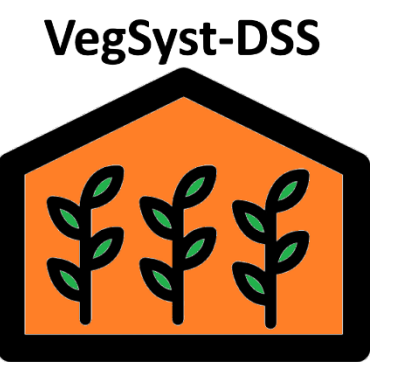


# VegSyst-DSS to calculate N and irrigation requirements for vegetables grown with fertigation in Mediterranean greenhouses



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## Description of the VegSyst-DSS

- VegSyst-DSS is a decision support system (DSS) to make recommendations of daily irrigation volumes, daily amount of fertilizer N, and the N concentration in nutrient solutions applied by fertigation (Figure 1), for vegetable crops grown in Mediterranean greenhouses
- It calculates: (i) N requirements using a N balance, based on modelled daily crop N uptake, and that considers soil mineral N at planting and N mineralized from manure and soil organic matter, and (ii) irrigation from modelled ETC considering irrigation application efficiency and water salinity (Figure 2)
- VegSyst-DSS assumes that crops have no water or nutrient limitations; calculations are daily, and are based on historical climate data
- An English version of the software (for Windows, programmed in Visual C#) is freely available at <https://w3.ual.es/GruposInv/nitrogeno/VegSyst-DSS.shtml>
- The software has been designed to be intuitive for practical use by farmers and advisors; few inputs are required

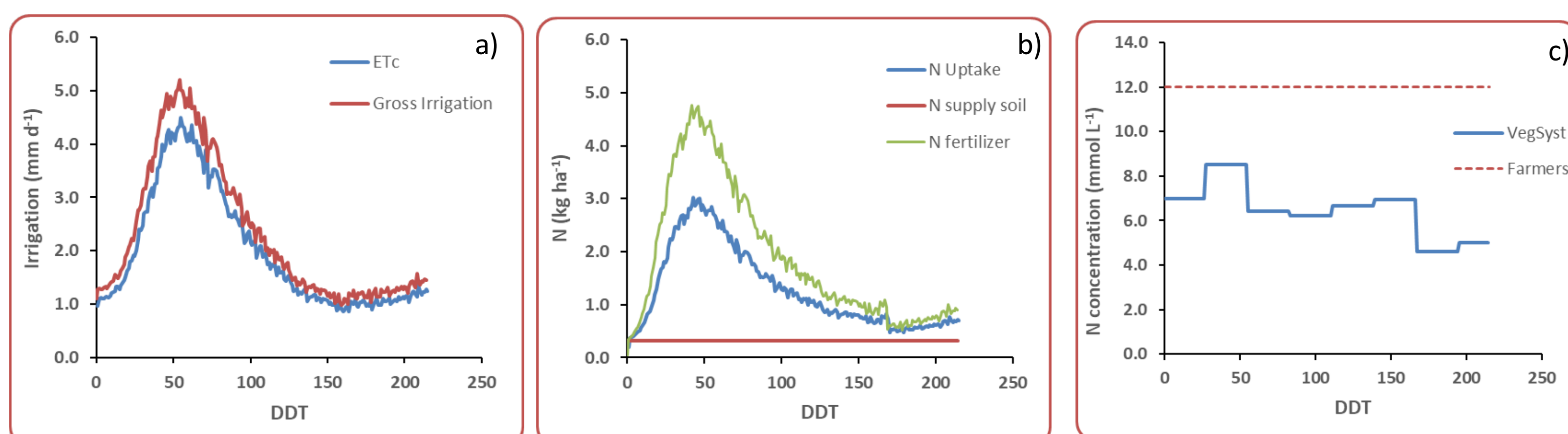


Figure 1. Example of the outputs of the VegSyst-DSS for a pepper crop showing seasonal daily values of a) ETC and gross irrigation volume, b) N uptake, N supply from the soil and N fertilizer requirements, and c) the recommended four-weekly N concentration of the fertigation nutrient solution

