

Canada-Nepal Export Report: Pheromone Traps and Lures for Integrated Pest Management.

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AGR1110

Tuesday, December 1, 2015

The aim of this paper was to identify and evaluate the advantages and disadvantages of exporting pheromone traps and lures from Canada to Nepal. These are further explored within sections below. A great focus on the product itself and its characteristics is followed by information regarding its use. Companies involved and the benefits they stand to gain, both directly and indirectly, are explored and explained. Furthermore, an analysis of the labour required and the various costs involved are described following these sections. Lastly the data provided was used to make a recommendation on the viability of exporting the product and its benefits to Nepal and other developing nations as well.

Part 1: General information on Pheromone Traps and Lures.

i)Product Description:

Pheromone traps and lures are, in the simplest term, traps designed to attract a specific insect or insects with the use of pheromones, normally sex pheromones. The objective of this can vary. Pheromone traps can be used for detection of invasive pests, monitoring populations of pests and/or controlling pest populations through various methods (Eveden, 2011). Sex pheromones are how specific insects are able to find members of the same species. These are chemical messengers that females will usually secrete to attract males towards them in order to mate (Carter & Fraser, 2005). Artificial pheromones can be made to mimic the effects of natural pheromones and trick insects into traps that capture them. Normally the use of a rubber "septa" is the first step in making the trap as it is later placed in a sticky trap where the insects will get stuck (Carter & Fraser, 2005).

A huge range of insects exist that plague farmlands which is why there is also a wide variety of traps and lures available commercially. Natural Insect Control offers many

pheromone traps that can be used in the farm and attract many species of pests such as fruit flies. The advantage flying insect trap with fly banquet is one of their products and is suitable to be used in Nepalese farms as it is reusable and contains an assortment of pheromones to attract many species of insects out to a distance of 30 feet and costs \$24.99 for a kit (Natural Insect Control, 2015). This kit contains the trap along with bait and a liner.

Cooper Mill Ltd. is also in the pest management market and provides many moth traps along with fly traps. Moth traps are needed as moths are an issue for some Nepalese farmers. The Delta 1 Trap is the largest and one of the many available traps. It is very well suited for outdoor use as it is constructed from weatherproof plastic making it ideal for small fruit farms and it offers a replaceable sticky area of 350 sq. cm (Cooper Mill Ltd., 2015) that can be easily removed to examine the pests. It is suitable for both large and small moths, another advantage. Other traps from Cooper Mill Ltd include the Delta 2 trap, a smaller version of the Delta 1, the Black Stripe Trap, which uses both pheromones and a visual stimulus to attract moths and has proven to be 60% more effective than its standard competitors (Cooper Mill Ltd., 2015). It should be noted that, like all traps, these require maintenance and good care in order to maximize their efficiency. Many companies offer replacement parts for their traps at a low cost usually ranging from <1\$ to \$5 (Natural Insect Control & Cooper Mill Ltd., 2015).

ii) Company information:

Natural Insect Control (NIC) is a company based in Stevensville, Ontario. They are located 10.0 km south-east of Niagara Falls (NIC & Google, 2015). NIC was first established in

1989 as a family business with an eco-friendly mindset (NIC, Website, 2015). This can be viewed as both a disadvantage and an advantage. A small company like such can struggle to keep up with the large demand which is a problem, but it can also use the increase in demand for their product to expand and promote green alternatives to control and manage pests.

Cooper Mill Ltd. is recognized as an industry leader in the pest management sector with a reputation for its speed and reliability of supply of products in Canada and around the world. It was the first company in Canada, in the year 1986, to run commercial-scale trials related to pheromone mating disruption (Cooper Mill Ltd, Website, 2015). The company is currently located in Madoc, Ontario, one-hour east of Peterborough. With its already established reputation and expertise in pheromone and insect monitoring (Industry Canada, 2015), Cooper Mill Ltd. can show its potential and knowledge of pheromone traps and lures and attract new customers and enter the international market in countries that are less developed as an industry leader.

Table 1: Information regarding the companies involved.

	Cooper Mill Ltd.	Natural Insect Control
Number of Employees	2	N/A
Total Sales (CAN)	\$500,000 to \$999,999	N/A
Export Sales (CAN)	\$1 to \$99,999	N/A
Contact Information:	31 Hastings Road, RR #3. Madoc, Ontario. K0K 2K0. Phone: 613-473-4847 Website: http://www.coopermill.com/	3737 Netherby Rd., Stevensville, Ontario. L0S 1S0. Phone: 905-382-2904 Website: http://www.naturalinsectcontrol.com/

Table 1: Above is a description of Cooper Mill Ltd. in terms of employees and sales. The information was taken from the Government of Canada, Industry Canada, Canadian Company Capabilities website and the Ontario Ministry of Agriculture, Food and Rural Affairs [OMAFRA], Pest Monitoring Equipment Suppliers list webpage.

