



**IRRIGATION  
TRAINING AND  
RESEARCH  
CENTER**

# Avoiding Common Problems with Drip Tape



**Drip/Micro CIG of the Irrigation Association**

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## **Irrigation Training and Research Center**

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## PURPOSE OF THIS PUBLICATION

The evolution of drip tape materials, drip tape emitter pathways, and hardware to connect, install, and remove/retrieve drip tape has been nothing short of phenomenal since the early drip tape days of the 1970's. Drip tape has been successfully used on millions of acres of cropland, often with phenomenal savings in water and improvements in crop quality and yields.

A major advantage of using tape materials, as compared to harder wall hose and emitters, is a low price per foot. But this tremendous advantage brings with it a higher sensitivity to physical damage. Precautions must also be taken to minimize problems with plugging the relatively small flow passageways of the emitters. This is not to say that problems will unavoidably occur with drip tape – but problems have occurred and they are often misunderstood or misdiagnosed.

This publication is meant to help farmers, dealers, and manufacturers recognize and understand some of the problems that have been experienced with drip tape – problems that are quite different from manufacturing defects. Problems that are quickly detected and properly identified can often be remedied, or be avoided in the future.

This publication is organized by the category of problems that have been encountered. The primary categories are:

- Insects, gophers, and other pests
- Installation
- Emitter plugging
- High pressure
- “Magnifying glass” or “lens” effects

*For further information:* Manufacturers can often provide excellent brochures related to irrigation system maintenance. The book *Drip and Micro Irrigation* is published by ITRC ([www.itrc.org](http://www.itrc.org)) and contains detailed information regarding maintenance, filtration, and other important issues related to drip irrigation.

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## IMPORTANT GUIDELINES FOR DRIP TAPE USERS

1. Drip tape is one component of a complete irrigation system. A complete irrigation system should have been designed by a competent designer and installed by a competent installer who included:
  - a. Proper filtration.
  - b. A means to frequently and adequately flush water from the ends of tapes
  - c. Sufficient injection points for chemicals that are required to maintain the cleanliness of the tape and emitters. These chemicals may include acids, chlorine, and various polymers.
  - d. Fertilizer injection points upstream of the filters.
  - e. Fertilizer injection equipment.
  - f. Pressure regulation to limit excessive pressures in the tape, plus to minimize emitter pressure differences throughout the field.
2. The grower and persons who are responsible for irrigation must understand the fundamentals of:
  - a. Proper adjustment of filter backflush.
  - b. Chemical injection for minimization of emitter plugging.
  - c. Proper fertilizer injection, including how various chemicals can be checked in advance for reaction between each other and with the water.
  - d. Tape flushing.
  - e. Installation, retrieval, and field repair of tape.
3. Pest control (insect, rodent, etc.) is required at all times for drip tape systems. Before installing a tape system, consult a Pest Control Advisor (PCA) regarding pest problems noted in this publication, plus other locally known pests. The pest problem must be solved before installing the tape.
4. Take care to protect drip tape from indiscriminate damage during handling, storage, etc.
5. After installation, immediately pressurize the system and check for leaks and proper pressures.
6. Cover tape with soil to prevent sun damage from plastic covering, to minimize expansion/contraction due to temperature changes, and to prevent the wind from moving the tape.
7. Only use well-designed installation and retrieval equipment that is free from burrs and rough edges where tape can come in contact with the equipment.
8. Avoid excessive pulling on the tape, which can cause tape stretching or breakage.
9. Install the tape so that the holes are pointed up; this helps minimize plugging.
10. Properly prepare the soil before installing the tape. Soil clods that sit on top of the tape can prevent water from traveling past that point. It may take days to soften the clods enough so that the tape can expand and allow water to flow into the rest of the tape length.

11. The rated flow seen on the tape roll is the average flow rate if all emitters are at the rates pressure that is stated on the new roll of tape (e.g., 0.22 GPM/100' at 8 psi). There are always pressure differences, and there is usually a pressure drop along the manifolds and tape downstream of a block pressure regulator. Therefore, if a pressure regulator is adjusted to the pressure on the new tape roll, the average pressure is less, and the average flow is typically less than the “rated” or “nominal” flow rate.