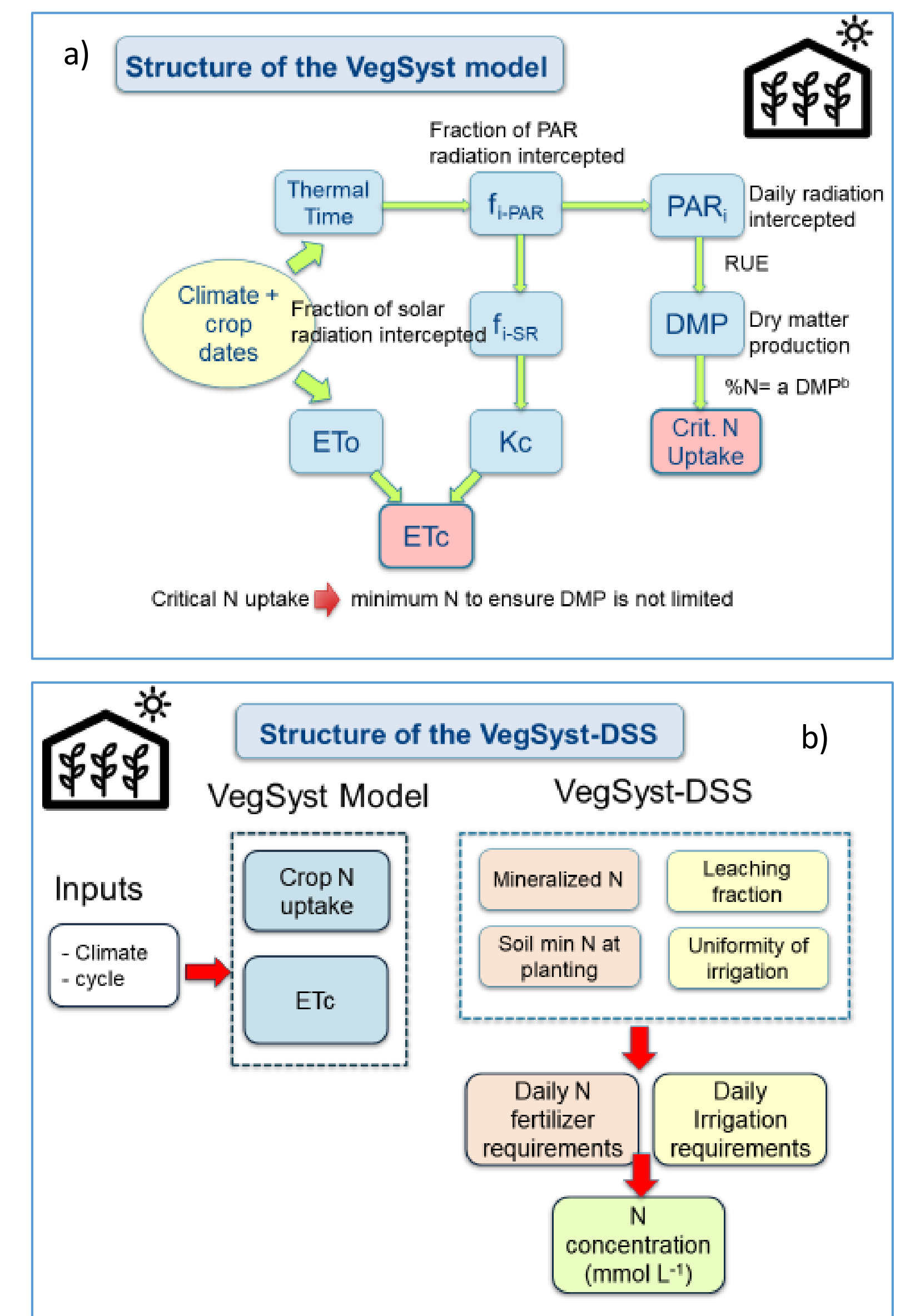


Figure 2. Schematic diagram of the VegSyst-DSS showing: a) the VegSyst model and b) integration between the model and the component that then calculates i) N fertilizer requirements, ii) gross irrigation requirements, and iii) the applied N concentration

## Example of the use of VegSyst-DSS (scenario analysis)

- Soil-grown pepper (*Capsicum annuum*) in a plastic greenhouse with autumn-winter cycle (15 July to 15 February)
- Electrical conductivity (EC) of water, 2 dS m<sup>-1</sup>, and uniformity coefficient (UC) of the irrigation system of 0.95

| Crop     | Soil N min at planting (kg ha <sup>-1</sup> ) | Sheep manure (m <sup>3</sup> ha <sup>-1</sup> ) |
|----------|---|---|
| Pepper-1 | 0   | 0   |
| Pepper-2 | 150   | 0   |
| Pepper-3 | 50  | 50  |

Table 1. For three theoretical pepper crops, the amount of mineral N at planting in the top 0.3 m of soil, and the amount of sheep manure applied one year before planting.

