The Certified Organic Seed Market: Implications of Delayed Development

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Executive Summary

This study looked at the implications of delayed development of the certified organic seed market. Beginning by looking at organic regulations in the United States and how authorized organic certifiers implement them, the paper introduces the general issue of "commercial availability" as it has arisen in the organic market in general and how it has impacted the use of certified organic seed. Complementing the issue of "commercial availability" is the discussion of the harmonization of organic standards between the U.S. and Europe. The rationale for this discussion is that harmonization provides a basis for differing organic standards to exist yet still facilitate trade in certified organic products between the two regions in spite of the regulatory differences. The paper then systematically provides the underlying information needed to look at the implications of the delay in the development of the use of certified organic seed. Specifically, the paper explains the nature of commercial seed production for horticultural crops, carrots and lettuce in particular, followed by the issues arising when a commercial seed producer moves from conventional seed production to certified organic seed production. Following this is a discussion of how the European Union has addressed the issue of commercial availability of seed. These discussions of certified organic seed production and how commercial availability is addressed in the regulatory arena is presented in terms of areas where commercial seed producers have control over the development of certified organic seed and areas where they have little control – the institutional constraints. Ultimately the paper comes to the conclusion that, in spite of the steps that have been taken to address the lack of certified organic seed use in the U.S. and Europe, U.S. producers of organic crops who are either participating in the European export market or are planning to do so will bear costs should the EU impose mandatory use of certified organic seed before the U.S. While no data is available to prove this conclusively, the logic of the argument (which is based on the underlying information presented in the paper) is that given the high cost of certified organic seed and the generally high costs of organic production, it will be very difficult to address a domestic and an export organic market when an important and high cost regulatory difference exists – primarily the difference between being allowed to use lower-cost conventional untreated seed and the higher-cost certified organic seed. Essentially, a grower serving both markets must adopt either two separate production systems (and absorb the attendant costs inherent in that) or grow to the higher (and higher-cost) standard. Current policy actions and market realities make it unlikely for commercial seed producers to increase the pace of organic seed development, thus leaving the grower of organic crops for export in a bind should the Europeans move first.

I. Introduction

A. Background

Organic agriculture has been a presence for centuries. As many organic proponents like to point out, agriculture was organic well before there was such a term as "organic agriculture". Prior to the broad development of synthetic pesticides, only "natural" substances could be used. Prior to the development of an enormous distribution system that allowed inputs to be transported from one end of the country to another, most agriculture depended upon locally- or regionally-based input suppliers to produce food and fiber for a locally- or regionally-based market. With the advent of a global supply chain as well as the extensive development of genetically modified organisms (GMOs) in agriculture, the idea of organic agriculture is now quite different. Organic agriculture now represents a formal niche market whose connotations, for many, emphasize quality and luxury rather than necessity.

Well before the U.S. federal government began its movement towards establishing federal regulations concerning organic agriculture (the Organic Foods Production Act (OFPA) of 1990, Title XXI of the Food, Agriculture, Conservation, and Trade Act of 1990, Public Law 101–624), there was a well-established organic agriculture movement. In the U.S., this movement progressed from loose, self-defined, locally-oriented organizations to a fairly well-organized system of independent groups that had established their own standards and certification systems. These certifiers, like California Certified Organic Farmers (CCOF) and Oregon Tilth, developed brand recognition among growers and processors as well as consumers. While primarily oriented towards their particular states in terms of certifying growers, processors and handlers[1], the value of the individual certifier's label was potentially more national in scope since the growers, processors and handlers of organic products were more likely to move their product as widely as possible. Certifiers were cognizant that having standards that were consistent with organic principles yet allowed profitable production, processing and handling was important towards maintaining their reputation and brand value. Clients that did not like the standards established by one organization were free to move on to another organization but risked the loss of the first organization's label and the substitution of a different but potentially less valuable label.

