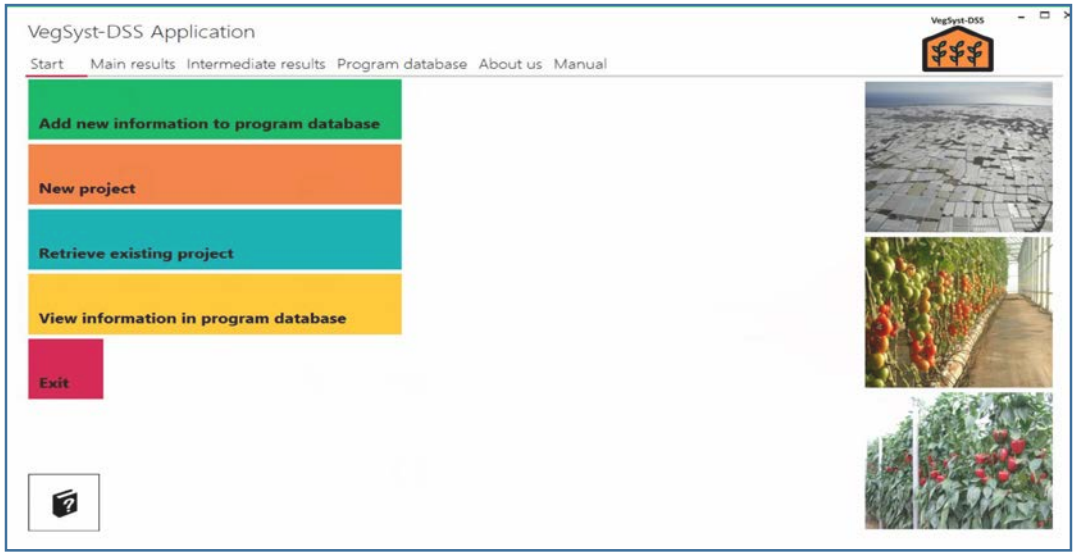


# VegSyt-DSS: herramienta para la toma de decisiones en el manejo de la fertilización N en cultivos hortícolas de invernadero

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# Razones para mejorar el manejo del N

- Reducir contaminación de acuíferos con $NO_3^-$ lixiviado desde los invernaderos (legislación autonómica, nacional y europea)
- Presión de la sociedad y de consumidores para reducir el impacto ambiental de la agricultura
- Reducir costes económicos


# ¿Cómo podemos mejorar el manejo del N?

**MANEJO DE N DE SEGURIDAD**
(basado en *incertidumbre*)

**Reemplazar INCERTIDUMBRE por INFORMACIÓN**

**MANEJO DE N MEJORADO**
(basado en *información*)

Análisis de N en suelo

Monitorización de N en planta


**Sistemas de ayuda a la toma de decisiones (DSS) y modelos de simulación**

# VEGSYST-DSS- herramienta de ayuda al manejo del N en fertirriego en cultivos de invernadero

## Inputs

### Datos climáticos
- Temperatura y HR invernadero
- Radiación solar exterior

### Datos de cultivo
- Especie
- Ciclo de cultivo
- Encalado

### Datos de suelo
- Profundidad sistema radicular
- Aplicaciones estiércol
- N mineral inicial

## VegSyst-DSS

## Outputs

- Necesidades de N
- Necesidades de riego
- Concentración N solución

(Valores diarios, semanales, mensuales o estacionales)

**Especies: tomate, pimiento, pepino, calabacín, berenjena, melón y sandia**

Recomendaciones de riego y N en fertirriego y riego por goteo **adaptables** a variaciones en especie, medio de cultivo, clima, ciclo de cultivo, invernadero, cubierta

# Componentes del VegSyst-DSS

Modelo VegSyst + DSS

El modelo de simulación calcula valores diarios/estacionales de:

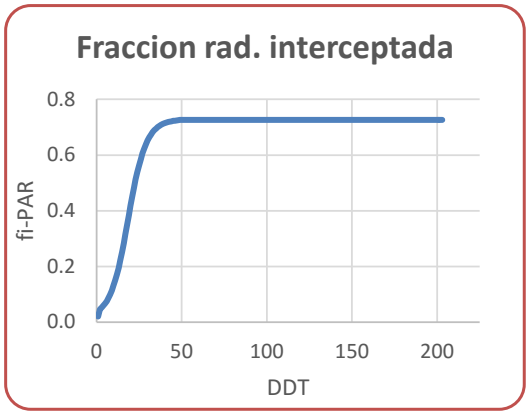
- Producción de materia seca
- Extracción de N del cultivo
- Evapotranspiración del cultivo (ETc)

**VegSyst-DSS**

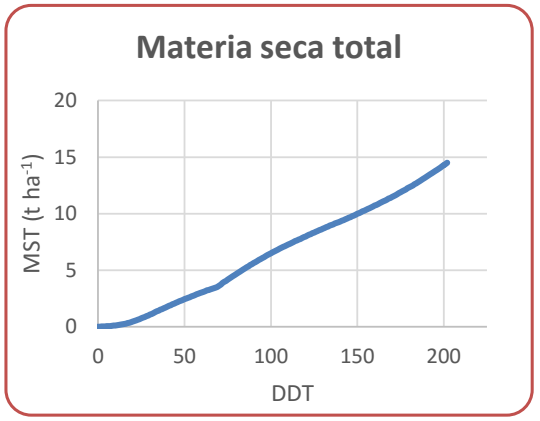
- Balance de N diario
- Volumen de riego considerando la salinidad del agua y la uniformidad del sistema de riego

