Practical manual for small scale dairy farmers in Vietnam

Implementation of Small Scale Sprinkler Irrigation System for High Quality Grasses

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Small Scale Sprinkler Irrigation System
for High Quality Grasses

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Forewords

The Vietnam Belgium Dairy Project (VBDP) aims to increase the income of the rural population by sustainable growth of the domestic milk production in Vietnam. The project is implemented from 2005-2009 by the Ministry of Agriculture and Rural Development (MARD) with technical assistance of the Belgian Technical Cooperation (BTC).

Comprehensive training of farmers is one of the main activities of the project. The project has chosen for a Training of Trainer system (TOT) in which leading demonstration farmers and/or technicians are trained to become a trainer of a group of dairy farmers. This booklet on **"Implementation of Small Scale Sprinkler Irrigation System for High Quality Forages"** is a part of a series of booklets that cover the different aspects of Good Dairy Farming Practice. Each booklet is accompanied by flipcharts that can be used during training sessions. All manuals and flipcharts can be downloaded from the Dairy Vietnam Website: www.dairyvietnam.org.vn

Although some knowledge and concepts might be unfamiliar to some dairy farmer in Vietnam, the authors made very short and simple expressions which are accompanied by animated and easy to understand images to intrigue readers and most importantly to convince farmers to follow the instructions in the manual.

We would like to thank all persons who contributed to the completion of this manual. Specials thanks go to all the Local Feeding Advisors (Đào Lan Nhi, Hoàng Huy, Lê Tuấn Thịnh, Ngô Văn Hiệp, Nguyễn Thị Thương and Trần Hoàng Chất) and to Neil T. Schultz of Agriculture Extension Company (KN) who guided us and the farmers how to implement and manage the system.

On this occasion, we would also like to express our gratitude and appreciation to the farmers and technicians who follow the guidelines of the manuals and who teach other farmers by using our publications. Sincere thanks!

Constructive feedback on any of our publications is always welcome!

NOTES BEFORE READING

This manual addresses farmers who wish to install a small scale sprinkler irrigation system (average field size of 1000 - 2000 m²).

There are a lot of other irrigation techniques, nevertheless this manual focus on the experiences of the Vietnam Belgium Dairy Project (VBDP) in the set-up and management of small scale sprinkler irrigation systems.

We give a lot of brand names to make clear to you which kind of material to use. We used those successfully, but we are aware that other similar brands are suitable as well.

INTRODUCTION

Sprinkler irrigation is an imitation of natural rainfall. Water is distributed through an underground pipe network by pumping. It is then sprayed into the air through sprinklers. The water breaks up into small water drops which fall to the ground. The pumping supply system, sprinklers and operating conditions must be properly designed to enable a uniform application of water.

An electric pump of 1 hp can run the system. Nevertheless, gasoline/diesel pumps are preferred because of the weak and irregular electricity supply to the countryside. Moreover those pumps can be modified to run fully on biogas.

Although the initial investment cost to set-up the irrigation system is relative high (about 9 million VND 1000 m² in 2008), the system has several advantages, like reducing workload and time to irrigate, and a uniform and efficient distribution of water and fertiliser. An absolutely must for professional high quality forage cultivation that will be paid off soon. Since better and more forages leads to less concentrate and healthier cows what ends in more and better milk!

Continuously providing enough water (in combination with sufficient fertiliser), gives the opportunity for forages to grow abundant all year-round, even during winter time for some grasses. Moreover, by mixing the irrigation water with effluent from the biodigester or barn, chemical fertiliser use is drastically decreased (often nearly to zero), and so are the expenses for it.

The flowchart on page 5 shows the different steps in the implementation of a sprinkler irrigation system. After selecting the field, the lay-out is drawn. The position of the main-line is carefully designed in relation with the water source, topography and dimension of the field. Making use of high quality materials and taking good care of the system prolong the lifespan of the system and the grasses up to 15 years.

The cultivation of the high quality forage Australian Mix under sprinkler irrigation is the management of Australian Mix under sprinkler irrigation is outlined. This technique was used as an example of forage cultivation under of sprinkler irrigation. This technique is successfully introduced by VBDP in North-Vietnam.

Australia Mix Grasses in Irrigation system

CHAPTER 1 INSTALLATION OF A SMALL SCALE SPRINKLER IRRIGATION SYSTEM

Flowchart

1. Field Selection

2. Materials
- Water Source
- Pumping System
- Irrigation Network

3. Design
- Main - Line
- Sub - Line
- Sprinkler Blocks

4. Installation
- Trenches
- Pipe Network
- Pump

5. Seedbed Preparation
- Closing Trenches
- Ploughing + Equalising
- Seeding

1. Field Selection

1.1. Factors to Take into Account During Field Selection

- Topography:
  - Flat land (slope < 5%)
  - If slope > 5%: use a special kind of sprinkler (Pressure Compensation Waterbird® from Toro®)
- Shape: Optimal = Square/Rectangular and regular. Other shapes are less feasible
- Position: Near the water source (river, pond or well)
- Area: At least 750 m^2 to be economic efficient
- Soil type:
  - **Sandy loam - Clay**
  - **Fertile** soil with neutral pH
  - **Good drainage.** Heavy clay soils may need shallow drainage canals along the prevailing slope to discharge an excess of water during high intensity rainstorms

1.2. Before Installation

- Free of the previous crop and weeds
- Free of stones, rocks, old tree logs or other obstructions

Free of the previous crops, weeds, stones and rocks before installation

2. Materials

2.1. Water Source

The water source is situated **as close as possible to the field.**

The water source can be:

- River/stream
- Pond
- Well

Note

- The well can be linked directly to the irrigation system. Nevertheless, we advise the farmers to foresee a concrete tank to mix the irrigation water with the effluent from the barn or biodigester!
- Diameter of the pipe to the groundwater is always bigger than diameter of the suction port of the pump (at least 48 mm)

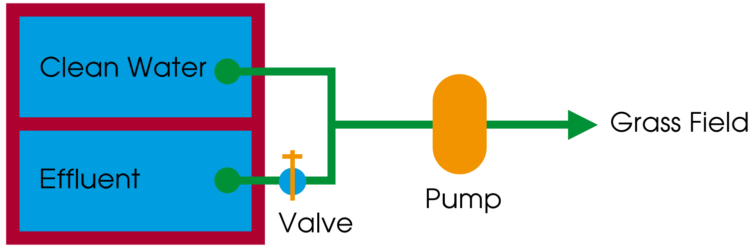
Place pump as close as possible to river

Pumping water from a pond

2.2. Temporary Water Storage

Recommended is the construction of a concrete tank to **store** the irrigation water and to **mix it with the effluent from the biodigester or the barn**.

- Divided into 2 parts: one for fresh water, the other one for the effluent. This makes it possible to apply only fresh water 10 days before harvesting. Cows don't like to eat grass smelling/tasting to effluent.
- Water is subtracted from both parts. A valve on the pipe to the effluent part will prevent applying effluent close to harvest.
- The bottom of the tank will be filled-up with mud, stones etc after awhile. It is advisable to clean the tank every 2-3 months.



Note

- Always **cover** the tank to preserve volatising of the nutrients of in the effluent
- No need to divide the concrete tank in 2 parts, if
  - The effluent is brought to the field in a plastic tank, mixed with clean irrigation water and fully used.
  - The water can be pumped direct from the well

Volume of Concrete Tank

At least the amount of water needed for 1 irrigation application:

$$V_{tank} = \frac{\text{Irrigation Time (h) x Discharge Sprinkler (l/h) x Sprinkler number}}{1000} \quad (m^3)$$

Discharge Sprinkler = Litres of water delivered by 1 sprinkler in 1 hour

Toro® Sprinkler

Example

- Area irrigation field: 1000m²
- 52 sprinklers
- Sprinkler discharge: 250 l/h
- 45 minutes (0.75 hours) of irrigation

$$\rightarrow V_{tank} = \frac{0.75 * 52 \text{ sprinklers} * 250\text{l/h}}{1000} = 9.75 \text{ m}^3$$

This farmer needs a tank of at least **10 m³.**

A bigger tank will be useful there the irrigation time depends on the wetness of the soil, which is related to the weather conditions and the grass cover. As the grass matures and grows abundant, extra water needs to be available, especially in very dry periods.