iii) Labour costs and inputs required:

Labour in Nepalese farms is relatively cheap and abundant for processes like land preparation and seeding at a rate of 300-400 Nepalese rupees a day (\$3.76-\$5 CAN) (International Potato Center [CIP] & Nepal Agricultural Research Council [NARC], 2013). These values can be used to estimate the costs of installment and upkeep of pheromone traps and lures for integrated pest management (IPM) practices. Canadian scientists will be needed at first to interpret data gathered and assist in using the information as effectively as possible to determine further steps. These being the monitoring or controlling of the populations of pests, the step to be taken would be determined by local farmers along with scientists.

Raw materials needed to implement traps can be bought cheaply or made from household items. The exact materials needed is dependent on the type, size and location of the farm and the pests present. Nonetheless, a general list can be devised. The traps themselves can be bought from local Canadian suppliers for export to Nepal, a wide variety should be chosen to ensure most pests can be covered and dealt with. Ropes or wires are needed to hang them in appropriate places above ground (OMAFRA, 2005), these materials can be obtained in Nepal for lower costs. Wooden stakes to place the traps on are optional but

could prove to be beneficial. These can either be made by local farmers or a market to provide stakes could be created.

iv) Proper use of traps:

It should be kept in mind that pheromone traps and lures should not be the only method employed for pest management and should be used in conjunction with other practices (OMAFRA, 2005). They can be a useful tool, if used correctly, to determine conditions regarding pests in a farm and the data gathered should be used to determine what methods should be used to minimize pest problems such as pesticides and the use of natural predators (CIP & NARC, 2013). According to OMAFRA, CIP and NARC, traps for common pests should be placed according to the table below:

Table 2: Appropriate placement of traps for common pests.

Pest	Separation	Height	Trap line placement
Oriental fruit moth	40m	1.2-1.5m	Edge to interior
Grape berry moth	40m	On second wire	Varies with site. A guideline of 10m within the infestation source is recommended.
Leafminer fly	1/500 sq. m.	Varies with site	Carried around field.

Constant monitoring and some maintenance will be required, this should be done twice weekly (OMAFRA, 2005). Dirt, undesirable insects and leaf bits are most likely to get inside the traps and impair their use, if this were to happen the medium (pheromone infused liquids or sticky coatings) used to catch pests or the whole trap should be replaced with a

new one. Most pheromone lures in traps will come with a replacement time but if it is not specified it should be assumed they last a length of 6 weeks on average (OMAFRA, 2005). Appropriate handling and storage is very important. Lures must be kept inside their package sealed until they are ready to be used, they must also be refrigerated according to the manufacturers specifications. Lures should be taken out of their package and left to sit for a few days prior to use in traps as the pheromones tend to release a “flush” when the package is first opened that will attract undesired insects and corrupt the data making interpretation more difficult (OMAFRA, 2005). Once they are in use it is essential to be able to identify the targeted pest.

v) Market opportunity and benefits to Canada:

Currently there is not a well established market for pheromone traps and lures focused towards agricultural use, specifically the in the pest management sector. The Pest Management Centre (PMC) is a partnership between local and federal governments and the crop protection industry whose goal is to improve the accessibility of tools with a reduced-risk to crop protection (Agriculture and Agri-Food Canada, PMC division, 2015). Their current programs focus only on pesticide use and risk reduction (PMC, 2015). This leaves an opening to a new market based on pheromone traps and lures to be used in conjunction with current projects in order to reduce pest populations and pesticide use as they are both correlated.

By creating a market that works alongside the current ones, jobs would be created and secured. The existing industries would integrate the pheromone trap market ensuring it has a well established beginning. This would also help manufacturers of the products and

