Fertigation - the right way!

Gershon Kalyan - ICL Israel
16-3-15 IFA Delhi

“That’s explains everything…”- control and influence !!!

Curtsey: Ben Gal, Gilat exp Station, Il
What is fertigation?

Fertigation is the application of plant nutrients through the irrigation system.

We take the fertilizers and dissolve them into the irrigation system.

The plant roots receive water + nutrients at the same time and location.
Advantages of fertigation

Maximizing crop and soil productivity:
- Higher yields and top quality of produce
- Marginal lands (sandy, rocky, shallow and salt affected soils) can be successfully put into cultivation

Maximizing fertilizer efficiency:
- Accurate and uniform application of fertilizers
- The amounts and concentrations of nutrients are adapted to the plant needs and climatic conditions
- Increases availability and uptake of nutrients
- Reduces nutrients losses by leaching and/or volatilization

Minimizing production costs:
- Large savings on time, traffic, labor and fuel costs

Fertigation – “Spoon feeding”

Fertigation allows nutrients application to plants in the correct dosage and at the time appropriate for a specific stage of plant growth:

This gives plants the needed amounts of fertilizer throughout the growth cycle
Dead sea works
Lowest point on earth

First sites of trickle irrigation

First site of Fertigation Experiment On sand dunes - 1968

Arava Valley
Dry saline desert
The site of first trickle irrigation by Netafim

First sites of trickle irrigation

Israel Map

Dry saline desert
The site of first trickle irrigation by Netafim
WORLD WATER SCARCITY

Source: World Water Organization
1. SHORTAGE IN ARABLE LAND

2. SHORTAGE IN WATER

1. Techniques that will increase the efficiency of food production

2. Techniques that will add marginal soils and water for food production use

### World Arable Land

Total: 1 billion hectares

- 280 million hectares, irrigated arable land
- 28 million hectares by pressurized irrigation
- 6 million hectares by micro-irrigation (Feb 2007)

Source: FAO
Advantages of Micro-irrigation

1. Increasing yields
2. Saving water
3. Allows growing in marginal soils
4. Water in due time (crop cycle)
5. Uniformity watering
6. Enables fertigation

FERTIGATION: Dripped date palms, high salinity
Irrigated land & average water consumption in Israel, 1951-1990

Water saving is a dynamic process

Source: Tarchitzky and Magen, 1997

Less water, more yield

1. MICRO-IRRIGATION ALLOWS US TO GROW ON MARGINAL SOILS AND TO USE MARGINAL WATER

2. MICRO-IRRIGATION SAVES WATER AND INCREASES YIELDS

3. FERTILIZERS INCREASE YIELDS

4. FERTIGATION INCREASES YIELDS
Why fertigate?

- Save water?
- Use MIS
- Limited root zone

**Fertigation:**
- Fertilizers applied with the water
- Nutrients are dissolved and taken up in the root zone
- High fertilization efficiency
- Preferred method to correctly apply fertilizers to irrigated crops

**Conventional fertilization:**
- Fertilizers applied separately from the water
- Nutrients are not dissolved in the dry zones where the soil is not wetted
- Fertilization efficiency decreases
- The benefits of MIS are not expressed

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**Fertigation vs. Fertilization**

**APPLICATION OF NUTRIENTS**

- **pre-plant fertilization**
  - 160 kg ha⁻¹

**LOSSES:**
- leaching
- Volatilization

**DEFICIENCY?**
APPLICATION OF NUTRIENTS
FERTIGATION vs. FERTILIZATION

Conventional preplant fertilizer:
Plants get a larger dosage of fertilizer than they require at the time it is applied. Losses occur.

Fertigation:
Fertilizers are applied according the need for nutrients, following the uptake rate of the crop.