2.3. Pump

Pump Function

The pump will push the water through the system to the sprinklers. Therefore, select a pump which main function is **to push** but also can suck a little bit. The power of the pump is at least 1 hp/0.74 kW. Depending on the energy source, the farmer can choose:

- An electric pump: capacity > 1hp or 0. 75kW
- A gasoline/diesel pump (lowest power available is 4 hp/3 kW)
- A modified gasoline/ diesel pump run 100 % on biogas

Note

- Remember that an electric pump is not only cheaper to purchase but that the price of gasoline is also higher than the price of electricity
- A modified gasoline pump run on biogas has the lowest operating costs

A modified gasoline pump run on biogas

Locate the pump as close as possible to the water source. The closer the pump to the water surface, the less energy is used to suck and the stronger the pump can push the water to the field.

Locate the pump as close as possible to the water surface.

Example of Electric Pump

- Brand: Sea Land (Italy)
- Height difference, H: 15 - 30m (Vertical distance between the water level in the water source and the sprinkler)
- Discharge, Q: 35 - 130 l/min
- Power: 1 hp / 0.74 kW

Due to the weak and unstable electricity supply at the countryside, a **stabiliser** might be needed to secure sufficient operation of the electric pump at the right moment.

Good farming practices lead the farmer to irrigate in the **early morning**, when the electricity supply is the strongest, compared to midday and afternoon, where there is peak usage of electricity.

Use shorts electric wires to overcome unnecessary energy losses.

Electric pump Sea Land (Italy)

Example of Gasoline Pump

- Brand: Koshin (Honda engine)
- Height difference, H: 30m
- Suction head: 8m
- Discharge, Q: 600 l/min
- Power: 4 hp / 3 kW

Gasoline pump Koshin (Honda)

Note

- Any brand on the market with the desired characteristics can be used
- The capacity of the pump and the number of sprinklers will depend on the installation area

Other suitable brands are available on the market

Pump Operation

Read carefully and understand fully the instruction manual of the pump before use!

Suitable pumps are centrifugal pumps, existing of a case in which an element, called the impeller, rotates driven by a motor. Water enters the case at the centre, through the suction pipe. The water is immediately caught by the rapidly rotating impeller and expelled through the discharge pipe.

The centrifugal pump will only operate when the case is completely filled with water. **Add priming WATER every time before switching on the pump**. Don't let the pump run dry because of a lack of water. Foresee always water, pumping of air will burn the pump.

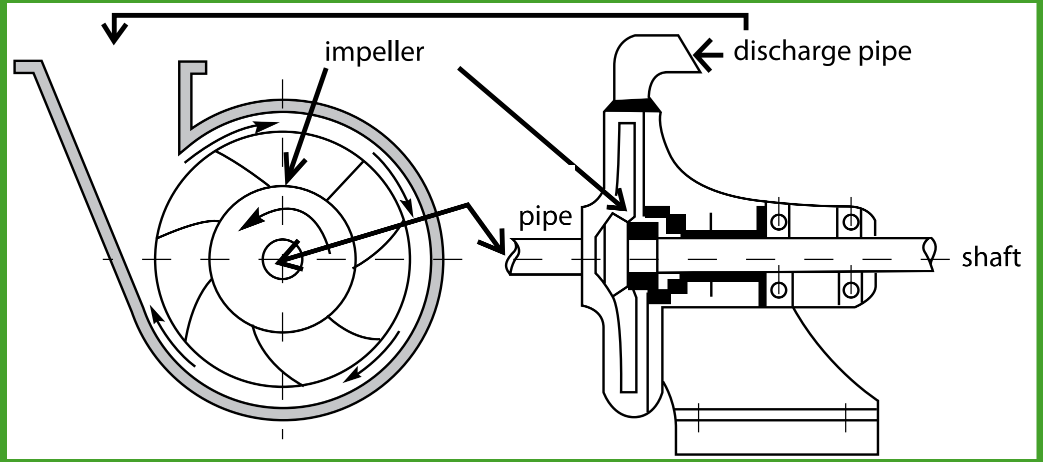


Diagram of a centrifugal pump

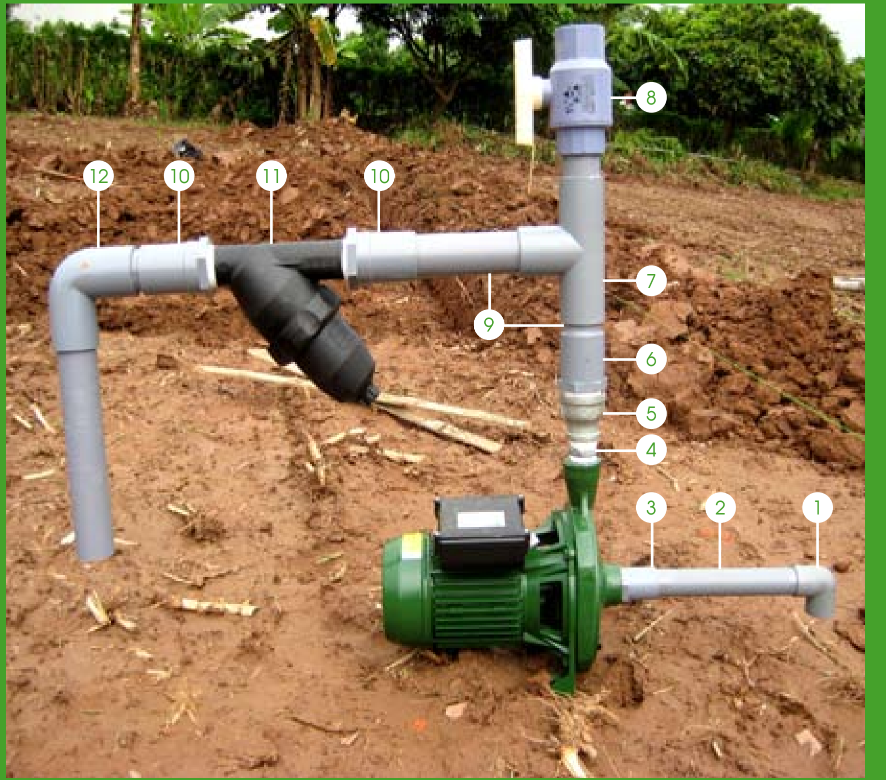
Add water before switching on the pump, to prevent burning of the pump

2.4. Pumping System

Set-Up of Electric Pump

Material needed

1. 90° Elbow - Φ34 mm[1]
2. Suction pipe - Φ34 mm (electric pump)
3. PVC adaptor bush equal - Φ34 mm
4. Iron hexagon nipple - Φ34 mm
5. Iron bell reducer - Φ48-34 mm
6. PVC adaptor bush equal - Φ48 mm
7. 90° T - Φ48 mm (Class 3 - Tiphoplast = higher resistance)
8. Ball valve - Φ48 mm
9. Outlet pipe - Φ48 mm
10. PVC adaptor socket - Φ48 mm
11. Toro® F-40 Filter
12. Elbow - Φ48mm (if needed)



[1]Φ: diameter of the pipe

Set-Up of Gasoline Pump

In case of a gasoline pump, a flexible pipe (Φ 50 mm) links the pump with the well tube at one side and the main-line of the irrigation system at the other side. The pipe is connected to the hose nipple by a hose bound. In between the pump and the pipe network, the filter is installed, using 2 PVC adaptor sockets Φ 48 mm *(Number 10 in picture on page 16)*

The application of white PTFE thread tape at threaded pipe connections is important to ensure that the threaded pipe connections will not leak!

