resources (Subbaiah & Mashru, 2013). Trickle or drip also called micro or localized irrigation technique involves the wetting of the root zone of plant by using a set of pipes with emitters (Huang et al., 2015). Water is applied as continuous drops, tiny or minute spray through applicators placed along a water delivery line (Onwualu, et al., 2006 and ASABE, 2007). Trickle irrigation is among the modern irrigation methods and is quite popular in areas with water scarcity and coarse soils having high infiltration rate (Mirjat et al., 2010). The potential of trickle irrigation lies in improving the crop yield and quality using less water and by controlling chemical and fertilizer applications to enhance their efficient use and reduce the risk of pollution (Pereira, 2005 and Fischer, et al., 2007). The objective of this work is to review and bring together a range of recent researches in the area of improvised trickle irrigation materials. The literature is reviewed under a number of subheadings for convenient and conclusion was drawn

Trickle Irrigation Materials

Conventional pipes used for most of the outstanding schemes of trickle irrigation are made mainly of polyvinylchloride (PVC) and asbestos cement, occasionally, while emission devices include emitters that operate either above or below the ground surface. Emitter is a device which

precisely deliver small amount of water. The capacity of the emitters available in the market varies from 2 to 16 litres per hour (Sharma, 2013). These pipes and emitters are very efficient and adequate but are being imported, beyond the reach of rural farmers who produced more than 90% of total agricultural commodities in Nigeria (Awe and Ogedengbe, 2010). Thus, the search for and use of substitute materials has become inevitable. An emitter could be formed by drilling a very small hole in a pipe (Bryan, 2007 and Jess, 2011). From such laterals the hole nearest to the water source will have larger water flow from them, while those at the far end will have very small or no flow. Since using a simple hole in a pipe does not work well, the pioneers of drip irrigation started using mechanical devices that would better regulate the flow. These devices have been given the name “emitter” or sometimes “drippers”. Emeagwara (2014) described two types of emitters; Point source emitters which discharge water from individual or multiple outlets, and line – source emitters which have perforations, holes, pores or emitters which extruded into the plastic lateral lines. Mofoke et al. (2004) worked on a gravity fed system that was constructed from cheap and locally available plumbing materials incorporating a modified form of medical infusion set as emitter and obtained distribution uniformity for four treatments as 90, 91.4, 93 and 97%.

Bamboo Pipe (*Bambusa vulgaris*, Schrad)

Bamboo is one of the nature’s gifts to mankind. Its nature as a pipe, with septum removed, either as a whole or part has enable many farmers and rural communities to carryout less expensive and complicated construction of water conveyance schemes for irrigation, drainage and water supply in Tanzania, Ethiopia, China and Indonesia (Lieses, 2015). The bamboo is used in Nigeria in various forms ranging from pulp and paper to building construction but its potential as substitute piping material for irrigation is yet to be established. Umar et al. (2011) worked on bamboo gravity fed micro irrigation lateral system but did not use any emitter. He punched the bamboo with holes of different diameters and evaluated the system. He got average discharge variations, coefficient of

manufacturing variation and emission uniformity (Christiansen 1942); coefficient of uniformity and distribution efficiency were: 30%, 9.8%, 73%, 92% and 88% respectively. Awe and Ogedengbe (2010) used medical emitters on bamboo pipes in gravity fed system. Their design involved the use of bamboo as the conveyance structure and medical infusion sets as drippers to deliver water to the field at 10, 15, 20, 25 and 30 drops of water per minutes. The variation in discharge ranged from 6.35 to 10.21% as the flow decreases from 30 to 10 drops of water per minute.

Medical Infusion Set

The medical infusion set (otherwise known as medical emitter) is used mainly in the hospital and clinics dedicated for transfusion purposes but, Mofoke et al., (2004), Awe and Ogedengbe, 2011) reported a satisfactory performance as drippers for a drip irrigation system installed in tomato plots. One shortcoming about this study is that the medical emitters were calibrated to supply to the field in drops of water per minutes, in other words, they were calibrated to supply water to the field at discharge rates that could be comparable to those of conventional emitters, therefore, there is gap in knowledge on how to improvised systems perform over time (Awe et al., 2017). An affordable continuous-flow drip irrigation system was designed, and evaluated in Bauchi state, Nigeria with tomato as test crop. The system was designed to deliver the daily crop water requirement on a continuous basis throughout the day. The calculated continuous-flow rate was 9 drops of water per minute. The hydraulic design was based on a step wise use of the energy equation. The system was constructed exclusively from cheap and locally available materials, incorporating a modified form of the medical infusion set as emitter (Mofoke et al., 2004).

Drum and Bucket Trickle kit

Low cost micro – irrigation systems in use today include drum and bucket drip kits (Cornish and Brabben, 2001) which apply water pulses often more than once a day. In order to evaluate the efficiency and applicability of these systems, considerable studies have been conducted with success.

KB Drip

Krishak Bhandu (KB) or “farmers’ friend” in local Hindu parlance is a low – cost drip kit developed and promoted by International Development Enterprises (IDE) in India and other South Asian regions over the past decades. High adoption rates and widespread use of these kits have been reported (Heierli & Katz, 2007; IDE, 2007) leading to their promotion in Zambia and other African countries. The objective of the low cost micro drip kit is to empower ‘poor’ small holder farmers to invest their way out of poverty. The study concluded that the configuration of drip on farmers’ field was determined largely by farmer’s innovation, availability of spares and cost of drip equipment, profitability of markets, labour, system capacity and technical knowledge of farmers as well as the availability and depth of groundwater (Tuabu et al., 2013)

Localized Trickle Irrigation System

Zakari et al., (2013) designed, constructed and installed a localized trickle irrigation system. The system was designed to deliver water required by the crop intermittently. The system was constructed exclusively from locally available materials (PVC pipes, GP plastic tanks, bricks stand, filter made using sponge and water pump). The emitter was punched using 1 mm diameter needle on a 20 m long lateral. It was designed for tomato crop (*Lycopersicum esculentum* spp) with irrigation interval of five days. The test of the system shows that the water application is adequate; the pump used for operation of water lifting was 2” water pump. The result of system’s test revealed a nice outcome by wetting the area situated on the lateral at 60 cm to one another at almost same application rate.

Ngigi et al., (2001) reported that unreliable rainfall causes periodic droughts in Kenya. This unpredictability, coupled with the lack of local capacity to deal with the situation, creates a persistent threat of household food insecurity in the region. Low-head drip irrigation technologies were introduced to combat this problem and alleviate food insecurity for thousands of people. First indications from a variety of research sources are that these technologies are a formidable poverty-fighting tool and address the technical constraints of the systems and to develop practical

recommendations for smallholder farmers, so that they can maximize the benefits of this technology.

CNCLUSION

Some improvised materials for trickle irrigation system has been studied and literature has shown that various materials have been utilized in pilot scale to provide enough data for enhanced understanding of the technique. Trickle irrigation system is particularly useful in the control of the quantity of water passing through the root zone by regulating the emitter discharge or selecting appropriate size emitter, minimizing deep percolation, leaching of nutrients beyond the root zone and keeping the water and nutrients distribution near the roots. The configuration of drip irrigation system on farmers' field is determined largely by farmer innovation, availability of spares and costs of drip equipment, profitability of markets, labour, system capacity and technical knowledge of farmers.

This review has shown that the selection of materials is critical to the success of any trickle irrigation system to optimize the technique. The cost and availability of these materials have to be evaluated to ensure that the system is cost effective.

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