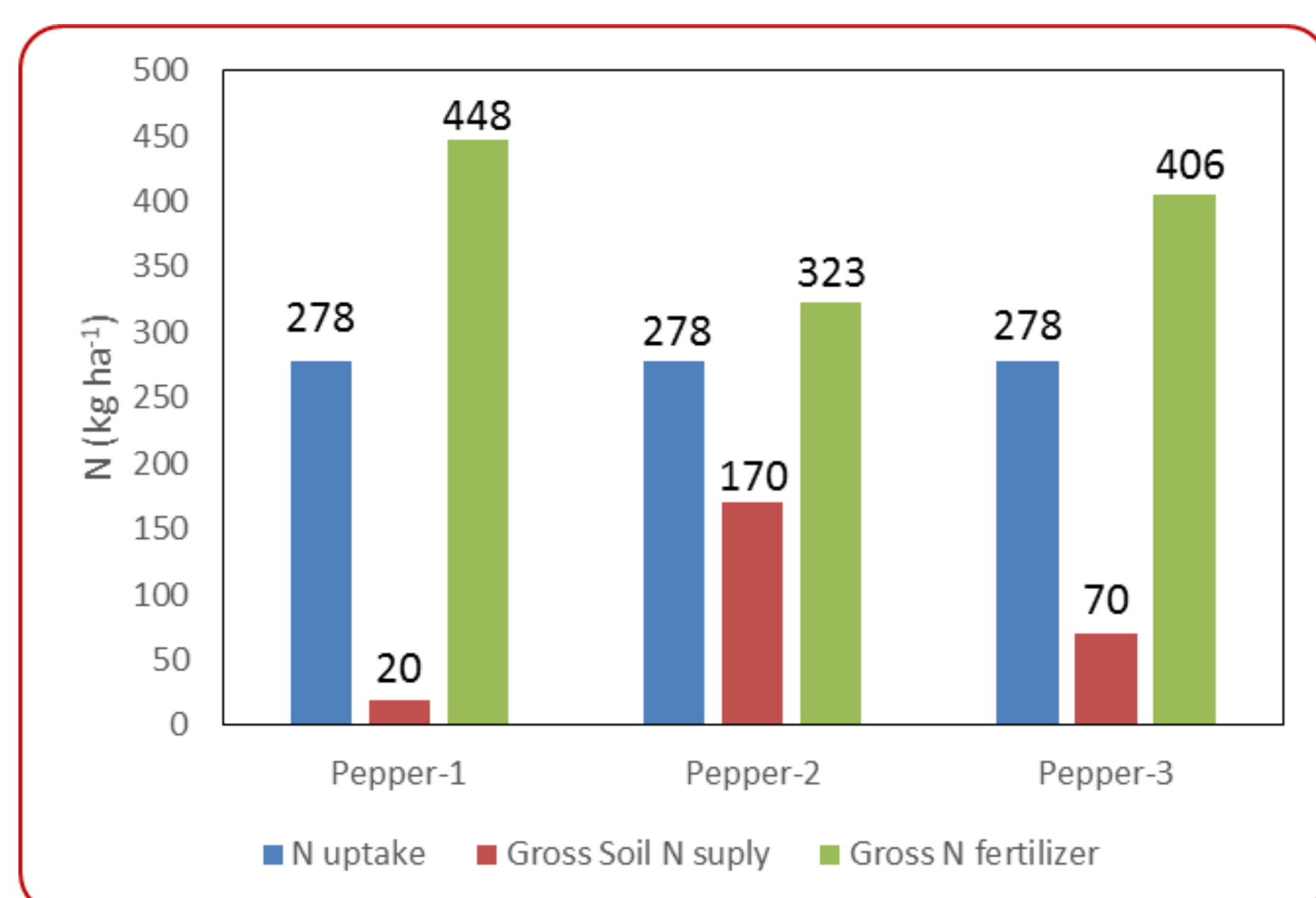


Figure 3. Total values of N uptake, gross N supply and gross N fertilizer for the three pepper crops compared and described in Table 1