If the farmer wants to take the pump home, a screwing pipe union piece is placed in between the elbow ɸ 34 mm and the adaptor socket ɸ 34 mm *(number 1 and 3 on picture page 16)* as well as in between the adaptor socket ɸ 48 mm and the elbow ɸ 48 mm *(number 10 and 12 on picture page 16).*

Note:

Always keep the diameter of the suction pipe bigger than the pump's suction port!

Screwing pipe union piece for mobile pumps

2.5. Filtering

Pre-Filtering

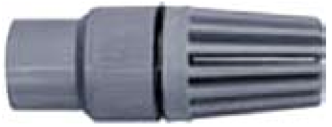
A filtering piece (like a foot valve) is placed at the beginning of the suction line:

- **To separate** bigger parts out of the irrigation water
- **To prevent blockage** of the pipes and sprinkler nozzles and by this a quick decrease in the effectiveness of the second finer filter close to the pump

Time and money on setting up excellent filtration is more practical than spending hours on cleaning blocked nozzles

Location of the Foot Valve

- Place the suction pipe at least 15 centimetres above the bottom to prevent blockage by mud from the bottom of the tank/pond
- A flexible pipe with a plastic bottle near the end will keep the pipe floating to prevent pumping mud



Foot valve for suction pipe

Flouting pipe to prevent mud entering the system

Filter

- The use of a finer filter (e.g. Toro®F-40) after the pump is highly recommended. Water of poor quality (from river, pond or effluent) negatively affects the system's lifespan and reliability.
- The Toro® F-40 filter is able to clean water up to 18,000 l/h.

Note

- Very clean water ➡ no filter needed
- We recommend placing a 'pre-filter' (foot valve), a mesh or something similar, at the beginning of the suction tube. This will improve the efficiency of the subsequent finer filter.

Toro® F-40 Filter

2.6. Pipes

Installing the pipes underground protects them against the sun and makes them less sensible to damaging. Given that the pipes are in the ground for 10 years or longer, **good quality** is desired. Use **Class 2 PVC pipes** from the brand 'Tien Phong' (Tiphoplast) to overcome breaking and rapid wearing.

The diameter of the PVC pipes depends on their function and their length.

Class 2 'Tien Phong' (Tiphoplast) PVC pipes.

Main-lines: the diameter is in relation with the total length of the main-line

- < 40 meters long: ϕ48mm
- 40 - 80 metres long: ϕ60 mm
- 80 - 150 metres long: ϕ90 mm
- > 150 metres long: ϕ110 mm

Sub-lines: ϕ34 mm

The maximum length of the sub-line is 80 metres. If the field is longer, the main-line is placed in the middle to safeguard enough water pressure at the end of the main- and sub-lines.

Sprinkler sticks: ϕ21 mm with a length of 1.3 m

2.7. Connections

To connect the pipes in the field, the farmer needs:

90° Tees

90° Reducing tees

90° Elbows

Reducers

Caps

Sockets

Ball valves

2.8. Sprinklers

A sprinkler stick consists of:

1. Reducing 90° T - ϕ 21-34 mm
2. (If the sticks are taken home, adaptor socket and adaptor bush equal of ϕ 21 mm to uncouple the sprinklers)
3. 1.3 m long pipe of ϕ 21 mm
4. PVC adaptor socket to screw in the sprinkler (ϕ 21-16 mm)
5. Micro-sprinkler (Red Nozzle Toro® Waterbird® VI, 200 -250 l/h)
6. Red deflectors at the borders

Sprinkler stick

Note

To screw in and out the sprinkler sticks every irrigation application asks a lot of time

3. Design

Rules of Thumb

An optimal lay-out of the irrigation system will reduce the investment costs even as the operating costs of the sprinkler irrigation system. Some rules of thumb:

Main-line:

- Close to water source
- At the shortest side
- Correct diameter to prevent losses in pressure (the longer the main-line, the wider the diameter)

Sloping land:

- Main-line from the highest to the lowest side with the water inlet at the highest point
- Sub-lines along the contour

Adequate pump with filter: capacity in relationship with the irrigated area

Good quality material and pump

Drawing land map before making design

Based on the field dimensions and the relative position of the water source, the design of the irrigation field is sketched.

To **ensure a uniform water distribution**, the field needs to be designed appropriate. The uniformity depends on:

- Sprinkler stick height and spacing
- Operating capacity of the pump (1 - 4 hp)
- Water application rate according to soil infiltration
- Aspects of maintenance

Planning and design are crucial to ensure optimal use of the advantages of a sprinkler irrigation system. The aim is to maximise the returns (high quality forage for healthy high-producing dairy cows) and to minimise the investment and operating costs (irrigation, fertilisation and labour).

Three steps are run through the alignment of the lay-out:

- Position of the main-line
- Lay-out of the sub-line
- Sprinkler blocks of 5m x 5m

Page 28 shows a sketch of the pipe network of a sprinkler irrigation field.

Sized design ensures a uniform water distribution

Step 1: Position of main-line

The best position of the main-line is a balance between:

- From highest to lowest point resulting in a similar pressure in each subine
- At the shortest side
- Close to water source
- Consideration of future extensions

Note

- For main-lines carrying the water to the small valves and grassed areas, it is wise to buy and install large diameter pipes to assist in the efficiency of water transport. More litres per hour and higher pressure are obtained if larger pipes are used.
- In larger fields, the main-line is better suited in the middle of the field. All this will overcome the use of too many pipes and connections. Asides from the inefficiency of pumping water over long distances, involving energy and pressure losses.
- Optimal = straight main-line
- Good design = lowest installation + operating costs

Trenches for the main-line

Step 2: Lay-Out of Sub-Line

- After every intake from main- to sub-line, a valve is placed (every 5m)
- A sub-line is maximum 80 m long. If the field is longer, the main-line is placed in the middle of the field with sub-lines at both sides. The distance in between 2 opposite sub-lines on the main-line is around 30 cm.

