

Challenges and Tribulations in the Commercialization of New Crops: Aromatic and Medicinal Plants

James E. Simon*, Elton Jefthas**, Petrus Longenhaven**, Marianna Smith**, Erica Renaud*, Rodolfo Juliani*,
Mingfu Wang*, Noah Zimba***, Dan Acquaye****, ChungHeon Park*****†, Ilya Raskin* and Pierre Tannous*

* ASNAPP and the New Use Agriculture and Natural Plant Products Program,
Department of Plant Biology and Plant Pathology Cook College, Rutgers University,
59 Dudley Road, New Brunswick, NJ 08901, USA (www.asnapp.org; www.nuanpp.org)

** ASNAPP, University of Stellenbosch

*** ASNAPP, Lusaka, Zambia

**** ASNAPP, Accra, Ghana

***** National Crop Experiment Station, Rural Development Administration, Suwon, Kyunggi, Republic of Korea

The introduction of new crops into any region, or the cultivation of otherwise wild crafted plants can be a significant benefit to the growers, processors and rural communities (Halloy, 1999; Small, 1999; Janick and Simon, 1990; Janick and Simon, 1993). Whether the interest is in the diversification of their agro/forestry systems or to explore increased market and economic options, successful introduction of any new crop requires a purposeful market-driven strategy which includes careful consideration and detailed studies on the plant of interest and its biology and natural products, the development of appropriate sustainable production systems, harvesting and processing requirements, and marketing factors that ultimately lead to the development of a new product for sale.

Those involved in new crop development have long recognized the difficulties in the commercialization and the multitude of obstacles that arise during the introductory phase. New crop introduction has been described as a "Catch-22" phenomena where buyers first require reliability of product supply, reliability of product quality and delivery schedule for contractual relationships to commence, while growers first need a real market prior to scale-up and absorbing such a risk to generate the sufficient product quantity (Simon,

1993). Several general difficulties are recognized and include the following: With aromatic and medicinal plants, botanical authentication is critical and refers to more than simply correctly identifying the genus and species (Simon, 1999). Rather, it also involves ensuring that an acceptable genotype is grown and introduced into cultivation. The often lack of adequate research prior to the commencement of commercialization and the lack of adequate sustainable harvesting systems from the wild, sustainable production systems and the ability to link the systems through and into the market chain can create difficulties and risk. These commodities, when originating from non-domesticated plants, will lack uniform and standard product quality often by definition, and between the typical high variability in the genetics of the species coupled with variation associated by production and environmental factors obtaining a consistent product is challenging. Given the multitude of challenges in new crop introduction, six different functional models of crop commercialization for aromatic and medicinal plants will be presented for consideration. They include: (1) Improvement of the traditional aromatic and medicinal crop(s) in a region or the methodology employed in its production and processing; (2) Introduction of new herbs,

† Corresponding author (Phone) : 031-290-6727, E-mail : parkOhc@rda.go.kr
Received 11 October, 2002 / Accepted 30 October, 2002

medicinals and botanicals from one region into another, or from the wild into cultivation, based upon market demand or other needs; (3) Introduce a Crop Clustering Concept; (4) Identify new Uses of Traditional or Current Aromatic and Medicinal Plants; (5) Identify New Uses of New Aromatic and Medicinal Plants; and (6) Focus on Developing a Contractual Out-Grower Scheme for Pharmaceuticals and Specialized Botanicals. From a market perspective, several models of natural product commercialization can also be discussed and two of these include the: (7) Buyer-Industry Driven Model; and (8) Crop Champion Model.

Model 1: Improvement of the traditional aromatic and medicinal crop(s) in a region or the methodology employed in its production and processing.

Here, each country has a range of locally and national produced herbs, spices and medicinal plants. Some of that industry is based upon fresh products; others dried (such as your famed Korean ginseng products); and others are produced for extract and the pharmaceutical industry. This model addresses the opportunity to improve your own varieties based upon a variety of traits including but not limited to: disease resistance, cold tolerance, higher yields of the fresh and dried product, higher yields of the targeted natural products of interest; other characteristics. There would be great opportunity for those herbs and medicinal plants now collected from the wild, or even the ones that have been recently introduced into cultivation but not yet selected for uniformity to be further domesticated. Significant progress in a sort time period can be more easily achieved with non-domesticated plants. New chemotypes of aromatic and medicinal plants would be included under this model. Such improvement has always been a basis for the horticultural industries around the world.

