Rural development innovation week:
29th March 2019- Field trip to VANNUCCI PIANTE farm

Project IRRIGO

Sustainable IRRIGation of the ornamental nursery crops

Partner of the project:

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The project “Pistoia: gli stilisti del vivaismo”

- In the framework of the 2007-2013 European Rural development plan, the company Vannucci Piante had presented an integrated project plan of chain (PIF);
- The project was composed by different actions:
  - **114-** Use of business consulting services (1 farm);
  - **121-** Modernization of protective and marketing structures (15 companies);
  - **124-** Cooperation for the development of new products and technologies (Vannucci Piante and University of Pisa).
- A total of 15 companies participated in the PIF project and the University of Pisa and indirectly 8 other companies participated in the project.

Action 121: Pistoia Nursery Park

Action 124: The project IRRIGO

The project “Pistoia: gli stilisti del vivaismo”

Main drawbacks in the irrigation of HONS

Water consumption is high, until 10 000 m^3/ha (10-13 millions m^3/anno in the district);

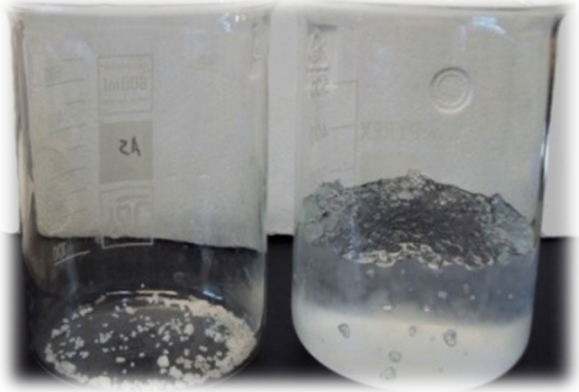
- Large use of rain irrigation and not compensating dripper irrigation;
- Irrigation scheduling is based on grower's experience (fixed time);
- The water retention of growing media (peat-pumice mix) is low;
- Large inter-pot variability exists in terms of ET;
- The leaching fraction ranged from 30 to 60% with the possible nitrate and pesticides leaching.

The low efficiency of the overhead irrigation

Large inter-pot variability

The IRRIGO project: main goals

- Irrigation scheduling based on daily potential evapotranspiration(ET_0);
- Calculation of HONS crop coefficients (Kc), according to the species and the plant shape;
- Effectiveness of the use of water retention gels in the potted plants;
- Effectiveness of the use of mycorrhizae in the nursery to increase water and nutrient efficiency



Water retention crystals can adsorbe water until to 200x its weight

Roots of Lantana with mycorrhizae

Actions 121 and 124 for water saving

- **121**
  - The new nurseries built have been equipped with drip irrigation systems (water saving up to 25% with respect to overhead irrigation).

- **124**
  - Use of root zone sensor to determine the volumetric water content in the substrate and development of a protocol for irrigation scheduling ET0 based. The main goal was to increase the WUE in all the production chain (more than 295 ha).

The main goal of the project IRRIGO

1) Design, implement and test an automated prototype for estimating water consumption (Kc) of different ornamental species.
2) To verify the effectiveness of some techniques considered innovative in the ornamental nursery sector such as:
   - the deficit irrigation
   - use of water retention gel in the subtrate
   - use of mycorrhizae.
3) To disseminate the knowledge acquired on the supply chain.

The factors driven the transpiration

Solar radiation

Vapour pressure deficit (RH)

Wind

Leaf area index (LAI)

Stomatal resistence (according to the species)

ET_0

Reference evapo-transpiration: ET_0

It's the evapotranspiration of a uniform meadow with *Festuca arundinacea* with an plant height of 10 cm.

$$Kc = \frac{ETc}{ET_0}$$

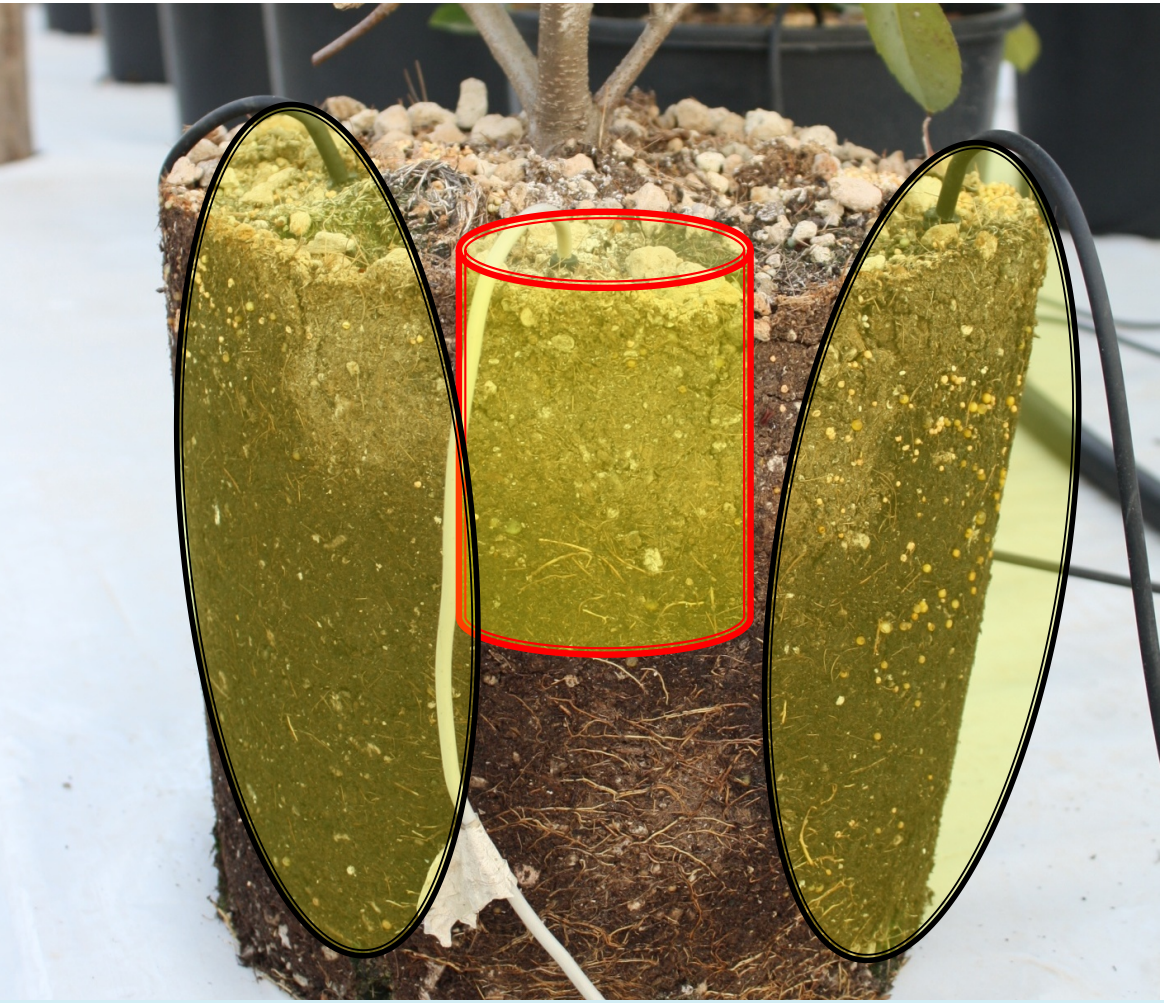
***Kc :* it is independent by the climate!**

