Demonstration plot Final report

Khirbet Kanafar center – Bekaa - Lebanon

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1. OBJECTIVES:

- Comparison of two different irrigation methods (Sprinklers and Drippers) on the same crop.
- Optimize the use of water irrigation through adequate irrigation practices and scheduling.
- Reduce water losses and increase the efficiency of the irrigation network.

2. TIMEFRAME:

- Installation: June 2007.
- Field monitoring: June – November 2007.
- Visits of farmers: September – October 2007.
- Data elaboration: December 2007.
- Dissemination of results: January – February 2008.

3. BASIC INFORMATION:

Demo-plot was conducted during summer 2007, on a total plot area of 30 du (3ha) at the Litani extension and service center. This center is located in Khirbet kanafar (lat 33°38'22.83"N, long 35°46'17.97"E and altitude 880 m.a.s.l), Bekaa valley, Lebanon, in a rural area characterized by intensive agricultural production.

Cultivated crops were potato and forage corn. Potato was chosen because it’s a major crop in Bekaa region, whereas for corn the growth uniformity can be visible to the naked eye.

Potato was irrigated with drip and sprinklers (2 different spacing), while Corn was irrigated with drip and gun.

Sand media filter and disc filter were used for drip irrigation only.

Water was supplied by the Litani River Authority (LRA) hydrants.

Cultivated areas per crop and per irrigation system were as follow:

- 6 dunums of potato irrigated with sprinklers (18 m x 18 m spacing).
- 6 dunums of potato irrigated with sprinklers (18m x 12 m spacing).
- 6 dunums of potato irrigated with T-Tape.
- 6 dunums of corn irrigated with GR.
- 6 dunums of corn irrigated with a traveler gun.

Potato was planted (10 plants/m^2) on the 21/07/07 and irrigation started 2 days later and 5 days later for the 18m x 12m sprinkler distance and the 18m x 18m sprinkler distance, respectively. Potato irrigated with T-tape was planted (10 plants/m^2) on the 24/07/07 and irrigation started 2 days later.

Corn was sown (10 plants/m^2) on the 24/07/07 and irrigation started 2 days later for both drip and gun irrigation systems.

Emergence occurred on the 30/07/07 and on the 9/08/07 for corn and potato, respectively.

3.1. Soil

Soil analysis was conducted in the laboratories of the Lebanese Agricultural Research Institute (LARI) and the results were as follow:

	Sample 1	Sample 2
Coarse Sand (%)	16	22
Fine Sand (%)	32	30
Coarse Silt (%)	12	8
Fine Silt (%)	8	8
Clay (%)	38	32
O.M. (%)	1.2	1.2
pH	7.4	7.3
EC	0.11	0.11
Total Calcareous (%)	6	7
Active Calcareous (%)	2	2
Available Nitrogen (Kg/Ha)	31	32
Phosphorus (Olsen's method) (ppm)	17	12
Available Potassium (ppm)	140	130
Available Sodium (ppm)	100	80
Exchangeable Magnesium (ppm)	194	148
Exchangeable Calcium (ppm)	4480	3520
Available Iron (ppm)	3	3

3.2. Fertilzation

The quantities of fertilizers applied to the demo plot were decided after many literature reviews taking into consideration the soil content. The applied quantities were as follow:

Potato fertilization:

	N (Kg/Ha)	P (Kg/Ha)	K (Kg/Ha)
Before Planting	112	144	112
Week 5	46.5	70	10
Week 7	26.5	10	10
Week 9	10	10	60
Week 12	10	10	85
Total	205	244	277

Corn fertilization:

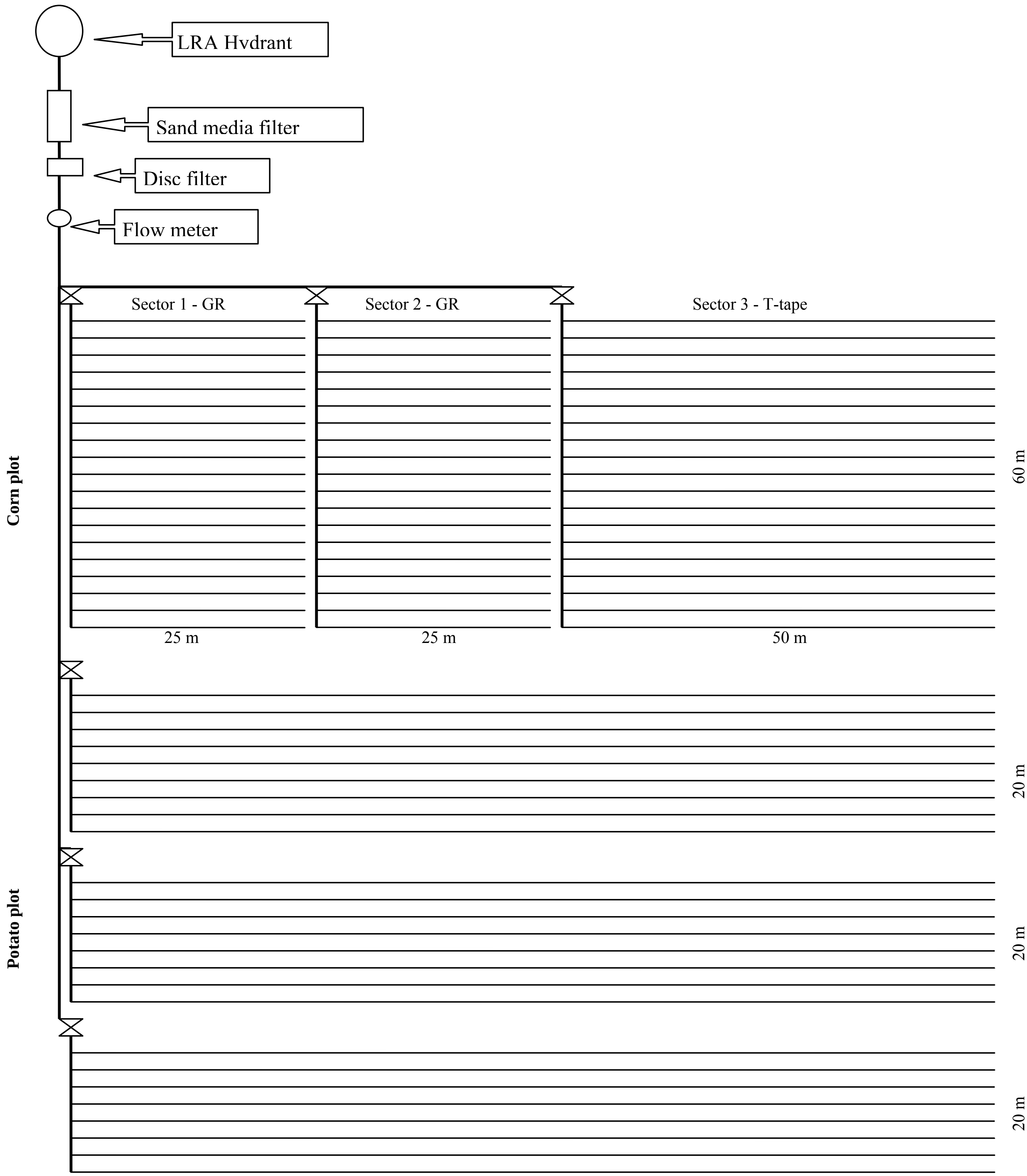
	N (Kg/Ha)	P (Kg/Ha)	K (Kg/Ha)
Before Planting	42	54	42
Week 5	143	92	20
Week 7	43	10	60
Week 9	10	10	35
Total	238	166	157

