Irrigation and Fertigation management for Tea

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INDIA – GROWING POPULATION AND FOOD REQUIREMENT

Agricultural Production Almost constant over Past Few Years

- Net Cropped area constant ~141 MHa
- Current Food grain Production ~ 220 MMt

Increase in Population & Food Requirement

- Population by 2050 expected at 1.6 Billion
- Food requirement by 2050 estimated to be 450 Million Tonnes

Increasing agricultural productivity only solution for food self-sufficiency
Drivers For Crop Production With Less Water

- Growing population
- Food security
- Unpredictable rains
- Groundwater mining
- Alternative demands
Did you know

(Directorate of Economics & Statistics, 2010)
Technological innovation is essential for human progress! It has been at the heart of development over the centuries.

Need to develop technologies to help farmers cope with water scarcity (i.e., not enough water to keep cropped fields intermittently/continuously flooded).

Though better term would be: Technologies to cope with water scarcity.
DIFFERENT IRRIGATION METHODS AND TECHNOLOGIES

FLOOD IRRIGATION

PIVOT IRRIGATION

BIG GUN IRRIGATION

DRAGLINE IRRIGATION

SURFACE DRIP IRRIGATION

SUB SURFACE DRIP IRRIGATION
Irrigation Efficiency

Which means through...
1. Drip – Irrigates 2 times the area
2. Sprinkler – Irrigates 1.5 times the area

Overall Irrigation Efficiency (%)

- Flood: 32% (30 - 35%)
- Furrow/Basin: 45% (40 - 50%)
- Rain Gun: 50% (45 - 55%)
- Overhead Sprinkler: 60% (55 - 65%)
- Micro Sprinkler: 80% (75 - 85%)
- Drip: 90% (85 - 95%)

NETAFIM™ GROW MORE WITH LESS
Irrigation Systems - Response option to level of water scarcity

How it is ....... Furrow irrigation

How it should be .. Drip Ferti-Irrigation
THE GOAL:
To irrigate the plants and NOT the soil
IRRIGATING & FERTIGATING TO THE PLANT ROOTS
What Crop Needs?

Drip system gives the grower the most control over water and nutrient delivery

Transpiration

Nutrients

H₂O

CO₂

O₂

Sunlight

Hard to manage Heat load
Drip Irrigation in Tea
Why do we do it?

Seasonal limiting factors in Tea production

**Dry season**  Sensitivity to water deficit / stress,
Low availability of nutrients

**Wet seasons**  Water logging,
Nutrients leaching, run-off, deep percolation
CURRENT ISSUES WITH OH SPRINKLERS

Overhead sprinkler:

- Poor overlap due to high wind speed
- Require high pressure
- Leaching, Low FUE
- Poor Root volume
- Erratic distribution of water
- Soil Erosion and Runoff water
- Sloppy areas, Poor WUE
Drip Irrigation is a production tool which delivers water, plant nutrients and chemicals:

- in the right place
- in correct amounts
- at the right time
- frequently
- with highest efficiency & uniformity
Soil Water Availability to Plants - Concepts

- Saturation (0 bars)
- Field Capacity (0.33 bars)
- Available Soil Moisture (0.33 – 15 bars)
- Wilting Point (15 bars)

Readily available

CSL

Slowly available
Drip Irrigation

DRIP & SDI

Higher Yield  Input saving  Value addition

Drip enables the grower to help crops achieve higher crop yield and premium quality, and hence greater profits!
NETAFIM’s Mission

1. Water resource development & Plan
2. Innovative irrigation products
3. Improve water use efficiency
4. Global Crop Teams
5. Agronomical solutions
6. Crop Management Technologies
7. Capacity building & Training
8. Big & small size project.
9. R&D

AIM – INCREASING WATER & FERTILIZER USE EFFICIENCY = HIGH YIELD & PROFIT
World's 1st Dripper Invented

Revolutionary Low Pressure System

Pressure Compensated Dripper Invented
Components of a Drip irrigation system:
Example of an irrigation block

- Flush valve
- Sub-main
- Riser assembly
- Filtration unit
- Safety valves
- Main line
- Fertigation unit
- Dripline
- Pumping unit
- Well
IMPORTANT COMPONENTS FOR SDI

Gravel Filter

Disc Filter

Spin Klin Automatic Filters

AQUANET VALVE

AIR RELEASE & VACUUM BREAK VALVE

NETA JET

DRIP NET PC

WATRE METERS
Classical questions of Irrigation management

- when to irrigate?
- how much to irrigate?
- how best to irrigate?
What is Evapotranspiration?