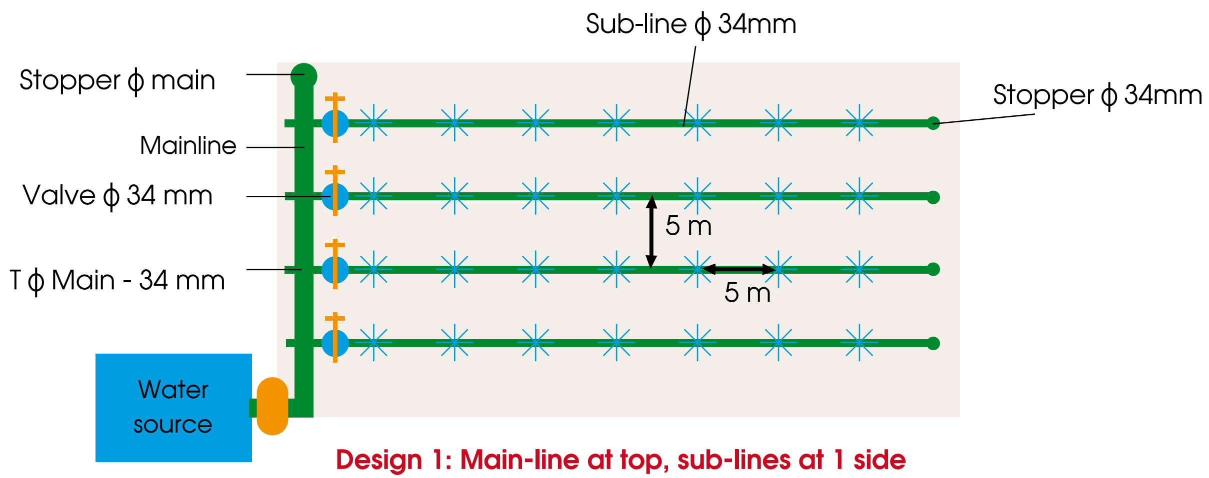
Mail-line in the middle of the field

Mail-line at the top of the field

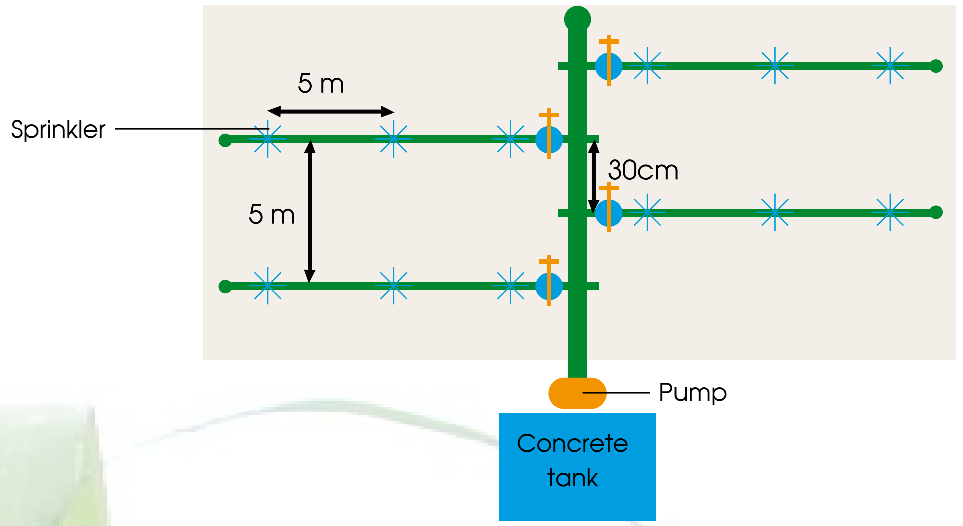
Step 3: Sprinkler Blocks

- Dimension: **5mx5m** or as close as possible to the distance, since the throw radius of a sprinkler is 5m
- Try to apply the same interspaces for whole the field to ensure an equal water distribution
- The best practice is to provide sprinklers at the **field borders**. Since the borders are always under-irrigated (due to wind effects and no overlap zone). Red deflectors at the border limit the trow radius to 180^{o}, preventing the water spraying on the neighbours' fields

Example of Design



Design 1: Main-line at top, sub-lines at 1 side



Design 2: Main-line in middle, sub-line at both sides

4. Installation

Installation Time

The system can be installed at any time. But most optimal is to install it **as close as possible to seeding time**, because of:

- Limiting the tillage operations to just one time. The more soil is worked (ploughed, turned, dug ...), the worse the soil structure will become
- Bare soil is more susceptible to water and wind erosion
- Weeds can develop and leave their seeds behind on the bare soil

Page 42 shows an example of a seeding calendar

4.1. Field Preparation

- The field should be carefully **measured**, using pegs and string lines, to ensure a uniform water distribution and a nicely parallel designed irrigation system
- **Dig** the trenches for the pipelines and **close** them after installation
- **Plough and level** the field right before seeding

Field preparation before seeding

4.2. Trenches for Pipe Network

- The installation begins with the excavation of the trenches for the irrigation pipes. This can be done using a simple spade and garden hoe.
- Linear and straight rows are obtained by pegs and strings
- Depth of the trenches:
  - Main-line: 40 cm deep
  - Sub-lines: 30 cm deep

Excavating the trenches for the underground pipe network

Note: Soil operations after installation

- Be careful with digging or ploughing the field when renovating the forage. The pipes are situated originally 30 - 40 cm deep under the surface. Hence,
  - Ploughing or other soil operations are done in between the sub-lines
  - Never cross the sub-lines, since the risk exist of damaging the pipes
- Don't enter the field with a barrow or motorised vehicle to pick up the cut grass. Crossing the pipes might damage the pipes and the grasses too!

4.3. Underground Pipe Network

Glue Instructions

- Always clean the pipes and connections, especially at the inside and the glue part. Sand, plastic flakes at the saw facet, water or other dirt will diminish the effectivity of the glue! Later on, they can cause blockage in the piping system.
- Apply glue at both 2 joiners
- Connect the 2 pieces
- Press and keep for 10 - 20 seconds

Clean the pipes, glue, connect and press

Connect main-line

Cut main-line and connect with the sub-line

Main-ine:

Start with the installation at the **pump side**

Connection of Main-line

- Put the pipes in the trench
- Glue and connect the pipes

Intersection Main - Sub-line:

- Saw the main-line at the intake to connect with the sub-line
- The distance between the sub-lines is 5m
- Use "90° Reducing T's" to connect the main-line with the sub-line ɸ 34 mm
- PVC pipes are best cut with an iron-saw

At the end of the main-line, a cap is placed

Close the trench after installing the whole pipe network

Sub-line

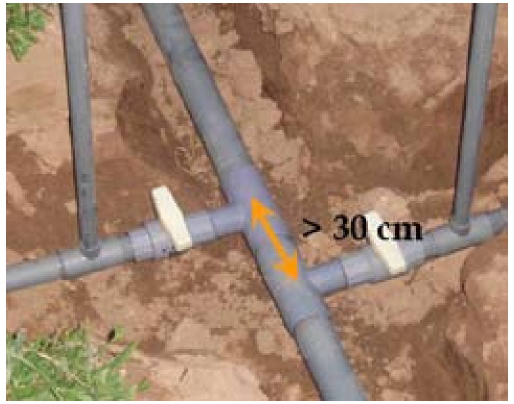
After the reducing T, a 'ball valve ϕ34 mm' is placed

2 designs are possible

Design 1: Main-line at the **top** of the field. Sub-line at one side of the main-line

Design 2: Main-line in the **middle** of the field if the sub-line will be more than 80 m long. Interspace between 2 opposite sub-lines is about 20 - 30 cm.

Design 1: Main-line at top



Design 2: Main-line in the middle of field with sub-lines at both sides

Installing Sub-line:

- Glue and connect the both ends of the 4 m long sub-line pipes
- Cut into pieces of 4.90 m
- In between these pieces, a vertical sprinkler stick is placed. The stick is connected with the sub-lines by a reducing T of ϕ 34-21 mm
- At the end of each sub-line, a cap is placed

The valves are protected by a plastic box or by bricks

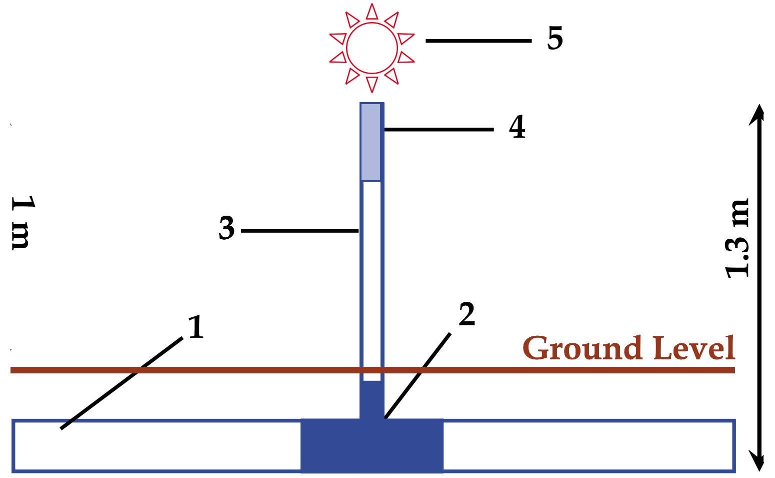
Close the trench after installing the whole pipe network