4. MATERIALS:

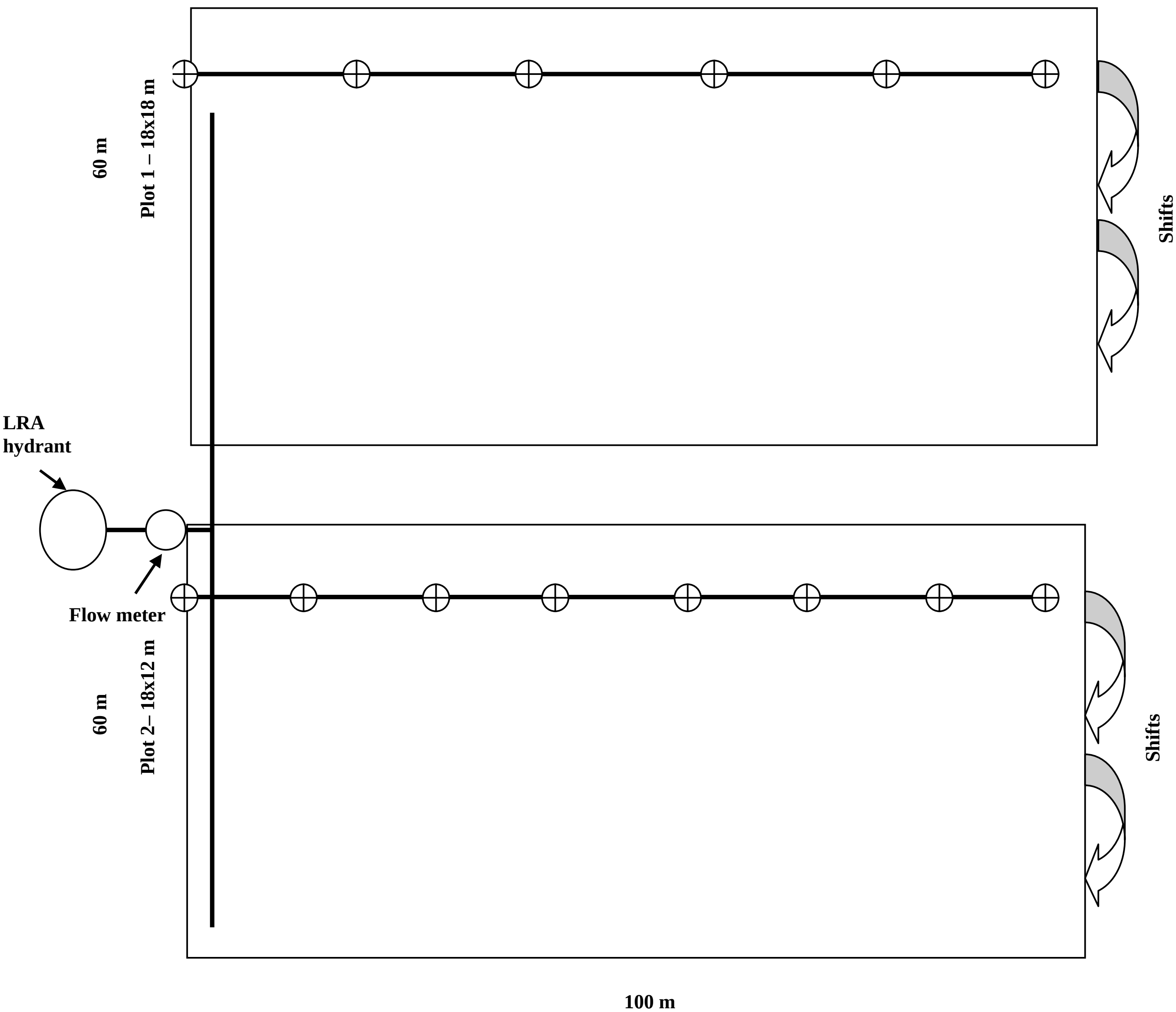
- Kit of GR: 16 mm diameter, 40 cm spacing and 4 l/h discharge.
- Kit of T-Tape: 16 mm diameter, 20 cm spacing and 1 l/h discharge.
- Kit of Sprinklers: 3 inches pipe diameter and 1.5 m^3/h/sprinkler.
- Traveler Gun: 63 mm pipe diameter and 20 m^3/h discharge.
- Booster Pump.
- Three water meters.
- Sand media filter.
- Disc filter.
- Weather station of IrWa - Khirbet Kanafar Center.