Soil Evaporation (E) + Plant Transpiration (T) → Evapotranspiration

WR = E + T

The amount of water required to compensate the Evapotranspiration from the cropped field is defined as Crop Water Requirement.
USWB Class A Pan Evaporimeter
For Irrigation Scheduling

It reflects the evaporative demand of the atmosphere
IRRIGATION MANAGEMENT

\[ \text{Crop Water requirement} = \text{ET}_c \times K_c \]

- \( \text{ET}_o \) is the Reference crop ET reflecting evaporative demand of the atmosphere.
- \( \text{Kc} \) is the Crop coefficient growth Stage-wise.
- \( \text{ET}_c \) is the Crop Water requirement under optimal water supply and agronomic conditions.

Solar radiation | Wind velocity
Temperature | Relative Humidity

Sugarcane – Determination of Water Requirement
The crop water requirement for scheduling irrigation is calculated according to the following formula:

\[
\text{Crop ETc} = (\text{Epan} \times \text{Kpan}) \times \text{Kc}
\]

\[
\text{Crop ETc} = \text{ETo} \times \text{Kc}
\]

Where,

- **Crop ETc** = Water requirement (mm/day)
- **Crop ETo** = Reference crop evapotranspiration (mm/day)
- **Epan** = Evaporation from USWB Class A Pan evaporimeter (previous day)
- **Kpan** = Pan coefficient
- **Kc** = Experimentally derived Crop factor
Typical Crop Coefficient Curve for Tea

<table>
<thead>
<tr>
<th>Time after pruning</th>
<th>Kc</th>
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<tr>
<td>0 – 30 days</td>
<td>0.25</td>
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<td>&gt; 90 days</td>
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**Initial**

1st Year

Canopy Development 1 to 3 years

After Table Top > 3rd year

Bush Age (Years)
ETO $\rightarrow$ ETc

$Kc = 0.95 \ (FAO)$ for mature

$Cf = >70\% \ Coverage = 1.0$

$ETc = ETO \times Kc \times Cf$

**Example: no bare soil**

Coverage = >70%

$Cf = 1$

$ETc = ETO \times 0.95 \times 1$
Root penetration & proliferation of Tea clone BBT 133, recently pruned, irrigated by dripper line placed between two rows
TEA - WATER MANAGEMENT:

Tensiometer for scheduling irrigations in TEA plantations
The Basic Theory of Drip Irrigation

Soil Water Availability to Plants - Concepts

- Saturation (0 bars)
- Field Capacity (0.33 bars)
- Available Soil Moisture (0.33 – 15 bars)
- Wilting Point (15 bars)

Readily available vs. Slowly available soil moisture

CSL
Fertigation precisely delivers the plant nutrients via irrigation system in the crop root zone according to the crop demand during crop growing season.

$N = \text{Nitrogen}, \quad K = \text{Potassium}$

$P = \text{Phosphorus}, \quad + = \text{Micro elements}$
N —— P —— K
& Micronutrients

- Urea (46-0-0)
- Ammonium Nitrate (34-0-0)
- Ammonium Sulphate (21-0-0)
- Calcium Nitrate (16-0-0)

MAP (12-61-0)
MKP (0-54-32)
Phosphoric Acid (0-82-0)

KCl (0-0-60)
KNO₃ (13-0-46)
K₂SO₄ (0-0-50)

Micronutrients:
Fe EDTA (13%), Fe DTPA (12%),
Fe EDDHA (6%), Zn EDTA (15%),
Ca EDTA (9.7%), Rexolin CXK (B+Cu+Fe+Mn+Mo+Zn+Mg)
Drip Active root zone

The essence of drip Nutrigation:
High density of fine root- 0-20cm below surface,
Importance of Soil pH

Soil reaction (pH) is the most important factor in the crop production. The pH will governs the availability of various essential as well as functional elements in soil by influencing the various soil properties like physical, chemical and biological etc.,

Optimal pH value: 5.5
- Maximal nutrient availability

High pH values:
- Reduced nutrient availability

Low pH values:
- Reduced nutrient availability
- Toxic levels of Al, Mn
Nutrients removed by Tea yielding 5.0 tons/ha made Tea

(Source: Willson & Gunther, 1981; Gilbert, 1983)
## Fertigation schedules for Tea

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<th>N</th>
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<th>Urea</th>
<th>MOP</th>
<th>Total fer. qty (kg)</th>
<th>Total no</th>
<th>Qty /time</th>
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Drip Irrigation

Kibena Tea Ltd

Drip Irrigation

Why do we do it?