Protection of the valves

Vertical Sprinkler Sticks:

- The sprinkler sticks (Φ21 mm) are sawn into 1.3 m long parts, 1m will stay above the ground.
- At the base, a reducing T of Φ34-21 mm is placed and on top a reducing adaptor socket of Φ21-10 mm
- The sprinkler is screwed in this adaptor socket

A screw connection (adaptor socket and adaptor bush equal) near to the ground makes it possible to take the sticks home



1: Sub-line

2: Reducing T

3: Sprinkler stick

4: Reducing adaptor socket

5: Sprinkler

Note: Disadvantages of screw connections

- Soil and dust can easily fall in and block the pipes
- Arranging the sprinkler sticks every irrigation application is a huge job

Characteristics of the Toro® Waterbird® Micro-Sprinkler

- Operates under low pressure
- Supplies of 200 - 250 l/hour
- Little affected by wind
- Large droplet size and a balance spin rate, which ends up in a uniform water application
- The sprinkler can be taken apart to clean the inside parts. Procedure, see page 75

On sloping land, a special kind of sprinkler can used to guarantee equal water distribution (e.g. Toro® Pressure compensation Waterbird®)

Red deflectors, connected at the sprinkler, will prevent that nearby roads and neighbouring fields becoming wet and muddy

Sprinkler sticks with sprinkler and red deflector

Clean the underground pipe network BEFORE operating the sprinkler irrigation system for the first time

Note:

Clean the inside of the whole pipe network before using the irrigation system. This is done by pumping water through the system WITHOUT the sprinklers screwed in. All the sand, stones, plastic, dust etc will be washed out of the pipes.

5. Seedbed Preparation

- Close all trenches
- Plough the soil just before seeding if installation is done months before
- Tie up holes and small hills to overcome water accumulation in flooded zones or "wet spots"

Field preparation (ploughing and land levelling) at the day of seeding

CHAPTER 2 CULTIVATION OF AUSTRALIAN MIX UNDER SPRINKLER IRRIGATION

The Vietnam Belgium Dairy Project introduced an innovative technique of sprinkler irrigation in combination with Australian Mix (AM). This high quality forage is a mix of 5 tropical grasses *(Brachiaria decumbens* (signal grass), *Brachiaria brizantha, Digitaria milanjiana, Setaria sphacelate and Chloris gayana)* and 4 tropical legumes *(Clitoria ternatea, Macroptilium atropurpureum, Stylosanthes guianensis and Stylosanthes seabranna).*

The advantage of a mix is that, regardless the soil and climate conditions, always some species will grow well. Besides, AM still grows during the cooler winters in the North of Vietnam, providing year-round nutrient-rich fodder to dairy cows.

In the next section, more information is given about the management of an AM - sprinkler irrigation field.

1. Seeding

1.1. Seeding Calendar

Optimal

Suboptimal

Not suitable

Period	Explanation
February	Depending on the weather: - Temperature > 20° C from that day on - No clouds
March - April	**YES** - Spring is the most suitable season for seeding - Medium sunlight and temperatures are good for seedling development
May - September	**YES** BUT - Heavy rains lead to bad germination and the risk of flooding seeds/seedlings - Strong sunlight => Consider weather forecast
October - January	**NO** ➡ Too cold

1.2. Time of Seeding

- Seeding in spring season is the best choice
- The best time for sowing, is when the weather is **dry and sunny and least likely to have heavy storms, rains and dark days** for a long period. Then, the farmer has the completely control over the germination. If there is no rain, the watering is totally controlled by the farmer using the irrigation system.
- If the soil is wet, then seeding of the forage must be done immediately after tilling the soil. These to overcome that weed seeds germinate earlier or faster than the grass seeds, which can cause weed competition for the forage.

1.3. Temperature for Seeding

AM is a tropical forages. Its growth starts at temperatures >**15°C**.

1.4. Seeding Practice

- Calculate the amount of the seed (1kg/1000m²)
- Mix always the fertilisers and the forage seeds together with some sieved sand, compost or damp-soil
- On larger fields which are susceptible to worms or ants, add **Anti Ants & Worms chemicals** to the mix (e.g. Vifuran at 0.3 kg/1000m²). Ants are the most damaging insects at the time of sowing. They can carry away 95 - 98 % of the seeds. Worms, chickens and birds are the most damaging during germination

Farm chickens will rob the seeds and will eat the young forage plants. Therefore, protect the field with a fence.

1.5. Mixing

- Fertiliser: 40kg/1000m²
- Sieved soil: 20kg/1000m²
- AM seeds: 1kg/1000m²


Collection of seed mix ingredients



Mixing the sand with fertiliser and forage seeds




1.6. Fertiliser

Best fertiliser to use is Nitrophoska-Blau. If not available, apply N:P:K 18:18:6, 16:16:8 (as applied to corn) or other similar ratio of NPK at a rate of 40 kg/1000m².

1.7. Seeding

- **Divide the seed mix in smaller proportions** e.g. per 2-3 blocks or per row by dividing the total weight of the mix by the amount of blocks or row
- Sow the mix by hand
- Cover the seeds by "sweeping" the surface with a branch. Sweeping North-South and also East-West is best. The seeds must not be put under the soil any deeper than 1 cm

1.8. Irrigation

Immediately after seeding, the irrigation system must be turned on for 60 minutes per couple of valves. It is necessary to wash the fertiliser and seeds under the soil surface.

Seeding by hand

Sweeping the soil with a branch to cover seeding

Irrigate immediately after seeding

2. Irrigation

Irrigation Schedule of AM

Time	Frequency	Duration (minutes)	Depth of soil wetness (cm)
Seeding	Immediately	60	
Day 2 - 10	2 x per day	Early morning: 20 Late afternoon: 20	3 - 4
Day 11 - 20	Every day	20	20
> Day 20	Every 4 - 5 days	45 - 60	40
At harvest	Immediately after	20 - 60	40
After harvest	Every 4 - 5 days	45 - 60	40

Note

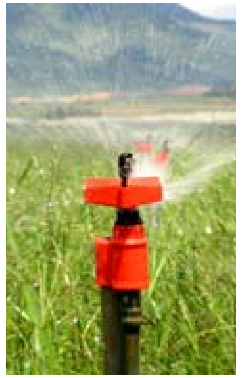
- The guideline can be slightly **adapted** to the soil, climate, growing stage, management and experience of the farmer after using this system for sufficient time.
- To get familiar with the right amount and frequency of irrigation, verify the depth of the water 2 or 3 hours after irrigation by digging a hole (see page 62)

- **Irrigate immediately after seeding**, so that the fertiliser and seeds can be washed under the soil surface. By providing water, optimal conditions for germination are created and seeds start to germinate immediately.
- **Day 2-10: 2 x 20 min/day (early morning and late afternoon)**

  For a fast germination and maximum percentage of germination, it is important to keep the soil surface wet for 24 hours per day to a depth of 3 – 4 cm. The soil surface will be quickly covered by new grass seedlings.
- **Day 11 – 20: 1 x 20 min/day**

  After the first 10 days, the irrigation plan can be changed to regular wetting, approximately 20 minutes per day or until the soil is wet over 20 cm deep (preferably in the morning).
- **From 20 days on: 45 to 60 min every 4 - 5 days**

  Irrigate to at least 40 cm deep or more. The irrigation duration will depend on the soil characteristics, the prevalent weather conditions and also the water delivering capacity of the system.