The layouts of the different demo-plots are shown below.

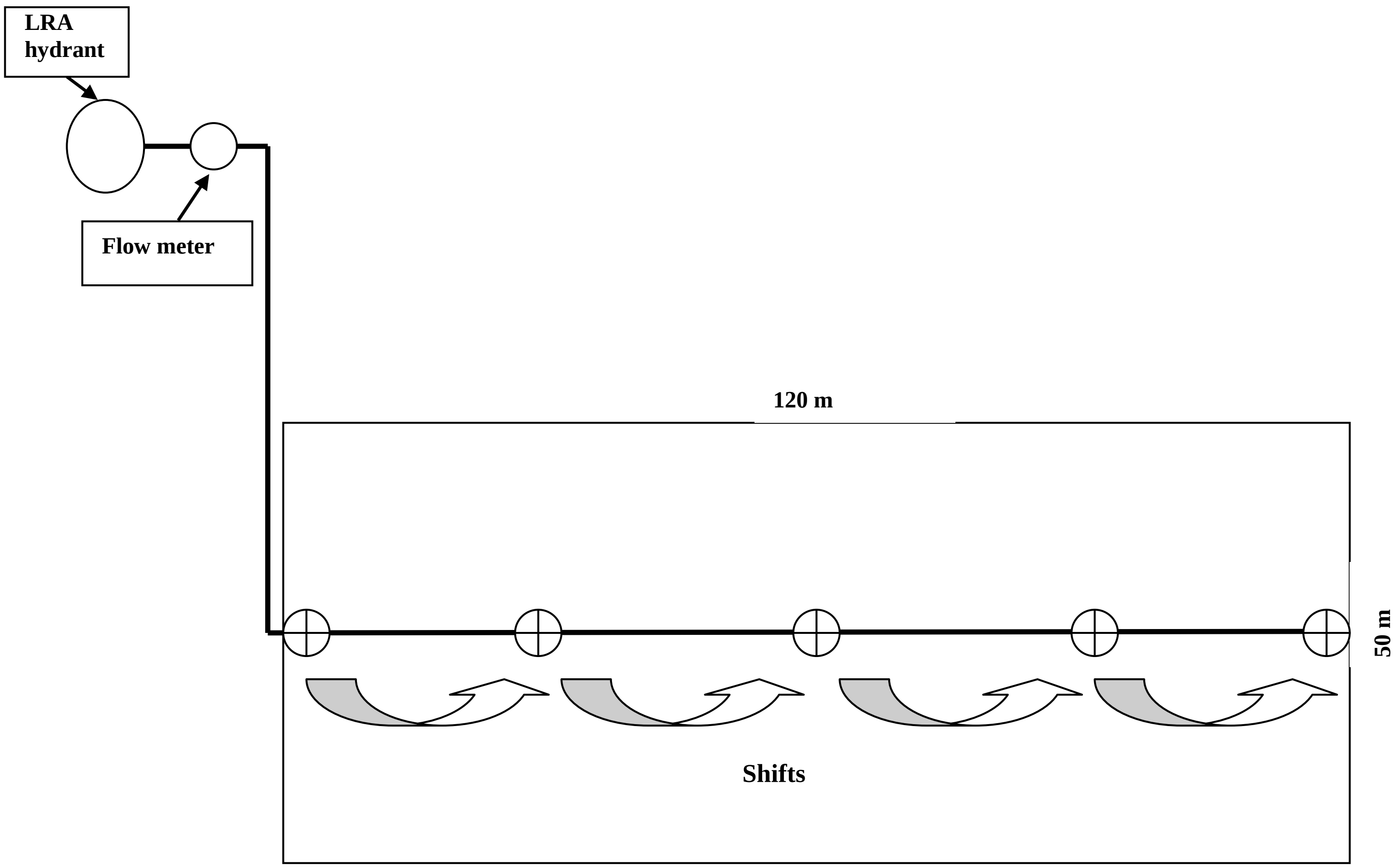
Layout of the Drip plots:



Layout of the potato plots irrigated with sprinklers:



Layout of the corn plot irrigated with gun:



5. Production cost

The production costs of the potato and corn irrigated with the different systems are shown in the tables below.

CROP: POTATO **Irrigated with drip**

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE (LBP)	PRICE Per Dunum	TOTAL PRICE (LBP)
Mechanization					
- Soil Preparation		2.00	12,000	24,000	192,000
- Rotary		1.00	7,500	7,500	60,000
- Planting		1.00	12,000	12,000	96,000
Seeds	Ton	0.22	2,250,000	499,500	2,997,000
Fertilizer					
- NPK(14-18-14)	Kg	80.00	600	48,000	316,800
- DAP	Kg	12.50	600	7,500	49,500
- NPK(20-20-20)	Kg	20.00	1,920	38,400	253,440
- Ammonium nitrate	Kg	10.00	488	4,880	32,208
- Potassium sulfate	Kg	25.00	990	24,750	163,350
Pesticides					
- Insecticides				30,000	180,000
- Fungicides				15,000	90,000
- Herbicides				9,000	54,000
Irrigation Water					
- Drip system depreciated on 5 years	years	5.00	543,000	108,600	651,600
- Drip system depreciated on 15 years	years	15.00	300,000	20,000	120,000
Labors					
- Labors for irrigation	labor*day	3.66	15,000	54,833	329,000
- Soil Preparation	labor*day	1.00	15,000	15,000	90,000
- Weeding	labor*day	5.00	8,000	40,000	240,000
- Harvesting	labor*day	2.50	8,000	20,000	120,000
PRODUCTION COST				**978,963**	**6,034,898**