$$ETc = ET_0 \times Kc$$

Dielectric sensors

- Accuracy
- Easy to use
-They do not need special maintenance
- Measurement of several variables (eg. temperature and salinity)
- Need a substrate-specific calibration
- Relatively low cost (€ 100-350; € 6,000-8,000 / ha)

The dieletric sensor measurement need a self-calibration for estimating the pot ET



The sensor measures only a small part of the substrate

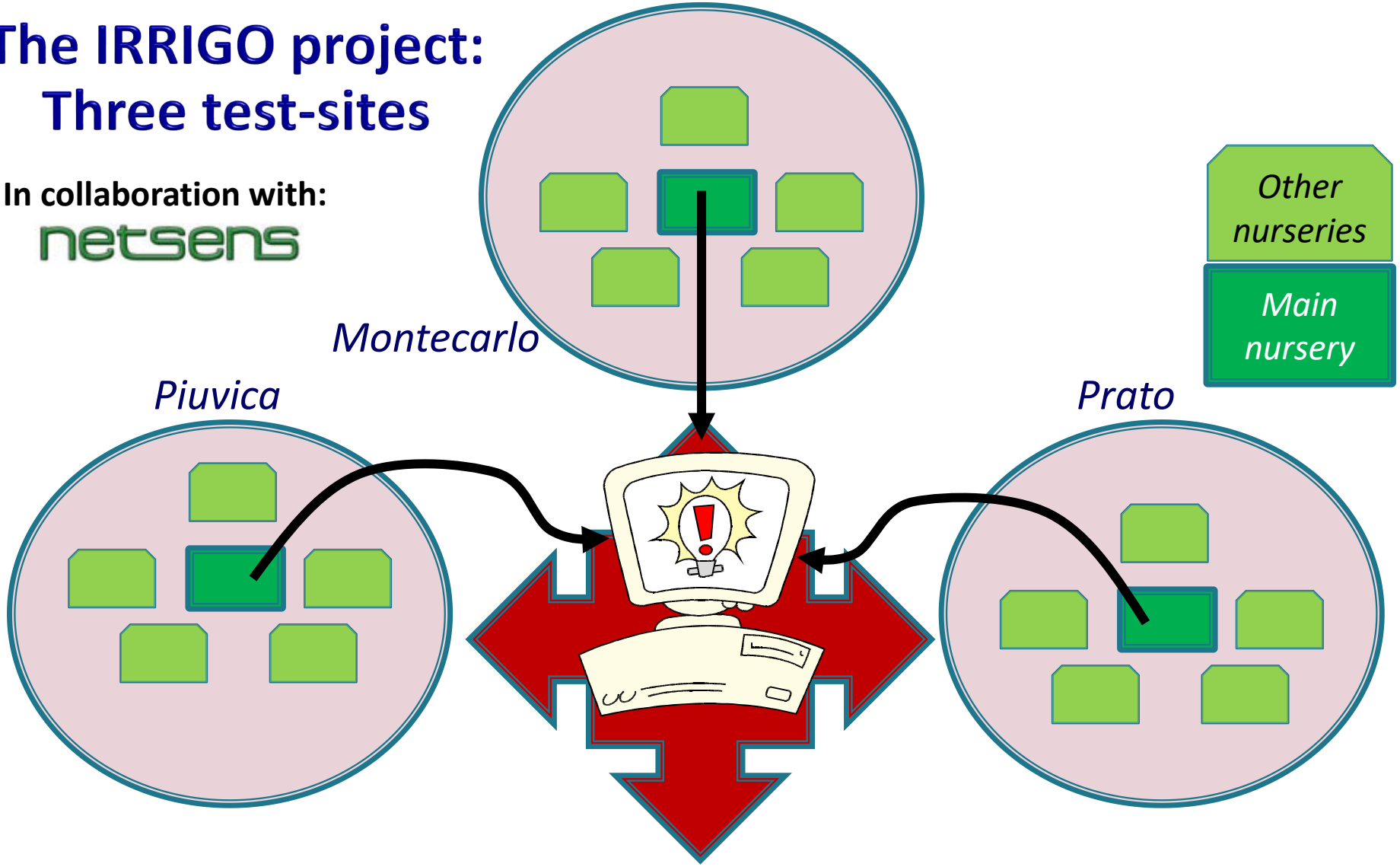
The measurement could be affected by the sensor position