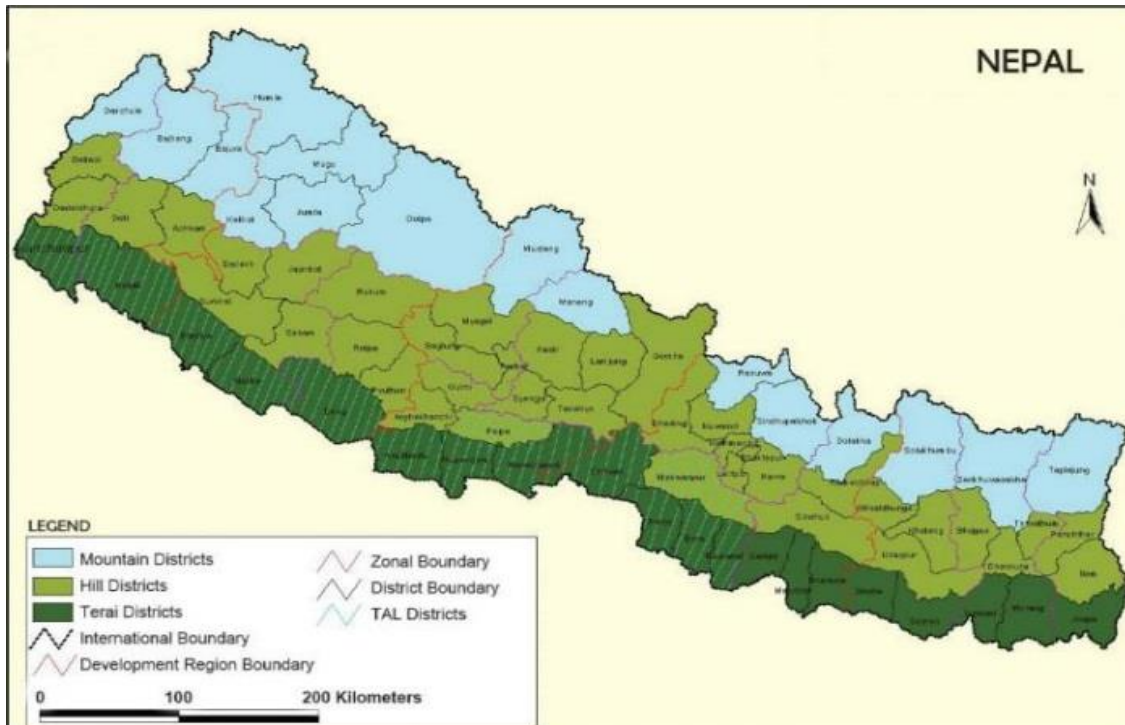
promote local businesses already established. Overall, the Canadian economy would receive a boost in stability and give rise to new opportunities.

Part 2: Export Potential to Nepal:

i)An introduction of Nepal:

Nepal is a small, landlocked country located between India and the Tibet region of China (Encyclopaedia Britannica, 2015) with an area of 147,141 sq. km. and a population of 27 million (T. Chapagain, lecture notes, AGR1110, September 18, 2015). It is a physiographic and culturally rich country housing 8 of the 14 highest peaks in the world, and the birthplace of Buddha. The country is divided into three major Agro-ecological regions classified according to altitude, crop and livestock systems: The Terai region (23% of land), the Hill region (42%), and the Mountain region (35%) (T. Chapagain, lecture notes, AGR1110, September 18, 2015).

Figure 1: The different districts Nepal is divided into.



These regions are popular for their produce and landscape. Terai produces the largest quantity of small grain crops due to its sub-tropical climate. Its climate also allows for tropical fruit production such as mangos and pineapple, fresh vegetables are also produced in this area. The Hill region employs a terrace farming system where maize and millet production is very common. Fruits, cash crops and vegetables and vegetable seeds are also produced. In the Mountain region crop growth is very limited by the climate and altitude making the food deficit in this area very large (80%) (T. Chapagain, lecture notes, AGR1110, September 18, 2015). The sole crops that can be grown are barley, buckwheat and potato.

The GDP as of 2014 was \$19.64 billion (US\$) (World Bank, 2015) with a growth of 5.5%, representing a low income level. The Agriculture sector employs over 70% of the

population and accounts for 38% of their GDP (T. Chapagain, lecture notes, AGR1110, September 18, 2015) making it their most important sector and form of revenue for individuals. This sector faces many challenges that impair its growth, some being poverty (25% below poverty line), high costs of farm supplies, low labour availability, illiteracy resulting in stunted technological growth and cultural barriers (T. Chapagain, lecture notes, AGR1110, September 18, 2015).

ii) Needs and Benefits to Nepal and Nepalese Farmers:

Increasing IPM practices in Nepal is essential to the development of the country, both for its economy and population. The increased use of pheromone traps and lures in IPM practices would not only benefit the farmers but also their families and local men and women labourers. This is seen presently in coffee farms where pheromone traps have increased the ability of producers to deal with the white stem borer, a severe threat (Feed the Future [FTF], U.S. Government's Global Hunger and Food Security Initiative [USGGHFSI], 2013). Women have also benefited from the extra revenue generated by IPM practices which is used to buy clothes for children, pay for schooling and in some cases build housing (FTF, USGGHFSI, 2013). It is clear that increasing the use of pheromone traps would contribute to current IPM practices in Nepal and create more jobs and revenue for labourers therefore increasing the quality of life of individuals. This increase in revenue will allow farmers and members of society to help each other out financially in order to buy more materials such as pheromone traps (FTF, USGGHFSI, 2013).

Farmers that have not yet started to use IPM strategies stand to gain the most benefits.