Peter Rowland

Tea Operations Director - TATEPA
Experience to date – Yield 2003

YIELDS COMPARISON (Cum) ON 5YR OLD FIELDS 6/8 unpruned DRIP Vs SPRINKLERS

MT (tons)

Month

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Sprinkler
Drip
OBSERVATIONS FROM KIBENA EXPERIMENTAL PLOTS

• **Rooting Depth**

Fertigation had no effect on the depth of anchorage roots, however, feeder roots were found to move towards and concentrate around the emitters.

• **Shoot Regeneration Cycle**

Harvested shoots were tagged soon after plucking and the number of days taken by the triggered bud to pluckable size was determined. It was found that shoots from fertigated plots regenerates faster than those from non fertigated plots.

• **Drought associated mortality**

It is very important to note that, data indicated a much lower rate of mortality in drip plots.

• **Running costs**

  compared to OH irrigation- Drip is less in Energy & Maintenance-labor, lower in water & fertilizers-.
OBJECTIVES

1. To determine the amount and frequency of water
2. To determine the nitrogen requirement for fertigation
3. To determine the extent of yield improvement under different frequencies and N levels
4. To study the effect of Fertigation on quality of made tea
5. To determine the suitability of cultivars for fertigation
Treatments- Sommerset Estate

- Fertigation daily for 1 hr
- Fertigation once in 2 days for 2 hrs
- Fertigation once in three days for 2 hrs
- Control

Fertigated plots:
180kg N, 60kg K₂O and 15 kg P₂O₅ for 1 ha - 300 days
Control
360kg N, 120kg K₂O and 30 kg P₂O₅ for 1 ha - 4 equal split application

- One drip line per row- Flow -3 mm/hour
Results

Yield (kg MT ha⁻¹)

- Fertigation daily 1hr: 6058
- Fertigation once in 2 days for 2 hrs: 5195
- Fertigation once in 3 days for 2 hrs: 4294
- Control: 2557
Conclusions

1. Fertigation daily for 1 hr gave the highest yield
2. Yield reduced progressively lower frequencies
3. The N requirement for mature tea is about 180 kg N
4. Yield Improvement by fertigation is more than 100%
5. Organoleptic evaluation revealed that fertigation do not reduce the quality in terms of infusion, color and strength
6. Low Discharge Dripper will improve fertigation efficiency by reducing the risk of leaching the nutrients.
UPASI Drip Study Findings

- Significant yield increment was noted in all drip irrigated plots than control.
- Daily 2mm irrigation has highest yield.
- Feeder roots are more in drip field than sprinkler field.
- Drip irrigation brought out higher yield than sprinkler.
## Our clients in south india

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<th>No.</th>
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<td>Nelliampathy, Vandiperiyar</td>
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<td>9</td>
<td>TATA TEA</td>
<td>Hathigarh</td>
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Country: India
Project Type: BBTC Group of Company
Crop: Tea
Establishment: March-2010

Product Used:
DNPC- 0.6, 1.6 LPH, NMC with FertiKit
System-Total Automation.
NETAFIM TEA Projects

Country: India
Project Type: Pasupara (AVT group)
Crop: Tea
Size: 15 Ha.
Drip Installation in Tea Plantation
# Yield Report from AVT Pasupara by drip fertigation

<table>
<thead>
<tr>
<th>Field No</th>
<th>Planting year</th>
<th>2010/11 (Before fertigation) (kg/ha/year)</th>
<th>2011/12 (kg/ha) (After fertigation)</th>
<th>2012/13 (kg/ha/yr) (After fertigation)</th>
<th>2013/14 (kg/ha/yr) (After fertigation)</th>
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Conclusions

• Drip technology improves the utilization of natural resources (water, energy & labor) and fertilizers.

• Drip system functions well in Tea Plantations environment

• In a Global warming situation Drip technology is the best insurance policy one can buy.

• Economy – Achievable.
THANK YOU