Therefore, it is necessary to calibrate the sensor on-site by a weighing balance

The IRRIGO project: Three test-sites

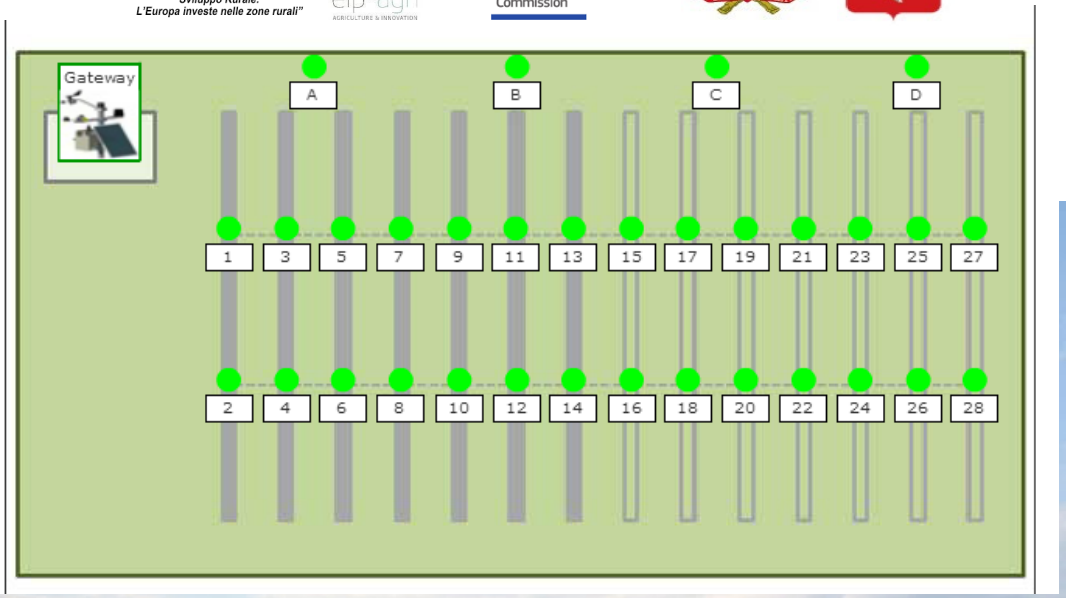
In collaboration with:

netsens

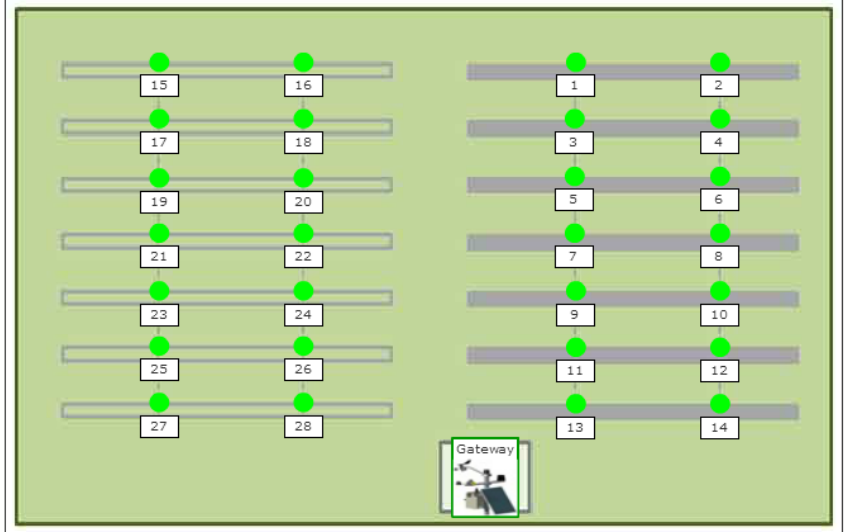


***Info**: Climate, ETP, ETE, Kc, h, d,….*

Nursery IRRIGO 01:
Piuvica- Pistoia:
18-litres pots
Vasi da 10 e 18 litri

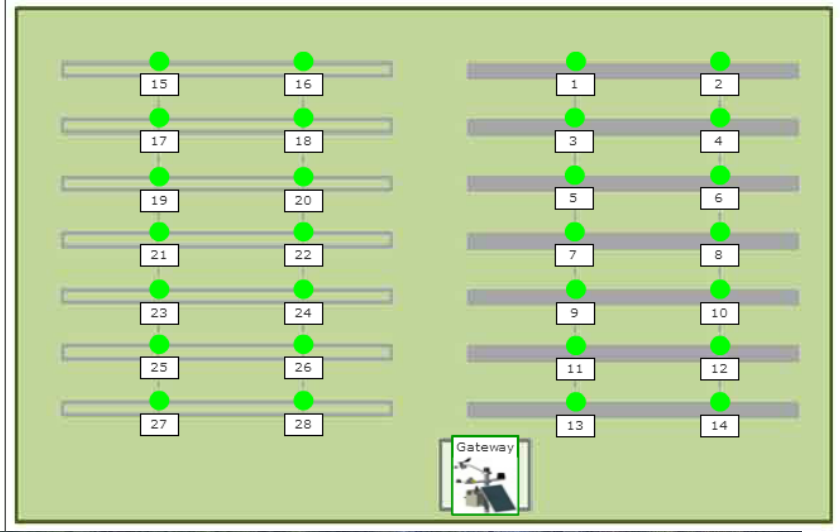


Nursery IRRIGO 02:
Prato "Le Risaie"
70-litres pots



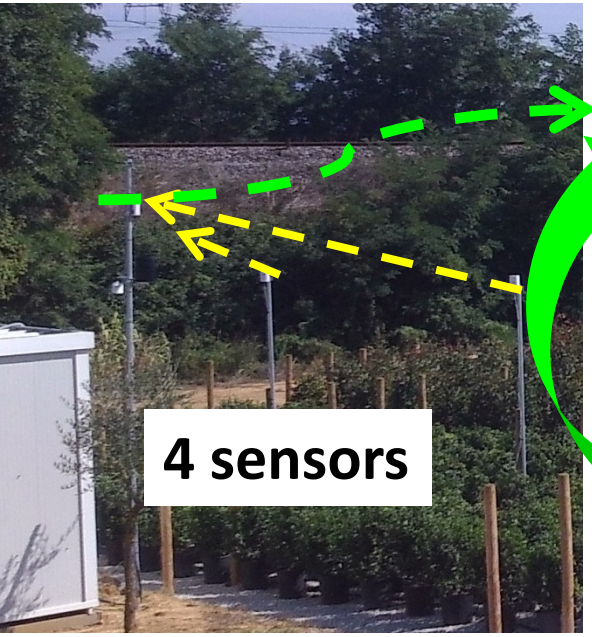
Nursery IRRIGO 03: Montecarlo (LU)