Model 2: Introduction of new herbs, medicinals and botanicals from one region into another, or from the wild into cultivation, based upon market demand or other needs:

The movement of herbs, spices, aromatic and medicinal plants from one country to another, from one continent to another provide an excellent and

rapid model for new crop introduction. Given changing demographics in the USA and in particular in the state of New Jersey (just south of New York City), we have significant populations of Koreans who are first generation now residing in the USA. In addition, significant population clusters of Arabic, Chinese Hispanic, Indian, and Russian are now found in New Jersey. As a consequence, there is increasing demand for the foods, flavors and spices of their home countries. For dried products, this can be accomplished easiest by simply shipping over the product, but for the fresh market fruits, vegetables, and herbs, this is a tremendous opportunity for local growers. Commercial seedstock from the targeted country can be purchased and the new crops field-grown and evaluated. If the plants are adaptable to the new region, of continued interest to the targeted community to purchase, the consumers and commercial growers can serve as the prime market movers. We often notice that the introduction of new varieties from another country lack insect and/or disease resistance needed when growing in the new region. While this is not unexpected, the improvement of the new crop still requires time, resources and a committed plant-breeding program. Varieties developed under different environmental conditions and introduced into a new region may also have some unexpected difficulties. Melons developed as dry semi-arid areas and which perform very well under dry growing season have been observed to collapse under times of heavy rainfall. New introductions need to be evaluated prior to large-scale introduction and commercialization. The commercialization of your indigenous plants for ornamental, food, flavoring, or for medicinal purposes is an exciting area to consider. The development of lesser-known aromatic and medicinal plants may have strong economic potential. Case studies from North America and from sub-Sahara Africa will be highlighted here. We also have recently begun an ethnic food produce program where fruits and vegetables from China, India, Korea, central Asia (for the Russian population), and Latin American are being evaluated in New Jersey.

Model 3: Introduce a Crop Clustering Concept.

The introduction of a new botanical product also

need not be pursued as a single new enterprise, but in regions and countries where multi-cropping is the norm, or in a combined agro/forestry system, the consideration of a crop cluster should also be considered. Here, crop clusters refer to the growing (in fields or forest) of several plants simultaneously to reduce grower risk, to enhance the number and nature of products that would then become available to the grower/community, and to provide more than one crop that could generate income and/or food/fiber/fence posts and other useful products to improve the quality of life. As many the growers and rural communities are small-scale, resource limited, their capacity to absorb risk is also limited. Given the volatile nature of the marketplace, the use of crop cluster can be a strategic vehicle used in the commercialization process as it offers to the community and grower a multitude of food and staple crops, several species for other uses, and new cash crops to supplement their traditional cash crops. The crop cluster therefore is a strategic vehicle used in the commercialization process and brings together multiple crops that are compatible with the existing agricultural or agro/forestry system. These crops share certain characteristics and therefore are easier to introduce together. The criteria for selection of crop clusters and the use of such crop clusters are now reviewed.

Criteria for Selection of Crop Clusters:

There are no fixed criteria for the selection of these crops as every situation is different. Final selection should also be made in a participatory manner with the growers or community involved. However, the basis of the selection processes must be market driven and/or needs driven by the community. The profitability and the economics of production and the overall contribution of any non-sale items must all be considered. Not all crops selected need to be more profitable than traditional crops normally grown in the area. But, if the new crops are not more profitable the benefits of their introduction must be carefully discussed with the community as the introduction of any new management technique, any new crop all brings risk, and involves time, dedication and work- additional resources to obtain

the same financial end often are not successful. Some crops are selected for strategic purposes so as to teach the grower and impart skills and training to her/him that would be required for them to move across into other potentially profitable crops in the future. Not all crops have to sources of natural products- or botanicals in this case. Rather a botanical vine needing a trellis could just as easily grow-up a needed fruit tree or shade tree that later becomes a source of timber for housing or fence posts later. Each crop should, if possible, have multiple purposes or end products- an extractable essential oil, a dried leaf or bark product and eventually after a destructive harvest the wood could be used for fuel or fencing. While there are many considerations in the selection of species that could be included in the development of a crop cluster for a rural community that is based upon the introduction of botanicals, here are a number of factors to consider:

- **Environmental Compatibility:** The cluster of crops should require similar agro-climatic conditions
- **Cropping Cycle:** Here, crops are selected to represent a combination of annuals, bi-annuals, and perennials linked to common markets and distribution chains but whose maturity from seeding to harvest are compatible in that one follows another thus bringing in a saleable product early-on to help in the cash flow, followed by others that are spread over time. This also allows crops to use as much as possible the same labor, equipment, tools in a compatible manner. New crops such as botanicals that would need to be harvested at the same time as traditional cash crops would be less likely to succeed, as growers will place all their attention and time toward their main cash crops.
- **Intercropping:** Species selected would ideally be suitable for intercropping with existing crops; with new food/fruit/timber species and/or with each other. Annuals growing with perennials can work fine, crops with varying growth habits, heights, maturities can be intercropped. Botanical vines can be planted with fruit, nut, timber or trees used for medicinal purposes.
- **Use:** Species can be selected based upon their use or application, such that excess product can be used by the local community for their own health

and/or use. This could include teas, spices and culinary herbs, traditional medicinals and aromatic plants, essential oils, and other non-timber forest products.

- **Difficulty or Ease in Introduction:** A balance needs to be considered between ease/difficulty in establishment and introduction; time to maturity and harvest (e.g. one year to many years), and a recognition that some crops or potential crop plants will require a different level of investment and production inputs versus another. These technical aspects must be considered along with the profitability and market potential. Crops with exceedingly promising value, or value-added potential may script out well but in practicality under a particular agricultural environment, may represent a very high risk relative to another like crop that offers less potential value but is easier and more likely to succeed with less inputs. Inputs here can be considered to include training, seeds and/or plants, and new technology.

- **Crop compatibility:** Crops that require similar management, planting, harvesting, and drying/processing equipment are more considered compatible and reduce the training, cost, and expense. Crops, whose end products are the similar (leaves vs. bark vs. roots vs. extractable essential oils) could also cluster well together as they would utilize many similar techniques and for value-added components, use similar technology helping to amortize investment costs across a wider range of crops/business enterprises. Clustering of crops in this category and into compatible ongoing agricultural enterprises would minimize disruption of scheduling, and spread the income generating activity across several crops and over a wider time frame, thus potentially increasing the efficiency of the overall operation, enhancing profitability and generating cash income or products of kind over a wider time frame than with what may occur with growers selling one to two traditional food crops over a narrow market window.

- **Technology:** Crop clusters must be considered not only from the production of the plant and the associated technologies in such production, but also in the range and nature of technologies needed in the

harvest, processing and packaging for sale of the product(s). The tools and equipment needed to efficiently harvest roots, tubers, bulbs, and rhizomes are different and distinct from those needed to harvest bark, flowers, or leaves. The tools or equipment needed must be available locally or regionally, and of low cost or easy to manufacture from local materials. Access to tractors and modern equipment for larger-scale agriculture and one that focused on a more monocultural orientation require very careful consideration, and may not be found to be as acceptable and desirable in all areas. To minimize investment, crop clusters again should be considered for similar requirements in technology. For example, with essential oil crops, most are extracted using hydrodistillation, a few from steam and even fewer from solvent technology. A few are processed using high pressure CO₂ extraction. What types are acceptable for market entry and what technologies impact market price and acceptability? Selecting those essential oil crops that could be processed using hydrodistillation would minimize investment and allow for a number of like products to be grown and processed over time by the same operators. Many botanicals require drying technologies and the range of dryer types for tropical and subtropical areas are well know and have been characterized. The considerations then are which are most compatible to use within a particular micro-region and which have already been introduced, if any, into that region.