## ***Recognizing Problems***

### **Non-uniform wetting patterns**

Non-uniform wetting patterns at the soil surface are often not related to tape damage. Tape emitter flow rates may be very uniform, yet the wetted pattern on the top of the soil throughout a field may appear very erratic. This is especially noticeable with subsurface drip irrigation (SDI). Causes include:

- Varying soil textures throughout a field (e.g., sand vs. loam vs. clay)
- Varying installation depths of the tape.
- Varying soil compaction.
- Different soil chemistry conditions.

### **Water exiting from holes other than emitters**

This problem is easy to spot, but it can be difficult to identify the exact cause. Possible causes include:

- Insect damage. This publication contains photos and a discussion of this common problem.
- Rodent damage. Gophers and similar rodents can cause extensive damage with SDI.
- Rabbits and birds. These problems can appear on surface-laid tape.
- Mechanical damage due to handling (storage, transportation, installation, or retrieval).
- Mechanical damage while in the field, such as by workers, tractors, etc.
- Sunburn of tape under plastic mulch (“lens” or “magnifying glass” effect).
- Bursting of the tape due to high pressure in the tape.
- Manufacturing defects.

### **Non-uniform flows from emitters themselves**

There is no shortcut to knowing if the emitter flow rates are uniform. A sufficient number of accurate field measurements must be made, and this means that tape must be dug up. Two types of measurements are needed; the basics of taking these measurements are described below. If a person wants to use the measurements to calculate the “Distribution Uniformity” (DU) of water within a field, there is a specific procedure to use that is not explained here. Cal Poly ITRC provides an annual short course to train people on the procedures to determine DU on drip/micro systems. ITRC also has a software package to assist people in performing a Rapid Field Evaluation ([www.itrc.org](http://www.itrc.org)).

## ***Measuring DU on Drip Systems***

The two types of measurements needed are:

1. *Pressure measurements.* Pressure measurements must be made throughout the field, because the question is if there are pressure differences between emitters. All pressure measurements must be taken in the tape itself – not in PVC, oval hose, or lay-flat hose. Locations for pressure measurements are:
  - A. At the first hose in each manifold
    - A1. Beginning of the hose (upstream end)
    - A2. End of the hose (downstream end(s))
  - B. At the last hose in each manifold
    - B1. Beginning of the hose (upstream end)
    - B2. End of the hose (downstream end(s))
2. *Emitter flow rate measurements.* The objective is to determine whether there are differences in flow between emitters that all have the same pressure. Therefore, it is common to take emitter flow rate measurements at a minimum of three locations throughout a field. At each of the three locations, at least 16 individual emitter flows should be measured and recorded. The measurement locations can be described as:
  - a. In the middle of a tape (halfway between the tape inlet and the downstream end) near the filter.
  - b. In the middle of a tape in the middle of the field.
  - c. At the end-of-the-end. That is, the end of the last hose on the last manifold. This is usually where plugging problems show up first.

### **Equipment Needed for Measurements**

1. For pressure measurement, the general guidelines are:
  - Use a quality pressure gauge that is well-maintained. Those with an oil-filled case tend to have protection against pressure shock. A good pressure gauge typically costs at least \$50.
  - Use the proper range of pressure gauge. A 100 psi gauge is completely inadequate for measuring 8 psi, for example. The proper range for 8 psi tape would probably be 0-15 psi. However, some tape is over-pressurized, and if a 15 psi gauge is used on an 18 psi spot, the gauge can be damaged. Therefore, it is recommended that one start with a 0-30 psi gauge. Once the pressures are known, if more precision is needed one can use 0-15 psi gauges where the pressures are known to be low.
  - Install a pitot tube on the end of the pressure gauge.
  - Punch a hole in the tape, and then insert the end of the pitot tube into the tape – making sure that there is a snug fit and there is minimal leakage. Lay the gauge on the ground, facing up, and read the pressure.
  - Repair the tape with a good plug or coupling after removing the pitot tube.





**Figure 1. 30 psi pressure gauge with pitot tube stuck into tubing. Gauge is oil-filled.**

2. For emitter flow measurement, the general guidelines are:
  - First, place a loose piece of hose segment on each side of each emitter hole, to ensure that the water from each hole will not run down the tape.
  - Use 16 or more freezerettes or other similar plastic containers, to be placed under each emitter.