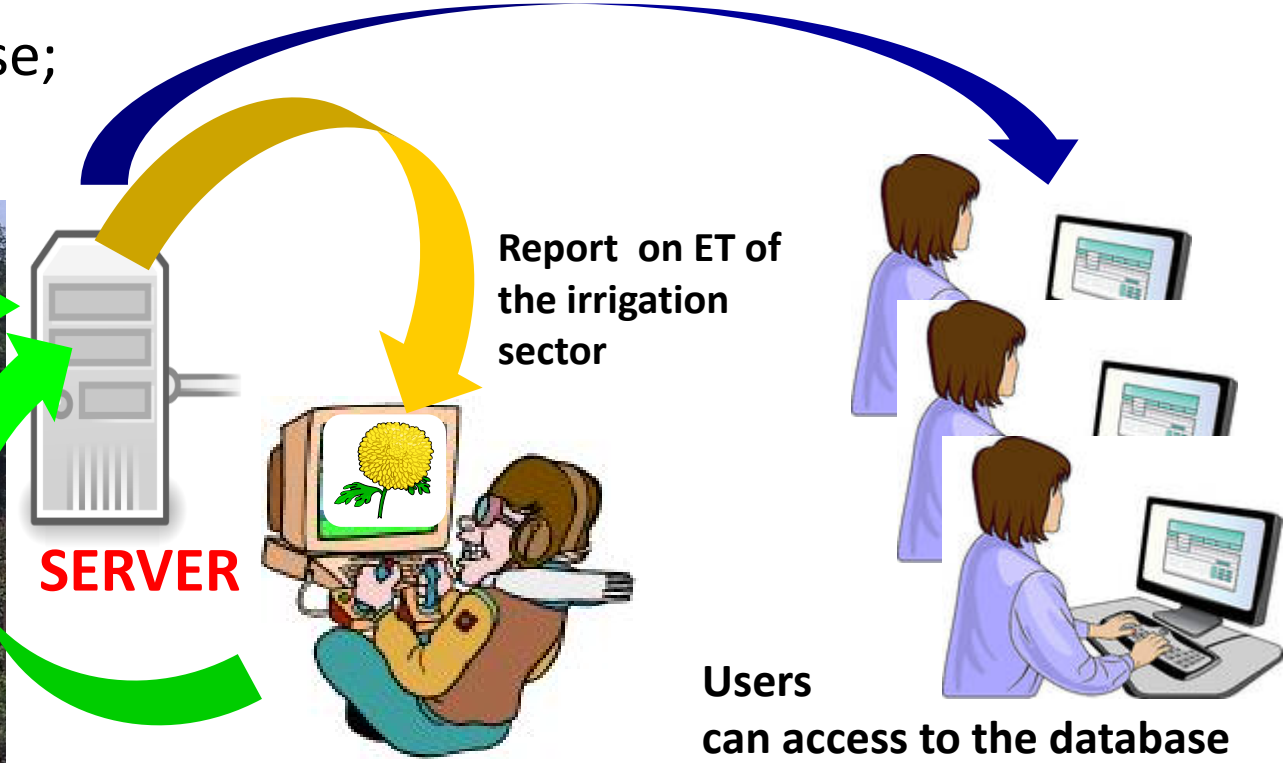
35-litres pot



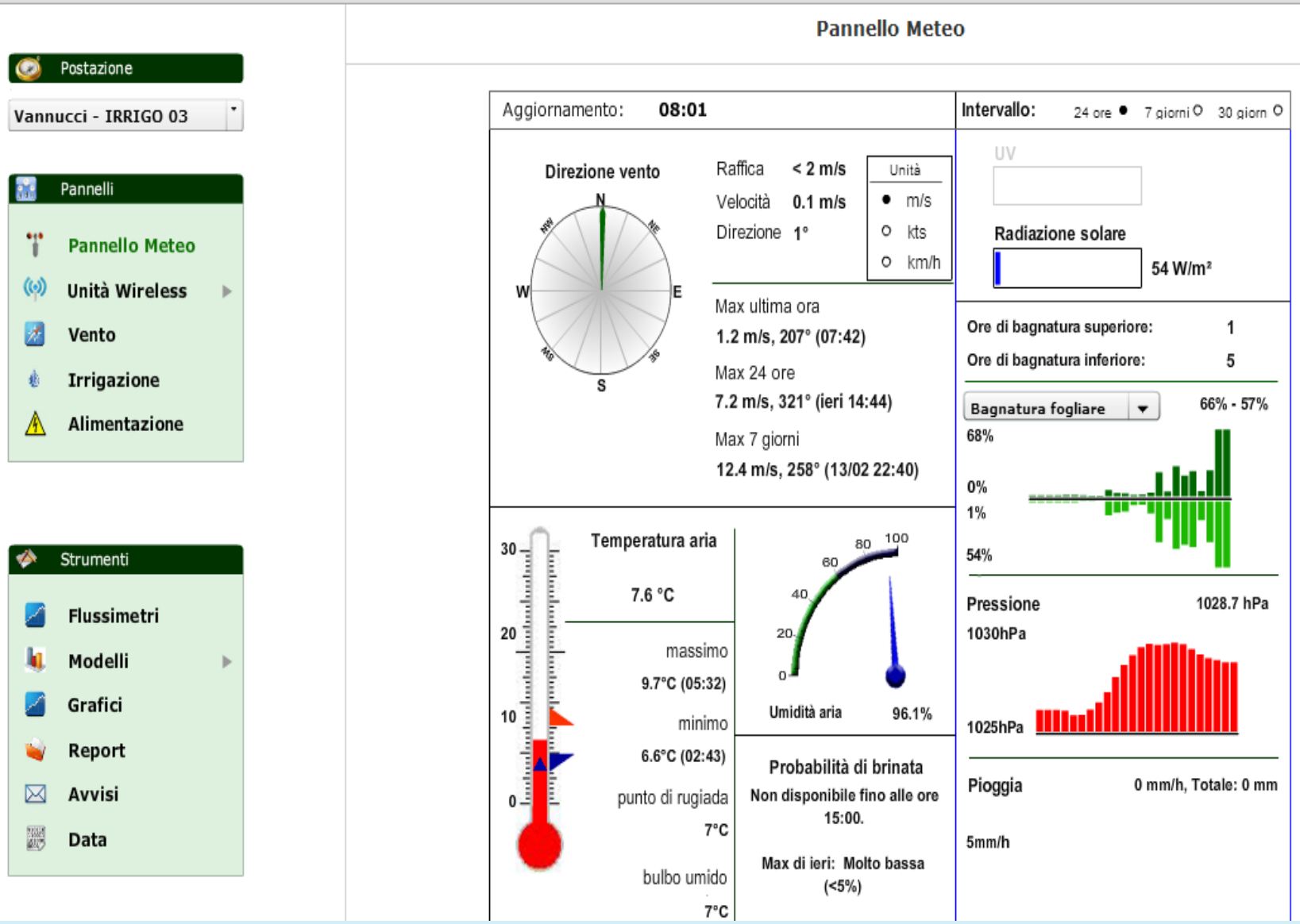
IRRIGO NURSERY AND SOFTWARE

Main goals: to manage irrigation, collect data and produce every 15 days and for each irrigation sector a report: the average Kc values, ETc (L / plant), dimensional measurements was inserted in the IRRIGO database;





Software for the nursery management



Results

- 1 open day (11 ottobre 2013);
- 1 workshop (18 febbraio 2014);
- 1 handbook with the project results;
- 1 web site (www.vannuccipiante.it/cosa-facciamo/ricerca-e-innovazione)

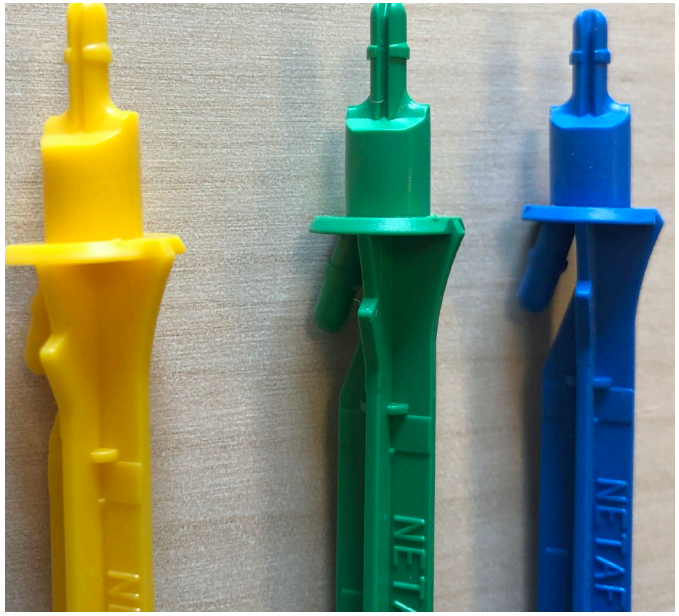
REPORT

Tabella 2. Consumi idrici medi quindicinali (per pianta e per metro quadrato), coefficienti colturali medi delle piante ornamentali coltivate nei tre vivai sperimentali. Per ogni specie sono riportate le dimensioni di altezza totale della pianta (H), del tronco (h), il diametro medio della chioma, il volume del vaso utilizzato e la densità colturale.