Many of these same organic certifiers were also integrated into a broader organic agriculture movement that moved beyond the state and national level. Because modern organic agriculture was first developed in Europe and because a number of organic growers, processors and handlers were serving the European market, U.S. certifiers were motivated to establish standards that satisfied the requirements of the European market

[1] In most organic standards, the standard breakdown is growers, processors and handlers. These designations represent relatively distinct activities in the process of getting agricultural products from the field to the table. The rationale for the breakdown is that these three groups and their distinct activities require very different types of inspection and certification.

and European regulations.[2] Because of the potential for stricter or, more precisely, philosophically different standards, U.S. certifiers often established two distinct certification standards – one geared towards the domestic U.S. market and one which was geared towards the European market. These two standards were distinct in that they represented the needs and requirements of different markets and regulatory systems but the standards were not necessarily in conflict.[3] For those growers addressing only the domestic market, they could choose a certifier based on reputation and cost for certifying for the domestic market only. Growers growing exclusively for the European market, rare as it might be, would choose a certifier based, again, on reputation and cost as well as the certifier's ability to certify to the European market. More likely, though, growers producing for both the U.S. domestic and the European export markets would have to find a certifier who could certify to both standards. In such cases, many certifiers would use the European standards as an incremental step up from the domestic certification process and, thus, take advantage of as much of the overlap between standards as possible. This would reduce the overall cost to the grower, processor and/or handler. This ability on the part of the certifier to certify to European standards put additional pressure on the certifier to maintain the quality of its standards and, thus, its market reputation. Failing to satisfy the European controls on organic certifiers would limit its ability to certify the "mixed" operations wanting to serve both the domestic and European markets.

When the U.S. federal organic regulations went into effect on October 21, 2002, the issue of differing standards among different U.S. organic certifiers changed substantially. Prior to the federal regulations, domestic certifiers were able to establish different standards, potentially addressing different clienteles based on the crops grown, processed and handled, and different certification procedures, including judicial procedures. With the federal government establishing rules as to what constituted organic production, processing and handling, certifiers were forced to adjust. Rather than establishing their own rules, certifiers were required to come up with their own methods for meeting the U.S. Department of Agriculture's (USDA) organic regulations. These regulations were broadly written and certifiers were required to submit their policies and procedures to the USDA's National Organic Program (NOP) for approval. These policies and procedures had to make the regulations more concrete yet still satisfy the regulations. Once the certifiers had their policies and procedures approved, they were authorized by the federal government to certify operations and products as being "organic".[4] The end result of a national organic system is that, regardless of which USDA authorized certifier did the certification, all products certified as being organic meet the same standard. Certifiers are not allowed to have higher standards than the federal standards unless it is to certify the

[2] This is not to say that no other regions were involved in organic production and regulation. For the sake of simplicity and because Europe remains the most developed market for organic production and consumption, this paper will continue to simply to refer to Europe.

[3] An analogy would be that of U.S. and Canadian football – two games which share the same roots but which have developed subtle but important differences that become more apparent as one becomes more familiar with the two games.

[4] The term "organic" in the food and fiber system can only be displayed by growers, processors and handlers who have been certified to the federal organic standards by USDA authorized certifiers.

product to something other than the term "organic".[5] While certifiers are still allowed to offer their original labels to their customers for use on their packaging, the fact that an official "USDA organic" seal has been established may result in the value of the certifier's label being limited, especially as the certifier broadens its certification business beyond its original clients.

According to the legislation (section 2102, Title XXI – Organic Certification of the OFPA), the purposes of organic certification are as follows:

(1) to establish national standards governing the marketing of certain agricultural products as organically produced products;
(2) to assure consumers that organically produced products meet a consistent standard; and
(3) to facilitate interstate commerce in fresh and processed food that is organically produced.

While not specifically stated in the purposes, it would be fair to say that having national organic standards in the U.S. would also enhance the flow of international trade of organic agricultural products.[6] Traditionally, this has been one of the primary public goods aspects of government regulation, lowering transaction costs in markets. While the domestic market for organics remains relatively small – approximately 2% of the domestic agricultural market – it does represent one of the fastest growing segments of the food market, growing at an annual rate of 20%.

