Grow More Food with Less Water

Training and Discussion Notes on Drip Irrigation for Extension staff

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A) What is drip irrigation?

Drip irrigation is a method of watering plants through devices called emitters. The drip emitters are usually industrially made tapes with very small outlets. Single drops of water come out at a time to wet the soil around the plants roots, hence the name 'drip irrigation'.
Low head drip irrigation uses scarce water most efficiently to produce vegetables and other crops during drought periods. Small-scale farmers in semi-arid areas who are using the systems are finding the technology to be very appropriate and suitable for production of fresh vegetables, field and tree crops throughout the year. The system is composed of a water container and tubes that delivers water slowly and directly to each plant.

B) Historical background

Drip irrigation is used around the world, especially in arid and semi-arid lands. An Israeli Symcha Blass first developed the technology and it has been used on an increasingly large scale since early 1960s. The Israelis are really in the forefront of drip irrigation research and design. The arid lands in Israeli, led to the development of these technologies that allow them to get produce out of the desert.

The USA has also used the technology for years, especially in the drier regions. Chapin Watermatics that produces the bucket drip kits has been in business since 1962. In Kenya small-scale bucket kits were introduced to farmers in the mid1990s by the Samaritan purse (Missionary group).

The concept of drip irrigation was born from the observation of a drip tap and the lush growth seen around it. This lushness gave indication of the healthy growth of the plant under these dripping conditions. Lush growth, not water conservation was the goal of the original drip irrigation set.

C) Advantages

1. **Water conservation**. There is up to 60% or more savings of water over traditional methods. Where water is scarce or expensive it is a good option.

2. **Better water control**. Water goes directly to the crop's roots, and weeds are not given a chance to grow. Because it slowly trickles into the soil, water is not lost to evaporation and also there is no hard crust formed as when water pools on the soil's surface, causing water to run off away from the plants.

3. **Disease occurrence limited**. The crop's leaves don't get wet, which often encourages the spreading of diseases. Fruiting is aided with drip irrigation because the blossoms don't get wet.

4. **Fertigation**. Liquid fertilizers can be used directly in the system and will be effectively used by the plants.
5. **Time and labour**. The main activities usually involve turning on the water or filling a bucket, and then the watering is done by the system. Less time is spent adding fertilizer and weeding as well.

6. **No Erosion.** Because of the slow dripping action, there is no erosion with drip systems.

D) Some Important Considerations before starting the project

- **Site selection** – is it secure from both people and livestock or other rodents?

- **What crops to grow** – Indigenous v/s exotics, crops for domestic use v/s for sale.

- **How do you handle bugs?** Pests can be a nuisance especially when it's dry and there is no other green stuff around.

- **Who to grow?** Do the farmers have any experience –dryland farming etc? Or are they going to engage someone else to do the farming??

- **Water availability** – Is there sufficient water for irrigation considering other important water requirements like for livestock, drinking and cooking etc in relationship to distance to water sources?

- **The right season** – Don't introduce drip in the middle of the rainy season when there is no need for irrigation! Wait for dry season "Necessity is the mother of invention".

- **Marketing of produce** – Is there ready market for the produce?

- **Access to technology** – Is there a sustainable local supply of the drip tapes in case farmers want to scale up?

- **Training and technical support-** Need for someone on the ground to serve as an enthusiastic promoter to help farmers and others to overcome basic problems and share innovations.

- **Extension materials and information support –** Are their appropriate extension materials to enhance drip technology diffusion?

- **Coordination, lesson learning and networking –** There is need for coordination of activities to promote information exchange and learning from farmer innovations etc.

E) Drip Irrigation types and configuration

1) The Bucket Kit

This is the most commonly promoted type of kit in home gardens to produce vegetables. The bucket kit consists a 20 litre capacity plastic container (can or bucket), 30 metre drip tape, filter plug, connectors and rubber washer.

The bucket kit header is 1 metre above the planting surface, with 2 parallel drip tapes measuring 15 - 16 metres each. Spacing between laterals is determined by crop type. However, a typical local spacing between laterals for kales, cabbages and tomatoes is at 0.6 metres. Emitter spacing on most commonly used tapes is 30 cm. One drip kit covers a bed of 1 metre by 16 metres.