- **Crops that are Culturally Acceptable:** In some countries, there may be crops that would appear from an economic analysis and market assessment to have great promise, but may not be as acceptable from a cultural perspective. Gender issues surrounding certain cropping and farming practices should also be considered. Exotic crops with a limited market and which are not indigenous to the region may not be as accepted by a local community for a variety of reasons (no prior knowledge or understanding of the crop; poor understanding of why it is being grown; may require extensive training; may require inputs that are excessively technical; may require too long of a delay to get the harvestable product to market). The issue of agricultural credit is difficult in many

countries around the world and to attempt to get agricultural credit to finance an exotic crop enterprise may be even more difficult even close to your own growing area.

- **Socio-Cultural Concerns:** In many countries, crops should be selected in part so that they support, rather than detract or compete with, the traditional income generating activities. Gender issues here too (as cited above) should be considered. Will the woman and children of a village still handle the new crops? Will men be required? If the needs of the crops require a differential gender involvement how will that impact the family and the village? How does the introduction of a set of new crops impact the production and marketing of the traditional crops— from a labor and management perspective?

- **Environmental/Conservation Concerns:** Species that are useful for environmental reasons (e.g. vetiver as a source of essential oil plus a powerful soil stabilizer to reduce soil erosion, and planted along highway banks and roadways); legumes which fix nitrogen; others which as trees may enhance the environment and soil stabilization all should be incorporated. In contrast, introduction of exotic or indigenous plants into cultivation but in a manner that continues to contribute to the degradation of the environment and the community should be avoided even if the market potential and economic aspects appear promising. Alternatively, the introduction of such plants in a manner that is sustainable, and still provides economic returns to the community should be actively pursued. In the case of cinnamon, leaves from young plants can be periodically harvested in lieu of destructively cutting down the tree for the first few years, and then when the bark is needed, the trees can be harvested in such a manner that permits regrowth and a sustainable harvesting system that preserves the land and the crop. In this way, altering the traditional manner in which a crop is grown to be more sustainable and more profitable to a community can provide an excellent model.

- **Market Characteristics:** Species, which have similar marketing channels, should be considered. Leaf teas are marketed in one way, essential oils in another. Alternatively, a same crop or a mix of

crops and plant products could enter different markets including local, regional, and international.

- **Economic Impact:** A fundamental in all crop cluster strategies is what is the economic and socio-economic impact of that cluster? This is often a most difficult question to answer. Growing a crop for sale is easy to track, but including into that mix fruit, nut, timber trees to provide the local growers and communities additional benefits is more challenging to document. What cluster is the right mix to minimize risk, provide a short and longer-term strategy for sustainable development? How is the impact of replacing wild collected medicinals with cultivated materials? The cultivated materials may certainly enhance the economic livelihood of those growers, but are they the same individuals as the collectors? What then happened economically to the collectors?

Model 4: Identify new Uses of Traditional or Current Aromatic and Medicinal Plants:

This model examines the new uses of traditionally known aromatic and medicinal plants. Cinnamon bark has long traditionally been used as a dried spice and source of highly aromatic essential oil, rich in cinnamic aldehyde, used in foods, perfumes and still grows wild. In contrast, essential oil extracted from the leaf contains a distinct oil, rich in eugenol. Both products can be commercialized, and done in a manner that allows the sustainability of the tree even when used for the bark. New classes of compounds from many herbs are being explored¹ to examine other attributes of these herbs, apart from their essential oils. New applications of Origanum oil as source of high phenolics in animal and as antimicrobial agents appear to be gaining interest relative to papers, patents and commercial products now found.

Current work examining the new uses of artichokes, asparagus, blueberries, cabbage, and a wide variety of other fruits and vegetables highlights this model. Many of our traditional foods can serve as rich sources of nutraceuticals or functional foods, and there appears to be significant variation in the bioactive compounds found in our fruits and vegetables. Our current research in the antioxidative activities and compounds in artichokes, a plant long

recognized as an herb, due to the presence of caffeoylquinic acids in both the leaves and edible heads seeks to identify a variety with such superior functional food traits. Current research on asparagus at Rutgers now seeks to identify varieties with high concentration of saponins, vitamin E and rutin.