CROP: POTATO **Irrigated with sprinklers**

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE (LBP)	PRICE Per Dunum	TOTAL PRICE (LBP)
Mechanization					
- Soil Preparation		2	12,000	24,000	360,000
- Rotary		1	7,500	7,500	112,500
- Planting		1	12,000	12,000	180,000
- Harvesting					
Seeds	Ton	0.222	2,250,000	499,500	5,994,000
Fertilizer					
- NPK(14-18-14)	Kg	80	600	48,000	648,000
- DAP	Kg	12.5	600	7,500	101,250
- NPK(20-20-20)	Kg	20	1,920	38,400	518,400
- Ammonium nitrate	Kg	10	488	4,880	65,880
- Potassium sulfate	Kg	25	990	24,750	334,125
Pesticides					
- Insecticides				30,000	360,000
- Fungicides				15,000	180,000
- Herbicides				9,000	108,000
Irrigation Water					
- Sprinklers depreciated on 15 years	years	15	578,550	38,570	462,840
Labors					
- Labors for irrigation	labor*day	4.62	15,000	69,333	832,000
- Soil Preparation	labor*day	1	15,000	15,000	180,000
- Weeding	labor*day	5	8,000	40,000	480,000
- Harvesting	labor*day	2.5	8,000	20,000	240,000
PRODUCTION COST				**903,433**	**11,156,995**

CROP: CORN FORAGE **Irrigated with Drip**

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE (LBP)	PRICE Per Dunum	TOTAL PRICE (LBP)
Mechanization					
- Soil Preparation		1	24,000	24,000	192,000
- Rotary		1	7,500	7,500	60,000
- Planting		1	12,000	12,000	96,000
- Harvesting		1			
Seeds	Seed	10000	2.34	23,400	140,400
Fertilizer					
- NPK(14-18-14)	Kg	30	600	18,000	118,800
- DAP	Kg	15	600	9,000	59,400
- NPK(20-20-20)	Kg	20	1,920	38,400	253,440
- Ammonium nitrate	Kg	50	488	24,400	161,040
- Potassium sulfate	Kg	15	990	14,850	98,010
Pesticides					
- Insecticides				15,000	90,000
- Fungicides				7,500	45,000
Irrigation Water					
- Drip system depreciated on 5 years	years	5	313,000	62,600	375,600
- Drip system depreciated on 15 years	years	15	300,000	20,000	120,000
Labors					
- Labors for irrigation	labor*day	3.43	15,000	51,500	309,000
- Soil Preparation	labor*day	1	15,000	15,000	90,000
- Weeding	labor*day	1	8,000	8,000	48,000
PRODUCTION COST				**351,150**	**2,256,690**

CROP: CORN FORAGE **Irrigated with gun**

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE (LBP)	PRICE Per Dunum	TOTAL PRICE (LBP)
Mechanization					
- Soil Preparation		1	24,000	24,000	192,000
- Rotary		1	7,500	7,500	60,000
- Planting		1	12,000	12,000	96,000
- Harvesting		1			
Seeds	Seed	10000	2.34	23,400	140,400
Fertilizers					
- NPK(14-18-14)	Kg	30	600	18,000	118,800
- DAP	Kg	15	600	9,000	59,400
- NPK(20-20-20)	Kg	20	1,920	38,400	253,440
- Ammonium nitrate	Kg	50	488	24,400	161,040
- Potassium sulfate	Kg	15	990	14,850	98,010
Pesticides					
- Insecticides				15,000	90,000
- Fungicides				7,500	45,000
Irrigation Water					
- Gun depreciated on 15 years	years	15	1,150,000	76,667	460,000
Labors					
- Labors for irrigation	labor*day	5.16	15,000	77,333	464,000
- Soil Preparation	labor*day	1	15,000	15,000	90,000
- Weeding	labor*day	1	8,000	8,000	48,000
PRODUCTION COST				**371,050**	**2,376,090**

5. METHODOLOGY:

5.1. Irrigation scheduling:

To compute the net irrigation requirement and schedule irrigation we consider the soil related parameters, the crop related parameters, the irrigation system related parameters and the climatic parameters.

a) Soil related parameters:

- Field capacity (FC) in % of weight: 22.6%
- Permanent wilting point (PWP) in % of weight: 13.6%
- Bulk density (ρ): 1.35 Kg/m^3
- Soil depth (d): soil depth for potato and corn varies between 0.2m and 0.6m according to the development stage.
- Total Available Water for d soil depth (TAW):

  $TAW = (FC-PWP) \times \rho \times d \times 10$
- Management Allowed Deficit (MAD) at 40% of TAW
- Soil Infiltration Rate: 12 mm/hr

P.S: FC, PWP and bulk density are estimated upon clay percentage

b) Crop related parameters

- Cultivated crop.
- Growth stage.
- Daily crop evapotranspiration (Etc) in mm/day.

c) Irrigation system parameters

- Irrigated area;
- Number of irrigated plots;
- Size of single irrigated plot;
- Spacing;
- Number of sprinklers or drippers per plot;
- Single sprinkler and dripper discharge (l/h or m^3/h).

d) Climatic parameters

Climatic parameters are provided by the weather station (Figure below) installed in the LRA center in khirbet Kanafar-Lebanon (860m a.s.l). This station stores on hourly basis the following parameters: Air temperature, relative humidity, rainfall, wind speed, wind direction, solar radiation, barometric pressure and soil temperature. These data are used to calculate daily ET_o using the software provided with the weather station.

Wheather station of the LRA center in Kherbet Kanafar-Lebanon

5.2. <u>Computations</u>:

The parameters necessary to be computed are the following:

- Net Irrigation Requirement (NIR) at 40% of TAW
- Gross Irrigation Requirement (GIR)
- Irrigation duration

5.3. <u>Data collection</u>:

5.3.1. Actions and measurements:

- The water volume (m^3) given at each irrigation application, which is measured by the water meter of each plot.
- The filtration procedure through the control of the manometers applied on each filter.
- Fertilizers applications.
- Weed control.
- Disease control.
- Control of the system operation: clogging, gaskets and nozzles of sprinklers and leakage.