As alluded to earlier, the size of the European market for organic goods is substantially greater and presents a significant opportunity for U.S. organic growers, processors and handlers willing to establish an export-oriented business. The benefit of consistent national organic standards in the U.S. lies in the potential for achieving some degree of reciprocity in certification between or among countries that would make the process of exporting much easier. Without national standards, each individual certifier would have to undertake a separate process for establishing a separate set of standards to address every other country's organic standards, should they deem it worth their time and resources. As the global market develops for organic agricultural products, it becomes quite difficult for a certifier to be able to address a potentially long list of differing national standards for its customers who export or desire to export to numerous countries. On the consumer side, there is also a benefit of national standards. Not only will the term "organic" have a consistency (in terms of production, processing, handling and marketing) among domestically produced products as a result of national organic

[5] Many certifiers have talked about establishing other kinds of labels, such as ecolabels, as a means of maintaining their pre-federal regulation reputations. Nonetheless, their primary constraint is that they cannot incorporate the word "organic" into that new label.
[6] The OFPA does explicitly address the issue of imported organic agricultural products in Section 2106(b): "Imported agricultural products may be sold or labeled as organically produced if the Secretary determines that such products have been produced and handled under an organic certification program that provides safeguards and guidelines governing the production and handling of such products that are at least equivalent to the requirements of this title."

standards, but by the same token, any foreign product sold in the U.S. will have to be held to the same standards and will essentially be comparable with domestically produced goods. Prior to discussing the issue of differing national organic standards (which will be covered in more detail in later sections of the paper), it is important to return to some important facets of the U.S. national organic standards.

The amount of time it took to establish national organic standards in the U.S. was considerable. From the time the Organic Food Production Act of 1990 was passed until national federal organic regulations were imposed on October 21, 2002, the USDA with input from the public and the food and fiber industry had to grapple with a number of different issues to make the regulations work. Crudely speaking, the process of developing federal organic standards consisted of an industry-oriented committee, the National Organics Standards Board (NOSB), developing suggested standards and passing them on to the National Organic Program (NOP), part of the USDA's Agricultural Marketing Service (AMS), who in turn, would finalize the standards and then submit them for public comment in the federal register. After public comment, the regulations would be amended as needed and, eventually, become law.[7] Issues that had to be confronted ranged from the nature of establishing the guidelines for a farm's formal Organic System Plan to determining which materials (both generic and brand name) were allowed for organic production to how cattle would be allowed to be sheltered and fed. The monumental nature of the task resulted in the process becoming a step-wise one where many of the difficult issues were postponed for later discussion.

It is important to note at this point that the organic regulations as promulgated in the U.S. are considered a "process" oriented set of regulations. This means that the regulations are designed to lay out all the procedures for growing, processing and handling that make an agricultural or agriculturally-based product "certified organic". Contrary to much public perception, organic regulations are not strictly focused on pesticides and the related residue issues – the fact that a conventionally-produced has no detectable pesticide residue, or even had pesticides used on it, does not make the product organic or even close to being organic. In fact, an organic product could have detectable synthetic pesticide residue on it and still be legally certified organic, so long as the grower took all appropriate measures to keep the "pesticide drift" from occurring.[8] In general and for standard agricultural production, the organic process begins with having agricultural ground being free of synthetic chemicals for at least three years and subsequently using

[7] During the early process of rule-setting, the USDA put out for federal comment rules which would have allowed the use of biosolids and genetically modified organisms (GMOs) in certified organic production. These items had not been included in the recommendations put forth by the NOSB. This suggested rule resulted in the largest number of public comments – almost entirely critical of the inclusion of biosolids and GMOs – made on any federal rule in the history of the U.S. government.

[8] Related to the pesticide issue is the issue of what is called "genetic drift" or the more politically-charged term of "genetic pollution" in which the DNA of one crop becomes "contaminated" with the DNA of another crop due to a number of factors. A certified organic product having been affected by genetic drift cannot be decertified of its organic status if the producer's process of growing took reasonable measures to try to prevent the genetic drift from occurring.

appropriate and acceptable methods of planting, weeding and harvesting on the desired crop for it to become certified organic.[9] The difficulty arises when the regulations must deal with all the possible details of the production of a huge variety of crops.[10] In addition to the plethora of simple details, there are also significant cost issues to be considered in organic regulation. Establishing strict rules on organic production which would make organic crop production unprofitable flies in the face of the purposes of the regulation. The inability to make a profit in general organic production would negate any need for organic regulation. Issues included in this general idea include animal protection and feed and fertilizer use. According to the regulations, all inputs going into organic agricultural production must be either certified organic or meet the general guidelines of what constitutes an organically consistent product.[11] The NOP and NOSB have been and continue to be quite cognizant of cost and availability issues and, at the same time, recognize that market development can and will provide more competitively priced certified organic inputs and technologies. When cost and availability becomes an issue, the federal rules allow some flexibility but other factors can limit the extent to which the flexibility can be effective.

