

Re-usable surface drip irrigation: a solution for corn in France

Bertrand PINEL, Terrena Innovation, bpinel@terrena.fr ; Nicolas LELABOURIER, Ného, nlelabourier@neho.fr ; Sophie GIRONDE, Terrena Innovation, sgironde@terrena.fr - FRANCE

Do drip irrigation systems can be economic and technical viable answers for corn irrigation ?

Ecologically Intensive Farming, also called Sustainable Crop Production Intensification (SCPI) by FAO, could be one of the current paradigm of world agriculture, aiming at "producing more and better with less inputs", and therefore less irrigation water. Moreover, farmers have to find solutions for climate change and drip irrigation could be an answer (Payero et al., 2014).

Drip irrigation is considered as a solution that uses less water than overhead aspersion systems. Irrigation efficiency of subsurface drip irrigation (SDI) is reported to be reaching 95 % while pivot irrigation system achieved 85% (Payero et al., 2005). Switching from aspersion irrigation systems (AIS) to SDI would allow to 17% water saving (Mailhol et al., 2013). But drip irrigation has several disadvantages compared with AIS, the more relevant is its initial cost that is higher than overhead systems.

In west part of France, TERRENA cooperative experimented three kinds of drip irrigation systems: annual surface tapes (AST), sub-surface drip irrigation (SDI) and re-usable surface drip irrigation (RDI), in order to evaluate their logistical feasibility, technical use and economic viability. This case study is specifically related to farming system of the west part of France. In this region, the AIS is concerned by gun sprinklers (85%), center pivot (10%) and integral micro sprinklers (5%).

MATERIAL AND METHOD

For six years, twenty one experiments (Table 1) were conducted in large trail plots with farmers who cultivated sprinkler-irrigated corn. The trial conditions were closed to real-farm conditions (soil, machinery, pumps, water quality, workforce skill...).

	AST	SDI	RDI
2009	3		
2010	3		
2011	2	2	
2012	2	2	
2013		2	1
2014			4

Table 1. Number of trials led by Terrena each year for every system.

Each system (Figure 1) was compared in the same corn field to AS on technical and economic concerns.

These willing farmers were specifically qualified as "Forward Looking Farmers" (Sentinelles de la Terre®) for their commitment in experimentation. Every trial was contracted by a bipartite commitment between the cooperative and farmers.

In order to succeed in elaborating a commercial solution, not only farmers but also irrigation experts were involved in the experimentations, in particular NSA company (local irrigation technical and commercial dealer) and Naan Dan Jain company (worldwide drip lines constructor).



Figure 1. Tested irrigation equipment.

A : Annual surface tape ; B : Subsurface drip irrigation ; C : Re-usable surface dripper. Pictures 1 and 2 respectively represent the machinery used for installation and/or removal, and drip lines.

CONCLUSION

- Non re-usable surface and subsurface drip irrigation present more disadvantages than benefits for corn irrigation in France compare to classical sprinkler irrigation. These commercial solutions will remain rare.
- Thanks to several recent innovations (new high-quality drip lines, new drippers, new machinery to unroll and rewind drip lines...), re-usable surface drip lines system is considered as the technical and economic efficient solution for corn irrigation.
- In 2014, Terrena decided to launch a commercial solution for corn drip irrigation. It is called AquaTempo® and is sold by Ného, a Terrena's daughter company.
- As drip irrigation does not suit all field situations, AquaTempo® needs to include a holistic approach, including an initial diagnosis: water quality; shape, length and slope of the field; specifications for the pump and the pipes (Figure 3).
- To be profitable, according to our economic simulations, the drip-lines have to be re-used at least 8 years: this brought us to include advice in the holistic solution :
 - Checking the water pressure at the beginning of the season,
 - Delivering fertigation advice,
 - Cleaning the lines before rewinding with nitrogen at the end of the campaign,
 - Storing the reels with care during winter, in particular: protection against rodents,
 - ...

RESULTS

Gross margin ratio of experimented dripper systems on aspersion irrigation system

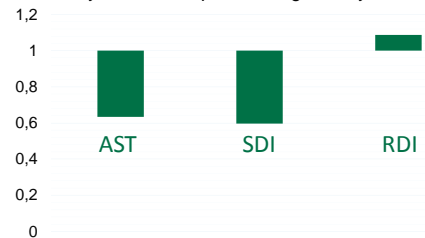


Figure 2. Gross margin (€/Ha) ratio of experimented dripper systems on aspersion irrigation systems

After four years of trials, AST appeared to be a too expensive system (over 200-400 euros per ha more with AST than with AIS) and with the extra problem of the tapes recycling. AST is interesting for short high-value crops (vegetables...). These results were integrated in the study led by Arvalis, the French crop research institute (Pagliarino, 2012).

SDI presented a very high initial investment (€ 4000-5000 per ha) that could be amortized during the following years. But, unlike with the perennial crops (tree, vineyard...), many problems appeared with corn production, in particular during the harvest: bad soil and climate conditions have led to seriously damage the drip lines. This required additional heavy costs to repair them.

In 2013, Terrena discovered and adapted a new Spanish machinery created by PaniAgua company (Figure 1, picture C1). It allows to install (8 ha per day) and to rewind (10 ha per day) the drip lines. This innovation has opened up opportunities for the development of RDI. Including the price of the machinery (€ 10000) and the high quality drip lines (Amnon Drip produced by Naan Dan Jain, 6700 meters per ha x €0,3 per meter), our studies showed that if the drip lines could be re-used at least 8 times, then RDI is more profitable than AIS (Figure 2). To obtain this economic advantage, we also have to include reduction of fertilizer and herbicide use (respectively 30 kg N per ha ; €20 per ha), pump energy saving (€5 per ha) and yield increase (+10%, considering the better water distribution on the field margin).

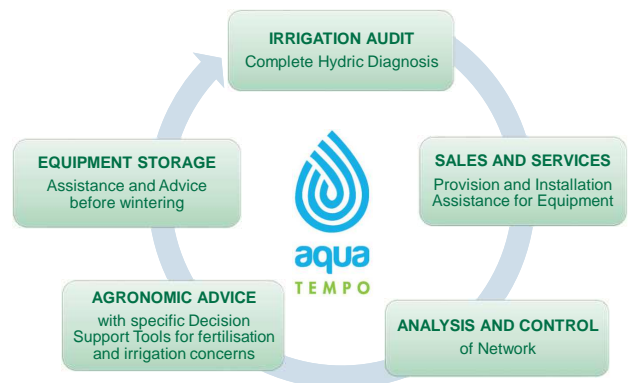


Figure 3. Scheme of AquaTempo® holistic approach.

REFERENCES :

- MAILHOL, J. C., RUELLE, P., DEJEAN, C., & ROSIQUE, P. (2013). Focus—Le goutte à goutte enterré: une solution innovante pour irriguer sous conditions restrictives en eau.
- PAGLIARINO, V., DEUMIER, J.-M., ESPAGNOL, G., LACROIX, B., MARSAC, S., BERRODIER, M. (2012). L'irrigation par goutte-à-goutte des grandes cultures en France : pratiques, axes de recherche et perspectives.
- PAYERO, J., DAVIS, R., & KHALILIAN, A. (2014). Demonstrating subsurface drip irrigation as a climate adaptation strategy for sustainable crop production in South Carolina.
- PAYERO, J., YONTS, C. D., & IRMAK, S. (2005). EC05-776 Advantages and Disadvantages of Subsurface Drip Irrigation.