# Modelo VegSyst

Temperatura

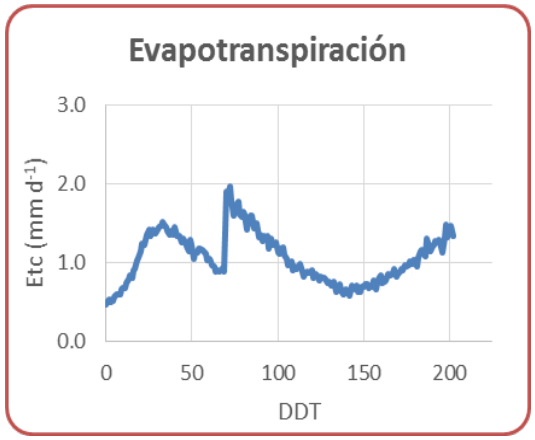


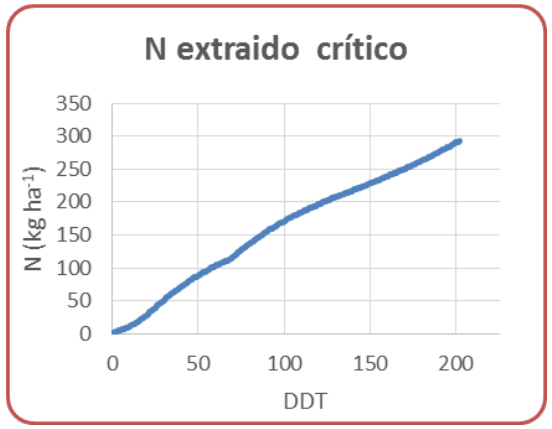

Radiación



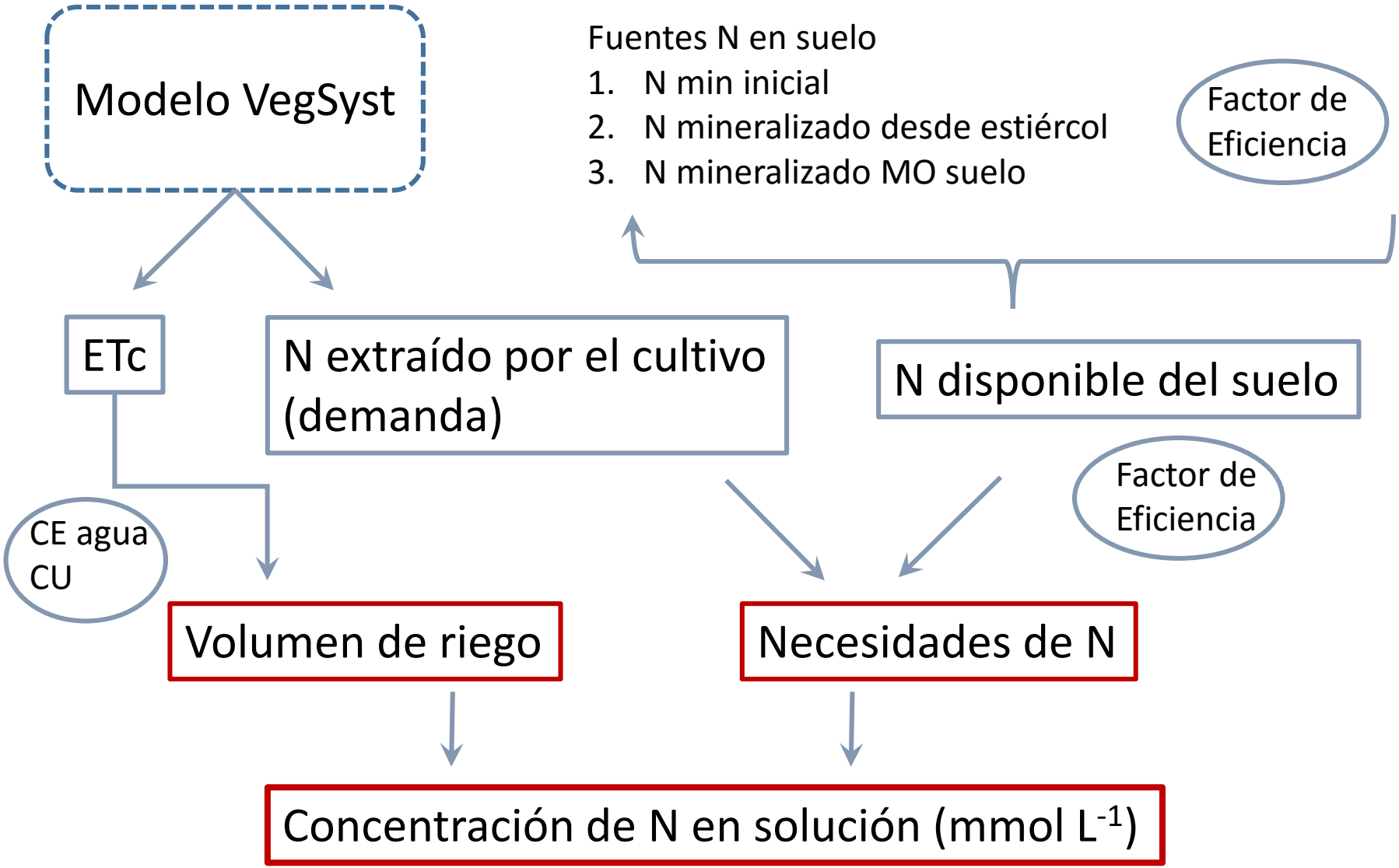

Curva crítica N

Temperatura y
Radiación exterior




N crítico- contenido mínimo
de N en planta para obtener máxima biomasa


Modelo VegSyst
Fuentes N en suelo
1. N min inicial
2. N mineralizado desde estiércol
3. N mineralizado MO suelo
Factor de Eficiencia
ETc
N extraído por el cultivo (demanda)
N disponible del suelo
Factor de Eficiencia
CE agua
CU
Volumen de riego
Necesidades de N
Concentración de N en solución (mmol L-1)

# Presentación del software

VegSyst-DSS Application

Start | Main results | Intermediate results | Program database | About us | Manual

**Add new information to program database**

*Añadir información a la base de datos*

**New project**

*Crear proyecto nuevo*

**Retrieve existing project**

*Descargar proyecto (existente)*

**View information in program database**

**Exit**

# Primer paso- Añadir información a la base de datos

VegSyst-DSS Application

Start | Main results | Intermediate results | Program database | About us

**Add new information to program database**

**New project**

**Retrieve existing project**

**View information in program database**

**Exit**

Add climate — ***Clima***

Add manure — ***Estiércol***

Add irrigation — ***Sistema de riego***

Add soil — ***Suelo***

# Añadir archivo Excel con datos de clima

VegSyst-DSS Application

Start | Main results | Intermediate results | Program database | About us

**Add new information to program database**

**New project**

**Retrieve existing project**

**View information in program databa**

**Exit**

Import Climate

Import excel file

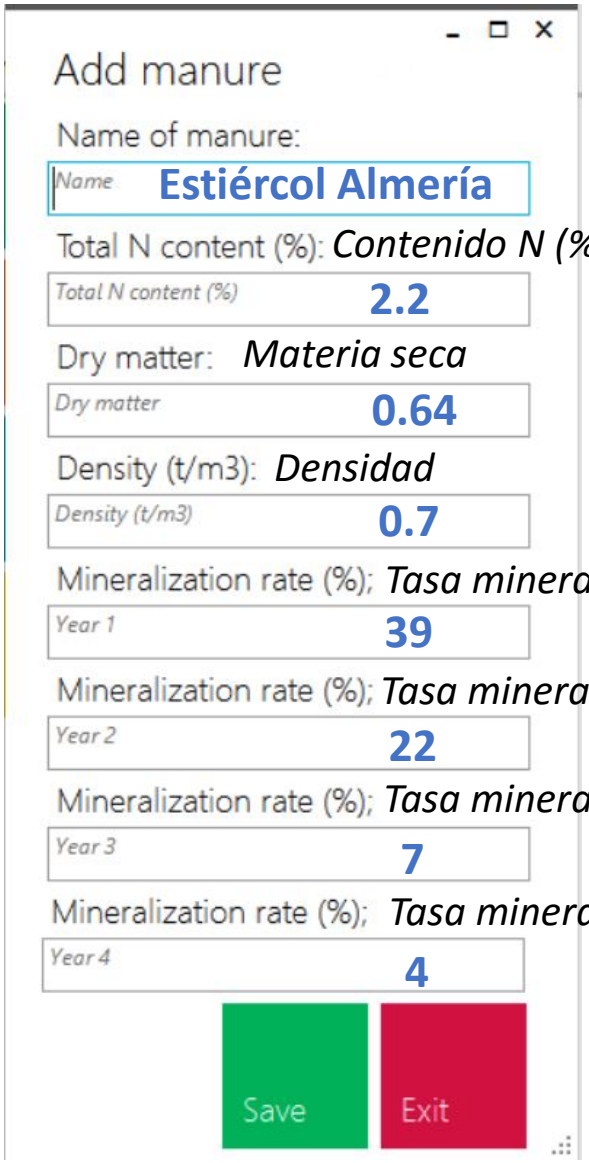
Save

Exit

# Archivo Excel con datos de clima- por defecto datos históricos de Cajamar

| Name | CAJAMAR-HISTORICAL | | | | | |
|---|---|---|---|---|---|---|
| | degrees | minutes | N/S | | | |
| Latitude | 36 | 48 | N | | | |
| DOY | Tmax | Tmin | RHmax | RHmin | SR outside (MJ $m^{-2}$ $d^{-1}$) | TR |
| 1 | 19.6 | 7.5 | 90.4 | 60.3 | 8.24 | 0.65 |
| 2 | 19.6 | 7.4 | 91.6 | 57.4 | 8.98 | 0.65 |
| 3 | 19.7 | 6.9 | 92.2 | 59.6 | 8.98 | 0.65 |
| 4 | 20.0 | 6.9 | 92.1 | 58.4 | 9.31 | 0.65 |
| 5 | 20.2 | 7.3 | 92.1 | 58.8 | 9.30 | 0.65 |
| 6 | 18.9 | 6.7 | 93.4 | 56.2 | 8.60 | 0.65 |
| 7 | 18.9 | 6.2 | 93.1 | 60.2 | 8.89 | 0.65 |
| 8 | 18.8 | 6.3 | 92.0 | 59.6 | 8.65 | 0.65 |
| 9 | 19.2 | 6.2 | 92.6 | 57.7 | 9.74 | 0.65 |
| 10 | 18.8 | 6.7 | 91.9 | 57.7 | 8.11 | 0.65 |
| 11 | 20.2 | 6.9 | 90.7 | 62.8 | 9.06 | 0.65 |
| 12 | 19.8 | 6.9 | 93.9 | 61.1 | 9.63 | 0.65 |
| 13 | 19.8 | 6.5 | 91.6 | 60.1 | 10.27 | 0.65 |
| 14 | 19.5 | 7.3 | 91.8 | 61.3 | 9.02 | 0.65 |
| 15 | 20.2 | 7.0 | 92.3 | 60.6 | 9.13 | 0.65 |
| 16 | 19.3 | 6.8 | 91.9 | 61.0 | 9.17 | 0.65 |
| 17 | 21.1 | 7.1 | 91.4 | 58.9 | 10.21 | 0.65 |
| 18 | 20.3 | 6.9 | 91.4 | 59.3 | 9.88 | 0.65 |
| 19 | 20.5 | 7.5 | 91.3 | 57.4 | 9.89 | 0.65 |
| 20 | 21.0 | 6.9 | 89.5 | 57.4 | 10.10 | 0.65 |
| 21 | 21.1 | 7.0 | 91.5 | 60.4 | 10.64 | 0.65 |
| 22 | 20.5 | 7.3 | 93.2 | 62.3 | 9.48 | 0.65 |
| 23 | 21.1 | 7.0 | 92.5 | 59.3 | 9.77 | 0.65 |
| 24 | 21.0 | 7.0 | 90.2 | 58.3 | 10.18 | 0.65 |