Sections 205.201(a)(2) and 205.301(b) and (f) of the rule say that non-organic agricultural ingredients may be used under certain circumstances – primarily when critical organic ingredients are not commercially available. Specifically, "commercially available" is defined in the rule as "the ability to obtain a production input in an appropriate form, quality, or quantity to fulfill an essential function in a system of organic production or handling as determined by the certifying agent in the course of reviewing the organic plan."[12] The review process undertaken by the certifier must ensure that the concept of commercial availability is satisfied. Therefore, the OSP of any producer must document how such an ingredient is not commercially available.[13] Knowing that the commercial availability clause was a loophole of sorts when the final rule was published, the USDA did indicate that it would be further investigated and refined. Specifically, it called for comments regarding the following questions:

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[9] At this point in the paper, the issue of processing and handling is being dropped, as it is less relevant to the ultimate issue of organic seed certification.

[10] An example includes the type of materials that could be used for grape trellises – wood treated with synthetic chemicals is not allowed, so metal trellising is preferred.

[11] For instance, a grower has an option to purchase certified organic soil amendments from an outside vendor or he/she can produce his/her own soil amendments from on-farm composting of manure and crop residues. If the grower opted for the on-farm compost, it would not have to be officially certified organic but the Organic System Plan (OSP) would have to lay out all the steps of the composting and the inspector for the certifier would have to agree that the approach is acceptable and does not use prohibited materials or methods.

[12] §205.2

[13] It should be pointed out that the OSP must list <u>all</u> ingredients used in production, not just the ingredients that are not organic. As §205.201(a)(2) of the final rule states, for an agricultural product to be considered certified organic, "[a]n organic production or handling system plan must include: … (2) A list of each substance to be used as a production or handling input, indicating its composition, source, location(s) where it will be used, and documentation of commercial availability, as applicable."

> What factors, such as quantity, quality, consistency of supply, and expense of different sources of an ingredient, should be factored into the consideration of commercial availability? What relative importance should each of these factors possess, and are there circumstances under which the relative importance can change?
>
> What activities and documentation are sufficient to demonstrate that a handler has taken appropriate and adequate measures to ascertain whether an ingredient is commercially available?
>
> How can AMS [Agricultural Marketing Service] ensure the greatest possible degree of consistency in the application of the commercial availability standard among multiple certifying agents?
>
> Could potentially adverse effects of a commercial availability standard, such as uncertainty over the cost and availability of essential ingredients, impact or impede the development of markets for organically processed products?
>
> What economic and administrative burdens are imposed by the commercial availability standards found in existing organic certification programs?
>
> How would producers benefit from market incentives to increase use of organic ingredients that result from a commercial availability standard?
>
> Would lack of a commercial availability standard provide a disincentive for handlers of products labeled "organic" to seek out additional organic minor ingredients? What impacts could this have on producers of minor ingredients?[14]

In general, one of the concerns was that if some non-organic substance was allowed in certified organic production, that there would be little or no movement nor incentive to alter the development of an organic substitute. This has been the case with certified organic seed.

B. Certified Organic Seed and the Cost/Availability Issue

It is a truism that seed is critical to the production of any agricultural commodity. Yet, given the seminal[15] nature of seed use, the vast majority of certified organic crop production is done without the use of certified organic seed.[16] According to the NOP

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[14] From the Preamble to Final Rule, page 80563 as quoted in an April 29, 2004 NOSB Commercial Availability (606) Task Force report, page 3 found at www.ams.usda.gov/nosb/poldevcommRMR/CommercialAvailability429.pdf.