Model 5: Identify New Uses of New Aromatic and Medicinal Plants:

Research examining new uses of herbs, aromatic and medicinal plants as sources of natural pigments and coloring agents, mosquito repellents, and antifeedants from plants is in high gear as is the continued quest for new antimicrobials. At Rutgers, we screen the extract of aromatic and medicinal plants against a wide variety of microbes (*E.coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Saccharomyces cerevisia*, and *Aspergillus niger*).

Some aromatic and medicinal plants may have potential as nursery and ornamental plants. The selection and breeding of aromatic and medicinal plants primarily or even exclusively for ornamental characteristics has largely been ignored and therefore creates an opportunity.

Model 6: Focus on Developing a Contractual Out-Grower Scheme for Pharmaceuticals and Specialized Botanicals:

Pharmaceutical companies need large quantities of products for manufacture, develop out-grower programs to ensure adequate supply, or contract to get their needed raw materials. The contractor may buy, rent and produce the product himself or herself or arrange to contract out the production of the material. Here, the company often provides seeds and/or plants free or at cost later to be subtracted from delivered product. The company may advance partial payment to growers to defray input costs, typically provide instructions and guidance to the growers. Industry may partners their research and outreach needs to a university or research organization, but generally tend to keep most of their research in-house.

Model 7: Buyer-Industry Driven Model:

Historically, this has generally been the largest driving force in commercialization of aromatic and

medicinal plants. While the botanical products may be in demand due to consumer demand, it is the marketplace that has led to the wide expansion and growth of the natural product sector around the world. In this model, the buyer may buy or rent land and either own and operate or rent the land and farm themselves to procure the product of interest. Alternatively, the buyer or industry buys the products on the open market and/or under contract and is removed from the production process itself. A third option within this model is when a buyer seeks to develop from the outset a partnership to accomplish the production and procurement of the natural product (s). This model leads to trade and capacity enhancement. Each producer or collector would be in competition with each other to sell to the same buyer (s); and there may or may not be opportunity for value-adding; this would be at the discretion of the buyer. This model in a variety of forms is the common model, provides less control to the grower, and the grower is at higher risk if the buyer goes out of business.

Model 8: Crop Champion Model:

Here, one or more individuals, either researchers or lead growers, 'champion' the introduction and production of a new botanical within the context of the models already described. This 'crop champion' is the one passionate about the crop and plant product, responsible for teaching and training others and showing others who later may participate in the plant's commercialization.

Model 9: The ASNAPP Approach:

ASNAPP employs a combination approach whereby we in concert with our in-country partners identify communities/leaders/producers (or crop champions from within the community) and markets and buyers at the outset and with both communities, forge strategic alliances from the outset attempting to create a win-win situation. ASNAPP then assists in providing market access/information and appropriate technology transfer delivery systems and QC systems to existing national and local government or NGO's or development organizations. ASNAPP always works with in-country universities and research institutions in

a strategic partnership and relies on local expertise in the academic and research communities. The goal of this model is to enhance trade, but also strengthen the local community and source country via empowerment program and crop options, while competitive, each producer is needed so that as an aggregate group the products produced can then meet international needs of quantity and quality. This model strives to enhance the local opportunities for adding further value to each product.

“Murphy’s Law”: What Can Go Wrong Does Go Wrong: Examples of Problems

It is easy to over look the real problems that the horticultural industry faces with new crops. Here, we point out several examples of what can go wrong to learn from the unexpected and minimize future risk:

- Growers are encouraged to raise herbs, production looks good, product ready for market, but now market interest disappears, as the buyer quietly explored and encouraged another grower(s) from whom they are now buying. Buyer was either seeking the lowest price and/or wanted insurance that they would be able to get the product so quietly encouraged several producers:

- Growers that cannot really assume the high risk of the new crop were not able to obtain resources to invest in the equipment needed to adequately produce the crop and so fails due to poor yields and/or poor quality:

- Growers that cannot really assume high risk of the new crop enterprise find few resources available to invest into production nor time to grow a quality product: or quantity falls far below processor/market needs, project fails:

- Growers are contracted to grow ‘oregano’ the hot new crop, for an extractable compound. Growers receive a contract from the buyer, free seed from company, produces and harvests the new crop, the crop looks good, but the variety they raised from the company lacks the chemical of market interest, project fails:

- Growers contracted by a new company at the beginning of the growing season to raise a new medicinal plant under contract. Contracts are signed,

and growers produce, harvest and have product ready for sale. Yields and quality are high, but buyer disappears:

- Growers are contracted to raise an aromatic and medicinal plant. Company invests in the growers partially pays production expenses, company files for bankruptcy. What happens?

These examples come from actual cases studies for medicinal plants in Canada and the USA. Strategic alliances with processors, manufacturers or distributors can be of value to minimize these risks. While your experimenting with your new crops, be sure to maintain your focus and profitability on your traditional ones as well.

SUMMARY AND CONCLUSION

The appropriate model of crop commercialization to consider is based upon the strategic goals of the project, the region or locale into which the crop will be introduced, the speed of development required to meet both market needs as well as production considerations. Commercialization with medicinal plants is even more arduous than traditional fruits, vegetables and agronomic crops because the natural products must also be within the desirable range of composition and content. We predict that whichever road or model used in your research and development process, you will come across both trials and tribulations in the path toward the commercialization of aromatic and medicinal plants.

There are however, several characteristics in common regardless of the model employed for new crop introduction and sustainable commercialization. Some of these include:

1. Need to Ensure The Project is Market-Driven and Needs Based, Rather than

Solely Research-Based. This challenge is strongest for those in academia and federal/national research centers whose area of strength, expertise and interest is often in conducting basic research leading to discovery and science, not necessarily in considering impact and commercialization. The gap between the research community in public institutions and the private sector can be wide.

2. Profitability at the Producer/Collector Level:

While several products appear to be market driven and of considerable promise, the relative opportunities in production for any specific region or country also will be impacted by their competition position. Those medicinal products in the market that come from growers that can provide the raw materials in the quantity needed, are available when needed and at a price that meets national and/or international specifications will have a considerable advantage to those whose production and supply are irregular and lack consistency. Demonstrating to many international buyers that the product can be sourced by a reliable supplier, and were produced following which follows both Good Agricultural Practices (GAP) or Good Sourcing Practices (GSP) and in compliance with Good Manufacturing Practices (GMP) may also have a competitive advantage, though not always resulting in an improved market price. Providing confidence to the producer, that there is a real market through advance contracts, working relationships, formal business linkages or other avenues, and ensuring economic incentive to bring into cultivation a plant normally found and collected in the wild is not an easy task. All botanical products that are targeted to be developed should be analyzed for profitability at the farmer level, and compared to their traditional and alternate crop/agricultural options.

3. Profitability at the Processor/Dealer/Trader Level and a Linkage to the Supplier in the Procurement of Raw Botanical Product:

Attention from the outset must be given to the needs and expectations of targeted farmers and communities. The producers should be brought into the process at the outset, and there should be consideration of criteria used in the selection of those producers. In many areas where the growers are small scale and resource limited, this group represents your producers/collectors and potentially initial processors of the botanical products. It is here that discussions of fair trade policy to ensure their profitability in the chain of events should be considered when developing a long-term market and product introduction strategy. This part of the supply

chain brings to the market the raw botanical product. International buyers either weary of new suppliers or who simply 'lack the confidence that a regular supply of a botanical product is possible' from a new region need to be able to see product samples and know that a technology transfer system is in place that can work with the producers to assure future product availability. The procurement of a medicinal plant from a new region or new country, and even from a new producer or grower association presents significant risk to the buyer. This major constraint could be overcome using several avenues including but not limited to an overall quality assurance program which would involve: (a) technology transfer programs to train growers in the collection, propagation, production systems, harvesting, and drying or post-harvest handling systems, tracking, and business development skills including record keeping, and storage of product; (b) ensuring the correct species is being introduced; (c) comparing the competitive crops that are grown by the targeted community to ensure a 'fit' with the new crop (see earlier description on crop clustering which defines 'fit' in detail; and (d) development of a grower association that can represent the growers with buyers and can assist in developing a minimum product inventory and tracking of the inventory; and (e) assurance that all legal permits and export licenses, if applicable, can be obtained when needed.