# Creación archivo de estiércol




| Tipo estiércol | Description | Total N content (%) | Mineralization coefficients (%) | | | |
|---|---|---|---|---|---|---|
| | | | Year 1 | Year 2 | Year 3 | Year 4 |
| Oveja | Almeria | 2.2 | 39 | 22 | 7 | 4 |
| Ave-1 | hens fresh | 4.5 | 90 | 10 | 5 | 5 |
| Ave-2 | broilers and turkeys, fresh | 3.8 | 75 | 5 | 5 | 5 |
| Ave-3 | broilers and turkeys, aged | 3 | 60 | 5 | 5 | 4 |
| Cerdo | | 2.8 | 90 | 4 | 2 | 2 |
| Dairy fresh | | 3.5 | 50 | 15 | 5 | 5 |
| liquid Liquido en tanque | | 3 | 42 | 12 | 6 | 4 |
| Vacuno-1 | fresh | 3.5 | 75 | 15 | 10 | 5 |
| Vacuno-2 | dry | 2.5 | 40 | 25 | 6 | 3 |
| Vacuno-3 | dry | 1.5 | 35 | 15 | 10 | 5 |
| Vacuno-4 | dry | 1 | 20 | 10 | 5 | 5 |

# Creación archivo de riego

Add irrigation layout

*Configuración riego*

Name:

Enter name **Simple-1.5 x 0.5**

Dripper flow rate (L/h):

Enter value **3** *Caudal gotero (L/h)*

Single drippers line *Líneas simples de goteros*

Distance between lines (m):

Enter value **1.5** *Distancia entre líneas*

Distance between drippers within lines (m):

Enter value **0.5** *Distancia entre goteros*

Double drippers lines *Líneas pareadas de goteros*

Distance between pairs (m):

Enter value **1.2** *Distancia entre líneas alejadas*

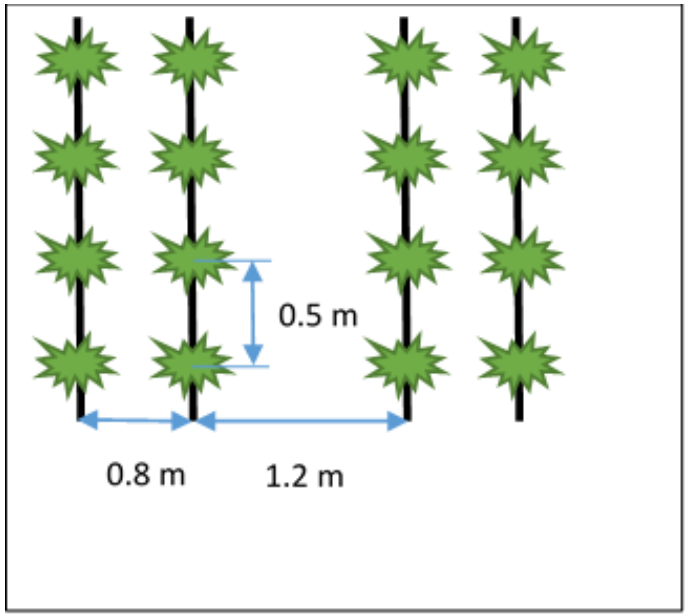
Distance within pairs (m):

Enter value **0.8** *Distancia entre líneas pareadas*

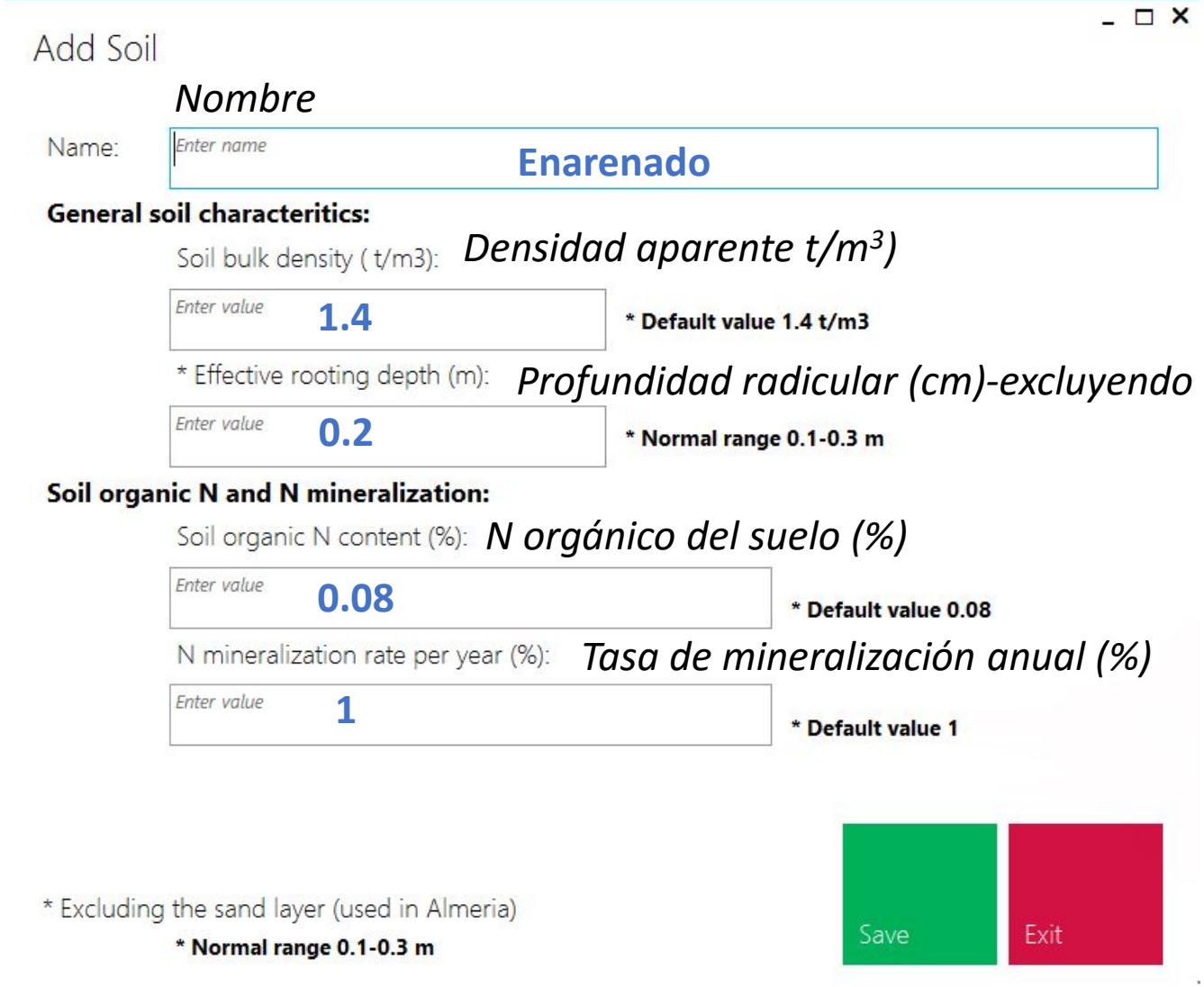
Distance between drippers within lines (m)