A closer look at the bucket set up

For effective irrigation, a bucket is filled with clean water twice in a day, early morning and late afternoon. Local farmers use different sources of water depending on its accessibility, but the most common ones are rivers, boreholes, shallow wells or surface dams. The cost for a bucket kit varies from country to country but will cost not more than USD 15. The bucket kit is quite flexible and can be modified to suit different lengths of rows or plot sizes.

2) The drum kit

This is a variation of the bucket kit. It involves a drum of about 200 litres capacity in place of 5 buckets. The drum is connected to a manifold with 5 openings, each located to cover a bed of 1 metre by 15 metres.

The total length of the drip tape for drum kit is 150 metres. For the drum kit the following fittings are essential:

- 10 barb fitting
- 10 × 1.0 metres supply tubing
- 4 ¾" PVC Tee
- 3 ¾" PVC Bend
- 3 ¾" Valve socket
- 1 Back nut
- 5 Filter plug
- 1 Rubber washer
- 1 ¾" Gate valve
- 1 200-250 Drum
- 1 × 6 metre ¾" PVC Pipe
- 1 PVC Tangit
- 1 Roll Threat seal
- Material for constructing platform for supporting the drum at 1 metre head.

Atypical drum set up at the KARI NARL, Nairobi

The drum kit has 10 drip laterals, covering a garden plot area of 6.5 metres × 15 metres. Unlike the bucket kits, the drum kit is filled with clean water once a day and the irrigation is regulated by opening the gate valve twice daily - early morning and late afternoon.

3) One eighth acre kit:
The eighth acre kit is another variation from the bucket kit. It covers an area of 1/8 acre with 20 drip laterals each 30metres long. Apart from quantities, the fittings for eighth acre kit are similar to those of drum kit. In areas where there is water is supplied in pipes, farmers can connect the system directly to main pipelines from water reservoir.

However, in places where such pipelines are non-existent then a strong stand should be constructed about five metres above the ground that can hold a tank with a capacity of 1000 litres. To irrigate the farm, water is regulated using a gate valve.

F) Issues Affecting Adaptation and Diffusion

Drip irrigation has increasingly become popular in the region and there are many development agencies involved. A critical issue is the **approach** that each organisation uses. There are three scenarios currently existing, and a fourth possibility that nobody has really looked into yet:

1). Free handouts: This has been common practice especially among mission organisations. It almost universally leads to LOW APPRECIATION of the technology, or at the very least, the expectation that NGOs will continue to provide them at NO CHARGE. By undermining the value of drip kits, such an approach makes all future 'free market' or 'private sector' promotion of the technology extremely difficult. This approach should be discouraged.

2). Subsidised kits: This is the most common approach used by about all other promoters. It seems to work, except that SOMEONE must pay for 'overhead' costs like shipping, clearing, re-packaging, delivery to farmers, training and trouble-shooting.
Obviously, low- or no-income farmers could never afford to pay all those costs associated with introducing a technology like drip irrigation.
As an example, KAP-Kitui buys the kits from FPEAK or KARI for 1,100/= [including a 30-litre jerry can] then requests farmers to pay 660/= on a cost-sharing basis. The main reason for this is the fact that the project works in drought-affected Yatta & Central Kitui, where majority of farmers have severely reduced incomes.

3). Bought by cash: There is very substantial evidence to show that when any farmer pays the real price for her bucket kit, she will make MORE effort to use the kit, and recover her expense via good management and sales of surplus vegetables. At the same time, there is compelling evidence that people who are relatively wealthy [school teachers, large farmers, politicians etc.] often buy kits and NEVER EVEN INSTALL THEM - giving many curious excuses why not. Actions speak louder than words.

4). Micro-credit: This is perhaps one of the most powerful approaches to making drip irrigation more affordable and accessible. However it has not been given much attention, perhaps due to few organisations knowing how to manage micro-credit activities... Something to consider!

G) Lessons and Experiences from the Kitui Agricultural Project (KAP) Evaluation.