**Figure 2. Freezerettes lined up in preparation for flow measurement of individual emitters. Notice the pressure gauge in the foreground.**

- Collect water from each emitter for exactly the same amount of time. For drip tape, the minimum collection time is usually about 5 minutes. It is easiest to have 2 people available, so the tape can be lifted and placed over all the containers simultaneously.

- Measure and record the water collected in each individual container, using an appropriately sized graduated cylinder. Graduated cylinders can be purchased online from companies such as Gemplars ([www.gemplars.com](http://www.gemplars.com)). The appropriate size of graduated cylinder for medium and low flow rate is 100 ml. The appropriate size for the high flow rate is 250 ml. Typical volumes of water one might collect in 5 minutes are:
 

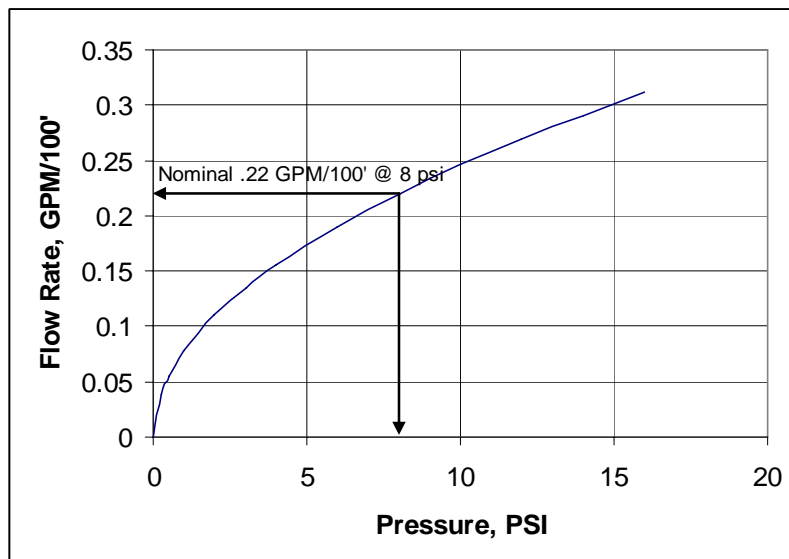
“low flow tape”	40 milliliters (ml)
“medium flow” tape	60 ml
“high flow” tape	80 ml
- Cut apart any emitters that appear to have unusually high or low flows. Carefully inspect the insides for blockage and wear, and try to identify any substances that you see.

## *Interpreting the Results*

- Pressure differences.* Large pressure differences do not necessarily mean there are large flow rate differences. Some tapes have pressure compensating (“PC”) features so that if the pressures vary but lie within a specified range, the emitter flows are supposed to be about the same. Most tapes have non-PC emitters that give 41% more flow if the pressure is doubled. That is,

If the flow rate is 8 ml/minute at 7 psi, the flow rate will be about  
11 ml/minute at 14 psi.

Once you know the pressures, consult with an irrigation expert to determine how the flows of the specific tape product you have should respond to pressure differences.



**Figure 3. Example drip tape performance graph**

Possible causes of pressure differences include:

- Improperly adjusted automatic pressure regulators
- Lack of sufficient automatic pressure regulators
- Malfunctioning pressure regulators
- Pipe/hose/tubing with small diameters
- Tape lengths too long for the diameter of tubing, flow, and slope
- Partial blockage of a pipe or tape

2. *Flow rate differences between adjacent emitters – with all emitters in a group having the same pressure.* The causes of emitter flow differences can be numerous. The observations of cut-apart emitter pathways are important in making the determination.

Possible causes of flow differences include:

- Root intrusions – especially in SDI
- Precipitation of chemicals, such as:
  - Calcium carbonate
  - Fertilizers
  - Gypsum
  - Iron
- Bacterial growth, including
  - Slimy bacteria
  - Sulfur bacteria
  - Manganese bacteria
  - Iron bacteria
- Dirt that has flowed through the filter, or that was in the pipes since installation.
- Manufacturing variation. In general, this is relatively minor (less than +/- 5% or so) with good tape products.

This publication contains a variety of figures that illustrate some of the plugging possibilities. A chemical analysis of the plugging material may be necessary in some cases to determine the source.

