Gum Arabic via a Canadian Trading Company for Coating of Rhizobium Inoculants on Legume Seeds

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Introduction

Through the discretion and guidance of Professor Manish Raizada a class of over 115 Introduction to the Agri-Food System 1110 students have developed ways to create jobs in Canada while helping to advance the Nepalese agriculture system. All research projects will be made available for review to anyone internationally.

Part 1 Product Info

Product description

Legumes are notable in the plant world for their ability to fix nitrogen, through nitrogen fixation (Grow Organic, 2009). These plants can convert nitrogen from the gaseous form found in the air, which is unattainable by crops, and can transform it into a plant usable form (Daramola et al., 1994). The additional nitrogen gained by the plant can be used for plant growth (Grow Organic, 2009). For this to happen a bacteria known as rhizobium bacteria must be inoculated onto the legume seed prior to planting (CSU, 2013). The symbiotic relationship between the plant and the rhizobacteria is what allows the nitrogen fixation to happen (Deaker et al., 2004). One of the best suited inoculants has been found to be gum arabic (Temprano et al., 2002). Gum Arabic could be purchased as a raw product and sold to Nepal for the application on to the countries legume seeds.

Product Information

Gum arabic is one of the most widely used and traded soluble gums and is also an adhesive (FAO, 2014). The Gum Arabic Company, located in Sudan, was granted an exclusive succession to export raw gum arabic in 1969 but this was recently retracted in order to open up the market (IDE-JETRO, 2009). 80% of all gum arabic production occurs in Sudan, under The

Gum Arabic Company name, which approximates to 30,000 to 40,000 tonnes worth of exported economic gain (FAO, 2014). Production of gum arabic is concentrated within a 520,000 square kilometer radius of central Sudan, commonly known as the gum belt. The gum is procured from the acacia tree by tapping, and can be harvested after 5 weeks. Following the 5 weeks it can then withstand 15 day intervals of collection (FAO, 2014). An average stock of 15,000 tonnes is maintained at their Port Sudan location where it is then shipped to approved clientele (IDE-JETRO, 2009). The Gum Arabic Company owns 60% of The Khartoum Gum Arabic Processing Company, located in Port Sudan, which maintains the warehousing and quality testing of the gum arabic (IDE-JETRO, 2009). This company has a fully equipped laboratory and operates a modern processing plant at the port. The gum arabic can be processed in a powered form or kibbled form depending on the order preference (IDE-JETRO, 2009).

Company Information

This product would not be available to the Nepalese marketplace without the investment of three companies. The first company is Agrocorp International of Vancouver, Canada. Located at Suite 390 – 375 Water Street Agrocorp houses one of its head offices with the other located in Singapore (Agrocorp, 2014). Agrocorp is focused on building their rapidly expanding logistical networks, and consolidating growth in new market regions (Agrocorp, 2014). Bulk purchases are the company's specialty and ensuring competitive prices are one of their priorities (Agrocorp, 2014). The professionals at Agrocorp International can be reached by telephone at (604)-681-8675 and by fax at (866)-337-4559.

The second company that will be dealt with will be the Gum Arabic Company of Khartoum, Sudan, Africa. The GAC is the world's largest producer of gum arabic, and takes pride in the exportation of their clean grade product (IDE-JETRO, 2009). The company currently

has 500 employees with a total sales volume of $50 Million - $100 Million USD (IDE-JETRO, 2009). If needed the company can be reached by telephone + (249) (1) (83)-462111, 461960; and by Fax: + (249) (1) (83)-467923, 461960.

The third and final company is Anubahv International. An importer of agriculture, confectionary, fertilizer, furniture, plant and medical products (Business Portal, 2014). Anubahv would be the Nepalese company in which the gum arabic would be imported by. Established in 1990 Anubahv deals with exportations to Asia, Europe, the Middle East, and South America with an approximate $1 Million CAD turn over (Business Portal, 2014).

