"Teaspoon feeding": precise plant nutrition through advanced application methods

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Agricultural research is continuously seeking for ways to maximize crop yields and quality, and to minimize production costs. To maintain sustained farming systems, the environmental impact of every field operation should be considered. Optimized crop-production practices necessarily involve optimization of water supply and nutrient application, in order to maximize efficiency and minimize wastes.

Efficient fertilization schedules aim to provide plant nutrients with precise timing and composition to match plant growth needs, at a precise location to enhance uptake efficiency, and with precise dosing to avoid waste and contamination.

Advanced methods of fertilizer application permit a nutrient supply that matches very closely the requirements of the plant, in a manner sometimes described as '*teaspoon feeding*'.

It is already well established that the most advanced and efficient practice of delivering plant nutrients is fertilization via the irrigation system, known as Nutrigation™ [1] (fertigation with pure nutrients). Nutrigation combines the two major factors affecting plant performance - water and nutrients - in a controlled and balanced manner. Nutrigation features the advantages of uniform fertilizer application throughout the irrigated area, and accurate feeding based on plant needs and climatic conditions.

There are two main methods of Nutrigation: quantitative and proportional.

In the quantitative method, the fertilizer is introduced into the irrigation water using a bypass fertilizer tank. The grower determines the total quantity and the composition of the fertilizer. The concentration of nutrients in the irrigation water and in the soil decreases with time, as the fertilizer in the tank dissolves and is washed out. This method provides adequate nutrition for the crop only if the soil has some capacity to retain the nutrients. Otherwise, the plant is exposed to an excess of nutrients at the beginning of the irrigation cycle, when the concentration in the water is high, followed by a shortage later and between irrigations.

In the proportional method, the fertilizer concentration is kept steady throughout the course of irrigation, using a fertilizer pump or injector that introduces a fertilizer solution of constant composition and concentration into the irrigation line. This method permits a higher degree of control over plant nutrition, even on light soils or in inert growing media.

[1] Trademark registered by Haifa Chemicals

Nutrigation is highly beneficial as long as irrigation and fertilizers are applied simultaneously. If the water supply depends on rainfall, the nutrient supply by Nutrigation requires technical irrigations, which involves a waste of water and extra labor. Furthermore, heavy or frequent rains may leach the applied nutrients under the root zone. For the same reason, Nutrigation is wasteful and polluting if irrigation is given in excess (e.g. to prevent salt build-up). Another limitation of Nutrigation is the dependence on relatively sophisticated irrigation and dosing equipment.

In cases where Nutrigation is not practical or inadequate, controlled-release nutrition may be employed. Here, single, pre-plant application of polymer-coated fertilizers with predetermined release longevity (e.g. Multicote®[1] products) provides the crop's nutritional requirements throughout the growth season. Following application, the granules start to absorb moisture that dissolves the nutrients inside the granules. The dissolved nutrients then diffuse, slowly and continuously, into the root zone. The rate of diffusion – the actual release rate - depends upon and is dictated solely by the soil temperature.

Efficiency is achieved by this method, due to the high correlation between the plant nutrient-demand curve, and the nutrient-release pattern from the coated fertilizer granules. This correlation occurs because both development of the plant and the rate of release of the nutrient are regulated by soil temperature. The efficiency of controlled-release fertilizers (CRFs) provides economic benefits due to reduced labor and a lower application rate, while achieving the same or even better crop performance.

To follow plant nutritional requirements as they change during the growth season, innovative products offer different NPK ratios at every stage. For both agronomic and economic reasons, controlled-release products for agricultural applications usually combine polymer-coated nutrients and non-coated-readily available nutrients.

Controlled-release nutrition is recommended on light soils, in rainy areas, where mid-season application is not feasible, or where nitrogen application is restricted (e.g. by environmental legislation).

Nutrigation and controlled-release nutrition can be combined to best suit the conditions in regions with distinct dry and rainy seasons. Nutrigation supplies nutrients in the dry season, while controlled-release fertilizers take care of the crop nutrition when irrigation is not needed and water should be saved.

Another possible combination is Nutrigation at the beginning of the growth season and CRFs with low initial release. The Nutrigation will boost initial establishment, while the CRFs provide nutrition for later stages.

Another method that offers plant nutrition with high added value is foliar feeding, whereby nutrients are applied to and absorbed by the leaves rather than by roots. Foliar feeding can provide the nutrients needed for normal development of crops in cases where absorption of nutrients from the soil is disturbed.

As the uptake of nutrients through the foliage is considerably faster than through roots, foliar sprays are also the method of choice when prompt correction of nutrient deficiencies is required.

Foliar application of nutrients during critical growth stages dramatically increase yields and improve yield quality.

Foliar nutrition may be combined with any other application method, to complete and to enhance plant nutrition.

The ideal product for foliar feeding should have a composition that meets specific crop requirements, good adhesion to the leaf surface, a reduced scorching hazard and wide-range compatibility, so it can be applied together with other agrochemicals, thus saving on field operations.

Advanced foliar formulations also feature prolonged action: the leaves absorb the nutrients over time, without being washed away.

Haifa-Bonus™ is an example of a fertilizer specially formulated for foliar application, fulfilling the requirements mentioned above.

Modern agriculture is required to maximize the nutrient use efficiency of all resources and inputs, while maintaining high yields and minimizing environmental impacts. This can be achieved by the "Teaspoon-Feeding" approach, taking advantage of highly efficient fertilizer application by Nutrigation, controlled-release nutrition and foliar feeding.

The ideal fertilization schedule should combine the three methods, responding to crops needs, growth conditions, technical, economical and environmental considerations. By careful planning and in-season corrective operations, if needed, it is possible to follow plant nutritional requirements very closely, thus ensuring healthy growth, optimizing nutrients use efficiency and minimizing fertilizer losses and environmental contamination.

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