Enter value **0.5** *Distancia entre goteros*

Save Exit



# Creación archivo de suelo



# Creación proyecto nuevo

New project

Name of project:
TOMATE OTOÑO *Nombre*

Size of greenhouse (m2):
10000 *Superficie invernadero*

Select cropping media: *Medio cultivo*
- (•) Soil
- ( ) Substrate

*** Climate:** *Clima*
CAJAMAR-HISTORICAL

*** Soil:** *Suelo*
Enarenado soil

*** Irrigation layout:**
Single 1.5 x 0.5 *Configuración riego*

**Salinity:** *Salinidad*
Set salinity of irrigation water

Consider uniformity coefficient: *Considera coeficiente uniformidad*
- (•) Yes 0.95
- ( ) No

*Fecha última aplicación estiércol*

**Date of most recent manure application:**
05 August 2014

**Volume of manure applied (m3/ha):**
50 *Volumen de estiércol aplicado*

**Type of manure:** *Tipo de estiércol*
Standard Almeria sheep manure

**Crop species:** *Cultivo*
TOMATO

Planting method: *Siembra o trasplante*
- (•) Transplanting
- ( ) Sowing

**Transplanting/sowing date:**
05 August 2015 *Fecha trasplante*

**End of crop**
24 February 2016 *Fecha fin cultivo*

****Soil mineral N: (kg N/ha)**
Soil mineral N at planting: ☐ Unknown
100 *N mineral en suelo inicial*

**ETo Equation:** *Ecuación de ETo*
- ( ) FAO56 Penman-Monteith (fixed ra)
- (•) Almeria radiation

**Whitening** *Manejo del Encalado*
☐ No whitening *Sin Encalado*

Date of application
05 August 2015 *Fecha de aplicación*

Date of removal
15 October 2015 *Fecha de eliminación*

Transmissivity values
0.00 *Transmisividad tras encalado*

If not measured, select type of whitening:
( ) Light - 0.45 (•) Medium - 0.30 ( ) Severe - 0.20

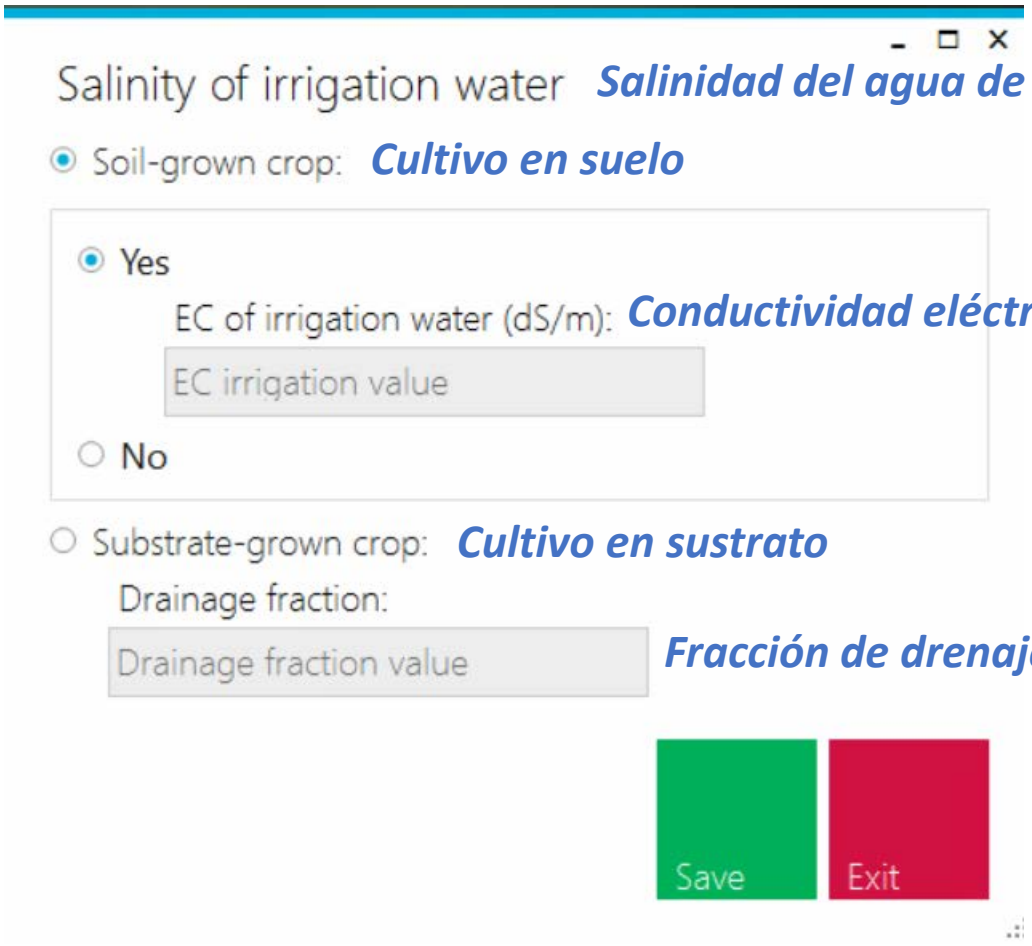
Add | Remove

| Date of application | Date of removal | Transmissivity |
|---|---|---|
| 05/08/2015 | 15/10/2015 | 0.3 |

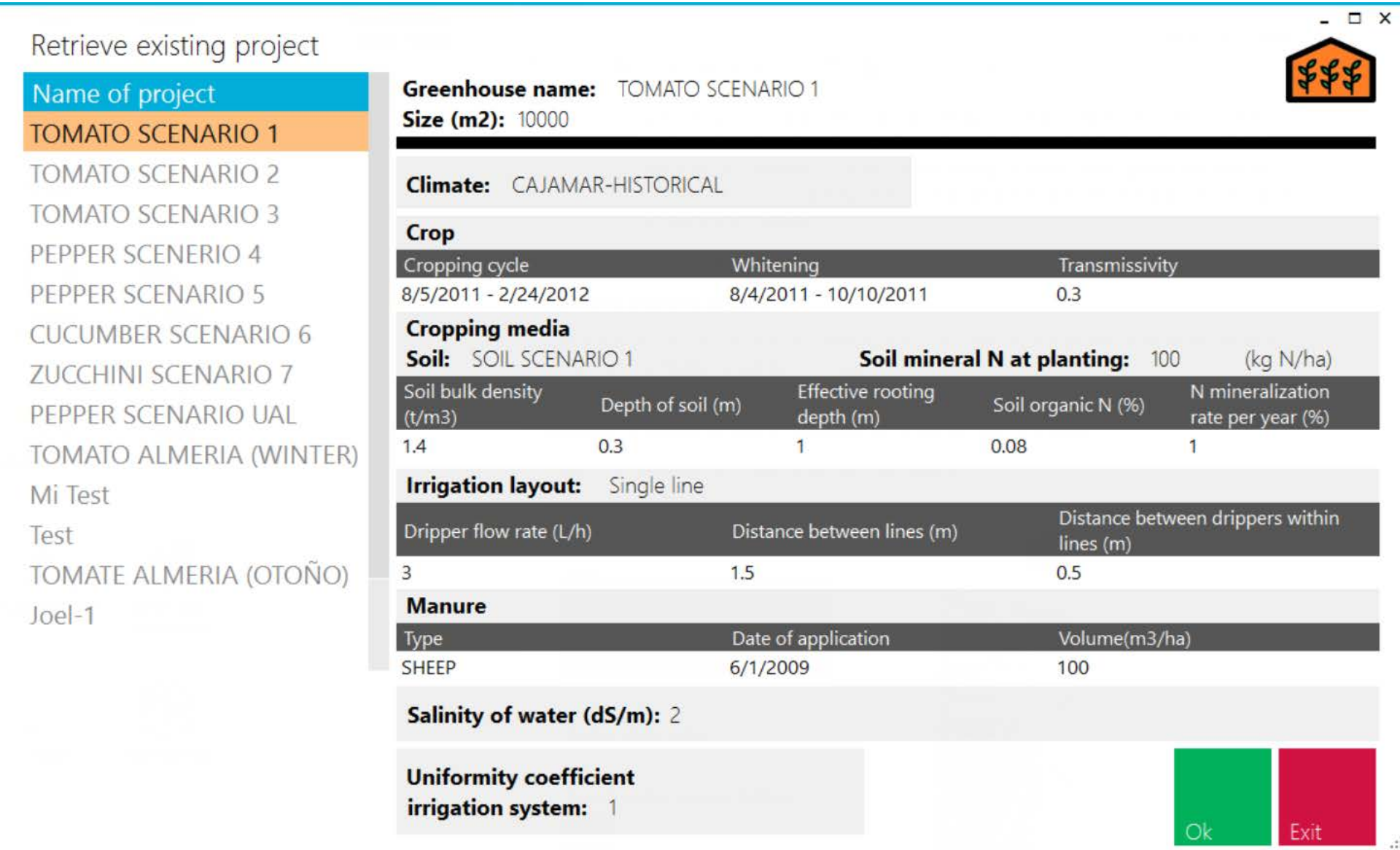
*** Add new information to database on start windows**
**** In the root zone (e.g. 0-30 cm soil depth)**