Cost

Gum arabic prices depend on a multitude of different factors such as time of year, location of harvest, and location of trader (World Bank, 2007). As seen below there are two breakdowns of the value chain of Gum Arabic.

Annex 2A. Gum Arabic Value chain Kordofan

Value Chain for Gum Arabic (Acacia Senegal - Hashab)
(based on information in Um Rwaba Village - North Kordofan at end February, 2006)

	Jan-06		Feb-06	
	Sd/kantar	$/ MT	Sd/kantar	$/ MT
Price received by producers from village trader	13,000	1256	17,000	1643
Price received by village trader at Um Rawaba market	13,500	1304	17,500	1691
Costs at Um Rawaba market (flat taxes per kantar)				
Locality tax	200	19	200	19
Zakat	1,300	126	1,300	126
Natl. Forest Corporation levy	600	58	600	58
Wounded soldiers levy	50	5	50	5
Sub-total	2150	208	2150	208
Cleaning and Grading by Um Ruwaba trader				
Labor	100	10	100	10
Management etc	10	1	10	1
Buildings etc	100	10	100	10
Jute bags	75	7	75	7
Sub-total	285	28	285	28
Cost ex trader store per Kantar purchased	15,935	1,540	19,935	1,926
Cost ex trader store (compensated for 25% weight loss)	21,247	2,053	26,580	2,568
Cost ex trader store assuming 15 percent profit	24,434	2,361	30,567	2,953
Transport from Um Ruwaba to GAC in Khartoum	300	29	300	29
Total cost for trader (including profit) in Khartoum	24,734	2,390	30,867	2,982

Source: (World Bank, 2007)

Annex 2B Gum Arabic Value Chain Blue Nile

Value Chain for Gum Arabic (Acacia Senegal - Hashab)
(based on information in Damazine - Blue Nile at end June, 2006)

	Feb-06		May-06	
	Sd/kantar	$/ MT	Sd/kantar	$/ MT
Price received by producers from village trader	20,000	2020	18,000	1739
Price received by village trader at Damazine	20,500	2071	18,500	1787
Costs at Damazine market (flat taxes per kantar)				
Locality tax	200	20	200	20
Zakat	1,600	162	1,600	162
NFC levy (50% NFC / 50% State)	1200	121	1200	121
Wounded soldiers levy	125	13	125	13
Gum Arabic Union levy	250	25	250	25
General Tax (GNU 60% and State 40%)	350	35	350	35
Crop Marketing tax (state)	250	25	250	25
Sub-total	3975	402	3975	402
Cleaning and Grading by Damazine trader				
Labor	500	51	500	48
Management etc	10	1	10	1
Buildings etc	100	10	100	10
Jute bags	100	10	100	10
Sub-total	710	72	710	69
Cost ex trader store (without profit) per Kantar purchased	25,185	2,544	23,185	2,258
Cost ex trader store (compensated for 25% weight loss)	33,580	3,392	30,913	3,010
Cost ex trader store assuming 15 percent profit	38,617	3,901	35,550	3,462
Transport from Damazine to GAC in Khartoum	400	40	300	29
Total cost for trader (including profit) in Khartoum	39,017	3,941	35,850	3,491

Source: (World Bank, 2007)

It is evident that the gum arabic that was purchased from the Um Rwaba Village of Sudan in 2006 was the cheapest option with a $959/MT difference between the two February values. The labour cost for the grading and cleaning of the gum arabic by the Damazine trader had a variance from $48-$51 in the Blue Nile chain to only $10 by the Um Ruwaba trader in the Kordofan chain. Transportation costs in May 2006 for the Blue Nile equaled that of the Kordofan transportation which was a $29 cost, while the month of February totaled at $40/MT. The input costs made by Agrocorp international would vary depending on what the trading and transport costs were within the gum arabic production chain that month. An estimation of cost could be anywhere between $2300-$4000/MT for the purchase of the gum arabic from the GAC Port Sudan location.