[15] The reader will forgive the subtle pun.

[16] While there is little specific data showing this to be the case, the author's personal experience with reviewing inspection folders for the San Luis Obispo chapter of the California Certified Organic Farmers (CCOF) as well as ongoing discussions in the

website's Q&A section, there are many options to using certified organic seed. According to the USDA, the "seed of any generation planted with conventional, untreated seed and produced under organic conditions can be certified as organic." Another option is the use of "nonorganically produced, untreated seeds … when an equivalent organically produced variety is not commercially available." Also, "nonorganically produced, treated seeds may be used to produce an organic crop when an equivalent organically produced or untreated variety is not commercially available."[17]

What seems to distinguish the seed issue from other inputs to organic production is the centrality of seed to production. Unlike fertilizers, pesticides and other important inputs to production, there is no substitute, management or otherwise, for the use of seed. In the case of fertilizers and pesticides, it is theoretically possible to substitute crop management approaches for the use of such substances and this often happens when price or regulatory issues make the use of the substance economically infeasible.[18] This is not possible with seed.

Compounding the certified organic seed issue is the fact that the seed industry, particularly in the grain sector but increasingly so in the horticultural crop sector, has undergone and continues to undergo a severe consolidation and concentration process. Most of this has been driven by the costs and opportunities presented by biotechnology and its facilitation of the creation of genetically modified crops. In the grain sector, much attention has been given to bt crops and RoundUp Ready crops, whose attraction has been their cost-reduction characteristics. The early commercial success of such crops has accelerated the development of other crops with such characteristics but many of these crops are widely grown commodities. On the horticultural side, consolidation has been driven more by the potential of genetically modified horticultural crops rather than any particular successes. One of the first attempts at a genetically modified horticultural crop was the Flavr-Savr tomato that was eventually pulled out of the market. The additional difficulty in the horticultural crop sector is the fact that, in spite of their high value per unit area of production, the sector is quite heterogeneous both in terms of crops grown but there is also a high degree of heterogeneity within the general types of horticultural crops. For example, lettuce crops can consist of head lettuce, leaf lettuces and spinaches – each of which will have a large number of varieties that are grown based on seasonality, horticultural characteristics, flavor characteristics and supply chain characteristics. Compare this with the relative simplicity of corn or soybean production and the complexity of producing genetically modified horticultural crops (and deciding where to begin) becomes quite clear.

Certification Standards Committee (CSC) of CCOF at the headquarters level as well as discussions with large growers of organic specialty crops in California clearly indicate that this is the case.

[17] From the USDA AMS website, www.ams.usda.gov/nop/q%26a.html accessed June 27, 2003.

[18] For instance, should the cost of an certified organic herbicide go up (but not enter the realm of being "commercially unavailable"), a grower may opt to alter the organization of production to reduce the probability of weeds occurring or becoming economically damaging.

Nonetheless, the perceived opportunities of producing seed for genetically modified horticultural crops are substantially greater than the perceived opportunities of producing certified organic seed for certified organic horticultural crops. First of all, aside from the general regulatory control over producing GMO varieties, there are no unique regulations concerning how the variety and its subsequent seed production is done. In the case of certified organic seed production, growers of organic seeds must go through the same process as other organic growers of becoming certified by USDA-authorized organic certifiers which means developing an OSP and undergoing annual inspections and maintaining specific paperwork – this is on top of the requirements that seed growers must undergo to produce certified seed as stipulated by the Plant Variety Protection Act.[19] Secondly, given the small portion of the agricultural market that organic production holds, the return to developing specialized production of organic seed is not very cost-effective.[20] Thirdly, if seed producers face a regulatory situation in which the government has indicated that growers are allowed to use nonorganic seed, so long as the seed is "commercially unavailable", then the profitability of developing this sector is even less attractive. A classic chicken and egg situation arises – growers won't buy organic seed because it is commercially unavailable so they opt for nonorganic seed but seed producers won't undertake the expense of developing more organic seed because they won't make money since organic growers have an out for not having to buy organic seed. In a way, as the regulatory situation now stands, neither side needs the other.

