HYDROPONICS AFRICA INTELLIGENT DRIP/RESPONSIVE DRIP IRRIGATION (RDI)

Hydroponics Africa Intelligent Drip is a disruptive irrigation technology, based on organic chemistry providing the best solution to irrigation farming. It is a "smart and precise" irrigation tubing that communicates directly with plants to regulate irrigation delivery. Using the basis of plant physiology and organic chemistry, the intelligent drip systems is a subsurface irrigation tube that interacts and responds to chemical signals released by plants' roots. This chemically-infused microporous tubing will hold water and nutrients until root exudates are emitted that trigger the release of water. It then provides a slow-release delivery of water that matches the roots' absorption capacity. Since the plant is self-regulating its water delivery, there is less stress on the plant, resulting in higher yields in crops. This plant-responsive method of irrigation uses 80% less water. The solution release continually fluctuates, responding "real-time" to plants' needs and changing weather conditions. The chemical responders of this system's tubing allow each plant to pull the water that it needs, so the system can support varying plant types on a single line. Along the same tube, different crops or plants with variable water needs are able to receive irrigation at variable release rates to meet their demands. The tube has millions of microscopic openings along its surface to release water and does not require any filtration as opposed to normal drip system that has emitters and are subject to clogging leading to malfunction. The system is easy to install and maintain. The installation is cost effective and less than the current sub-surface irrigation. One of the best elements of this technology is that the plant-responsive technology operates at extremely low pressure, so it's ideal in arid and semi-arid areas with no effect of high temperatures on the efficiency of the system. With its minimal operating pressure, the system can deliver water to plants in row lengths of over 1200 feet. There will be no need for electricity because there are no electronic components required, just a water source. The water source can be a well, a river, saline water, tap water, reclaimed water, etc. The drip system is made of bio-nondegradable material with a life span of 12 years. The system is designed to continuously release water for a period of 12 days in respect to when a seed is planted. After this period, the roots either from the seed or seedling will have formed hence will be sending signals that will trigger the drip to standby or responsive mode ready to respond to each plant's dynamic needs.

HYDROPONICS AFRICA RESEARCHED CASE STUDY

CASE I. THORN MELON IN A GREENHOUSE WITH RDI

THORN MELON IN A GREENHOUSE WITH RDI	Plant H_2O Usage/day	H_2O Saved	Labor/Day (mins)	Growth Rate	Leaching	Evaporation	Yield %
	0.2	80%	0	16% faster	0	0	70% more

- GHS Plant H_2O Requirement-Plants required 0.2lits per day which was **80% less** than conventional.
- RDI had **zero leaching** as the H_2O was released **ONLY** when the crops required it based on the dynamic needs.
- RDI had **zero evaporation** as it was subsurface hence not exposed to atmosphere
- RDI required **zero labor and zero energy** as H_2O was released gravitationally
- Growth rate was **16% faster** because of instant water response based on the plant dynamics
- RDI yield was **70% more** due to instant nutritional response

CASE II. BULB ONIONS IN OPEN FIELD WITH RDI

BULB ONIONS IN OPEN FIELD WITH RDI	Plant H_2O Usage/day	H_2O Saved	Labor /Day (mins)	Growth Rate	Leaching	Evaporation	Yield %
  	0.33	84%	0	14% faster	0	0	55%

- Open field Plant H_2O Requirement-Plants required 0.2lits per day which was **84% less** than conventional.
- RDI had **zero leaching** as the H_2O was released **ONLY** when the crops required it based on the dynamic needs.
- RDI had zero evaporation as it is subsurface hence not exposed to atmosphere
- RDI required **zero labor and zero energy** as H_2O was released gravitationally
- Growth rate was **14% faster** because of instant water response based on the plant dynamics
- RDI yield was **55% more** due to instant nutritional response

CASEIII. LETTUCE IN A (SIFI) WITH RDI

LETTUCE IN A (SIFI) WITH RDI	Plant H_2O Usage/day	H_2O Saved	Labor Day (mins)	Growth Rate	Leaching	Evaporation	Yield %
	0.05	98%	0	14	0	0	55%

- SIFI Plant H_2O Requirement-Plants required 0.05lits per day which is **98% less** than conventional.
- RDI had **zero leaching** as the H_2O carrier is impermeable & is released **ONLY** when the crops required it based on the dynamic needs and
- RDI had **zero evaporation** because the carrier is enclosed hence not exposed to atmosphere
- RDI required **zero labor and zero energy** as H_2O was released gravitationally
- Growth rate was **14% faster** because of instant water response based on the plant dynamics
- RDI yield was **55% more** due to instant nutritional response

CASE IV. BOMA RHODE GRASS

This drought-tolerant perennial grass that grows up to 90cm high and is very good for hay production to feed livestock.