5.3.2. Measurements at harvest:

At harvest (31/10/07), potato yield was analysed on 5 samples ($1m^2$ each) taken from each plot, in particular:

- Yield fresh and dry weight.
- WUE (kg/m^3) = yield dry weight (kg/m^2) / water consumption (m^3/m^2)

At harvest (5/11/07), corn development and yield were analysed on 6 samples ($1m^2$ each) taken from each plot, in particular:

- Plant height (cm)
- Ear number
- Dry straw weight (kg/m^2)
- Ear dry weight (kg/m^2)
- Total fresh and dry weight (kg/m^2)
- Harvest Index (HI) = ear dry weight / total dry weight
- WUE (kg/m^3) = yield dry weight (kg/m^2) / water consumption (m^3/m^2)

For dry weight, above ground yield of corn and below ground yield of potato are kept in an oven at 75º C for 72 hours.

6. Results

6.1. Demo-plot visits

77 farmers visited the demo-plot on the 25, 26, 30 and 31/10/2007. A hand out was distributed to farmers with the program and the organization of the visit (see Appendix A).
A registration list with farmers' names, addresses and contact number was also prepared for any eventual meeting. Farmers present filled an evaluation sheet, where they showed to be highly interested in the visits topic. They asked for more demo-plots on new irrigation techniques and new crops, and half of them accepted to install a demo-plot on their own farm.
Photos taken during the different visits are shown bellow:

Photos of the several visits to the demo-plot

6.2. ETo, ETc and gross irrigation rate (GIR)

6.2.1. Potato

Reference evapotranspiration (ETo) as calculated by the program (Penman monteith equation) delivered with the meteorological station, showed high values during almost all the late potato growing season (hot summer). Values varied between 4 and 6 mm (Figure 1).

Seasonal crop evapotranspiration (Etc) of potato reached 304mm for a growing period of 93 days from sowing until harvest.

Average Etc value was relatively low at the beginning of the season until 6 nodes stage, where it reached 3.7 mm/day (Figure 1). Then, ETc increased gradually and rapidly to reach higher values at full cover. The highest values were recorded at tuber bulking and they reached approximately 5mm.

Seasonal gross irrigation rates were 256mm and 424mm for the drip irrigation and the sprinkler irrigation, respectively. Hence water consumption considering the irrigation system parameters was 40% lower under drip irrigation system.

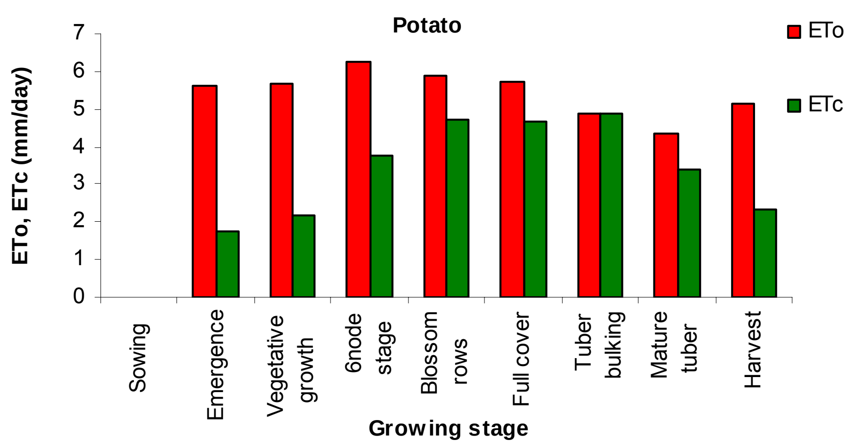


Figure 1. Average crop evapotranspiration (ETc) and reference evapotranspiration values observed during potato growing season.

6.2.2. Corn

Reference evapotranspiration during corn growing season has values similar to the ones discussed in the previous paragraph on potato.

Seasonal crop evapotranspiration for corn reached 369mm for a growing period of 100 days from sowing until harvest.

Average ETc value was low at the beginning of the season (1mm). It increased gradually to reach a maximum value at anthesis (6.74mm). During the period of full ripening, ETc decreased to a value of 5.52mm and it reached 2.75mm before harvest (Figure 2).

Seasonal gross irrigation rates were 356mm and 478mm for the drip and the gun, respectively. Hence, water consumption considering the irrigation system parameters was 26% lower under drip irrigation.

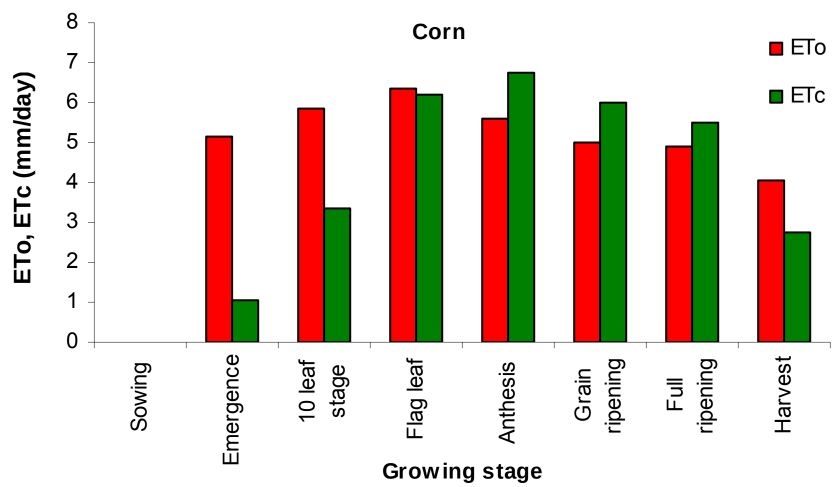


Figure 2. Average crop evapotranspiration (ETc) and reference evapotranspiration values observed during corn growing season.

6.3. Plant development

6.3.1 Corn

Table 1 shows the plant height and the ears number values observed under Gun, GR and T-tape irrigation systems.

