UBC Social Ecological Economic Development Studies (SEEDS) Student Report

An Investigation into Drip Tape Use for Annual Crops: 8-mil versus 15-mil Thickness

Kamil Kadziolka

Armin Maghsoud

Adam Brar

Andrew Rooney

Stanislav Zarud

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By: Kamil Kadziolka, Armin Maghsoud, Adam Brar,
Andrew Rooney, Stanislav Zarud

Source: Andrew Rooney at UBC Farm

Tutorial T2E: Carla Patterson

University of British Columbia
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ABSTRACT

Drip tape, an increasingly popular form of irrigation is being used world-wide including the UBC farm. This triple-bottom-line assessment will compare the differences in using 8 mil (0.2 mm) and 15 mil (0.4 mm) drip tape for UBC farm agriculture. Analyzing whether the single year use of 8 mil or multi-year use of 15 mil are the more viable option is the main focus of this paper. The lack of differences regarding the two thicknesses of drip tape and the fact that the UBC Farm must till the soil every year led to constraints on the paper. Through research articles, interviews with the UBC farm coordinator Andrew Rushmere and first-hand experience at the farm, enough information was gathered to form a conclusion. Some important findings included: the lack of disposal of old drip tape in the farm, less waste from the use of the 15 mil product and the similarities in the cost of both products. After processing the social, environmental and economic aspects of both size drip tapes, the 15 mil product was recommended as the better fit for the UBC farm.

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GLOSSARY

Percolation - the slow movement of water through the pores in soil or permeable rock.

Agriculture – the science, art or occupation concerned with cultivating land, raising crops, and feeding, breeding, and raising livestock; farming.

Irrigation - the artificial application of water to land to assist in the production of crops.

Drip Tape - thin plastic tubes which allow for water to slowly leak out and apply water to the surrounding area.

Biodegradable - capable of decaying through the action of living organisms

Polymers - a compound of high molecular weight derived either by the addition of many smaller molecules, as polyethylene, or by the condensation of many smaller molecules with the elimination of water, alcohol, or the like, as nylon.

Salination - the concentrating of salt in soil due to increased presence of water.

1.0 INTRODUCTION

Drip tape is a product that is used for irrigation. It allows for watering of specific, targeted areas with minimum waste. It was developed in the 1960's in America. Despite being over fifty years old, it has not become widely used until fairly recently. This new technology has ushered in a reform in crop irrigation. It allows for reduced water usage which is important in the present as the world is becoming more focused on resource conservation. There are many varieties of drip tape differentiated by emitter spacing, wall thickness and diameters. In this paper, we will consider the 8 mil (0.2 mm) and 15 mil (0.4 mm) wall thicknesses and decide which is the better choice based on our triple bottom line assessment.

2.0 ECONOMIC ASSESMENT

When comparing the 8 mil and 15 mil drip tapes with respect to cost, we considered all possible costs, such as: upfront costs, maintenance costs and disposal costs.

2.1 8 MIL VS 15 MIL DRIP TAPE

It is obvious to note that a 15 mil drip tape is much longer than an 8 mil drip tape. This therefore implies that the 15 mil one is bound to contain more energy and allow more fluid to pass through it per second. This is in contrast with the 8 mil drip tape. Hence, economically speaking, it is much better to have the 15 mil drip tape.[1] This paper shall analyze the economics of the two different sizes of drip tapes.

Under the cost of purchase, we truly discover that it is quite cost effective to therefore purchase the 15 mil drip tape; even though the 8 mil drip tape would be cheaper in cost. Hence, it would be imperative to consider other aspects such as durability and energy efficiency of the drip tape when considering the cost of purchase of the drip tape. According to Cummings [2], the cost of purchase is dictated by the efficiency of the drip tape. The maintenance of the 15 mil drip tape would be much higher than that of the 8 mils. What this therefore means is that for the 8 mil drip tape, the cost of maintaining it will be half that of the 15 mils.

On the other hand, the parts of the smaller drip tape would cost more using the principle of economies of scale. It is cheaper to purchase more or in large quantities than to engage in small unit purchase, which is often expensive in the long-run. While considering the disposal or recycling aspect of the drip tape, it is perhaps imperative to consider the length.[3] says that it is easier and cost effective to dispose a smaller size drip pipe than a longer one. On the other hand, length and costs means having no legal recourse for its disposal or rights as the state doesn't recognize an individual. In fact, it considers an individual as an impediment to the administration of justice.

Under the expected lifespan of the product, the 15 mil drip tape would last longer than the 8 mil. This is because the 15 mil drip tape is not prone to strong weather attack and has its entire tensile strength spread across the surface. It is thus important that the length dictates the

purchasing of the drip tape.[4] This would definitely be factored into the aspects of strength and durability of the drip tape.