Patents

Currently there is a US patent, now held by Novozymes Bioag Inc of Wisconsin, which was filed on June 26, 1996 (United States Patent, 1999) by the inventors R. Stewart Smith and Robert M. Osburn of Wisconsin. This patent license clearly states in the claim section that any seed that is coated with the use of a carbohydrate that is essentially of gum arabic would be considered their product (United States Patent, 1999).

Market Opportunity

The market for the gum arabic would be considered niche within Nepal due to that fact that only 16% of the land is considered arable (CIA 2014). In comparison to the large population, every farmer would have a small amount of land in which to plant his crops. Currently there is no direct supplier of gum arabic for the use of inoculation of legume seeds within Nepal (Joshi et al., 2012). This is a perfect opportunity for a company to establish a connection with the farmers and become the sole provider of the gum arabic. The only issue would be there is not an enormous demand due to the fact that the farmers only have a small amount of land that the crop can be planted on (RPP, 2014). There are two directions that this product could take. The first being that the seed distributor would sell the seeds inoculated with the gum arabic powder already applied, or the seed distributor could sell their seeds and the gum powder as an additional product.

Benefits to Canada

Gum Arabic is a speciality product that is primarily grown in Africa (UNCTAD, 2013) and because of this Canada will not be producing a specific product. For the purpose of this project a Canadian trading company can be used to export the product from Africa to Nepal.

The use of Agrocorp International as the Canadian trading company involved in the trade of the gum arabic to Nepal will be beneficial to Canada for multiple reasons. This company will be able to develop two new global trading partnerships. The first partnership would have to be established with the Gum Arabic Company of Sudan, whom of which is the largest exporter of Gum Arabic (IDE-JETRO, 2009). This would also ensure that Canada would have a share in the African economy. Secondly Canada would need to partner with a Nepalese seed distributor such as Anubahv International (Business Portal, 2014). Partnering with Nepal is essential for the success of this product. The use of gum arabic as an inoculant is still a niche market which means that there will not be a major competition in the marketplace, making the three companies involved the sole producers and distributors of the gum arabic as an inoculant. If needed a trained professional from Canada could be hired by the Anubahv International company to be in charge of inoculation if the proper technique has not yet been perfected in Nepal. Several inoculation techniques are available such as dusting, slurry, pelleting, and vacuum impregnation (Deaker et al., 2004). The seeds can be inoculated by farmers immediately prior to use or by custom inoculation through the seed distributor that can be used within a week of inoculation (Deaker et al., 2004). If the product does well and farmers are satisfied with the results that they receive on the crop it would bring positive attention to Agrocorp International, and their ability to source and provide a quality product to its customers. This use of marketing

Legume inoculation techniques

Technique	Description
Seed inoculation	
Dusting	Peat inoculant is mixed with the seed without re-wetting
Slurry	Seed is mixed with a water solution of peat often with the addition of an adhesive
Lime or phosphate pelleting	Seed is treated with a slurry peat inoculant followed by a coating of calcium carbonate (superfine limestone) or rock phosphate
Vacuum impregnation	Rhizobia is introduced into or beneath the seed coat under vacuum
Soil inoculation	
Liquid inoculation	Peat culture mixed with water or liquid inoculant applied to the seedbed at the time of sowing (liquid inoculants may also be applied to seed)
Granular inoculation	Granules containing inoculum sown with seed in seedbed

Summarised from Brockwell, J., 1977; Bio-Care Technology Pty. Ltd. Inoculant Brochure 1998; Thompson, J., 1988).

for the company could lead to business growth for Agrocorp International. This new growth will lead to foreign money entering Canada which will benefit the Canadian economy, as well as benefitting the Nepalese people with a way in which to better grow legumes.