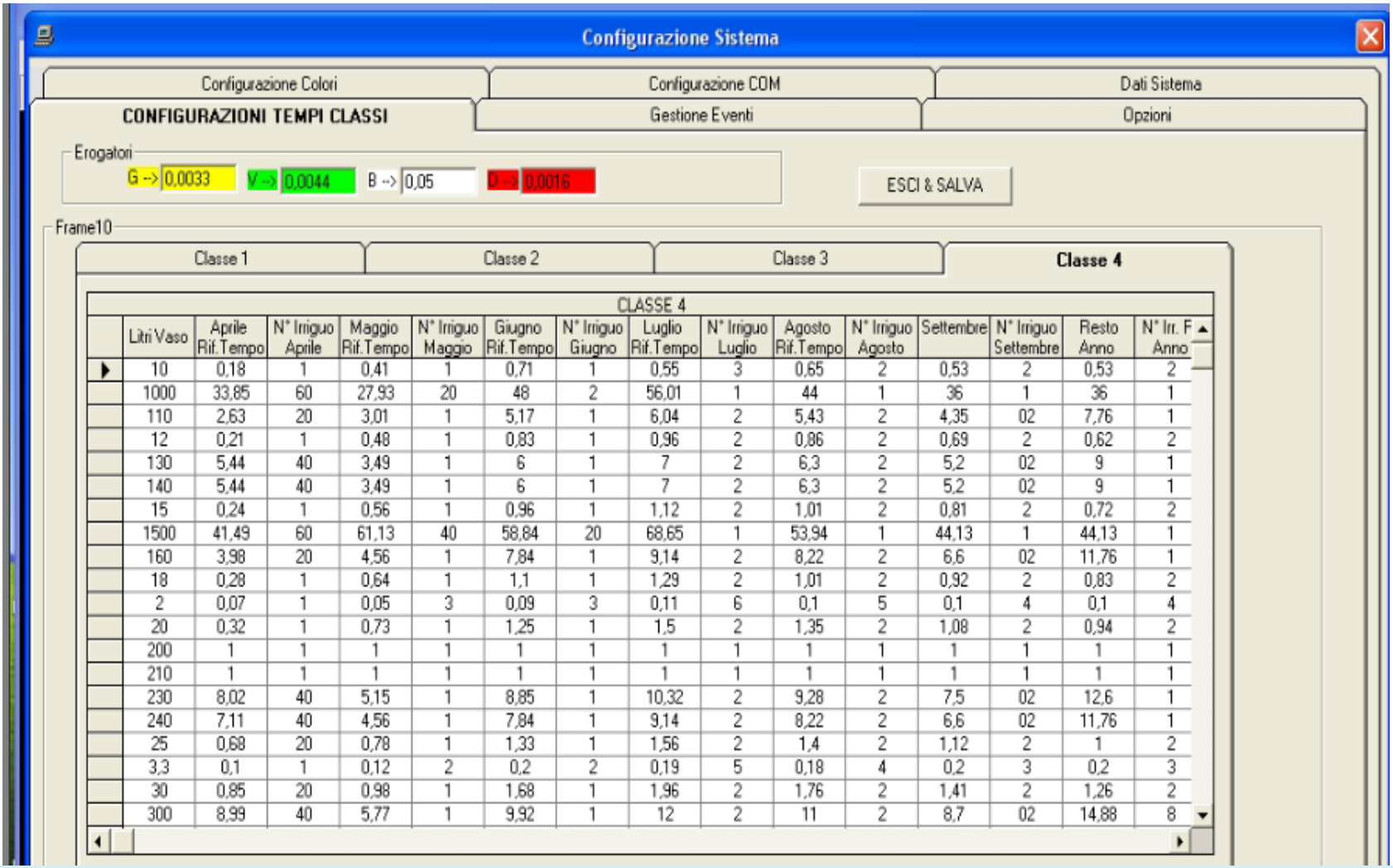
Mese-quindicina			6-I	6-II	7-I	7-II	8-I	8-II	9-I	9-II	10-I	10-II
Settore	**ET0 media**	**mm/giorno**	**4.23**	**3.82**	**5.31**	**5.19**	**5.66**	**4.47**	**3.76**	**2.67**	**1.82**	**1.42**
IRRIGO 01_02	**H pianta**	m	0.51	0.64	0.65	0.68	0.68	0.70	0.84	0.96	0.98	1.09
Vaso 18 L	**h fusto**	m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Specie	**(H-h)**	m	0.51	0.64	0.65	0.68	0.68	0.70	0.84	0.96	0.98	1.09
Photinia x fraseri	**Diametro**	m	0.42	0.55	0.56	0.60	0.60	0.63	0.72	0.90	0.90	1.02
'Red Robin'	**Kc**		**0.19**	**0.21**	**0.24**	**0.28**	**0.35**	**0.42**	**0.48**	**0.55**	**0.62**	**0.68**
Densità (p/m²)	**ETc Pianta**	$L*p.^{-1}*giorno^{-1}$	0.44	0.45	0.70	0.81	1.10	1.05	1.00	0.82	0.63	0.54
1.80	**ETEc**	$L*m^{-2}*giorno^{-1}$	0.79	0.80	1.26	1.45	1.98	1.90	1.80	1.48	1.14	0.97
IRRIGO 01_04	**H pianta**	m	2.38	2.29	2.26	2.26	2.30	2.35	2.39	2.42	2.42	2.38
Vaso 18 L	**h fusto**	m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Specie	**(H-h)**	m	2.38	2.29	2.26	2.26	2.30	2.35	2.39	2.42	2.42	2.38
	Diametro	m	0.64	0.88	1.06	1.17	1.25	1.28	1.30	1.31	1.32	1.35
Bambusa aurea	**Kc**		**0.35**	**0.41**	**0.48**	**0.54**	**0.61**	**0.67**	**0.74**	**0.80**	**0.87**	**0.93**
Densità (p/m²)	**ETc Pianta**	$L*p.^{-1}*giorno^{-1}$	0.74	0.79	1.27	1.41	1.72	1.50	1.39	1.07	0.79	0.66
2.00	**ETEc**	$L*m^{-2}*giorno^{-1}$	1.47	1.58	2.54	2.82	3.44	3.01	2.79	2.14	1.58	1.32