Note

- In some cases (heavy clay soils) shallow drains are needed to drain excess water after heavy rain
- It may have rained, but never stop irrigating, unless the soil is wet deeper than 40 cm. Consider rain as a bonus for irrigating less minutes
- AM is resistant to some flooding if it is not cut right before the flood
- Never delay irrigating the grass after it has been cut or fertilised. It may get some "sunburn"
- The irrigation system can be used as a very efficient *"Fertiliser Application Tool"*. The irrigation/soil water not only transports the fertiliser to the grass roots, the fertiliser also dissolved in it. Roots only absorb dissolved nutrients
- Clean the filter as much as possible. At least 1 time every application (see page 73)!

3. Fertilisation

Fertiliser Schedule of AM

Moment	Type	Amount (kg/1000m²)
Seeding	Nitrophoska-Blau or N:P:K	40
25 days after seeding	Urea or Calcium nitrate or Potassium nitrate	6
6 days after harvest	Nitrophoska-Blau or N:P:K	8 - 10
25 days after harvest	Urea or Calcium nitrate or Potassium nitrate	6
After 1° harvest	Effluent from biodigester/barn	1-1 ratio
From harvest 4/5, 2 weeks after harvest	Manure	3000 - 4000 (Thin layer)

Note

- The guideline can be slightly **adapted** to the soil, climate, growing stage, management and experience of the farmer after using this system for sufficient time.
- Add lime to neutralise acid soils

- **Always irrigate right after fertilisation** to transport and to dissolve the nutrients in the soil water, and to prevent that the grass gets sunburned
- Fertilisers which dissolve well in water can be applied through the irrigation system, leading to a uniform fertiliser distribution
- After the first harvest, the farmer can use the effluent of the biogas tank (bio-slurry) or barn. A cheap fertiliser that
  - Reduces significantly the use of chemical fertilisers
  - Improves the soil by adding more organic material

  Practice:
  - Mix this waste water with the irrigation water in the concrete tank at a 50-50 ratio
  - Apply in late afternoon to limit nitrogen losses and to prevent the grass from sunburn!
  - Stop 10 days before harvest as the cows aren't eager to eat from this grass


Effluent improves the soil significantly

4. Weeding

- During germination, the grass seeds will germinate and so will the weed seeds. This is not a problem. **Do NOT weed before the second harvest!**
- Just be patient! The weeds will die out after 2-3 harvests! After every cut, the pasture will grow up, stronger than the weeds. Cutting the grass will stimulate it to grow, while weeds get damage and hurt when cut. After a few cuts, the weeds will die out.
- A density of **7 - 10 seedlings per m²** is more than enough to get a productive grass pasture
- If mature, grass bushes can be transplanted from dens to bare places

Note

Some bushy, broadleaf weeds can be carefully pulled out after 2 - 3 months


Tranplant from dens to bare places

Look for the Difference!

This farmer ruined his field and wasted his time by pulling out the weed

A clever and patient farmer who lets the grass grow together with weeds, protecting the soil and the young grasses

From Weed Field to Top Producing Grass Field

Before 1° harvest:

90 % weeds and 7 - 10 forage plants/m² seedlings

After 1° harvest:

60 % weeds and bunches of grass

6 months later:

0% weeds and thick bunches of dark green grass

5. Development Australian Mix

- A density of 7 – 10 seedlings per m² is more than enough to get a productive grass pasture. Don't worry about weeds. DO NOT take them out. After 2-3cuts, the grass will outgrow the weeds!
- AM seeds have a high degree of dormancy (sleeping before germinating). They can stay for a long period inactive in the soil, waiting for the right conditions to shoot up.
- In the most cases not all the species in the mix develop. 2 or 3 species will dominate according to the weather, soil and management conditions.

Germination

10 days old

15 days old

30 days old

First harvest

6 months

6. Harvesting

Harvesting Schedule of AM

Harvest	Conditions	Interval (days)*	Grass Height (cm)	Cutting Height
1°	Warm sunny weather/fertile soils Dark cold weather/infertile soils	± 30 ± 50	> 50	Half height > 25 cm
From 2°	Warm weather Cold weather	20 – 30 40 - 60	75 - 100	**> 20 cm**

**Depending on the season, the weather conditions and the soil conditions*

- At these stages, the grass contains the highest amount of nutrients (crude protein, vitamins, starches, sugars ...); it is very palatable and easy to digest
- At the first cut, the grasses will require a "trimming", down to half of the height and always higher than 25 cm
- Second and consecutive harvests should be done according to the needs of the cattle. The optimal harvesting height is when the grass is between 75 cm and 1 m tall. Always cut at **minimum 20 cm above the ground!**

Cut the grass at a height of minimum 20 cm above the ground!

- It is necessary to leave still some buds of the stem and the deep roots will stay active. Overnight, the grass will immediately shoot up again.
- Harvest before flowering appears! Flowering asks a lot of energy from the grass what makes the regrowth poorer.
- If grass production is bigger than the need for grass, make hay by drying the grass in the sun. Turn frequently.
- Use a guillotine to slice the grass. The soft leaves and stems of AM get squashed in a chopping machine.

CHAPTER 3 MANAGEMENT

1. Irrigation Practices & Management

1.1 Amount of Valves Operating per Time

How many valves to open in one time depends on

- Pump capacity (power and discharge volume)
- Amount of sprinklers per valve
- Dimension of the field (length of sub-line)
- (Strength of the electricity supply)

The farmer can calculate how many water the pump can discharge to the field. This gives an idea how many sprinklers can operate and how many valves can be opened simultaneously.

Calculation example:

- Electric pump
  - Discharge, Q = 100 l/min = 6 000 l/h
  - 10 sprinklers per sub-line = 10 sprinkler per valve
  - 1 sprinkler use 250 l/h => 6 000 : 250 = 24 sprinklers can be supplied
  - 24 sprinklers : 10 sprinkler/valve = 2.4 => Open 3 valves and adjust to observations

- Gasoline pump
  - Discharge, Q = 600 l/min = 36 000 l/h
  - 15 sprinklers per sub-line = 15 sprinkler per valve
  - 1 sprinkler use 250 l/h => 36 000 : 250 = 114 sprinklers can be supplied
  - 114 sprinklers : 15 sprinkler/valve = 7.6 => Open 8 valves and adjust to observations

Note: If less sprinklers in the field than calculated

This means that the power of the pump is bigger than the maximum amount of valves that can be opened in one time (mostly the case with powerful gasoline/diesel pumps). Adjust the power with the engine throttle lever.

Look & Listen

- Open the calculated amount of valves and not less!
- Swith the engin throttle lever of the gasoline/diesel pump to moderate power level
- Turn on the pump
- Observe: look and listen (see next pages 59 + 60)
- Adapt based on observation

If you can hear a **little hissing noise** and you can see the **water curve** reaching the next sprinkler, then the right amount of valves is open. Indicating the right pressure in the pipes.