In conclusion, it would therefore be wise to use the 15 mil drip tape since it would not only last longer, but also ensure that there is maximum energy for the tasks to be performed. The amount of energy dissipated by the drip tape is directly proportional to its length. The benefits are thus outlined in the physical aspects of the drip tape that translate into the economic aspect.[5] Hence, the 15 mil drip tape is bound to contain more energy and allow more fluid to pass through it per second. This is in contrast with the 8 mil drip tape.

We looked for drip tape prices online and took an average of a few offers. The average price per 100 feet was: seven dollars for 8 mil and ten dollars for 15 mil. If the 15 mil drip tape is used over two years on average, with additional maintenance costs, the price would amount to the same value on average as two years' use of 8 mil drip tape. If the 15 mil lasted longer than two years, savings would be incurred for the farm.

2.2 CONCLUSION

The two thicknesses of drip tape are not very different economically. If a price comparison is done, the average cost for each choice is about equal over a two year period. The 15 mil tape is more expensive upfront but it's lifespan is 2-3 times longer. The savings over time are offset by higher maintenance and operation costs. The economic assessment pointed to the 15 mil as being the better option for the farm at UBC, but only by a slim margin. The choice is largely because the farm gets free water from Metro Vancouver and if this was not the case, the differences would be negligible.

3.0 ENVIRONMENTAL ASSESMENT

Drip tape creates many environmental positives, but there are also some negative environmental aspects which need to be considered. This section looks at all of these effects.

3.1 8 MIL VS 15 MIL DRIP TAPE

The biggest environmental advantage of drip tape is the reduction in water use. Drip tape provides water directly where it is needed rather than uniformly watering everything to achieve the same result. This eliminates the need for the excess water, which gets wasted in the end. This environmental benefit, along with the added economic advantage of cutting water costs, is the main reason farmers use drip tape.

The main negative environmental effect of drip tape is the salination created by the application of water continuously to the same spot. Drip tape systems apply water by constantly dripping water onto the same spots. This creates an unbalanced water concentration in the soil which causes a downward flow of nutrients. This creates a "significant amount of salt accumulation on the edges of the wetted areas" created by drip irrigation.[6] To counter this, farmers must keep their farms at field capacity all the time. Some areas may even require more water than necessary, up to as much as 10-20% of total water application, to keep the salination away from the roots. The problem arises because the salination build-up still occurs; it is just away from the plants. This solution just increases the wetted area to reduce the impact on the farmer's plants. After the drip irrigation system is removed, the salination remains.[6] This can greatly affect the yield of the plants next put in by the farmer. Without proper treatment, the soil will remain salinated.

Currently, drip tape is not a very reusable material. Recycling and reclamation programs have been started in various places throughout North America, but because drip tape is a new technology, they are not yet accessible enough to all areas to be a viable option.[7] Drip tape is not durable equipment at all. It is made intentionally thin and as such it breaks easily. Patches are available which keeps the tape functional for longer, but after too many patches the irrigation system stops functioning and the tape must be replaced.[8] This creates a lot of excess garbage when compared to older irrigation systems which last much longer. An effective

recycling program would make drip tape a much more environmental product. Thin drip tape costs less money, but, predictably, must be replaced much more often. Eight mil tape must be replaced approximately every year, while 15 mil tape can be used for up to three years.[9] Because drip tape cannot be effectively reused and recycling is not a viable option, 15 mil drip tape is a much more environmental option.

Subsurface Drip Irrigation (SDI) has become an alternative type of irrigation to the more traditional types.[10] These traditional types involve everything from overhead aluminum sprinklers, to flood irrigation. Examining the environmental impacts of these systems can prove the benefits or faults of SDI. The UBC Farm uses a variety of irrigation types, the two main being subsurface irrigation and overhead sprinkler irrigation. Overhead sprinkler systems often have a main source point, and emit water from this point in varying directions.[11] Subsurface involves the use of drip tape, which is laid down under the ground and adjusted to the crops. Using water emitters, the water is then able to travel through the tape and be released directly to the root of the plant.[10]

When comparing overhead to subsurface, it is almost clear to see the differences between them. Subsurface is able to deliver water directly to the root, eliminating any chance of evaporation or percolation. This reduced water consumption is a key benefit to the water shortages being experienced world-wide.[12] There is also a reduced environmental impact from runoff and percolation of damaging chemicals and fertilizers.