4. Linkages to Processors and/or Brokers/Traders/Buyers:

The relationships between brokers and traders with the targeted farmer as well as the relationship between the broker and the buyer need to be considered. In the buyer-industry driven model, it is often the brokers who serve as the principal market force that lead to the collection of the botanical, storage of the botanical, and who largely set the market price. The broker may serve as the contact point in the market channel between the secondary buyer and the collector/grower. This group typically absorbs the risk by purchasing the material rather than moving the botanical on consignment, and generally seeks to purchase the raw botanical product at a low

short-term price and must later absorb storage and insurance. Introduction into cultivation, rather than wild collection, and longer-term arrangements with growers, necessitates the profitability of each participating group in the market chain, requiring a rethinking of the relationship and price structure that could be needed to ensure that consistent availability of a particular botanical products at competitive regional/international prices. The challenge will be to ensure an economic incentive for/buy each participant, something not necessarily practiced at present.

5. Quality Control:

The need to introduce quality control into the botanical trade has been a major obstacle in commercialization of aromatic and medicinal plants. Quality control procedures beginning at the collector and grower phase and which include but are not limited to following GAP, GSP, and the incorporation of GMP will be critical at the outset of development. This is not an easy task as each participant in the development of a botanical must adhere to the QA plan by proper record keeping, following the developed and 'required' tracking system, and must accept responsibility of their active role in quality control. This requires not only training and technology transfer programs throughout the development of the botanical market, but willingness for each participant to implement, and track the quality parameters required for their 'part'. If there is economic incentive to follow such a quality control guideline, it is more likely that it will be followed. Purchase of a product contingent upon a minimum quality standard is essential, and this decision to purchase or not to purchase creates an economic incentive to meet a minimum quality. Technology transfer programs that are aimed at not only developing QA guidelines for each product but which also includes training program for each segment of the market chain in-country is also recommended. Such quality training and product evaluation must be considered as ongoing tools needed to help the botanical products meet a consistent market quality. We also recognize that different quality standards may be required or acceptable depending upon the targeted market- local quality is

far different and less strenuous than international market specifications. At present, few guidelines are written for each botanical now in the trade; few quality control procedures are followed in any depth, and high variability is evident both from the pre-farm or collecting gate throughout the post-farm gate or processing level. Many companies even when reporting the existence of a quality control program, appeared to have QA programs which were variable at best, not implemented or limited in their consistency of use over time and which varied between products and market demand for a product. Most collectors had a rudimentary understanding of the minimum required product standard- and which to a large degree include collecting the right species, at a particular time. Systems of tracking quality, record keeping, and the development of SOP guidelines for Material Specification Sheets need to be available with each and every botanical product, and each participant in the market chain should follow a specific quality regime framework. Such a quality control procedure and tracking system need not be overly complicated nor overly costly, but the lack of using such tracking procedures can continue to limit market opportunities.

6. Profitability at the Wholesale/Retail Level:

Plant products not found to be of sufficient profit will not be continued.

7. Laws and Regulations.

Natural product commercialization interfaces with issues of health, and when conducting import/export trade, the business and regulatory environment of each country can have a major impact on the development of international trade- and in the development of the botanical trade. The ease of which the botanical products can be shipped with needed government permits, the costs of such permits, the taxes and associated duties, the ease of moving product from area of origin to storage and shipping points all significantly contribute to the cost of the final botanical product, the potential profitability and the ability to adhere to a predictable schedule for shipping to reach specific regional and international marketplaces.