No significant differences were observed on the plant height values of corn irrigated with GR and T-tape (Table 1a). Whereas, plant height was reduced of 12% under Gun irrigation system compared to drip (GR and T-tape), this reduction was significant statistically (Table 1b). Ear number was not affected by the irrigation system (Table 1). The reduction in plant height under the gun irrigation system was the result of the large variability in plant height, which is due to the system efficiency (Figure 3).

Figure 3. Corn irrigated with gun.

Table 1. Plant height and ears number observed under Gun, GR and T-tape irrigation systems.

	Gun	GR	T-tape
Plant height (cm)	161	183	180
Ears/plant	1	1	1

Table 1a. Statistical analysis of plant height observed on GR and T-tape irrigation systems.

ANOVA	Sum of Squares	df	Mean Square	F	Sig. (α)
Between Groups	10.667	1	10.667	.130	.736
Within Groups	327.333	4	81.833		
Total	338.000	5			

(α) > 0.05 so there is **no** significant difference between GR and T-tape concerning the plant height.

Table 1b. Statistical analysis of the plant height observed on gun and drip (GR and T-tape) irrigation systems.

ANOVA	Sum of Squares	df	Mean Square	F	Sig. (α)
Between Groups	1180.083	1	1180.083	5.210	.046
Within Groups	2264.833	10	226.483		
Total	3444.917	11			

(α) < 0.05 so there is significant difference between Gun and Drip concerning the plant height.

6.4. Yield and water use efficiency

6.4.1. Potato

Potato tubercles were taken off from fridge on the 18/06/07 in order to be planted on the 1/07/07 as planned (potato seeds should be planted within 10 to 15 days after being taken off from fridge)**.** However, this was not possible due to the lack of water in the LRA network.

The lack of water in the latter delayed the seeding bed preparation and the plating date till 21/07/07. Meanwhile potato germinated in the warehouse and this resulted in a reduction in the emergence and it was verified as follow:

a-<u>Sprinkler demo plot</u>

Potato was planted on the 21/07/07 and irrigation started on the 23/07/07 and the 24/07/07 for the 18x12m sprinkler distance and the 18x18m sprinkler distance, respectively.

b-<u>T-tape demo plot</u>

Potato was planted on the 24/07/07 and irrigation started on the 25/07/07.

Emergence was verified weekly and the low values resulted to be due to the pre-planting germination that reduced the emergence potential. This was verified by digging the rows of potato where emergence didn't occur and checking the adequate distribution of water as well as the presence of tubercles. Results showed that water was distributed uniformly and the problem of emergence was due to the tubercles. Emergence was about 50% under sprinkler irrigation and lower than 30% under T-tape irrigation.

Water shortage occurred during flowering stage (20/08/07 until 29/08/07) due to the lack of water in the LRA network.

Under these conditions mentioned above and due to the low plant density, we considered the plant number to analyze potato yield according to the plant density (10plants/m^2). Hence, we sampled in m^2 by verifying the plant number (10 plants /sample).

Yield fresh weight was 3.6, 3 and 2.14 Kg/m^2 respectively for T-tape, sprinkler 18x12 and sprinkler 18x18. These values are within the range (2 - 3.5 t/du) obtained for late potato in West Bekaa region.

Table 2 shows a 19% reduction in potato yield dry weight of sprinkler 18x12 compared to T-tape. This reduction reaches 42% when T-tape is compared to sprinkler 18x18. Whereas it's of 29% between sprinkler 18x18 and sprinkler 18x12. All these reductions were significant statistically as shown in the table 2a, 2b and 2c. Water consumption however shows a reduction under T-tape system in comparison with sprinkler system and this leads to an increase of 65% and 51% in the WUE of T-tape compared with sprinkler 18x18 and 18x12, respectively.

Hence, the use of T-tape had a positive effect by increasing yield and reducing water consumption in comparison with both sprinkler distances. The same effect was observed when sprinkler spacing was reduced from 18x18 to 18x12.

Table 2. Potato yield dry weight, water consumption and WUE observed under T-tape and sprinkler irrigation systems.

	T-tape	Sprinkler 18x12	Sprinkler 18x18
Yield dry weight (Kg/m^2)	0.738	0.602	0.428
Water consumption (m^3/ m^2)	0.256	0.424	0.424
WUE (kg/ m^3)	2.88	1.41	1

Table 2a. Statistical analysis of dry weight observed on sprinkler 18x18 and 18x12.

ANOVA	Sum of Squares	df	Mean Square	F	Sig. (α)
Between Groups	76038.400	1	76038.400	60.169	5.53×10^{-5}
Within Groups	10110.000	8	1263.750		
Total	86148.400	9			

(α) < 0.05 so there is significant difference between 18x18 and 18x12 concerning the dry weight.

Table 2b. Statistical analysis of dry weight observed on T-tape and sprinklers 18x18

ANOVA	Sum of Squares	df	Mean Square	F	Sig. (α)
Between Groups	241180.900	1	241180.900	144.320	2.12×10^{-5}
Within Groups	13369.200	8	1671.150		
Total	254550.100	9			

(α) < 0.05 so there is significant difference between T-tape and 18x18 concerning the dry weight.

Table 2c. Statistical analysis of dry weight observed on T-tape and sprinklers 18x12

ANOVA	Sum of Squares	df	Mean Square	F	Sig. (α)
Between Groups	46376.100	1	46376.100	27.860	.001
Within Groups	13316.800	8	1664.600		
Total	59692.900	9			

(α) < 0.05 so there is significant difference between T-tape and 18x12 concerning the dry weight.

6.4.2. Corn

Yield fresh weight was 3.9 and 4.9 Kg/m^2 for gun and drip irrigation (GR and T-tape), respectively. These values are within the range (3.5 – 5t/du) obtained for corn (100 days growing season) in West Bekaa region.