The UBC Farm is debating whether to have a single year use of 8 mil drip tape, or possibly a 2-3 year use of 15 mil drip tape. The difference between 8 mil and 15 mil drip tape is the thickness. Thinner drip tapes are often used for temporary projects or single year use, where as thicker drip tape has a more permanent basis.[13] After evaluating both, 15 mil drip tape takes more resources to make and therefore produces more green house gases. Although the 15 mil may be more permanent and would require less drip tape being bought in the long run, it does pose a problem. The UBC Farm must pull out all the drip tape regardless of whether it would be 8 mil or 15 mil. At the end of the season, they must flip the soil and prepare it for the next year. Since the retrieval system for the drip tape is reliable and little to no damage occurs

when the drip tape is retrieved, there is not much difference in this aspect. The lack of storage for the drip tape at the farm makes it more viable to have the 8 mil. Drip tape is a recyclable plastic, but recycling is not an option for the UBC farm at this point in time. The environmental aspects concerning the two are very similar, but the 8 mil is the better option based on the manufacturing of it.

Drip tape has both negative and positive side effects as with any new technology, but as its use becomes more and more widespread, the negatives will become less pronounced. As recycling used drip tape becomes easier, that will eliminate the waste which is the biggest negative environmental aspect of drip tape usage. 15 mil drip tape also makes more sense in terms of environmental impact because it lasts longer. Rather than only one year of use, 15 mil lasts for 3 years which means less production costs on the environment. From an environmental standpoint, 15 mil drip tape is the best option.

3.2 CONCLUSION

The major breakthrough in deciding the more sustainable option for the farm at UBC came from the environmental assessment. The 15 mil drip tape is the better option because it produces 2-3 times less waste when compared to the 8 mil drip tape. This is a notable difference environmentally and will also save a lot of space at the farm, since they have no way of disposing of the tape in a sustainable way in the present.

4.0 SOCIAL ASSEMSMENT

“One has yet to come across a drip study that gives a concrete value of social benefit”.[14] Nevertheless, UBC’s push for sustainability can be seen campus wide, ranging from the design ideas concerning the new SUB, to the already established UBC Farm. The social aspects and how a certain project may affect the people involved play an immense role when considering various options. The following is a consensus on the social issues associated with using 8 mil drip tape versus 15 mil drip tape as irrigation for the UBC Farm.

4.1 8 MIL VS 15 MIL DRIP TAPE

When considering the social aspects of a product, it is important to consider if the producers used the triple bottom line theory.[5] In this theory, the consumer must think broadly beyond the cost of an item before making a purchase. Therefore, we will discuss how the production of these two drip tapes has affected the health of the users, ethical considerations, and social aspects of the community around UBC. At UBC, sustainability is very important in all aspects. There are many projects around the campus that focus on efficiency of waste, water and energy resources. The vision of the university is to adapt the green mission even in buildings such as the new Student Union Building. The materials used in building it must be those that preserve all the resources available. All of these ideologies are also applied to existing programs at UBC, such as the UBC farm.

From the ecological perspective, both drip tapes are made of polyethylene that is recyclable and may be used as plastic resins for reuse. The 8 mil drip tape has a smaller width on the laser cut outlet, so it drips slowly on to the ground. In lieu of this, it is efficient in the usage of water and the splash on the ground does not cause erosion or drain off nutrients and fertilizer from the soil. It is also operated at reduced pressure thus saves up on energy costs for the user. The 8 mil drip tape outlet is very narrow and if it not properly maintained, it may clog causing a health hazard. The area around the outlet may be a breeding zone for algae that has negative repercussions to human life.[2] On the other hand, the 15 mil drip pipe is wider so it uses a larger portion of the material. The 8 mil drip tape also consumes more water than the 15 mil drip tape and thus does not aim at water conservation. Both types of drip tape have a low capillary causing the salts to be drawn up to the surface making the soil barren.

These two drip tapes are installed manually so they have a positive effect on the economy as they create employment. The 15 mil drip tape requires experts to carry out a study on the land topography, soil structure and water availability before setting up the equipment. This is a job opportunity for UBC graduates who study agroecology or environmental economics. They have also allowed small-scale farming to take place efficiently and promoted greenhouse activities due their low water consumption.[15] The drip tapes allow the farmers to use biological effluents without the risk of contamination of rivers or springs. This is because the effluents such as animal waste used as humus are applied directly into the root zone through the tape's outlet. There are also reduced chances of irrigation system being corroded because of the plastic material used. Thus, the humans can cannot assimilate any of the corroded elements and their skin is unaffected by the acidity that arises from corrosion. On the ethical considerations, the drip tapes are made by companies such as Jain Irrigation Systems in the UK that operate in line with the International Labour laws.[3] There is no evidence of sweatshops as far as the drip tapes are concerned since the technology requires high skilled technicians. The company also has a supplier code that it is against all suppliers who deal in child labour or unethical practices.

The coyotes of the local forest pose a constant problem for drip tape use on the UBC Farm. Although at times damages can be minimal, repetitive maintenance on the system can affect the outcome of crop yields and make the work seem meaningless.[16] Since the 8mm is laid across the surface of the soil, the coyotes have easy access and therefore often chew the tape in various areas. The 15mm tape could be used as an alternative to offset these damages. Being able to leave the 15mm in the ground after each year and possibly placing it deeper could be an option for displacing these foreign damages. Of course this option is only viable for crops that allow for the drip tape to be deeper in the ground.