Save | Exit

# Manejo de la salinidad



# Descargar un proyecto existente



# Resultados globales

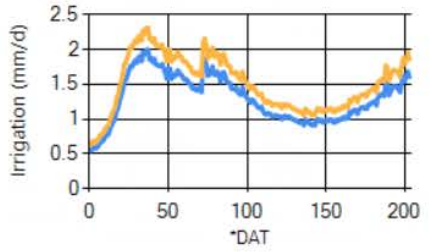
- En Pantalla- Gráficos y tabla
- Descarga de archivos (Excel)

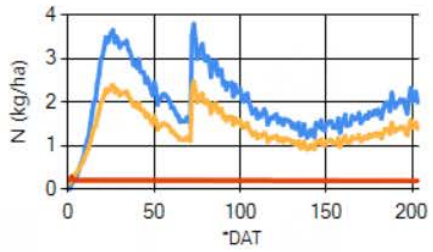
VegSyst-DSS Application

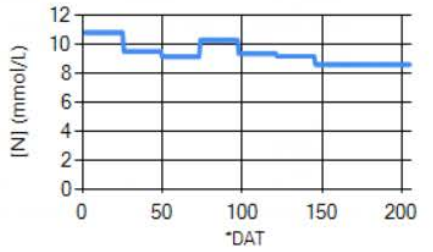
Start | Main results | Intermediate results | Program database | About us

**Export report to EXCEL**

**Daily values during the crop** *Valores diarios durante el ciclo*




| Day after transplanting | Irrigation volume (mm) | Irrigation time (min) | N fertilizer (Kg/ha) | N Concentration (mmol/L) |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.63 | 9.38 | 0.00 | 0.00 |
| 3 | 0.69 | 10.29 | 0.12 | 1.27 |
| 4 | 0.69 | 10.28 | 0.18 | 1.86 |
| 5 | 0.69 | 10.03 | 0.21 | 2.26 |
| 6 | 0.69 | 10.38 | 0.29 | 2.95 |
| 7 | 0.75 | 11.18 | 0.41 | 3.94 |
| 8 | 0.77 | 11.59 | 0.54 | 5.02 |
| 9 | 0.79 | 11.79 | 0.62 | 5.66 |
| 10 | 0.82 | 12.27 | 0.74 | 6.50 |
| 11 | 0.87 | 13.08 | 0.96 | 7.85 |
| 12 | 0.90 | 13.43 | 1.10 | 8.77 |
| 13 | 0.91 | 13.62 | 1.23 | 9.68 |
| 14 | 1.01 | 15.08 | 1.49 | 10.62 |
| 15 | 1.06 | 15.87 | 1.76 | 11.91 |
| 16 | 1.12 | 16.81 | 2.00 | 12.76 |

*Días después trasplante* *Volumen riego* *Minutos de riego* *Fertilizante N* *Concentración N en solución*

*Day after transplanting

# Descarga r

Option selection

- Short excel report
  - Irrigation require
  - N fertilizer
- Detailed excel rep
  - Irrigation require
  - N uptake
  - N sources
  - Fertilizer requirer

Repo

Libro1 - Excel

ARCHIVO | INICIO | INSERTAR | DISEÑO DE PÁGINA | FÓRMULAS | DATOS | REVISAR | VISTA | DESARROLLADOR | COMPLEMENTOS | ACROBAT

Pegar | Calibri | 24 | General | Formato condicional | Dar formato como tabla | Estilos de celda | Insertar | Eliminar | Formato | Ordenar y filtrar

Portapapeles | Fuente | Alineación | Número | Estilos | Celdas | Modificar

A1 | VegSys-DSS

## VegSys-DSS

13/03/2016

## TOMATE ALMERIA (OTOÑO)

| | | | |
|---|---|---|---|
| **Project:** | TOMATE ALMERIA (OTOÑO) | **Climate:** | CAJAMAR-HISTORICAL |
| | | **Latitude:** | 36º 43' N |

## Sumary

| | | |
|---|---|---|
| Irrigation Volume | (mm) | 306.97 |
| Soil mineral N | (kg/ha) | 49.51 |
| Mineralized N | (kg/ha) | 30.98 |
| N crop uptake | (kg/ha) | 285.25 |
| N fertilizer requirement | (kg/ha) | 408.48 |
| Total amount of irrigation | (m3) | 306.97 |
| Total amount of N fertilizer | (kg) | 40.85 |

| | | | | Irrigation Requirements | | | | | N Fertilizer | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Date | DAT | Weeks | Daily volume | Cumulative volume | Weekly irrigation volume | Daily irrigation time | weekly irrigation time | Daily fertilizer requirements | N concentration ( 4 weeks) |
| | | | | mm/d | mm | mm/w | min | min w-1 | kg/ha d | mmol N/L |
| 1 | 05/08/2011 | 0 | 1 | | | | | | | |
| 2 | 06/08/2011 | 1 | | 0.63 | 0 | | 9.38 | | 0 | 9.27 |
| 3 | 07/08/2011 | 2 | | 0.69 | 0.63 | | 10.29 | | 0.12 | 9.27 |
| 4 | 08/08/2011 | 3 | | 0.69 | 1.31 | | 10.28 | | 0.18 | 9.27 |
| 5 | 09/08/2011 | 4 | | 0.67 | 2 | | 10.05 | | 0.21 | 9.27 |
| 6 | 10/08/2011 | 5 | | 0.69 | 2.67 | | 10.38 | | 0.29 | 9.27 |
| 7 | 11/08/2011 | 6 | 2 | 0.75 | 3.36 | 4.1 | 11.18 | 4.1 | 0.41 | 9.27 |
| 1 | 12/08/2011 | 7 | | 0.77 | 4.1 | | 11.59 | | 0.54 | 9.27 |
| 2 | 13/08/2011 | 8 | | 0.79 | 4.88 | | 11.79 | | 0.62 | 9.27 |
| 3 | 14/08/2011 | 9 | | 0.82 | 5.66 | | 12.27 | | 0.74 | 9.27 |
| 4 | 15/08/2011 | 10 | | 0.87 | 6.48 | | 13.08 | | 0.96 | 9.27 |
| 5 | 16/08/2011 | 11 | | 0.9 | 7.35 | | 13.43 | | 1.1 | 9.27 |

Hoja1

LISTO

# Informe detallado- valores diarios

**Necesidades hídricas**

ETo - Volumen riego
Kc - Tiempo de riego
ETc - Tiempo semanal

**Extracción N**

- Extracción N diaria
- Extracción estacional

**Aportes N del suelo**

- N min suelo día y acumul.
- N mineralizado N
- Aporte total N

**Necesidades de N**

- Necesidades N (diarias acuml. y semanales)
- Concentración N semanal

Y en periodos de 4 semanas

VegSys-DSS

18/05/2016

TOMATO-SOIL

| | | | |
|---|---|---|---|
| Project: | TOMATO-SOIL | Climate: | CAJAMAR-HISTORICAL |
| | | Latitude: | 36º 43' N |