The situation described above begs the question, why is the issue even worth addressing? It is worth addressing because of the desire to harmonize organic regulations internationally. Just as national organic regulations were developed in the U.S. to promote trade domestically, coordinated organic regulations internationally will enhance the international trade of organic products and free and fair international trade is one of the primary stated goals of the international community. If U.S. organic regulations were solely geared towards the domestic market, the unfortunate seed loophole would not be one of great concern. On the other hand, if the U.S. was intent on promoting the international trade of organic products produced in the U.S., then this issue of the use of certified organic seed could become critical should Europe require the use of certified organic seed prior to the U.S. If this should be the case, any U.S. grower, processor and/or handler producing an organic product that did not start with the use of certified organic seed would not be able to market the product as certified organic in the European market, nor would European processors and/or handlers be able to purchase such U.S. products, which are certified organic for the U.S. domestic market, for use in organic products in Europe or any other country whose organic standards require the use of certified organic seed.[21]

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[19] It is important to note here that seed certification is quite separate from organic certification but plays a similar role of ensuring quality and confidence in the seed market. This seed certification process establishes levels of quality and nomenclature (such as Breeder seed, Foundation seed, etc.) and, thus, reduces risk in purchasing.

[20] Specifics of this will be addressed later in the paper.

[21] At this point it is important to point out that the European Union also does not require the use of certified organic seed for the production certified organic agricultural products. What does distinguish the European Union from the U.S., aside from its earlier start in the development of organic regulations, is that since 2001 the European Union has been

C. What's Ahead

Having set the context for the issue of the non-mandated use of certified organic seed, the reader can move on to looking at the particular details that influence or will influence an initial analysis of the issue. Because of the technical nature of the topic, this paper will have to work through a number of topics that will clarify the economic implications of mandatory use of certified organic seed.

The second section of this paper will look at the broad issue of harmonization of organic standards, particularly harmonization between the U.S. and Europe. While this harmonization issue goes beyond the specific issue of certified organic seed, it does provide an important context of how problematic it is to achieve formal equivalence in organic production, processing and handling.

The third section of the paper will look briefly at the nature of seed production to demonstrate in a broad sense what the constraints are for seed producers to develop certified organic seed. This section will also briefly look at the specific horticultural characteristics of carrots and lettuce. Finally, the section will address some of the issues that separate the production of certified organic seed from the production of conventional seed – again, addressing some of the particulars of carrot and lettuce seed.

The fourth section will address the current actions being taken to move towards a situation in which certified organic seed approaches the formal definition of "commercial availability" as described in the federal organic regulations. Information from both the regulatory and industry perspectives will be presented and will be contrasted with the available information on the activities being taken by European organic regulators and seed producers. The final part of this section of the paper will briefly discuss a basis for planning out a formal case study that will be undertaken in subsequent research.

II. The Harmonization of Organic Standards

A. Importing Organic Products

Earlier in the paper, an overview of U.S. standards for organic production and processing was presented. In this section, the paper will discuss issues of harmonization of organic regulations with an emphasis not so much on specific regulations but rather on how the U.S. and Europe treat organic products coming in from outside the immediate regulatory area, i.e., products produced in a geographic area having its own organic regulations. This subsection will briefly look at the rules for importation of organic products into the U.S. and then for importing into the EU.

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announcing a date for mandating the use of certified organic seed. While each of the announcements has subsequently been delayed for the past two years, it does demonstrate an ongoing process for moving closer to closing the loophole.

According the regulations laid out by the USDA's National Organic Program, there are three methods of importing organic products into the U.S. These methods are:

(1) Products produced abroad which are certified by an entity which has been accredited as an organic certifier by the USDA;
(2) Products produced in a country where the government's regulations has been accredited by the USDA and that government has certified the product by its own accredited certifiers; and,
(3) Products produced in a country where a government has negotiated a formal "equivalency" agreement with the USDA which allows certifiers authorized by the government to certify to a standard that is equivalent to the USDA's regulations. (Bowen, pp. 11-12)