Part 2 Potential to Nepal

Nepal

Landlocked between China and India, Nepal has a land size of a little over 147,000 km^2 (CIA, 2014). Nepal is known for the beautiful Himalayas, including Mount Everest (CIA, 2014). Nepal also has a Terai or flat river plain area in the south and a central hill region (CIA, 2014). The major agriculture products produced within Nepal range from rice, corn and wheat as well as root crops and water buffalo meat (CIA, 2014). With 75% of the population in the agriculture labour force this means that over 2,324,023 individuals have an impact on Nepal's agriculture (CIA, 2014). Farmers in Nepal are limited from agricultural inputs, modern technologies and technical knowhow (Joshi et al., 2012). Because of the lack of agricultural productivity, Nepal faces food shortages which severely affects the nutritional needs of the residents of Nepal (Joshi et al., 2012).

Needs and Benefits to Nepal

Following behind rice, wheat, and maize, legumes are the fourth most important component of the local Nepalese diet and are an established crop within the agriculture sector (Maskey et al., 2001). Not only are legume crops beneficial to the Nepalese diet but the legumes are also valuable resources for the soil (Brockwell and Bottomley, 1995). Grain legumes are able to fix the atmospheric nitrogen that resides in the soil, this is done through a process called nitrogen fixation in association with the symbiotic rhizobium bacteria (Mauromicale et al. 2005).

The rhizobia create nodes that are packed with thousands of the rhizobia that are constantly working to fix the nitrogen within the plant (Burdass, 2002). Crop yields are greatly improved in nodulated plants due to the fact that they have the ability to live and grow in poor soils because the rhizobia are fixing the nitrogen (Amarger, 1981). This is especially useful in the diverse Nepalese terrain. Post-harvest the remaining roots decompose and release nitrogen in the soils. The nitrogen can be recycled by the plants that are planted in the same location the following crop season (Elegba and Rennie, 1984). This process is called natural fertilization (Burdass, 2002). In order to enhance the rhizobia it is common practice to inoculate the legume seed with numerous studies having shown that gum arabic is one of the most beneficial inoculant coatings as it produces a greater number of infected root hairs, and nodules (Rao et al., 1971).

Cost Analysis

Business/Step	Markup %	Cost per Ton
Um Ruwaba Trader		$2,300
Agrocorp Purchases	25%	$2,875
Shipping (estimated).		$2,500
		$5,375
Sold to Anubahv Int.	11.63%	$6,000
	$6000/ton = $6/kg	
	20%	$7.20/kg
		$180/25kg bag
		25x40bags=$7200

Anubahv	Total Profit:	$1,200
Agrocorp	Total Profit:	$625

The variability of quality, availability, need for high concentrations (15-40%w/v) and cost have all limited the use of gum arabic as an inoculant adhesive (Deaker et al., 2004). As shown by the cost breakdown above, the use of gum arabic as a niche product is very expensive for the

Canadian company that is exporting the product to Nepal. A 20% markup was chosen for the Nepalese seed distributor because of the inputs that are required to purchase the product, $6000. From here the seed distributor could sell the gum arabic as is to the farmer for their own personal use, or most likely they will coat their seeds with the newly purchased gum arabic. This will make their seeds more expensive but more valuable. 24.8% of Nepalese people are living below the international poverty line by only earning $1.25 per day (Unicef, 2013). The issue of money is very much present in the Nepalese economy. The price of the product is relatively expensive for farmers at $7.20/kg and $180/25kg bag. It may be more cost efficient for farmers to purchase the pre-inoculated legume seeds. It does not seem efficient for a farmer to purchase a 25kg bag when in reality the chances that it will be entirely used would be slim, and the gum arabic would be wasted.

Marketing

The need for coated inoculated seeds may be unknown by the Nepalese farmers and it would be in the best interest of the agriculture company that will deal with selling the inoculated legume seeds to create an information package to distribute to the farmers. The information would be in an easy to read context (refer to image to the right) to enable the best understanding to the prospective buyers of the gum arabic coating. It is extremely important that the farmers realize that by using the coating technique on the legume seeds they can save money, increase yields, and improve their soil quality for future crops they wish to plant (Stephens and Rask, 2000).