Table 3 shows the yield, yield components, water consumption and WUE observed on corn irrigate d with gun, GR and T-tape. Results observed on GR and T-tape irrigation systems didn't show any significant differences (Table 3a). When compared to drip irrigation systems (T-tape and GR) the gun showed reductions of 30%, 25% and 27% for dry straw weight, ear dry weight and total dry weight respectively. These reductions were significant statistically (Table 3b). The increase of the ear straw weight/m^2 was not due to an increase in the number of ear per plant, this later was equal to 1 under all irrigation systems (as we saw in the paragraph 6.3.1. on corn growth). HI was similar for all the irrigation systems.

Water consumption was 26% lower under drip irrigation compared to the gun and this leaded to an increase of 44% in the WUE of drip irrigation system.

Table 3. Yield, yield components, water consumption and WUE observed on corn irrigated with gun, GR and T-tape.

	Gun	GR	T-tape
Dry weight (Kg/m^2)	**0.540**	**0.727**	**0.699**
Ear dry weight (Kg/m^2)	**0.937**	**1.245**	**1.226**
Total dry weight (Kg/m^2)	**1.441**	**1.972**	**1.926**
HI	**0.65**	**0.63**	**0.63**
Water consumption (m^3/ m^2)	**0.478**	**0.356**	**0.356**
WUE (kg/ m^3)	**1.96**	**3.49**	**3.44**

Table. 3a. Statistical analysis of yield and its components observed on the corn irrigated with GR and T-tape.

ANOVA		Sum of Squares	df	Mean Square	F	Sig. (α)
Dry Straw Weight	Between Groups	1204.167	1	1204.167	.212	.669
	Within Groups	22699.333	4	5674.833		
	Total	23903.500	5			
Ear Dry Weight	Between Groups	504.167	1	504.167	.033	.864
	Within Groups	60227.333	4	15056.833		
	Total	60731.500	5			
Total Dry Weight	Between Groups	3266.667	1	3266.667	.133	.734
	Within Groups	98081.333	4	24520.333		
	Total	101348.000	5			

(α) > 0.05 so there is **no** significant difference between GR and T-tape concerning the Dry Straw Weight, the Ear Dry Weight and the Total Dry Weight.

Table 3b. Statistical analysis of yield and its components observed on the corn irrigated with gun and drip (GR and T-tape).

ANOVA		Sum of Squares	df	Mean Square	F	Sig. (α)
Dry Straw Weight	Between Groups	131670.750	1	131670.750	14.815	.003
	Within Groups	88879.500	10	8887.950		
	Total	220550.250	11			
Ear Dry Weight	Between Groups	267904.083	1	267904.083	36.371	1.2×10^{-4}
	Within Groups	73658.833	10	7365.883		
	Total	341562.917	11			
Total Dry Weight	Between Groups	775208.333	1	775208.333	35.425	1.4×10^{-4}
	Within Groups	218831.333	10	21883.133		
	Total	994039.667	11			

(α) < 0.05 so there is significant difference Gun and Drip concerning the Dry Straw Weight, the Ear Dry Weight and the Total Dry Weight.

7. Recommendations:

The results of the demonstration plot are summarized in the following recommendations:

- It is necessary to create different demo plots on the farmers own lands as they requested during the visits (50% of the farmers).

- To succeed the irrigation, farmers should analyse their soil in order to obtain the values of the field capacity, the permanent wilting point and the bulk density. These parameters are necessary to compute the soil available water and succeed the irrigation scheduling. Other important data are the climatic parameters which help calculating the ETo and the ETc. These data can be obtained from the closest meteorological station.

- The sprinkler distance 18mx12m used to irrigate potato showed to improve the water use efficiency in comparison with the 18mx18m sprinkler distance. Hence, the 18mx12m sprinkler distance can be adopted in windy regions.

- The T-tape showed to improve the water use efficiency of potato; however, it was highly sensitive to the cultural practices and to field mice (high population density of field mice in West Bekaa region). From here comes the necessity of using GR irrigation system in future demo plots on potato, one of the major crops in West Bekaa region. Such demo-plots can be installed on the farmers own land as requested during the visits.

- The use of corn resulted to be a good idea to show the growth uniformity to the naked eye. Corn irrigated with drip had better growth and yield uniformity than the one irrigated with gun. However, one should consider the production cost impact when using the GR system.

- When irrigating on LRA network, in order to obtain similar results under drip irrigation system, it is recommended to use the proper filtration kit (see Appendix A).

- Proper design of a drip or sprinkler system does not in itself ensure success. Good system operation and maintenance are two fundamentals to succeed irrigation.

1- A proper operation and maintenance of drip systems consist in the following:

- Ensuring a correct connection of all quick couplings;
- Operating with the pressure value necessary for an efficient system functioning;
- Checking leakage occasionally and keeping all couplings tight;
- Using a collection pipe to increase the water use efficiency and ease the flushing operations.

2- A proper operation and maintenance of sprinkler systems consist in the following:

- Ensuring a correct connection of all quick couplings;
- Keeping both couplings and rubber seal rings clean;
- Operating with the pressure value necessary for an efficient system functioning;
- Keepings all nuts and bolts tight;
- Keeping fertilizers pipes away from pipes;
- Moving the sprinkler lines without pushing them into the soil;
- use uniform nozzle diameter;
- Storing sprinklers in a cool dry place;
- Removing the rubber sealing rings from the couplers and fitting and store them in a cool dark place.