Follow-up of the project “Irrigo”

- Project results allowed to confirm the classification of the crops in 4 groups regarding the water requirements;
- Each group was associated to a different flow rate dripper (different color) in order to supply different quantities of water for the same delivery time.
- It could be reached a water saving of 20-25%



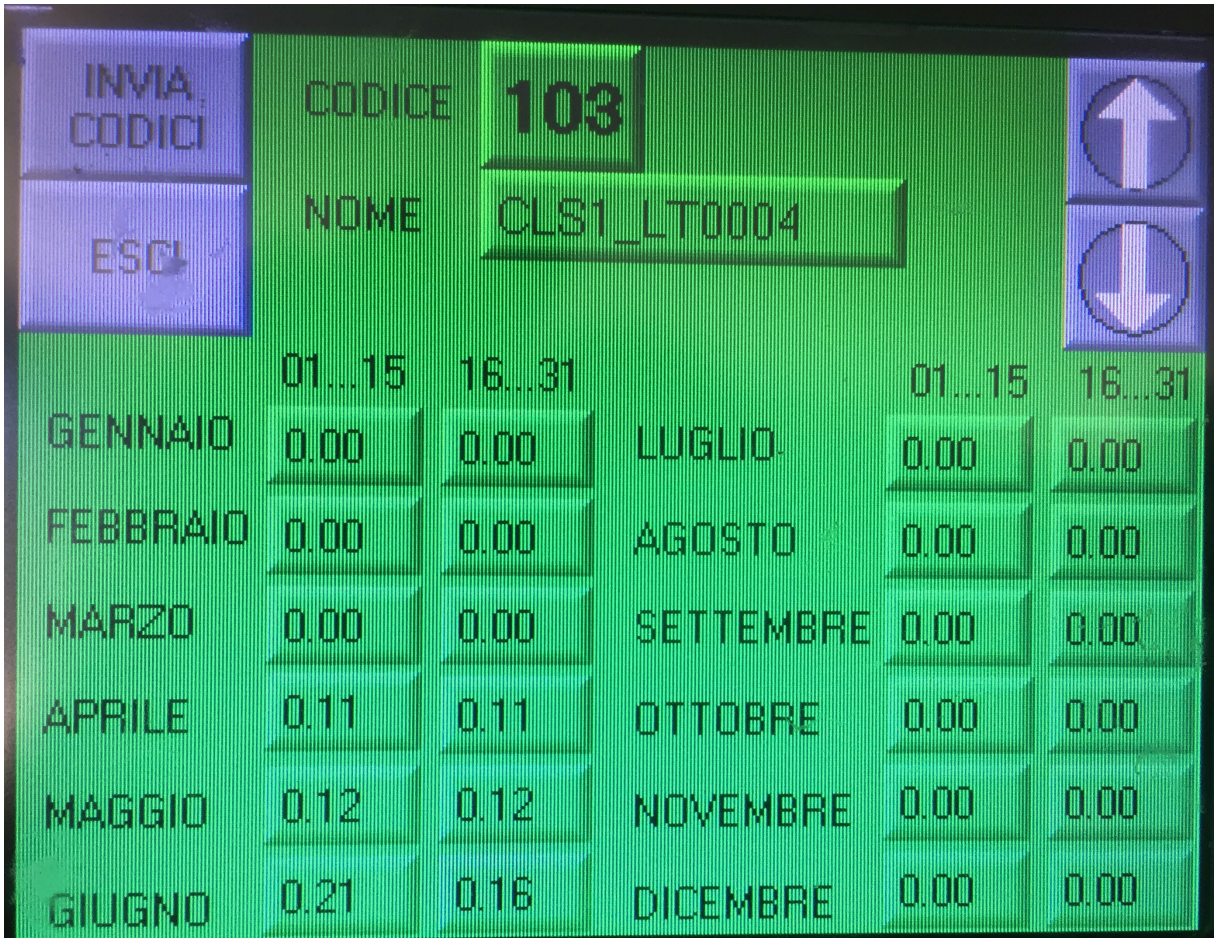
Database for irrigation scheduling



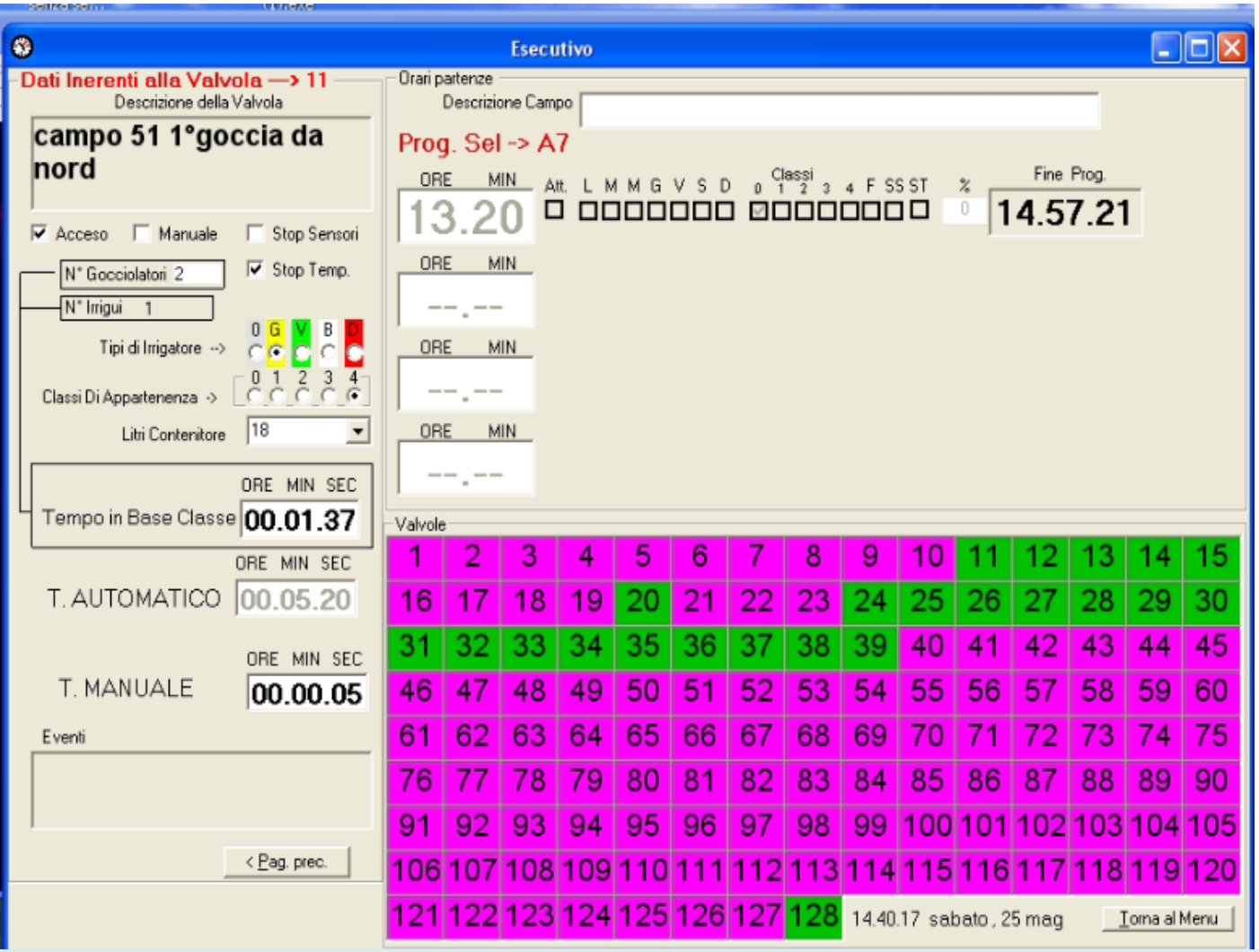
CLASSE 4

Litri Vaso	Aprile Rif.Tempo	N° Irriguo Aprile	Maggio Rif.Tempo	N° Irriguo Maggio	Giugno Rif.Tempo	N° Irriguo Giugno	Luglio Rif.Tempo	N° Irriguo Luglio	Agosto Rif.Tempo	N° Irriguo Agosto	Settembre	N° Irriguo Settembre	Resto Anno	N° Irr. F Anno
10	0,18	1	0,41	1	0,71	1	0,55	3	0,65	2	0,53	2	0,53	2
1000	33,85	60	27,93	20	48	2	56,01	1	44	1	36	1	36	1
110	2,63	20	3,01	1	5,17	1	6,04	2	5,43	2	4,35	02	7,76	1
12	0,21	1	0,48	1	0,83	1	0,96	2	0,86	2	0,69	2	0,62	2
130	5,44	40	3,49	1	6	1	7	2	6,3	2	5,2	02	9	1
140	5,44	40	3,49	1	6	1	7	2	6,3	2	5,2	02	9	1
15	0,24	1	0,56	1	0,96	1	1,12	2	1,01	2	0,81	2	0,72	2
1500	41,49	60	61,13	40	58,84	20	68,65	1	53,94	1	44,13	1	44,13	1
160	3,98	20	4,56	1	7,84	1	9,14	2	8,22	2	6,6	02	11,76	1