8. Risk Management and Expectations to the Farmer:

One of the major obstacles facing all farmers of new crops, and in particular small farmers is their difficulty in absorbing risk, the limited agricultural credit often available to them, and the difficulty in crop diversification. The challenge here is to match the new crop enterprise opportunities with the appropriate producers and rural communities and to develop criteria by which they can best be selected, and then to work in partnership with them to identify those initial growers who are interested, have the management skills and drive, and economic viability to begin to explore the commercialization of additional crop enterprises such as one or more botanicals. The introduction of a single botanical versus a cluster of more than one new crop (as in crop clusters as defined earlier) needs to be examined in detail for each of these rural communities to develop guidelines as how best to introduce new crop enterprises while minimizing risk to that grower. Within a market-driven approach, special consideration would need to be given to the small farmer so that they can participate in such a potential economic opportunity while trying to minimize the inherent risk in the introduction of new crops and new enterprises. In countries, where small farmers are the norm, this practice is more common, but in countries and regions where the new crops will be championed by medium and large scale farmers, then many new crop opportunities often are focused toward these group of producers because they are often more entrepreneurial, have greater ability to absorb risk, often look for such new economic opportunities, and have greater expertise in farming; may already have much or all of the specialized equipment and facilities needed in the production, harvest, and storage of new crops. Their ability to handle more risk; more market-driven, as well as the buyers desire for success, speed and lowest cost makes working with large growers desirable.

9. Linkages and Gaps between Production, Processing and Research:

When there is a significant gap between research and development, more problems and obstacles can

arise with the introduction of a new crop. A crop looks good one season, then in the following growing season a new disease devastates the field; a crop looks good due to market demand, but the seeds don't germinate; the crop grows poorly, the yield expectations are higher than is being achieved, or in the case of the natural product industry, the incorrect genetic material is used, and the final yield of a beautiful crop has little to none of the required bioactive compounds. This is where the researcher has their greatest opportunity and in this they need to better connect with the commercial and private sector. The greater access the growers/farmers/collectors have to research and development findings with regard to production, new crop introduction, harvesting, and processing the more likely they will succeed in this area, and the greater potential profitability that can be realized. The better exposed the commercial processing and marketing sector is to the latest in processing, extraction, packaging and marketing, the greater likelihood that they can succeed. At present, the ability for the private sectors and commercial industry to access current research has been highly limited. Here, the use and integration of the local or in-country research expertise into this process from the outset, as well as the linkage and establishment of formal external partnerships (regional and international centers of research) may prove to be both cost effective and increase the chance of success.

10. Linkages between Production, Processing and Technology Transfer:

Successful new crop introduction requires a strong and targeted outreach program to the growers and the processors. In many countries the extension service is effective, in others it is wanting. In either case, the link between the research community to the user community or grower/processor and shipper needs to be strong.

LITERATURE CITED

- Halloy SRP** (1999) The dynamic contribution of new crops to the agricultural economy: Is it predictable? Pp. 53-39. In Janick, J. (ed). *Perspectives on New Crops and New Uses*, ASHS

Challenges and Tribulations in the Commercialization of New Crops: Aromatic and Medicinal Plants

- Press, Alexandria, VA, USA.
- Janick J and Simon JE (eds)** (1990) *Advances in New Crops*, Timber Press, Portland, OR. 560 pp.
- Janick J and Simon JE (eds.)** (1993) *Progress in New Crops*, John Wiley & Sons. 710 pg. 1990. Simon, J.E. Essential oils and culinary herbs. *Advances in New Crops*, Timber Press, Portland, OR. pp. 472-483.
- Simon JE** (1993) New Crop Introduction: Exploration, Research and Commercialization of Aromatic Plants in the New World. The First World Congress on Medicinal and Aromatic Plants for Human Welfare- WOCMAP, July 19-25, 1992, Maastricht. *Acta Horticulturae* 331:209-221.
- Simon JE** (1999) Domestication and production considerations in quality control of botanicals, pp. 133-137. In: D. Eskinazi, M. Blumenthal, N. Farnsworth, and C.W. Riggins (eds.). *Botanical Medicine. Efficacy, Quality Assurance, and Regulation*. Mary Ann Liebert, Inc. Larchmont, NY.
- Small E** (1999) New Crops for Canadian Agriculture, pp. 15-52. In Janick, J. (ed.). *Perspectives on New Crops and New Uses*, ASHS Press, Alexandria, VA, USA.