Regional and Global Competition

Company/Supplier	Location	Weight	Minimum Order	Cost
Henan Boom Gelatin Co., Ltd.	China (Mainland)	25kg/plastic woven bag	1 Metric Ton	$1,320-$6,700US Per M/T
DA LIAN HONGLU Chemicals Co., Ltd.	Liaoning China (Mainland)	25kg/plastic woven bag	32 Metric Ton	$4.5-$5.5US per Kg
Continental Star Impex General Trading	United Arab Emirates	25kg/plastic woven bag	10 Metric Ton	$1,600 - $2,400US Per M/T
Organic Crops Export Co. Ltd (Abnaa Sayed Elobied Agro Export)	Sudan (Port Sudan)	50kg/plastic woven bag	20 Metric Ton	$1,800-$2,200US Per M/T

There are many different companies throughout Asia and Africa that deal with the exportation of gum arabic (Alibaba, 2014). All the companies seem to have similar price ranges with nothing lower than $1,300 USD. The Organic Crops Export Co. Ltd is the only company that has a legitimate product from Sudan, where the GAC is also located. The GAC does not have distinct prices available so it could be assumed that the cost would be relatively similar to those of the Organic Crops Export Co. Ltd.

Unknowns

With any agricultural product there is the daunting possibility that crop yield could be affected by a multitude of factors such as poor weather and growing conditions (Ballal et al.,

2005). If crop yield was affected then the gum arabic available to the market place would decrease and the price for purchase of the product would increase. Something like this is an unknown factor in the market place because we cannot assume how the crop yield will carry out month to month due to the variables. Another unknown would be the actual amount of gum arabic that is available for purchase. A majority of the gum arabic is used in the beverage and confectionary industries (Elmgvist et al., 2005). Currently peat is the most commonly known inoculant that is used, with gum arabic primarily being used in research studies, but due to the current positive results given by the peat gum arabic my not ever make it to the marketplace as a commercial inoculant (Albareda et al. 2008).

The cost of gum arabic is another contributing unknown factor of whether or not Nepalese farmers will be interested in the product. It has been shown that seeds coated with approximately 800mg of the gum arabic adhesive produce over 10^6 viable rhizobia and more than 100 nodules per plant (Elegba and Rennie, 1984). The per seed price, with an application of 800mg at the $7.20/kg rate, would be $0.06. What we do not know is how many seeds will be needed by each farmer. Also because the pricing from the table above is only an approximation, exact figures were not available, this cost could be much higher than anticipated. Further investigation into proper pricing is needed for an accurate proposal. Further research on what areas of Nepal are most successful with the use of the gum arabic inoculant would also be an advantage.

Coating legume seeds with an inoculant is something that the farmers may not be fully aware of so testing of the product and also word of mouth will be an asset to the success. If the farmers are not satisfied with the gum arabic they will not purchase the product and the trade partnership will be discontinued.

Conclusion

The use of gum arabic as a legume seed inoculant is a beneficial investment to the Nepal agriculture sector if utilized properly and efficiently. The key to this product being successful within Nepal would be the education and information aspect of the gum arabic inoculant. Inoculating the rhizobia bacteria is extremely important for crop growth and soil health (Brockwell and Bottomley, 1995). Without nitrogen fixing bacteria the crop yields would not be as high and the farmers would also have an added expense to fertilize the soil for the following growing season. The extra money that farmers spend on buying the gum arabic coated legume seeds would be considered costly. Eventually if a more cost efficient way to transport the gum arabic into Nepal for inoculation purposes could be found it would cause the coated seeds to become more affordable to the farmers. Once this happens the money spent on the gum arabic inoculated legume seeds would eventually turn into savings and profits because of the increase of crop they can sell or trade, and of course the savings on the fertilizer (Anup and Subin, 2015). What is best about this product is that it not only benefits the Nepal eco-system, opposed to using harmful environmental chemicals (Lupwayi et al., 2000), it is a benefit to the Nepalese economy. In conclusion gum arabic is an inoculation coating for legume seeds that Nepal could benefit from but a thorough look at the cost and production system would have to be evaluated before the product could be properly utilized in Nepal.

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