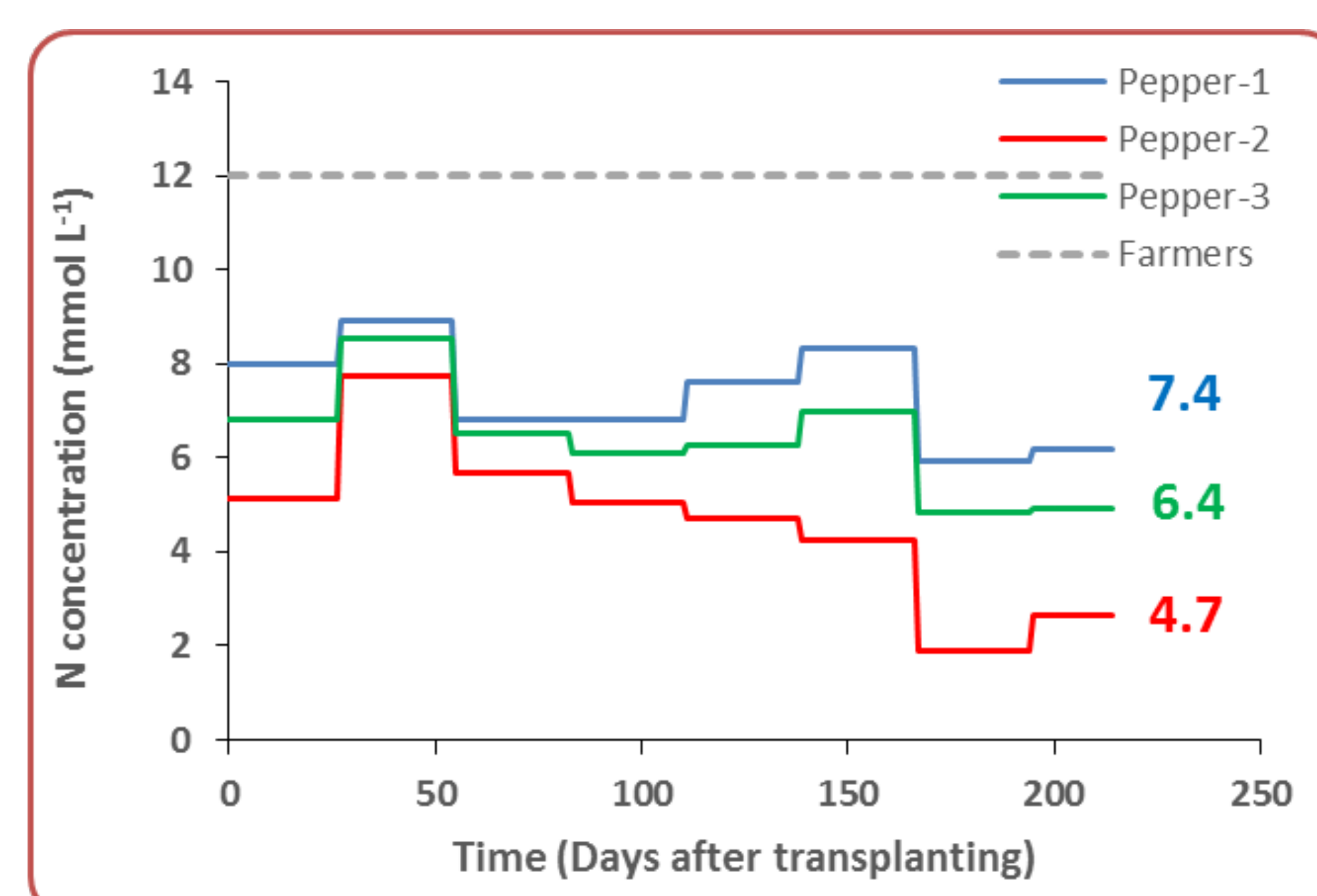


Figure 4. Seasonal evolution of the recommended four-week [N] of the nutrient solution applied by fertigation for the three pepper crops, and the commonly-used [N] in Almería greenhouses. The values correspond to the seasonal average of the applied [N] for each crop

- Total crop N uptake was the same for the three crops, as they had the same climate and growing season
- The gross N supply from the soil considered the root-zone mineral N at planting and N mineralized from soil organic matter and applied manure.
- In relation to pepper-1, the gross N fertilizer requirements were reduced by 28% and by 9% in pepper-2 and 3, respectively, on account of consideration of the N supply from the soil
- In all crops, the recommended applied [N] changed during the season due to the seasonal changes in N demand of the crop and to changes in ETC
- The recommended applied [N] in pepper-1 was higher than in the other crops, because in pepper-1 there was no supply of N from the soil, apart from mineralization of soil organic matter
- The crop with the lowest recommended applied [N] was pepper-2, because of the large amount of soil mineral N in the root zone at planting
- The average [N] was 7.4, 4.7 and 6.4 mmol L<sup>-1</sup> in pepper-1, -2 and -3, respectively, which was considerably lower than the [N] of 12 mmol L<sup>-1</sup> that is commonly applied by local farmers

## Conclusions

- The VegSyst-DSS calculates recommendations of the daily volume of irrigation, daily amount of fertilizer N, and the recommended N concentration to apply in nutrient solutions by fertigation, for vegetable crops grown in greenhouses
- The software is a practical, simple-to-use tool developed for farmers and advisors, to prepare plans of irrigation and N fertilization tailored to the specific characteristics of each crop and greenhouse
- By considering crop N demand and the N supplied by the soil and organic amendments, VegSyst-DSS can appreciably reduce the application of N fertilizer and consequently reduce N losses to the environment.