In July 1999, KAP invited ALIN staff to assess and evaluate their pilot drip irrigation project within Musosya FDA of Yatta division-Kitui district. Here are the key findings of this evaluation:

1) Strengths
a. All users built solid stands, at the correct height, with lines well laid. Generally good installation of kits has been achieved.

b. Nearly all farmers using their kits are growing a good crop - even if the kukus and goats are enjoying it!

c. The right information is generally trickling down to actual users (but see weakness #4) e.g. pre-filtering water using a cloth over the bucket is standard practice.

2) Weaknesses / suggestions

a. Selection of trainees: five or six people were not using their kits for various reasons. It was felt that a thorough screening of participants has to be done so that only those with keen interest are chosen.

b. Flushing lines

In this case - using the *manual* method - was apparently not dealt with in the training. This involves gently squeezing the tape [right from the barb connection to the end of the drip tape] using hands - until water coming out the far end was clear.

A basin was used to capture this water both to show the user the amount of accumulated silt in the lines, as well as to pour the dirty water onto crops so that it does not go to waste. This also made the farmers understand clearly why the drip holes should always face UP.

c. Outlets on buckets leaking

Four (of the eight) systems in operation had leakage at the outlet. This was caused either by small cracks in the bucket bottom* and occurs when forcing the filter into the outlet OR holes that were drilled too large, leaving a gap between the rubber washer and edge of the hole.

This method of cutting holes in buckets is encouraged as long as it's done slowly and carefully to avoid cracking the bucket.

d. Distance from bucket to bed too far

Almost all the installed bucket systems have the supply tubes / barb connections to the drip tape hanging and are not pegged. This has an effect on the first few drip holes since they are raised at an angle. The water does not drip at the right spacing but rather trickles down the tape. Since the ends are not pegged, the drip tape can easily be miss-located from its position on the soil and therefore drips on untargeted areas.

Suggestion: To correct this, the bottom of the bucket should not exceed one metre above the bed and the stand has to be right at the edge of the garden. The supply tubes/barb connection to the drip tape should touch the ground just a few centimetres from the edge of the garden. Pegs are then fixed right at the barb to secure it.

e. Some planting beds not dug deep enough

Three of the beds were very shallow, inhibiting smooth water percolation to the lower horizons of the soil. This is likely to affect root penetration and ability to get nutrients from the deep soil. This in turn will affect the yields.

Suggestions: Raised beds if well mulched can perform better since the mulching material will greatly reduce evaporation of water from the surface. Sunken beds are best for dry regions because maximum water is retained. Deeper digging or even Double Digging should be encouraged for a more robust/intensive crop.

f. Lack of crop diversity in plots.

Most farmers visited preferred to plant mboga like, sukuma wiki, tomatoes and spinach. Only two farmers had planted onions and one had eggplants [brinjals]. Carrots were nowhere to be seen. The local varieties like cow peas [kunde] and amaranth [*Mchicha*] were not preferred though the amaranth could be seen drying up in patches on the farms.

The local *mboga* varieties can perform better since they are drought resistant and therefore will require only minimal amounts of water if well planted.

Suggestions: Farmers should be encouraged to choose both local and exotic crops that can perform better under their local conditions. Most of these local varieties have high nutritional value and can also alleviate some common diseases arising from micronutrient deficiencies.

g. Few farmers were keeping records.

Keeping simple garden records is important in monitoring progress of the plots. Only two farmers had a clear record of what they were getting from their gardens i.e. the number of leaves / fruits harvested each day.

This important issue should be included in the training for farmers or alternatively as part of the follow-up visits to the farmers hence a standard record-keeping format needs to be developed.

H). Some common problems with the Drip kits.

- ***Clogging of the trip tapes;*** This occurs if the drip lines are not flushed regularly and the water used not well filtered.

- ***Leakages;*** occurs if the connectors are not firmly screwed or if the hole on bucket is too big.

- ***Broken filters;*** Sometimes the filter outlet breaks due to mishandling. Early kits had weak filter-screens, but the new kits have stronger filters, eliminating this problem.

- ***Punctured tapes:*** The drip tapes get punctured if weeding is not done carefully or if the garden has lots of thorns.

- ***Damaged tapes:*** sometimes birds, rats, squirrels, damage the drip tapes as they look for water.