18	0,28	1	0,64	1	1,1	1	1,29	2	1,01	2	0,92	2	0,83	2
2	0,07	1	0,05	3	0,09	3	0,11	6	0,1	5	0,1	4	0,1	4
20	0,32	1	0,73	1	1,25	1	1,5	2	1,35	2	1,08	2	0,94	2
200	1	1	1	1	1	1	1	1	1	1	1	1	1	1
210	1	1	1	1	1	1	1	1	1	1	1	1	1	1
230	8,02	40	5,15	1	8,85	1	10,32	2	9,28	2	7,5	02	12,6	1
240	7,11	40	4,56	1	7,84	1	9,14	2	8,22	2	6,6	02	11,76	1
25	0,68	20	0,78	1	1,33	1	1,56	2	1,4	2	1,12	2	1	2
3,3	0,1	1	0,12	2	0,2	2	0,19	5	0,18	4	0,2	3	0,2	3
30	0,85	20	0,98	1	1,68	1	1,96	2	1,76	2	1,41	2	1,26	2
300	8,99	40	5,77	1	9,92	1	12	2	11	2	8,7	02	14,88	8

Database PLC Classe 1 container of 4-litre



Example how to set an irrigation sector



May; pot of 18 L;

Nursery of Piuvica: irrigation based on dielectric sensors

Conclusions

(http://www.vannuccipiante.it/cosa-facciamo/ricerca-e-innovazione);

- Kc were calculated for more of 30 different combination of species, shape and size;
- The Kc estimation method with dielectric sensors has been validated, but still requires frequent calibrations (time consuming);
- It was possible to increase the knowledge along the supply chain for increase the water use efficiency;
- It is necessary to introduce new hardware in order to implement the irrigation scheduling based on ET_0;


Thank you for your attention