Ornamental crops, are a very important crop, grown worldwide outdoors and in growth houses, at an innumerable variety of species and cultivars. They grow on a range of soil types, like sand, loam and clay, an assortment of soilless media, like perlite, tuff/scoria, coir, and rockwool, and in diverse containers, such as pots, buckets and canals. But this large variety of growth methods, must not confuse the grower, regarding programming the mineral nutrition of these crops. We must always remember that crops' nutritional requirements are primarily determined by their genetic makeup. So, this major factor, combined with the actual fertility (the content of the available nutrient elements) of the growth soil, and the quality of the irrigation water, (EC, pH and contents of the cations and anions), are the ultimate factors, dictating the composition of the fertigation solution and its application timing.

Every crop species needs a unique amount of nutrients for each growing phase, and occasionally, each cultivar needs its specific nutrients composition too. Therefore, we, the suppliers of the plant nutrition products, must consider many factors, in order to offer you the grower, optimal nutrition solutions, considering mainly crops requirements, and additional relevant factors such as regulatory obligations, prevailing at any specific country.
We are glad to share with you the principles that guide our considerations and can help you in obtaining highest performance of your crops, thanks to the cutting-edge mineral nutrition management offered by our products.

For growing on soil

1. **Pre-planting stage**. It is warmly recommended to perform soil and irrigation-water analyses, at least one month prior to the new planting season. The main soil parameters that should be checked are: a) Soil fertility, in terms of contents of plant-available nitrogen, phosphorus, and potassium; and b) Soil salinity parameters, like EC, chlorides, and sodium. The irrigation-water analysis should also check the contents of various nutrients, like nitrates, sulphur, calcium and magnesium, and of the said salinity parameters.
   The desirable fertility values are:

- ✓ The desirable plant-available phosphorous (by Olsen) optimum level is 25 ppm for annual flower crops, and 40 ppm for perennials. Phosphorus deficiency, is amended by soil dressing of granular MAP (12-52-0), and incorporating it into the soil, at the depth of 15-30 cm.
  The shortfall of every 1 ppm, requires applying MAP at 20 kg/hectare.
- ✓ The desirable plant-available potassium level in medium-textured soil, should be higher than
  ΔF=-3200. K deficiency can be corrected by soil dressing of Potassium Chloride (KCl, MOP, muriate of potash, 0-0-60), and incorporating it into the soil, at the depth of 15-30 cm.
- ✓ Severe K shortage (ΔF=-3800) requires applying KCl at ~800 kg/hectare, while medium K shortage (ΔF=-3650) requires applying KCl at ~500 kg/hectare, and minor K shortage (ΔF=-3500) requires applying KCl at ~300 kg/hectare. If the soil-K analysis is done by extraction with $CaCl_2$, the satisfactory level is higher than 90 mg/kg. Slight shortage can be defined at 80 mg/kg, medium shortage- at 65 mg/kg, and severe shortage at <50 mg/kg.

- ✓ It is not recommended to perform soil analyses for micronutrients (manganese, zinc, copper molybdenum and iron; Mn, Zn, Cu, Mo and Fe, respectively), because such tests measure the total amount of these nutrients in the soil, but cannot assess their availability to the plants.

2. For the **planting to establishment** growth stage, the recommended $N:P_2O_5:K_2O$ application ratios, are 1:2:1, 1:1:1, 1:3:1, 1:1:0, they are supplied by **Gat Fertilizers'** **Tuv** or **Elit**e liquid fertilizers series. The specific fertilizer type and ratio should be determined considering the crop requirements and water quality.

- ✓ When growing cut-flowers on sandy- or calcareous- soil, and/or at pH>8, it is recommended to enrich the **Tuv** or **Elit**e fertilizers, with our specific concentrated micronutrients products. The products of choice are "**Micro-Plantations**" (a mixture of EDTA-chelated Mn, Zn, and Cu), and **Ferrogat**, (a mixture of three iron chelates), that are effective at high soil pH.

3. For the **vegetative growth** stages, Ammonium Nitrate and Uran solutions are ideal nitrogen fertilizers. **Gat Fertilizers'** **Tuv** and **Elit**e liquid fertilizers series, at ratios of 1:0:1, 2:0:1, 1:0:2 that supply also potassium for this growth stage, are suitable products. The specific fertilizer type and ratio should be determined considering the crop requirements and water quality.

4. For the **later vegetative-, to first flowering-bud** growth stage, Ammonium Nitrate and Uran solutions are ideal nitrogen fertilizers. **Gat Fertilizers'** **Tuv** and **Elit**e liquid fertilizers series, at
   $N:P_2O_5:K_2O$ ratios of 1:0:2, 2:0:3, 1:0:1 are suitable products. The specific fertilizer type and ratio should be determined considering the crop type and water quality.
   For the **first flowering-bud to harvest** growth stage, Ammonium Nitrate and Uran solutions are ideal nitrogen fertilizers. **Gat Fertilizers'** **Tuv** and **Elit**e liquid fertilizers series, at the following $N:P_2O_5:K_2O$ ratios 2:0:3, 1:0:3, 2:0:1, are suitable products. The specific fertilizer type and ratio should be determined considering the crop type and water quality.

Following are our recommendations, relating to very specific growth situations.
They are valid to all growth stages.