Double check if the sprinklers are throwing **the water equally in a circle of 5 meter around the sprinkler stick.**

A. Too **many valves** open in one time:

- Too low pressure leading to a unequalled water distribution
- Clear **wet rings** on the ground at a **distance** from the sprinkler stick after irrigation

SOLUTION:

- Close some valves
- Switch pump to higher power using the engine throttle lever

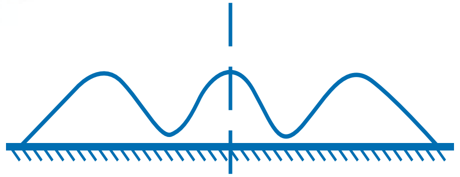
B. Right amount of valves open

C. Too **few valves** open in one time:

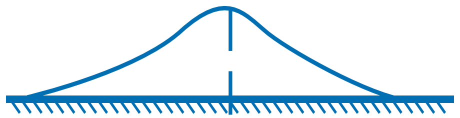
- Too high pressure breaks the water breaks into fine droplets. A fog is observed.
- Uneven water distribution concentrated **around the sprinkler stick**

SOLUTION:

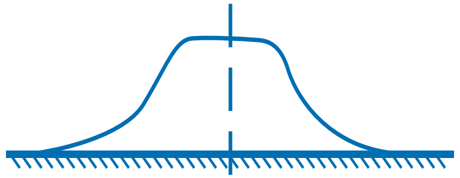
- Open more valves
- Switch pump to lower power using the engine throttle lever



A. PRESSURE TOO LOW



B. PRESSURE SATSFACTORY



C. PRESSURE TOO HIGH

Too strong (too high pressure) or too weak (too low pressure) pumps can have the same consequences. Pumps of 1 – 2 kW are recommended. In case of higher power pump, change the operation power with the engine throttle lever.

Note: Practical operation

- Open all valves
- Close one by one until it looks good and sounds well

Which picture shows a optimal operating sprinkler system?

Right amount of valves open in 1 time, because of

- Clear water curve
- No fog

Too many valves open in 1 time = too low pressure:

- Unequal water distribution
- Clear wet circles on the ground after irrigation and this at a distance from sprinkler stick

1.2 How Long Should You Irrigate?

- **Optimal Application Time:**

  Early morning and late afternoon to limit evaporation. As the electricity peaks are during the day time and in the evening, the early morning is the best time to irrigate if an electric pump is used.

- **Application Depth/Irrigation Volume:** The total amount of water given is linked to the irrigation duration
- **Irrigation Interval** depends on
  - Grass species and development stage
  - Weather conditions
  - Soil type

It is important that the soil get wet deep enough so the whole root system can absorb water and nutrients.

An easy method to ensure that the field is irrigated enough, is digging a hole 2-3 hours after irrigation and verifying how deep the water infiltrated. A practical method to anticipate on over- and under-irrigation.

- Wait for 2 or 3 hours after irrigation
- Dig a hole up to the recommended depth (see irrigation schedule at page 47)
- Observe how deep the irrigation water infiltrated
- Dig a new hole each time
- Do the same to check if irrigation is needed
- No need to always dig holes. After a few months of practise, the farmer will know how many minutes of irrigation are needed for his grass and his soil.

1.3 Under & Over-Irrigation

Both lead to a drop in growth and production of the grasses. Grass can even die, especially seedlings.

UNDER-IRRIGATION: Not sufficient water is provided to the forage field

Reason?

- Too short irrigation duration
- Too long irrigation interval
- Too many valves open
- Too weak electricity

Check?

- It can be simply checked by digging a hole and observe how deep the water infiltrated
- Dry soil
- Clear wet circles on the ground at a distance from the sprinkler stick

Solution?

- Follow the guidelines and adapt slightly to soil, weather and crop conditions
- Increase the duration and decrease the interval

OVER-IRRIGATION: Too much water applied in to the forage field

Reason?

- Too long irrigation duration
- Too short irrigation interval
- After heavy rain

Check?

- Slow water infiltration
- Hours after irrigation, soil is still wet and muddy
- Depth of wet soil

Consequence

- Soil becomes too wet
- Oxygen amount in the root zone becomes limited
- Soil temperature will drop
- Leaching out nutrients

Solution

- Follow the guidelines and adapt slightly to soil, weather and crop conditions
- Reduce the time of irrigation. Never prolong the interval!

On **heavy clayey soils** or soils with a **bad water infiltration**, it is recommended to dig superficial trenches to drain an excess of water. The trenches are positioned from the highest to the lowest point of the field.

To conclude:

- Poor irrigation means not enough water and not enough nutrients reaching the grass roots. This leads to a serious drop in forage production and quality. In the long end, it results in less profitable dairy farming.
- On the other side, too much water in one time makes the soil too wet and will leach out nutrients. A water saturated soil lacks oxygen and the temperature will drop, leading to a slowdown in growth.
- **Follow the irrigation advice in terms of duration/quantity and frequency!**

2. Fertigation

2.1.Fertigation

Is fertilisation and irrigation at the same moment by dissolving the fertiliser in the irrigation water or by mixing the irrigation water with effluent from biodigester or barn

2.2. Bio-Slurry

Bio-slurry is the effluent that runs out of the biodigester after the anaerobic fermentation of manure. Besides macronutrients (N, P &K), it also contains important micronutrients (Magnesium, Calcium, Zink, Manganese ...) which are crucial for the growth and development of crops and animals. Furthermore, it contains a lot of organic matter what act as a soil conditioner and slow releasable nutrients. Research shows that bio-slurry contain significantly less pathogens and weed seeds than fresh effluent and manure.

The slurry can be easily mixed with the irrigation water. Since the organic matter is digested, it doesn't contain big pieces that can block the pipes and sprinklers. As a safeguard, the filter will retain any 'bigger' piece.

Note

- It is recommended to stop irrigating with effluent 10 days before harvest. Cows don't like grass that has an effluent smell/taste.
- Fertigation is best done in the evening to limit the loss of nitrogen by ammonia volatilisation

2.3. Storage of Bio-Slurry

The bio-slurry is stored in a **covered concrete** tank to prevent volatilisation and leakage to soil and water bodies. Use a concrete or wooden panel to cover.

Prescriptions for the concrete tank on page 9-10

If the field is far away from the house and biogas installation, the bio-slurry is collected in a covered concrete or plastic tank near the house and then transported to the field.

Transportation by

- Trench
- Pipeline
- Plastic tank on wheel barrow

Advantages of using bio-slurry through the sprinkler irrigation system:

- 'Free' high quality fertiliser
- Range of nutrients
- Soil conditioner: adding organic matter to the soil makes the soil structure better Roots can grow deeper plus optimal transport and holding of water and nutrient.
- Forages less affected by pests and diseases
- Uniform distribution of fertiliser
- Convenient use of the liquid fraction from the biodigester (limiting poor sanitation and environmental burden)
- Turning an intrinsic polluting waste product in a highly valuable resource

Result:

Healthy, highly productive dark green forages!

That is what dairy cows like

They will eat more => Intake of nutrients increases => Increase in milk production!

CHAPTER 4 MAINTENANCE

1. Pump Use & Maintenance

Read carefully and understand fully the pump instruction manual before use!

1.1 Application

- Use on a flat surface. Not on a slope. Not on a bumpy underground.
- As close as possible to water surface since the main function of the pump is to push the water
- Keep away from flammable materials. No smoking!

Note: Electric pump

Be aware that electricity lines and plugs don't come directly in contact with water

1.2. Connection of Suction Hose

- **Electric:** Iron hexagon nipple and iron bell reducer
- **Diesel/gasoline:** connected to hose nipple by hose bound
- The diameter of the suction hose is always bigger than the pump's suction port!
- Check that the suction hose is well connected and ensure that the end is in the water to avoid air infiltration

1.3. Priming Water

- Every time before turning on the pump, add water up to the priming port
- Don't let the pump run dry due to a lack of water. Always foresee water because pumping AIR will burn the pump.