APPENDIX A

Demo plot visit Program
IrWa Project – West Bekaa

Extension and Service Center
Khirbet Kanafar

Welcome and Registration

Opening word by IRWA staff

Demo plot objectives

Demo plot visit and open discussion

Coffee Break

Organization of the visit

1. Number of farmers:
Each visit will be composed of 20 farmers.

2. Methodology of work:
Field visit; where the relevant topics of the demo plot will be illustrated to farmers.

3. Topics:
a. The use of gun vs. drip irrigation on corn
See appendix I.

b. Filtration technique and maintenance when irrigating with the LRA network
See appendix I.

c. The use of T-tape and different sprinklers spacing (18x18 and 12x18) on potato
c.1. T-tape
T-tape shows to complicate the cultural practices on potato mainly chemical treatments, weeding and earthing up; for these practices it is necessary to use a tractor, which damages the T-tape. The use of a GR drip irrigation system, maybe more resistant for these cultural practices.

c.2. Sprinklers

- Possibility of irrigating potato with sprinklers starting early in the morning.
- Irrigation scheduling depends on soil, growing stage and climate. It's not a rule to irrigate potato for 12 hours each 8 to 10 days. Irrigation amount is low in the beginning of the season and it increases to reach a maximum at full crop cover.

d. How to reduce water losses and increase the efficiency of the irrigation network:

- Control leakage as shown in figure 1.
- Use clean filters.
- Use uniform nozzles for sprinkler irrigation system.
- Use the proper number of drippers or sprinklers according to the proper available hydrant discharge.
- Use a loop drip irrigation system (Figure 2) which increases the water use efficiency and eases flushing practices (Figure 3) in comparison with an end-stop drip irrigation system (Figure 4).

e. The advantages of an efficient system (figures a and b, appendix I)

Figure 1. Leakage

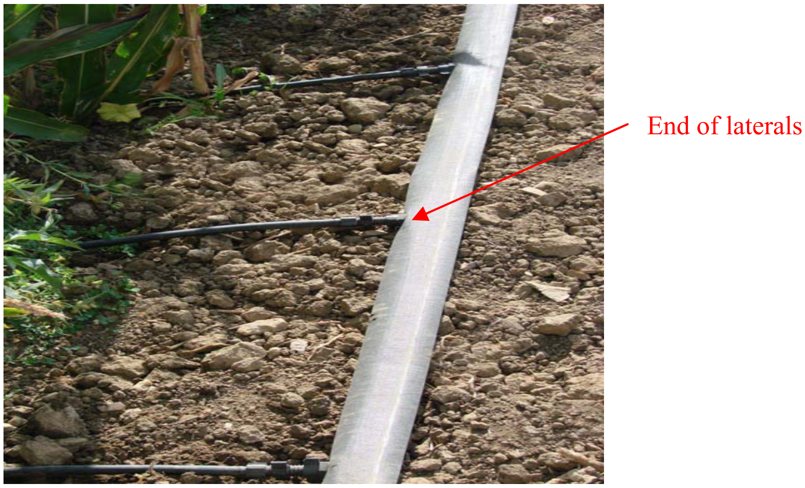


Figure 2. Loop system

Figure 3. Easy flushing under loop irrigation system

Figure 4. End-stop drip irrigation system

Appendix I: Corn demo plot

Objectives

- To show the effect of the irrigation system (drip, gun) on corn growth uniformity.
- To demonstrate the importance of the use of filtration under drip irrigation system.

Methodology

Field visit, will illustrate the following:

1- The drip irrigation system and the fertilization and filtration kit.
2- The filtration technique and maintenance when irrigating with LRA network.
3- The gun irrigation system.
4- The irrigation uniformity of each system.

Results

The relevant results observed until the date of visit are the following:

- The gun can be used on LRA irrigation network (pressure = 5bars)
- The traveler gun cannot be used on LRA network (maximum pressure 5bars) due to a head loss of 1 bar in the plastic pipe and another 1 bar in the turbine. The booster pump is not a solution because it damages the LRA network.
- Higher irrigation uniformity is observed under drip irrigation system when compared to the gun. This can be seen on plant height uniformity in the Figures a and b.

Fig. a: Corn irrigated with drip.

Fig. b: Corn irrigated with gun.

When irrigating on LRA network, in order to obtain similar results under drip irrigation system, it is recommended to use the proper filtration kit (Figure c), and to do the proper filter maintenance:
when the head loss increases too much (0.5 bar), it is time to clean the sand media filter through a back-flush (Figure d) and to open the disc filter, to withdraw the cylinders of piled up plastic discs and to wash them in water (figure e).
The low uniformity results observed under the gun irrigation system are due to:

- The higher irrigation water loss by evaporation.
- The effect of wind speed on water distribution.

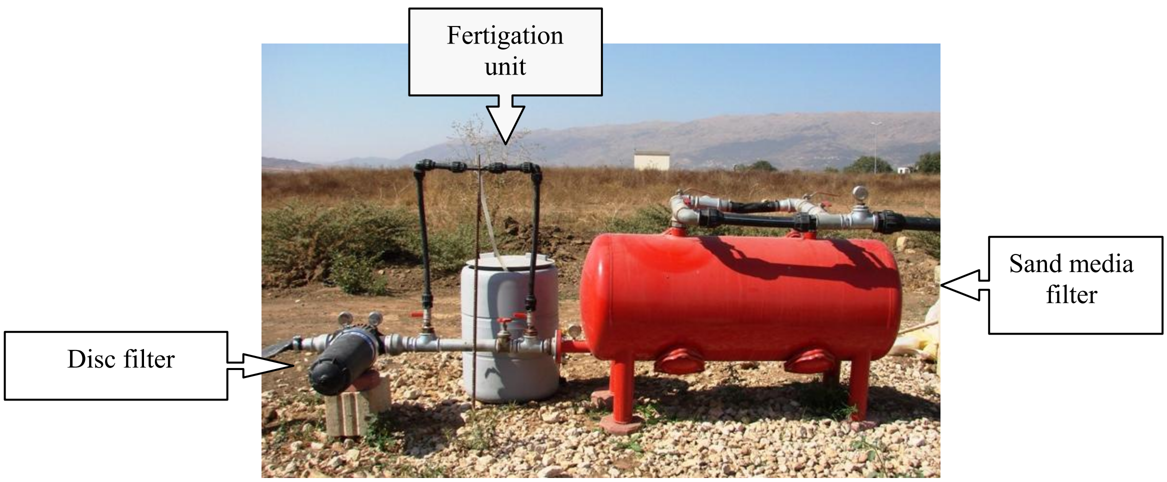


Fig. c: Filtration and fertigation kit.

Fig. d: Back-flush of sand media filter.

Fig. e: Cleaning of disc filter.