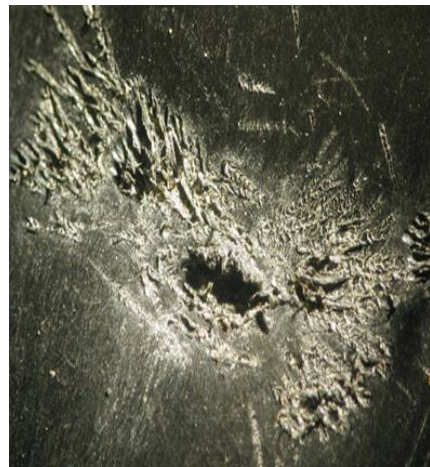
## PEST DAMAGE

### *Insects*

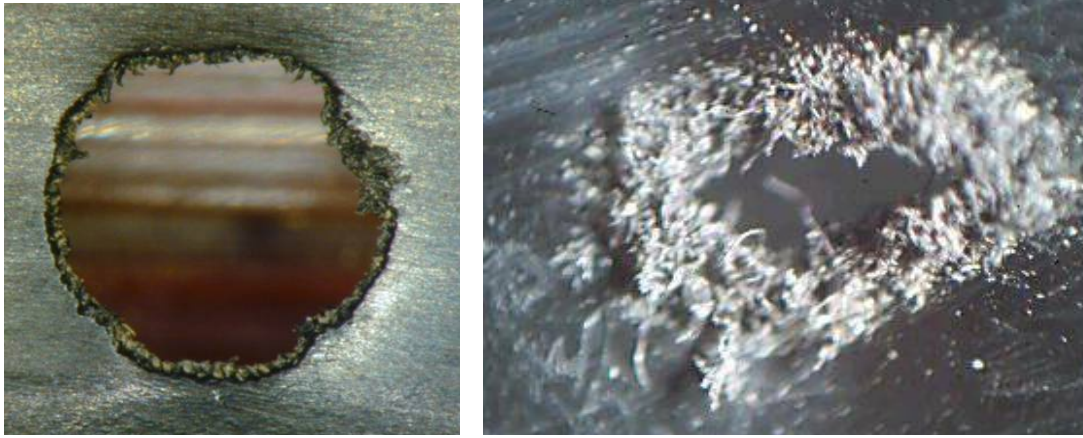
Guidelines include:

1. A qualified Pest Control Advisor should be enlisted to recommend the proper pesticide to use prior to installing the tape, where the pesticide should be applied, and the proper dosage.
2. Thicker tape is more capable of withstanding insect damage than thinner-walled tape. In some areas, 8 mil wall thickness has been sufficient to minimize insect damage. In other areas, 15 mil tape has been needed. There is no universal rule.
3. There are still many unknowns about insect damage, but the following practices have appeared to help minimize insect damage:
  - a. Pressurize the tape immediately after installation, to wet the soil
  - b. Practice crop rotation

The photos below illustrate insect problems that have been encountered. A qualified entomologist could identify the types of insects in the field.



**Figure 4. Examples of insect damage**



**Figure 5. Typical wireworm damage. An almost perfectly round hole is made in the tape. Frayed edges are also common with insect damage.**

## ***Rodents***

### **Gophers**

Gopher damage is not subtle. Gophers chew big holes in buried tape and hose. It can be troublesome to locate the damage because water will sometimes travel horizontally for some distance before rising to the ground surface. The author does not know of any easy cure for gophers.

If the downstream ends of the tapes are connected to a flushing manifold, the water will gush out of the hole from two directions. This helps minimize dirt from washing into the tape sections downstream of the cut.



**Figure 6. Surface water from gopher strikes on SDI tape**

## **Other Rodents**

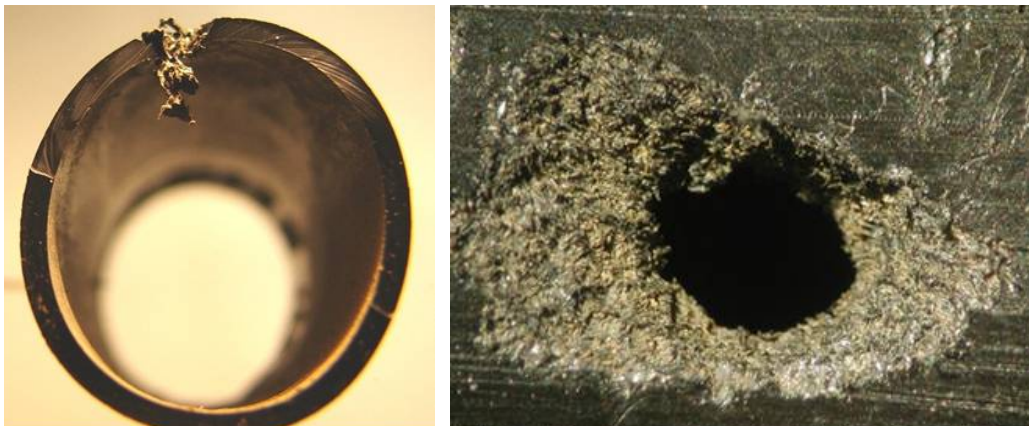
Sometimes rodents leave scratch marks on tape and hose.