Drip irrigation is a much more environmental approach to farming. It saves water by directly putting water where it needs to be. This can lead to savings in money for farmers who don't have easily accessible water. But, besides economic and environmental considerations, there are also social considerations to consider when using drip tape. This section will discuss how the use of drip tape on the UBC farm affects the UBC community, which consists of the

students and staff within the university as well as the many other residents living on the campus. This section will also talk about the ways that the farming community, which includes farmers worldwide, can be affected by the use of drip tape at the UBC farm.

There is also an innovative program started in Honduras where used drip tape that large farms dispose of is bought by smaller farms and reused.[17] Drip tape is thrown out because it has been cracked and is no longer useful, but smaller farms need smaller pieces of drip tape so they are able to reuse the broken tape. By doing this, farmers create an environment in which they can benefit from one another. Larger farms can help out smaller farms and reduce their waste while smaller farms can save on irrigation costs. This can also create opportunities for smaller farms that cannot afford the start-up costs of drip tape to implement drip tape.

The UBC farm enjoys a fairly unique position in that it receives free water directly from the City of Vancouver.[18] But, this difference further illustrates the benefits of using drip irrigation. Most farms, by using drip tape, would be able to save on water costs.[9] By providing a positive example for other farms, the UBC farm can create a change in the way other farmers approach irrigation. The UBC farm, using new, sustainable technologies, can operate and maintain a profit without taking advantage of savings on water.

The conservation of our natural resources has become a social issue as much as an economic over the last few decades. Society has been pushing for more sustainable practices in all sectors of the economy. The agricultural sector has often been looked down on as wasting a lot of water. Drip tape can easily solve that problem. It can provide water savings from the very moment it is first used. It also gives farmers a peace of mind since an unpredictable such as a drought could force a large farm to quickly run out of water and watch its crops wither. With drip tape, the water reserves would last longer to allow more time to fetch more water or wait out the unpredictable event.

4.2 CONCLUSION

In conclusion, the drip tapes have taken agricultural practices a notch higher in terms of efficiency of irrigation. The choice in the width of the tapes to use depends on the user and the

factors he or she considers useful. It is clear that the technology and labour used is efficient and does not harbour any major negative effects to the users. The 15 mil drip tape is recommended for bigger operations such as the UBC farm, while the 8 mil is more useful is small home gardening practice. Many of the social effects are similar for both thicknesses of drip tape, but the 15mm allows us to explore a farm with fewer drip tape damages and less maintenance costs.

5.0 ADDITIONAL INFORMATION

Our sustainability group also explored other aspects of the topic we were researching and we found two additional options that can be considered as future possibilities.

5.1 BIODEGRADABLE POLYMERS

We interviewed Dr. Fernlund of UBC's faculty of Materials Engineering. He spoke about the process of using biodegradable polymers in plastic creation. The process included the melting of small nurdles into the desired shape. Then the possibility of using biodegradable polymers in drip tape was discussed. Dr. Fernlund's outlook was very positive. He said it was a very viable option, although the implementation of such a product had to be carefully engineered so that the tape would work as desired.

5.2 SUBSURFACE DRIP IRRIGATION (SDI)

Many of the social questions raised are applied to both the 8mm drip tape and the 15mm. Along with the implementation of subsurface drip irrigation (SDI), planning and design are crucial factors for an efficient and successful system. One social factor that directly involves the workers and volunteers of the farm is the creation of jobs associated with the design, planting and maintenance of both these drip tape systems. Although the 8mm drip tape is thinner and therefore more susceptible to damages, it can often create more jobs for the students of UBC. Fixing the flow of water through the tape and making sure the water is being uniformly emitted not only creates jobs, but brings people together to solve a problem in the social context. This helps the farm act as a community-based environment where people work together for a single cause.

The benefits of SDI can be seen on an economic and environmental scale, but also in an ethical sense. Ethics and human rights are displayed all over UBC, and the school takes pride

in creating ethical people through studies and learning. Both the 8mm tape and the 15mm reduce groundwater pollution by delivering chemicals and fertilizers directly to the roots of the crop.[10] This can be looked at as not only an environmentally friendly option, but an ethical one. Percolation from a more standard overhead irrigation system can cause many of those chemicals and fertilizers to run through the ground and cause pollution to other organisms, but with SDI, these chemicals are able to be absorbed by the roots of the plants and therefore less run-off occurs.[12] As water sources deplete worldwide, conserving our resources is becoming the only viable option.[11] Another great thing both these drip tapes do is save water compared to an overhead aluminum sprinkler system.[11] Again this can be examined in an ethical way, as the future generations must critically investigate ways to be wise with our water resources.

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