Sumary

| | | |
|---|---|---|
| Irrigation Volume | (mm) | 257.14 |
| Soil mineral N | (kg/ha) | 99.02 |
| Mineralized N | (kg/ha) | 26.6 |
| N crop uptake | (kg/ha) | 285.25 |
| N fertilizer requirement | (kg/ha) | 318.13 |
| Total amount of irrigation | (m3) | 257.14 |
| Total amount of N fertilizer | (kg) | 31.81 |

| | | | | IRRIGATION REQUIREMENTS | | | | | | | N UPTAKE | | N SOURCES | | | | | FERTILIZER REQUIREME | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Date | DAT | Weeks | ETo (mm/d) | kc | ETc (mm/d) | Daily volume (mm/d) | Cumulative volume (mm) | Weekly irrigation volume (mm/w) | Daily irrigation time (min) | weekly irrigation time (min/w) | Daily crop N uptake (kg/ha/d) | Cumulative crop N uptake (kg N) | Daily soil mineral N (kg/ha/d) | Cumulative soil mineral N (kg/ha) | Mineralized N (daily) (kg/ha/d) | Mineralized N (cumulative) (kg/ha) | Total Net N supply (kg/ha/d) | Daily N fertilizer requirements (kg/ha/d) | Cumulative N fertilizer requirements (kg/ha) | Weekly N fertilizer requirements (kg/ha) | Weekly N concentration (mmol N/L) | Aver four N conc (mm |
| 1 | 05/08/2015 | 0 | 1 | | | | | | | | | | | | | | | | | | | | |
| 2 | 06/08/2015 | 1 | | 2.18 | 0.22 | 0.48 | 0.53 | 0 | | 7.92 | | 0.12 | 0.12 | 0.4878 | 0.4878 | 0.1544 | 0.1544 | 0.3211 | 0 | 0 | | | |
| 3 | 07/08/2015 | 2 | | 2.11 | 0.25 | 0.53 | 0.57 | 0.53 | | 8.62 | | 0.28 | 0.4 | 0.4878 | 0.9756 | 0.1541 | 0.3084 | 0.5176 | 0 | 0 | | | |
| 4 | 08/08/2015 | 3 | | 2.12 | 0.26 | 0.54 | 0.59 | 1.1 | | 8.9 | | 0.31 | 0.72 | 0.4878 | 1.4634 | 0.1538 | 0.4622 | 0.3637 | 0 | 0 | | | |
| 5 | 09/08/2015 | 4 | | 1.99 | 0.26 | 0.52 | 0.57 | 1.7 | | 8.57 | | 0.33 | 1.05 | 0.4878 | 1.9512 | 0.1535 | 0.6156 | 0.3282 | 0.02 | 0.02 | | | |
| 6 | 10/08/2015 | 5 | | 1.98 | 0.27 | 0.54 | 0.59 | 2.27 | | 8.82 | | 0.38 | 1.42 | 0.4878 | 2.439 | 0.1532 | 0.7688 | 0.3205 | 0.08 | 0.1 | | | |
| 7 | 11/08/2015 | 6 | 2 | 2.08 | 0.28 | 0.58 | 0.64 | 2.85 | 3.49 | 9.6 | 52.42 | 0.45 | 1.88 | 0.4878 | 2.9268 | 0.1529 | 0.9217 | 0.3203 | 0.19 | 0.28 | 0.28 | 0.58 | |
| 1 | 12/08/2015 | 7 | | 2.13 | 0.29 | 0.62 | 0.68 | 3.49 | | 10.24 | | 0.53 | 2.41 | 0.4878 | 3.4146 | 0.1526 | 1.0743 | 0.3202 | 0.3 | 0.58 | | | |
| 2 | 13/08/2015 | 8 | | 2.02 | 0.31 | 0.62 | 0.68 | 4.18 | | 10.14 | | 0.58 | 2.98 | 0.4878 | 3.9024 | 0.1523 | 1.2266 | 0.32 | 0.37 | 0.95 | | | |
| 3 | 14/08/2015 | 9 | | 1.97 | 0.32 | 0.63 | 0.69 | 4.85 | | 10.41 | | 0.65 | 3.64 | 0.4878 | 4.3902 | 0.152 | 1.3786 | 0.3199 | 0.47 | 1.43 | | | |
| 4 | 15/08/2015 | 10 | | 2.04 | 0.34 | 0.7 | 0.76 | 5.55 | | 11.43 | | 0.78 | 4.41 | 0.4878 | 4.878 | 0.1517 | 1.5303 | 0.3198 | 0.66 | 2.08 | | | |
| 5 | 16/08/2015 | 11 | | 1.97 | 0.36 | 0.71 | 0.78 | 6.31 | | 11.69 | | 0.86 | 5.28 | 0.4878 | 5.3659 | 0.1514 | 1.6817 | 0.3196 | 0.78 | 2.86 | | | |
| 6 | 17/08/2015 | 12 | | 1.87 | 0.39 | 0.72 | 0.79 | 7.09 | | 11.83 | | 0.94 | 6.22 | 0.4878 | 5.8537 | 0.1511 | 1.8328 | 0.3195 | 0.89 | 3.75 | | | |
| 7 | 18/08/2015 | 13 | 3 | 1.9 | 0.41 | 0.79 | 0.86 | 7.88 | 5.24 | 12.91 | 78.64 | 1.1 | 7.32 | 0.4878 | 6.3415 | 0.1509 | 1.9837 | 0.3193 | 1.12 | 4.87 | 4.58 | 6.24 | |
| 1 | 19/08/2015 | 14 | | 1.91 | 0.44 | 0.85 | 0.93 | 8.74 | | 13.92 | | 1.26 | 8.59 | 0.4878 | 6.8293 | 0.1506 | 2.1342 | 0.3192 | 1.35 | 6.22 | | | |
| 2 | 20/08/2015 | 15 | | 1.87 | 0.48 | 0.89 | 0.98 | 9.67 | | 14.65 | | 1.41 | 9.99 | 0.4878 | 7.3171 | 0.1503 | 2.2845 | 0.319 | 1.55 | 7.77 | | | |
| 3 | 21/08/2015 | 16 | | 1.7 | 0.51 | 0.87 | 0.96 | 10.64 | | 14.33 | | 1.44 | 11.43 | 0.4878 | 7.8049 | 0.15 | 2.4345 | 0.3189 | 1.61 | 9.37 | | | |
| 4 | 22/08/2015 | 17 | | 1.75 | 0.55 | 0.97 | 1.06 | 11.6 | | 15.88 | | 1.67 | 13.1 | 0.4878 | 8.2927 | 0.1497 | 2.5843 | 0.3188 | 1.93 | 11.3 | | | |
| 5 | 23/08/2015 | 18 | | 1.69 | 0.59 | 1 | 1.09 | 12.66 | | 16.42 | | 1.79 | 14.89 | 0.4878 | 8.7805 | 0.1494 | 2.7337 | 0.3186 | 2.1 | 13.4 | | | |
| 6 | 24/08/2015 | 19 | | 1.76 | 0.63 | 1.12 | 1.22 | 13.75 | | 18.34 | | 2 | 16.88 | 0.4878 | 9.2683 | 0.1492 | 2.8829 | 0.3185 | 2.4 | 15.79 | | | |

# Resultados intermedios

VegSyst-DSS Application

Start Main results Intermediate results Program database About us

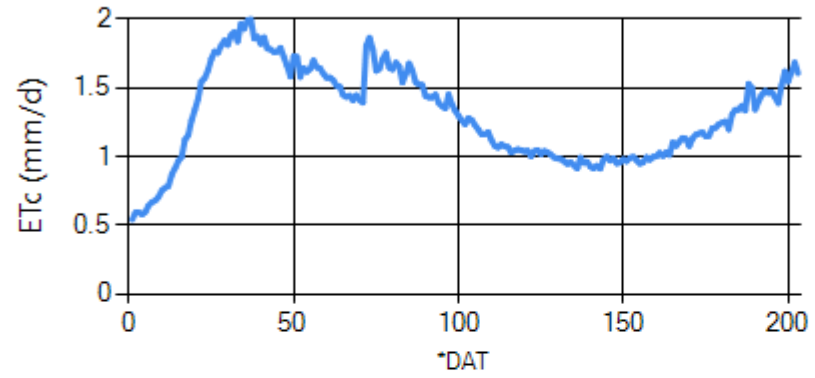
**Irrigation parameters**

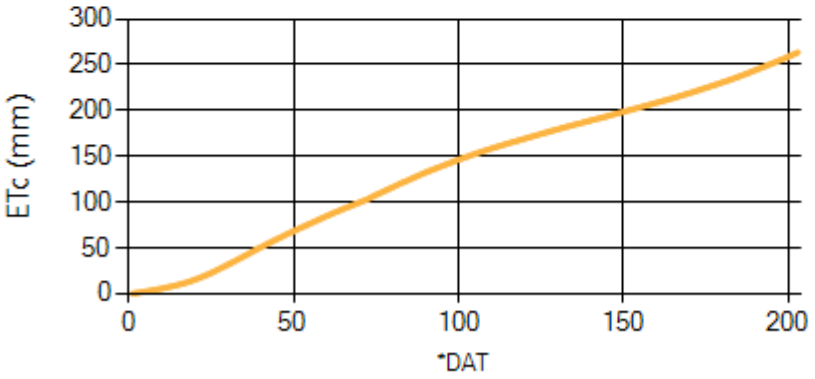
- ETo
- kc
- ETc
- Daily irrigation
- Leaching fraction