**Figure 7. Examples of rodent damage, generally with characteristic scratch marks.**

## ***Birds***

Bird damage is relatively rare on tape, but it is more common on harder drip hose. In general, one can identify birds as the culprits because shreds of tape are poked inward.



**Figure 8. Bird damage on hose. The hole is typically somewhat concave inward. The example on the right is on thicker hose.**

## INSTALLATION DAMAGE

The most common installation damage is caused by burrs and rough edges on installation equipment. The result is sometimes a systematic, repeatable pattern to the damage.

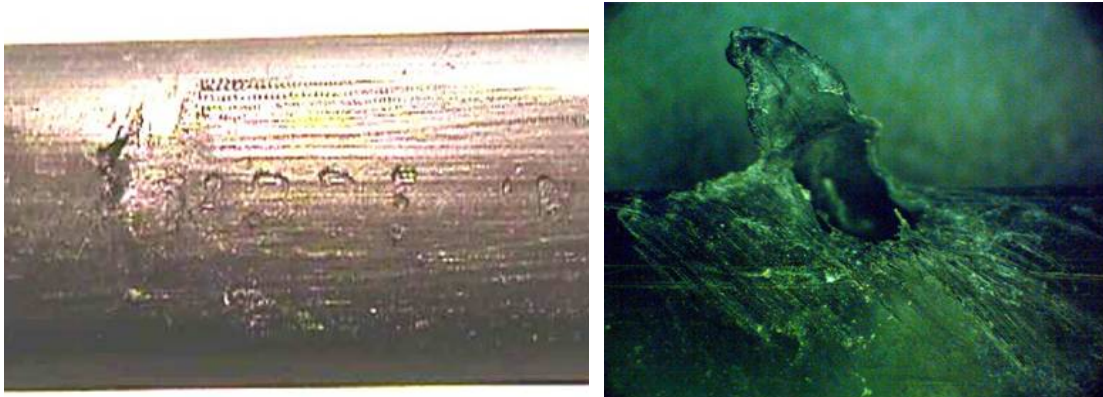


Figure 9. Equipment damage

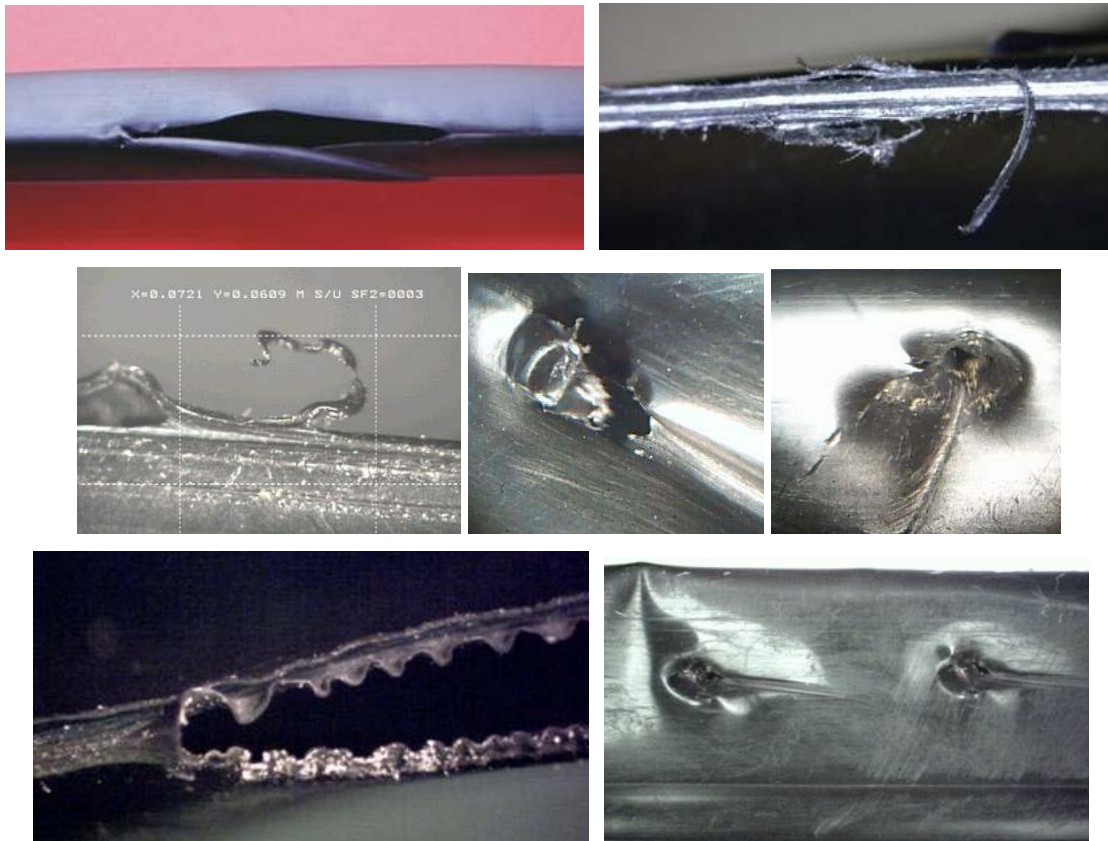


Figure 10. Installation damage to tape



**Figure 11. Leaks from mechanical damage. This tape had been retrieved and installed on 16 different crops when the photo was taken.**



## PLUGGED EMITTERS

### *Root Intrusion*

Quite often, root intrusion into emitters cannot be detected unless the emitter pathways are cut apart. The roots may be so fragile that they break off when the tape is unearthed.

Two common causes of root intrusion are:

1. Under-irrigation.
2. Partially plugged emitters due to other causes (e.g., dirt), which in turn causes under-irrigation near the emitters.



**Figure 12. Example of root intrusion**



**Figure 13. Root intrusion**

## ***Plugging Problems not Caused by Roots***

Considerable work has been done over the past 30 years to minimize plugging problems. However, plugging contaminants generally arise from three different conditions:

1. Material that moves with the water and plugs the emitters by itself, such as:
  - a. Sand or algae that is moving past filters. Filters should remove all sand and algae.
  - b. Material that was never flushed out during installation.
  - c. Material introduced with dirty chemical injection equipment.