Land preparation and Propagation

Because the intelligent drip system is compatible with both hydroponics systems and conventional, the land was prepared well by clearing the vegetation, ploughing and laying of the intelligent drip system. The grass family requires a spacing of 30cm apart because of the fibrous root system exhibited. This spacing ensures all the roots get access to water solution hence low stress and continuous high harvests exhibited in the semi-arid regions of northern Kenya-Lodwar. The drip laying process was simple and easy since it involved opening up the trenches to 4 inches, laying the linear drip line and covering with the soil. In an acre of land with the spacing of 30cm, the total number of lines were 210 each 63m long.

Planting

Propagation of grass family is mostly by seeds or stolons hence for Boma Rhode was done by use of seeds. It was a simple exercise where by the seeds were broadcasted on both sides of the RDI along the lines 4 inches deep and away from the drip line. The seeds were then lightly covered with soil and Irrigation system triggered. An acre consumed 4 kilograms of the Boma Rhode grass

Irrigation

This was set correctly since the intelligent drip system relies on the pressure in order to switch in to responsive or standby mode. The tank stand was raised 2 meters high that is the distance from the water level to ground level was 3m. The main tank of 10,000lits in capacity was then connected to small 210lits tank which were raised 1.3m high that is the top level of water to ground level was 1.3m with an acre requiring 10 pieces of 210lits tank if the topography is relatively flat. The number of the 210lits tank is dictated by the topography of the land with steeper slopes calling for more in order to achieve the required "psi" in each of the RDI lines. The RDI was then connected to the waste pipe which is 1 ¼ in diameter and with the above tank heights, the psi at the end of each of the 210 lit tanks was achieved as recommended that is 2.3 "psi". At planting, the RDI released water continuously for a period of 12days. This was to help in the root development from the seeds. After the elapse of these days, the roots were now able to send chemical signals to the RDI hence inducing the standby or responsive mode as described in the introductory. For the 10,000lit tank capacity used as the main reservoir, the tank was always full so that it continuously fed the 210 lit tanks whose brim was controlled by the floating ball valves. This always ensured the drip is having water hence after responsive mode was triggered, the plants were able to draw the solution at their required time as dictated by the chemical reactions within the plant system and ambient weather conditions.

Fertigation

For faster growth rate and early maturity, the crop nutrients were provided through the mixing of the hydroponics nutrients which are crop specific. This was aided by mixing of 1g of Hydro-A and 1g of Hydro-B in 1lit of water always starting with hydro-B so as to achieve full solubility. This mixing in Boma Rhode grass was done once every month to achieve the desired yields as it is low feeder.

Pests and Disease Management.

Boma Rhode had very minimal pests and diseases. The only pest experienced were caterpillars and locusts that foraged on them with insignificant economic damage hence no pesticide was applied as it could tolerate them.

Harvesting and Feeding

Boma Rhode grown with the hydroponics technology took 3 months to mature that is the first harvesting as opposed to 4-6 months when done conventionally. It produced up to 300 hay bales/acre per harvest each weighing 10kgs as opposed to 243 bails achieved conventionally with cutting intervals of 6-8 weeks with 8-10 weeks in conventional with good quality hay in every harvest. The ratoon has been harvested after every 6-8weeks since October 2019 and is expected to continue for a period of 3 years thereafter replanted as the harvesting peak starts dropping gradually. The grass was cut, dried and bailed for hay hence fed to the animals as hay although the animals can also be allowed to forage on them. Bailing was the most preferred method as it allowed good regeneration of the ratoon and had minimal damage as care was taken while cutting as opposed to animals troding or even uprooting in the forage method.

BOMA RHODE IN OPEN FIELD WITH RDI	Plant H_2O Usage/day	H_2O Saved	Labor /Day (mins)	Growth Rate	Leaching	Evaporation	Yield %
	0.33	84%	0	25% faster	0	0	19%

- Open field Plant H_2O Requirement-Plants required 0.2lits per day which was **84% less** than conventional.
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