Sub Surface Drip irrigation vineyard 8 years negev IL

Credit: Ben Gal, Gilat exp Station, Il
LIMITED ROOT ZONE WITH DRIP IRRIGATION SYSTEMS

DRIPPER

Sandy Soil  Medium Soil  Heavy Soil
Israel is a small but long country with high crops diversity.
More than half of Israel has an arid to semi-arid climate.
Approximately half of the cultivated area (200,000 hectares) has to can be irrigated due to lack of rainfall and other water resources.
Approximately 80% of the irrigated land uses the fertigation method.
Most of Israel agriculture use acid fertilizers—mainly liquids.
Most common K source for Israel agriculture is KCl.
The above related mainly to open fields which are the large areas of agriculture in Israel and the world!
Fertigation by irrigation - fertigation plan

- Analyzes of the water type: acidic, hard water, restored water
- Compatibility of the fertilizer to the irrigation water
- Simulation and Fertigation Plans as per crop and local conditions
- Bicarbonate/Carbonate reduction in irrigation water
- Disinfection of water in irrigation systems

Reacting to soil\ leaves\ water analysis

Fertigation program: nutrient ratio

Fertigation plan for open field tomatoes

<table>
<thead>
<tr>
<th>Growth month</th>
<th>N</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>NovAcid 13-13-13+1MgO</td>
<td></td>
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</tr>
<tr>
<td>NovAcid 11-8-16+3MgO</td>
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Israel- India similarities:

- Both democracies...
- Water shortages
- Need to use marginal soils
- High pH soils
- High pH water
- Same shape... different size...

pH control in the rhizosphere

- Control ammonium/nitrate
- Use of acids for decreasing solution pH (and cleaning drippers)
Why acid?

- Hard water
- Blockage-free irrigation
- Optimal nutrients availability
- Adding Ca + Mg to the formula

NO 1 blocker-caco₃

1. CO₂ + H₂O → H₂CO₃
2. Bicarbonate equilibrium:
   - pH 4.5 (acidic) → HCO₃⁻
   - pH 7.6 (alkaline) → CO₃²⁻
3. Calcium carbonate formation:
   - Ca²⁺ + CO₃²⁻ → CaCO₃
4. Atmosphere equilibrium:
   - CO₂ in the atmosphere
NovAcidNPK™ - antiblocking

<table>
<thead>
<tr>
<th>BLOCKED</th>
<th>CLEANING</th>
<th>UNBLOCKED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blocked dippers due to precipitates formed while using hard irrigation water</td>
<td>Drippers being cleaned while using NovAcidNPK™ (precipitates are dissolved)</td>
<td>Cleaned, unblocked dippers after using NovAcidNPK™</td>
</tr>
</tbody>
</table>

pH values associated with nutrient availability in soil
pH

Optimal pH value: 5 – 6
  – Maximal nutrient availability

High pH values:
  – Reduced nutrient availability

Low pH values:
  – Reduced nutrient availability
  – Toxic levels of Al, Mn

Nitrogen uptake/Fertilization Plan

- Ammonium (NH₄⁺)
- Nitrate (NO₃⁻)
**pH and NO$_3^-$ / NH$_4^+$ nutrition**

- **Ca(NO$_3$)$_2$**:
  - pH 7.5
- **(NH$_4$)$_2$SO$_4$**:
  - pH 4.5

**Initial pH**: 6.2

**Wheat rhizosphere, 2 weeks after application of 200 kg N/ha**

*(Roots grown in agar with pH indicator)*

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דשנים עתירי אמון

- 10% NH$_4$
- 20% NH$_4$
- 40% NH$_4$
- 10% NH$_4$
The plant absorbs: CATIONS $+$ and ANIONS $-$

**Electroneutrality:** $\Sigma$ CATIONS = $\Sigma$ ANIONS

- **NO$_3^-$** (anionic nutrition): A > C, OH out, pH ↑
- **NH$_4^+$** (cationic nutrition): C > A, H$^+$ out, pH ↓

Urea hydrolysis causes pH increase

Ammonification by heterotrophic bacteria leads to stable and absorbed nutrients to soil particles.
is a technique of feeding plants by applying liquid fertilizer directly to their leaves. High pH increase nutrients deficiencies

Effect of NovAcid™ on solution pH

NovAcid 13-13-13+1MgO
• Always use WSF - water soluble fertilizers
• Always use low pH fertilizers
• Prefer high Ammonium ratio fertilizers
• Proportional fertigation for better results