  - d. Dirt that is introduced during a line break.
  - e. Chemical precipitates. This is very common, and can be caused by fertilizers interacting with one another, or by fertilizers interacting with the irrigation water. Calcium carbonate precipitation is also a problem.
2. Bacterial growth within the emitters. This may be simple slimy bacteria or bacteria associated with a mineral in the water (e.g., iron, manganese, or sulfur). Slimy bacteria are problematic because silts and clays (which are rarely removed by drip filters) will attach to the slime and increase the blockage.
3. Dirt that is sucked backwards into the emitter outlet if a vacuum occurs in the tape when the system or block is shut off. This problem is typically characterized by dirt particles lodged in the emitter pathway near the outlet. Interestingly, the blockage usually occurs 3 or more zig-zags inside the emitter path from the outlet.



**Figure 14. Extreme case of bacterial slime plus silt and clay plugging an emitter**



**Figure 15. Classic iron deposits**



**Figure 16. Plugged inlets to the emitter path**



**Figure 17. Dirty flush water. This is an indication of impending plugging problems**



**Figure 18. Extreme cases of chemical plugging**



**Figure 19. Chemical precipitate flushed from tape. The unidentified chemical compound was supposed to be a fertilizer. It was injected downstream of the filters and plugged a complete irrigation system.**

## “MAGNIFYING GLASS” OR “LENS EFFECT” DAMAGE

If plastic mulch is used on top of beds, water droplets on the under side of the plastic can act as magnifying glasses – concentrating the sun’s rays on small areas of exposed drip tape and burning holes in the tape wall.



**Figure 20. Damage due to the “magnifying glass effect”. Note the rounded edges.**

## **HIGH PRESSURE**

High pressures will cause the tape to balloon out and burst.



**Figure 21. Tape damage due to excessive pressure**