Potato producers face many pests that plague their crops and dramatically reduce their yield

and profits. Below some common potato pests in Nepal and the losses they represent is represented along with a visual representation of the damage caused:

Table 3: Common potato pests and damage caused by them.

Potato Pest	Pre-harvest damage (%)	Post-harvest damage (%)	Yield Reduction (%)
Potato Tuber Moth	Below 5 initially	Between 40 and 100	Up to 100
Leafminer Fly	Some foliage damage	N/A	Greater than 20
White Grubs	Between 20 and 80	N/A	Up to 80

This chart was retrieved from the CIP and NARC training guide for extension officers.

Figure 2: Damage in foliage and tubers from the potato tuber moth.



Leaf damaged due to mining larvae

Tuber infestation in field

This image was retrieved from the CIP and NARC training guide for extension officers.

Figure 3: Foliage damage caused by the leafminer fly.



This image was retrieved from the CIP and NARC training guide for extension officers.

As it can be seen these pests represent a serious problem if they are not dealt with accordingly. Some farmers have already begun employing IPM practices, including the use of pheromone traps for monitoring purposes.

Table 4: Monitoring of various pests with IPM practices:

Potato pest	Trap used	Observation period	Insects captured
Potato tuber moth	Pheromone trap	24 hours	20 per trap
Leafminer fly	Sticky trap	24 hours	5 per trap
Cotton boll worm	Heli-pheromone trap	24 hours	5-6 per trap

Information retrieved from the CIP and NARC training guide for extension officers.

The gathered data can be used to assess the pest situation in a farm and help farmers determine which insects they should target at a given time effectively reducing unnecessary use of pesticides and chemicals that would have no effects on managing pests. From information this an income analysis can be formulated. Using sticky traps for leafminer flies instead of current practices can result in a net income increase by 1.58 times (CIP, NARC, 2013). This method can be used for other crops in the same way to achieve similar results.

iii) Targeted market and potential setbacks:

The individuals targeted would be low income farmers that struggle to maintain stability in crop yields. The relatively low cost of pheromone traps compared to the use of pesticides would promote the use of these and increase the demand. This would be the first step to getting the producers on track towards a better life and crop quality allowing for more profit and the use of more sophisticated methods. Women who work in farms can also be targeted and given jobs in the labour section of the project.

Refrigeration is one of the most severe drawbacks to pheromone use. Most packs come with instruction specifying that the product must be refrigerated properly before use (OMAFRA, 2005). This is a problem as most low income farmers do not possess the ability to keep them cooled accordingly and sometimes lack electricity as a whole making refrigeration impossible. A high cost is also associated as refrigerators are not a cheap commodity for the targeted market.

Neighbouring countries such as India and Bangladesh have also employed IPM practices (USAID & VirginiaTech, 2014) with pheromone traps and pose a danger to the market in

Nepal. Lower product costs as a result of decreased exportation costs can be achieved from these countries creating a more enticing offer than Canadian products.

An IPM Innovation Lab (IPM IL) project led by USAID and partnered with other associations is already in motion in Nepal with similar goals (USAID/Nepal, 2013). This can be viewed as established competitors in the eye of Canadian investors resulting in a decreased interest in establishing a market. They can also be viewed as partners with expertise in the area, if they are willing.

iv) Transportation logistics:

Transportation for Cooper Mill Ltd. and NIC would consist of moving the product to Pearson International Airport, Mississauga, ON, through either train or trucks mediated by a company like FedEx. From there, aerial transportation to the city of Kathmandu, Nepal will follow. Due to its central location in the Hill region trucking companies based in Kathmandu can distribute the product to many areas nearby where local markets for agricultural products are located. These would be businesses that already conduct business with local farmers effectively making the farmers come to the product. The use of “runners” from the businesses straight to farms can also be implemented in order to create more jobs.

v) Recommendations, unknowns, and conclusion:

As it currently stands, pheromone traps and lures for IPM practices have a great potential to better the low income agriculture sector of Nepal. However, obstacles such as refrigeration and transportation costs must be overcome to make this a reality. Canadian products are just too expensive after transportation and shipping costs are taken into consideration

making the acquisition of them hard. Neighbouring countries with pheromone traps already in use and production like India and Bangladesh (USAID & VirginiaTech, 2014) would be more suitable in terms of exportation and low costs. Extending research and aid would be an area where Canada stands to make a difference and further research should be focused on this. Relationships with the public should also be looked into to strengthen relationships with the marketing sector, ensure the needs of the people are met, and show the benefits of pheromone traps and lures. Future research should also put an emphasis on the export and import barriers as the information needed for this product was not available. The overall focus of this paper was to identify the potential benefits Nepal stands to gain from increasing the use of pheromone traps and lures in IPM practices and evaluate current pest issues plaguing the country and the farmers.

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