Note

- Drain water after use
- Clean the pump filters regularly
- Beware of water hammering. Don't block (by putting heavy item on) the delivery hose or don't close the delivery valve abruptly. It will cause water hammering leading to breakdown of the engine

1.4. Energy Source

Electric pump

- Stable electricity
- Stabiliser to prevent electric pulses
- Electric lines: strong, not too long and not cut

Diesel/gasoline pump

Engine oil

- Check the oil level
- If the oil level is low, fill to the upper level
- Change the oil regularly

Engine fuel:

- Diesel/Gasoline
- Check the fuel level
- STOP the pump when refilling

2. Cleaning Filter

The use of a filter will overcome blockage of the pipes and sprinkler nozzles by holding obstructing pieces. Moreover, it avoids quick wearing of the pump and the irrigation system.

The filter needs to be cleaned after every irrigation application. A dirty filter slows down the water flow.

- Take a bucket with clean water
- Screw the filter box open
- Take the yellow filter piece out
- Rinse the filter by shaking it. In the meantime, rub with your hands over the yellow filter plates so they separate from each other. This will release the deposits
- Hit the filter slightly to the border of the bucket
- Repeat all these actions a few times
- Put the filter back in the black cover, click in and screw on. Check that it is closed properly!
- Iron-clogged elements at the filter can be removed with vinegar or diluted Honda battery acid etc.

Note

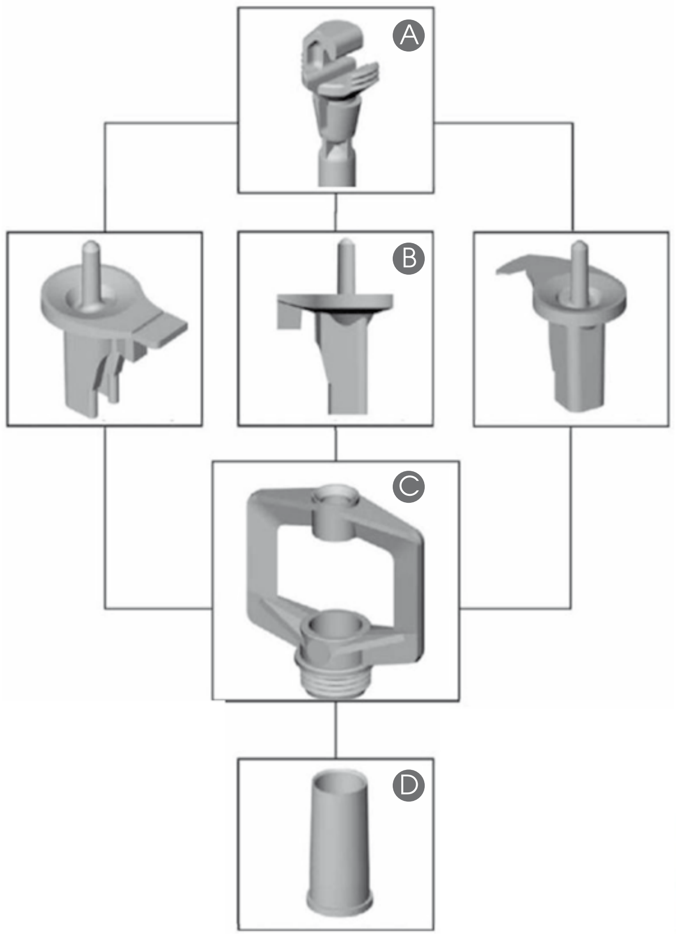
It will take 5 minutes to clean the filter compared to hours spend on unblocking sprinklers in the field.

What is wrong with the filter in the picture?

Filter needs to be urgently CLEANED in a bucket of water. The red color is a sign of iron-clogging. The percipitated iron can be removed with vinegar or diluted Honda battery acid ...

3. Cleaning Sprinklers

Inspect the field regularly on blocked sprinklers to overcome unequal water distribution



- Unscrew the sprinkler from the connector
- Remove the plug (A) on the top by pressing it together and pulling up
- Press the red cylinder (D) down and out the sprinkler
- Unblock the small opening in the red cylinder (D)
- Fit the red cylinder back in the frame (C)
- Place part B in the red cylinder (D)before pressing in
- Put the plug (A) back and press until `click'
- Screw the sprinkler in the connector again

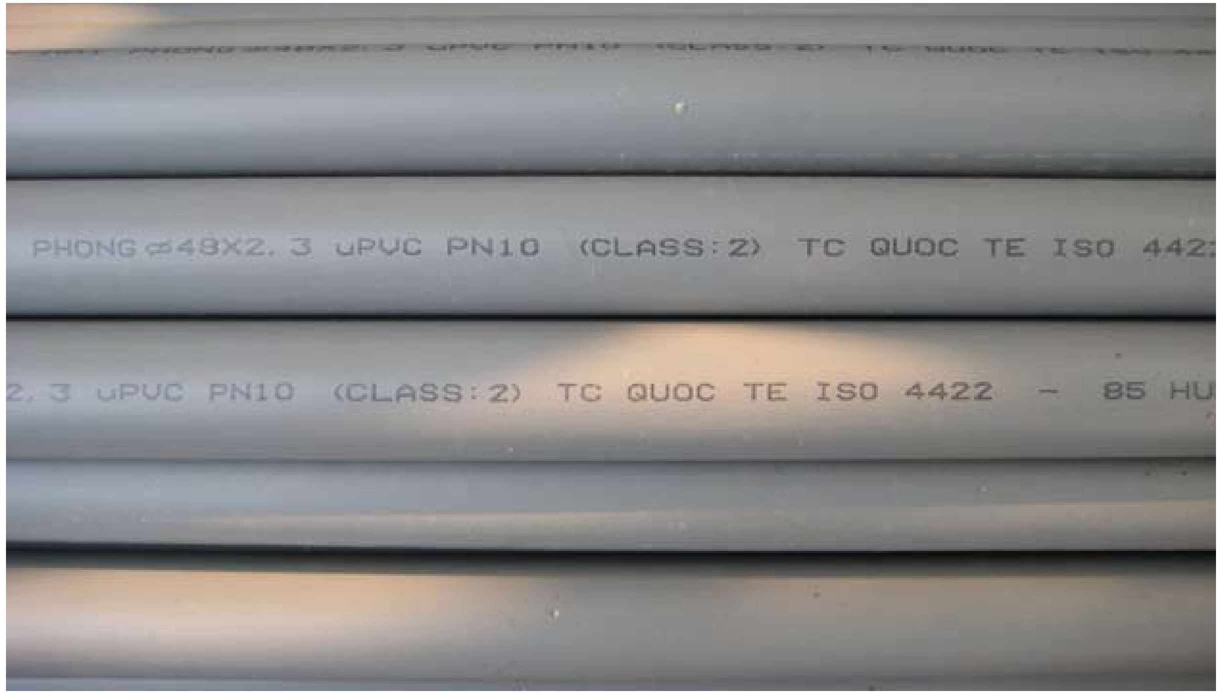
Note: Iron-clogging

Iron-clogged elements at the sprinkler can be removed with vinegar or diluted Honda battery acid

4. How to Avoid High Maintenance Costs

The investment cost of a sprinkler irrigation system is quiet high, about 9 million VND per 1000 m^2 or half the price of a milking cow. The use of high quality material and professional management of the system as well as appropriate irrigation and fertilisation management are more than a must! Some attention points and risks:

1. Use high quality materials, as class 2 PVC pipes of ʻTien Phong (Tiphoplast)
2. Follow closely the instructions for cleaning the filter, sprinklers and pump
3. Always use priming water when turning on the pump
4. Avoid to damage your pipes by ploughing, digging or riding over it by vehicles



Some related documents can be found on the Dairy Vietnam website
www.dairyvietnam.org.vn

- Complex designs
- Spreadsheets for calculation materials and set-up
- Interview with farmers using the sprinkler irrigation system (Milk Matters 3)
- Article clarifying the costs to set-up a sprinkler irrigation system (Milk Matters 3)

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