**N sources** | **N fertilizer** | **Crop** | **Climate**

Soil mineral N at planting | N Fertilizer | Crop details | Climate

## Crop evapotranspiration (ETc)



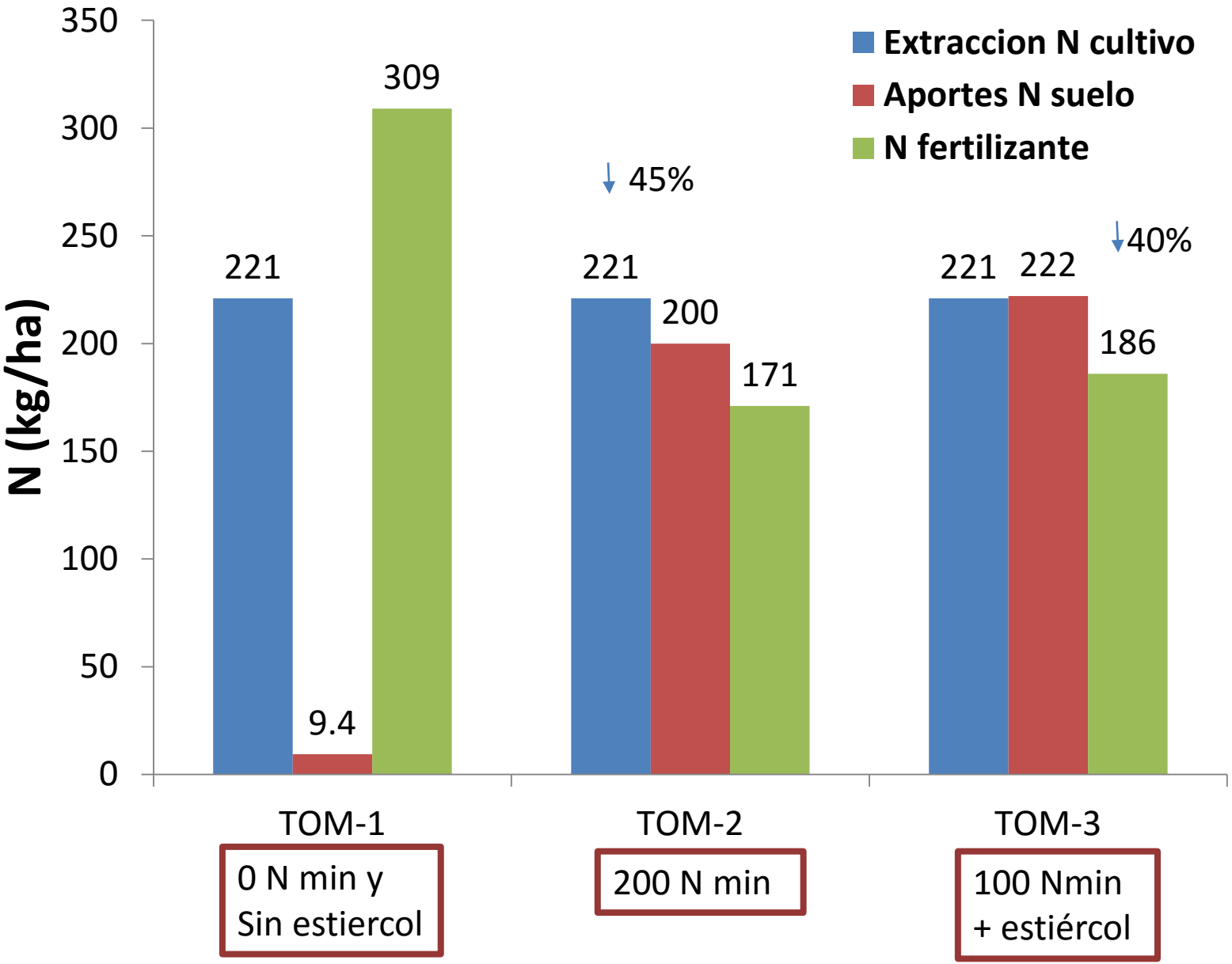

*Day after transplanting

# Análisis de escenarios en tomate

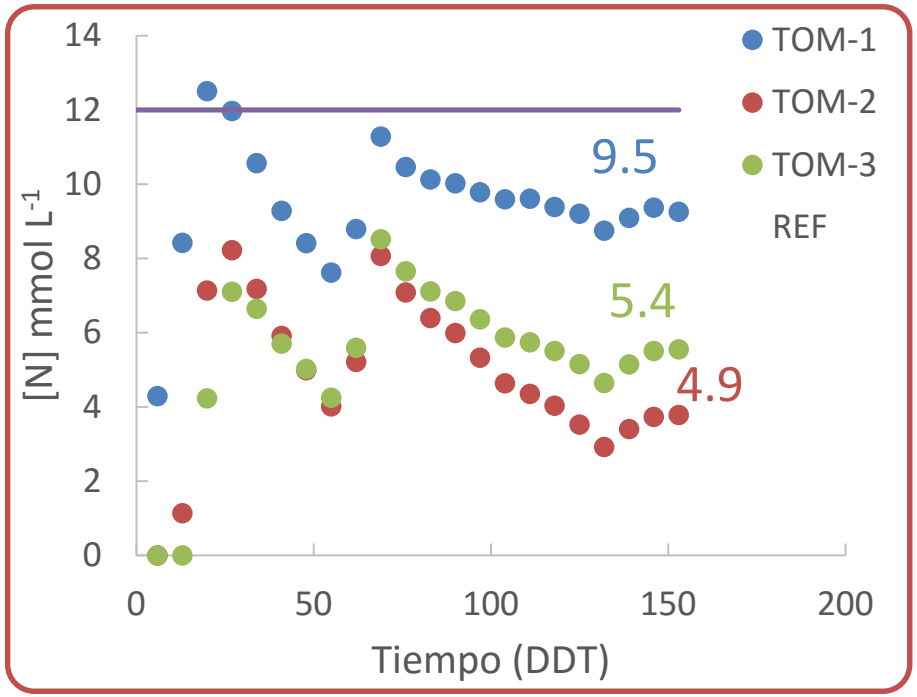
Ciclo: 15 agosto al 15 de enero
Blanqueo hasta el 15 de octubre
EC= 1.5 dS/m, UC=0.95
Goteros 1.5 x 0.5 y 3 L/h

