# Efficacy of Various Fertilization Strategies (Pre- and Post- Harvest) on Productivity, several Fruit Quality Attributes, Photosynthetic Parameters and Nutritional Status of Kiwifruit Vines

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## INTRODUCTION

Kiwifruit accumulate large amounts of nutrients in vegetative growth during spring. A part of this can be supplied by the reserves in the upper portion of the vine's perennial framework (Clark and Ledgard, 1993). Nutrients are also remobilized and translocated between various components within a vine. Autumn supplied $^{15}N$ was remobilized in spring to support the early shoot growth and the extent of remobilization to leaves and fruits depended upon the fertilizer rate (Tagliavini et al., 2000). Temporal changes in N within various plant components may also affect the efficiency of N fertilizer use and the importance of time of N fertilizer application (Ledgard and Smith, 1992).

The aim of this research was to study the efficacy of various fertilization strategies (pre- and post-harvest) on productivity, several fruit quality attributes, photosynthetic parameters and nutritional status of kiwifruit [Actinidia deliciosa (A. chev.) C.F. Liang et A.R. Ferguson var. deliciosa] vines of the cultivar 'Tsechelidis'.

## METHODS

The research was conducted in a commercial kiwifruit orchard in northern Greece. The vines were 6 years old planted at a spacing 4 x 5m and trained in a T-bar trellis system. The experiment included the following fertilization treatments:

Treatment 1. 11-15-15 +14S (Hellenic Fertilizers ELFE) (900 kg/ha in mid-February before budbreak), ammonium nitrate 34.5-0-0+0.5 MgO (Industry of Phosphate Fertilizers S.A., Greece) (200 kg/ha, 20 days before anthesis) and potassium nitrate 13.5-0-46 (Haifa Chemicals Ltd) (200 kg/ha, beginning of July). In total, 19.4 N, 5.9 P and 22.7 K units were applied.

Treatment 2. Duratec 14-7-14 +2MgO +9 S +0.02B +0.06 Fe +0.01 Zn (COMPO Hellas S.A.) (1200 kg/ha, mid May) and Duratec 14-7-14 +2MgO +9 S +0.02B +0.06 Fe +0.01 Zn (200 kg/ha, post harvest). In total, 19.6 N, 4.3 P and 19.6 K units.

Treatment 3. Novatec 12-8-16 +3MgO +10 S +0.02B +0.06 Fe +0.01 Zn (COMPO Hellas S.A.) (1000 kg/ha, mid April), Complesal premium 15-3-20 +3MgO +10 S +0.02B +0.06 Fe +0.01 Zn (COMPO Hellas S.A.) (300 kg/ha, beginning of July) and Duratec 14-7-14+2MgO +9 S +0.02B +0.06 Fe +0.01 Zn (200 kg/ha, post harvest). In total, 19.3 N, 4.5 P and 24.8 K units.

Treatment 4. 11-15-15 +14S (700 kg/ha, in mid-February before budbreak), ammonium nitrate (200 kg/ha, 20 days before anthesis), potassium nitrate (200 kg/ha, beginning of July) and Duratec 14-7-14 +2MgO +9 S +0.02B +0.06 Fe +0.01 Zn (200 kg/ha, post harvest). In total, 20.0 N, 5.2 P and 22.5 K units.

Novatec is a controlled release NPK complex fertilizer with nitrification inhibitor DMPP (3,4 – dimethylpyrazolphosphate). Duratec is a controlled release NPK complex fertilizer with nitrification inhibitor DMPP, partly coated. The experiment was conducted and repeated for 2 years; however results presented refer to the 2$^{nd}$ year of experimentation. The experimental design was a randomized block with three replications of four treatments (four vines per replication). Differences between means were evaluated by using the Duncan's multiple range test at $P \leq 0.05$.

**RESULTS AND DISCUSSION**

Productivity and mean fruit weight at harvest were higher in treatments 3 and 4 compared to the others. Higher flesh firmness was measured in treatment 4 compared to treatments 1 and 2. Total soluble solids were decreased in the following order: 1, 2 > 4 >3. Higher acidity was measured in treatment 4 compared to 1 and 3. Total phenolics were decreased in the order: 3>2,4>1. Total antioxidant activity and ascorbic acid content were decreased in the order: 3>2>4>1. Flesh color was not affected by the fertilization strategy. Higher photosynthetic rate was measured in treatments 1, 2 and 3 compared to 4. Higher transpiration rate was measured in treatments 1, 2 and 4 compared to 3. The highest water use efficiency was measured in treatment 3 compared to the rest ones. Internal $CO_2$ concentration and stomatal conductance were higher in treatment 2 compared to the rest ones. SPAD units, chlorophyll a, chlorophyll b as well as chlorophyll a+b concentrations were diminished in the order: 3>4>1 and 2. The initial fluorescence value was increased in the treatments 2 and 4 compared to 1 and 3, whereas the maximum level of chlorophyll fluorescence was lower in the treatments 1 and 2. The maximum quantum efficiency of photosystem II in treatment 2 was lower than 3 and 4. Leaf analysis in mid-August indicated that leaf N concentration was higher in the treatment 3 compared to 1 and 2. Leaf P, K, Ca, Mg, Fe, Mn, Zn and B concentrations did not differ among treatments. Fruit analysis at harvest revealed that N, P, K, Ca, Mg, Fe, Mn, Zn and B concentrations did not differ among treatments.

**CONCLUSIONS**

Nitrogen distribution within the vines may be improved by applying a low dosage of N-fertilizer during the post-harvest period. This means that the timing of N application is very important. Our results showed that the type of fertilizers and the time of their application affect nitrogen use efficiency by kiwifruit vines, since the fertilizers increased productivity and water use efficiency of the vines and improved many fruit quality attributes.

**REFERENCES**

Clark, C.J. and Ledgard, S.F. (1993). Uptake of $^{15}$N by kiwifruit vines from applications of nitrogen fertilizer prior to budbreak. *Ann. Bot.* 71: 311-316.

Ledgard, S.F. and Smith, G.S. (1992). Fate of $^{15}$N-labelled nitrogen fertilizer applied to kiwifruit vines. II. Temporal changes in $^{15}$N within vines. *Plant Soil.* 147: 59-68.

Tagliavini, M., Inglese, P. and Rombola, A. (2000). Root uptake, storage and remobilization of autumn applied nitrogen to kiwifruit vines. *Agronomie*, 20: 23-30.