- ❖ Crops grown on highly sandy soils (≥95% sand), and irrigated with very-low-EC water, (e.g., desalinized water), which is normally very low in calcium and magnesium, should be fertigated with "**Yamit Buffer**" solution, in addition to **Shaphir** fertilizer solutions. This step will ensure an appropriate cations balance, and increase the use efficiency of the **Shaphir** fertilizer solutions.
  Alternatively, apply the "**Or- Shaphir Nitrate Solutions**", which supply all the components of both aforementioned nutrients, in one product.
- ❖ For high-pH soils (e.g., alkaline or calcareous), and/or for growing a crop with low soil-pH requirement, it is recommended to use urea-rich fertilizers, such as **Uran** or **Tuv**.

- Sandy and easy-draining soils, with low clay levels, should be fertigated by **Tuv** and **Elite low-chloride** solutions series, or by **Shaphir** series. Their moderately acidic pH, makes them very compatible and suitable to be enriched with **Micro-Plantations** and **Ferrogat**. So, we warmly recommend on this enrichment at the said soil conditions.
- Whenever using a Shaphir product, if the crop requires low-pH soil solution, the fertilizer should be selected from the **Shaphir Sulphate Solutions** series, enrich with ammonium. The specific fertilizer type and ratio should be determined considering the crop requirements and water quality.
- If, at any growth stage, there show up any deficiency symptoms, related to the following micro-nutrients, B, Cu, Mo, Mn or Zn, or, if leaf tests indicate such deficiencies, then, **Micro-Plantations** should be applied. When leaves show iron deficiency, it is recommended to fertigated with **Ferrogat** solution to improve this deficiency. Either one of these products should be applied immediately following the detection of the deficiency. In order to ensure its efficiency by avoid losing it by leaching, it should be applied by fertigation, at the last third part of the irrigation application.

For any additional details regarding crop requirements, timing and application rates, we recommend consulting with the agronomy staff at **Gat Fertilizers**.

For growing on soilless substrates

It is mandatory that the fertilizers applied should be selected from the **Gat Fertilizers** **Shaphir** series exclusively. The advantages implied in all fertilizers belonging to this series, are the presence of all macro- and micronutrients, and absence of urea and chloride. Their pH range is mildly acidic (5.0-6.5), which makes them highly plant-available. We adapt their micronutrient contents to the season, i.e., Shaphir products contain 3% micronutrients concentrate for summer application, and 6% of this concentrate for winter application.

Shaphir Nitrate Solutions also contain relatively high concentrations of calcium and magnesium. Their pH range is mildly acidic (3.5-4.0).

Whenever using a Shaphir product, if the crop requires low-pH nutrient solution, the fertilizer should be selected from the Shaphir Sulphate Solutions series. The specific fertilizer type and ratio should be determined considering the crop requirements and water quality.

5. For the **planting to establishment** stage, the recommended $N:P_2O_5:K_2O$ application ratios, are 1:2:1, 1:1:1, 1:3:1, 1:1:0. The specific fertilizer type and ratio should be determined considering the crop requirements, substrate type and water quality.
6. For the **vegetative- to first flowering-bud** growth stage, the following $N:P_2O_5:K_2O$ ratios apply: 2:1:2, 2:1:3, 1:1:1. The specific fertilizer type and ratio should be determined considering the crop requirements, substrate type and water quality.
7. For the **first flowering-bud to harvest** growth stage, the following $N:P_2O_5:K_2O$ ratios apply: 2:1:3, 3:1:3, 2:1:1. The specific fertilizer type and ratio should be determined considering the crop requirements, substrate type and water quality.

8. In all the above-mentioned growth stages, it is our clear recommendation to select the actual fertilizer from the **Shaphir Nitrate Solutions (Or)** series, if one or more of the following conditions take place:
   - ✓ When the plants grow on inert substrate (e.g., perlite or rockwool). Fertilizing with **Shaphir Nitrate Solutions (Or)** will both supply all required nutrients, and use as a pH buffer that will ensure that the nutrient solution will stay at an optimal pH range, and will not drop to extremely low values.
   - ✓ If the crop is sensitive to calcium deficiency, such as tomato and bell-pepper cultivars, that suffer from BER (blossom-end rot) under such conditions.
   - ✓ If the irrigation water is very low in calcium and magnesium. See further information on clause No. 10, following.
9. If the crop requires low-pH media solution, the fertilizer should be selected from the **Shaphir Sulphate Solutions** series. The specific fertilizer type and ratio should be determined considering the crop requirements and water quality.
10. Crops that are irrigated with very-low-EC water, (e.g., desalinized water), which is normally very low in calcium and magnesium, should be fertigated with "**Yamit Buffer**" solution, in addition to **Shaphir** fertilizer solutions. This step will ensure an appropriate cations balance, and increase the use efficiency of the **Shaphir** fertilizer solutions. Alternatively, apply the "**Or- Shaphir Nitrate Solutions**", which supply all the components of both aforementioned products, in one product.
    This instruction regarding for irrigation water with stable very low concentration of calcium and magnesium throughout the entire growth cycle.

For any additional details regarding crop requirements, timing and application rates, we recommend consulting with the agronomy staff at **Gat Fertilizers**.

Yaron Yutal, **Chief agronomist**, **Gat Fertilizers**