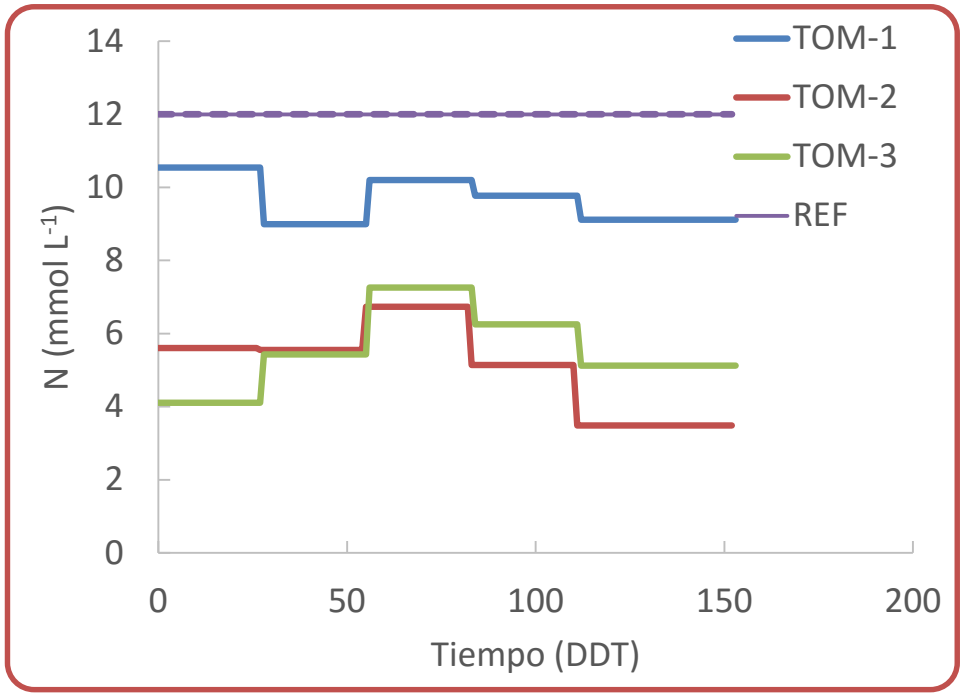
| ESCENARIO | Ciclo | N min suelo (kg N $ha^{-1}$) | Estiércol ($m^3$ $ha^{-1}$) | Comentarios |
|---|---|---|---|---|
| Tomate-1 | Otoño-invierno | 0 | 0 | Suelo referencia (N solo desde fertilizante) |
| Tomate 2 | Otoño-invierno | 200 | 0 | |
| Tomate 3 | Otoño-invierno | 100 | 50 | Estiércol (un año antes de siembra) |
| Tomate 4 | Primavera | 100 | 50 | Estiércol (un año antes de siembra) |

# Comparación de escenarios (tomate otoño)



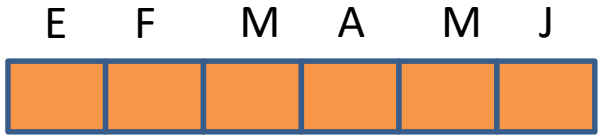
# Cultivo de tomate de otoño-invierno



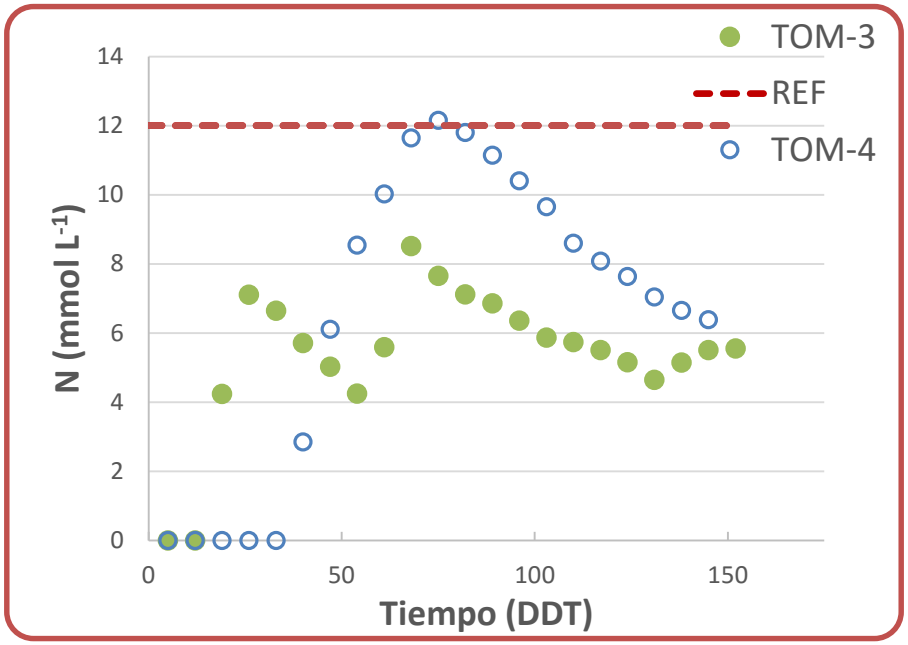



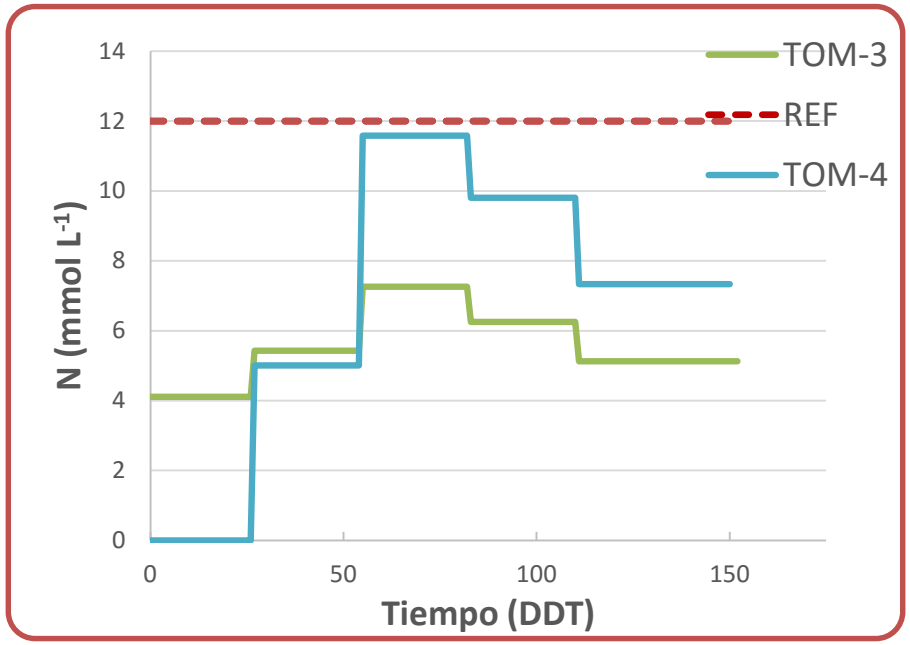
# Comparación cultivo de tomate de otoño-invierno y de primavera


Cultivo otoño-invierno




Cultivo primavera




100 kg N $ha^{-1}$ min inicial y 50 $m^3$ $ha^{-1}$ de estiércol aplicado un año antes; el cultivo de primavera no se blanquea

# VegSyt-DSS

El software se puede descargar en la pagina web del grupo:
http://www.ual.es/GruposInv/nitrogeno/VegSyst-DSS.shtml


Esperamos vuestros comentarios y sugerencias para incorporarlos en la segunda versión (mgallard@ual.es)

# Referencias


- Gallardo, M., Giménez, C., Martínez-Gaitán, C., Stöckle, C.O., Thompson, R.B., and Granados, M.R. (2011). Evaluation of the VegSyst model with muskmelon to simulate crop growth, nitrogen uptake and evapotranspiration. Agric. Water Manag. *101*, 107–117
- Giménez, C., Gallardo, M., Martínez-Gaitán, C., Stöckle, C.O., Thompson, R.B., and Granados, M.R. (2013). VegSyst, a simulation model of daily crop growth, nitrogen uptake and evapotranspiration for pepper crops for use in an on-farm decision support system. Irrig. Sci. *31*, 465–477.
- Gallardo, M., Thompson, R.B., Giménez, C., Padilla, F.M., and Stöckle, C.O. (2014). Prototype decision support system based on the VegSyst simulation model to calculate crop N and water requirements for tomato under plastic cover. Irrig. Sci. *32*, 237–253.
- Gallardo, M., Fernández, M.D., Giménez, C., Padilla, F.M., and Thompson, R.B. (2016). Revised VegSyst model to calculate dry matter production , critical N uptake and ET c of several vegetable species grown in Mediterranean greenhouses. Agric. Syst. *146*, 30–43.

# Artículos divulgativos

- Gallardo M., Thompson, R.B., Padilla, F.M. (2014). Sistema de apoyo a la toma de decisiones basado en el modelo VegSyst para calcular la [N] en fertirriego en tomate de invernadero. Horticultura, 313: 20-38

- Gallardo M., Thompson, R.B. (2015). Software VegSyst-DSS para calcular la dosis de riego, necesidades de N y la concentración de N en fertirriego en cultivos hortícolas de invernadero. Horticultura, 321: 16-21

# Pagina web del grupo de Nitrógeno y Riego de Cultivos de la UAL

- http://www.ual.es/GruposInv/nitrogeno