The first example is not different from a domestic production situation – if an organic certifier is accredited by the USDA, that certifier can certify a product organic irrespective of the location of the production. The second example addresses a situation where a foreign government has organic regulations that are essentially identical to those of the U.S. and that the certifiers in that country which are authorized by that country's government are recognized by the USDA but the certifiers are not directly accredited by the USDA. The final example addresses a situation where a formal "equivalency' agreement is negotiated between the U.S. government and the foreign government in which the foreign accreditation is accepted by the USDA and USDA accreditation is accepted by the foreign government. The apparent distinction between the second and third situations is that the second situation is in only one direction – the USDA accepts the foreign accreditation but the reverse is not necessarily true. The third situation indicates that, given a formal equivalency, a single certification by a certifier in either party to the equivalency agreement would satisfy the organic regulations in both countries. According to Bowen, no formal equivalency agreements of the type described in the third option have yet been established. As of March 2004, Denmark, New Zealand, the United Kingdom and the Canadian province of Quebec have achieved USDA accreditation for their regulations. Finally, as of March 2004, the USDA has directly certified 46 certifiers outside the U.S.

In the EU, there are also three means for importing organic products[22] as established by Council Regulation (EEC) No. 2092/91. Products are allowed into the EU when one of the following three requirements has been met:

(1) The EU has formally approved the organic regulations of third countries who are placed on the EU's "Article 11" list;
(2) An EU member state has authorized an importer to bring in a specific organic product from a non-Article 11 list country; or,
(3) An EU member state has approved a foreign inspection body. (Bowen, pp. 7-8)

[22] Obviously, these regulations do not apply to EU member countries. As a result, the regulations refer to non-EU countries as "third countries".

Portions of these three approaches are quite different from those of the U.S. given the multinational nature of the EU. The first situation is clearly the broadest. Once the EU, as a multinational body, has reviewed the organic regulations of a third country, it accepts the certification of the third country-authorized organizations and allows organic products to enter into the EU as certified organic. This approach covers any product certified by the certifier. Alternatively, the second approach is strictly a situation in which a specific product brought in by a specific importer is authorized by an individual EU member to enter that country. According to Bowen, the product must still meet EU organic standards and be subject to similar certification and inspection in the third country and only applies to that specific product from a specific country brought in by that particular importer. The final approach is quite similar to the first option in the US importation discussion – it is the certifier who is authorized by the government and, regardless of the source of the organic product, it is the certifier who ensures that the product meets the organic regulations of the member state and, implicitly, the EU. Bowen indicates that, as of March 2004, Argentina, Australia, Costa Rica, the Czech Republic, Hungary, Israel, New Zealand and Switzerland are on the EU's Article 11 list.

Clearly, there are similarities between the methods of importation of organic products into the U.S. and the EU. For both the U.S. and the EU, regulations are ostensibly designed to ensure that an imported product has been produced and processed in a manner similar to those goods produced domestically. On the other hand, in an increasingly global trading context, and recognizing that there are many other countries that have or will have organic regulations, the prospect of having to navigate numerous national or regional regulations and certifiers can be a substantial disincentive to producing organic products for export – raw or processed. The brief discussion above does show that there are some means to reducing transaction costs for organic production for export. In the next section, approaches and limits to harmonization of organic regulations will be discussed.

B. Harmonizing Organic Regulations

Beyond the specific case of the production of organic products, there has been a strong current towards harmonization of trade rules over the past number of years. The objectives of the former General Agreement on Trade and Tariffs (GATT) and the current World Trade Organization (WTO) have been to reduce the impediments to international trade as much as possible. While there has been substantial success in improving the flow of trade for many products, agriculture has proven to be one of the more problematic areas of improvement given the strong cultural role that agriculture plays in many countries and the long-standing structure of agricultural subsidies and opaque agricultural trade regulations. Nonetheless, the WTO has made progress in improving the situation by setting up mechanisms for clarifying trade issues and adjudicating trade disputes. Two critical areas helping to promote this are the work addressing sanitary and phytosanitary (SPS) regulations and the work addressing technical barriers to trade (TBT). The work done on these two issues has tried to ensure that national rules governing pest and disease issues and production and processing issues are based on real problems and not designed to keep competing products out of the national market.

With the ongoing multilateral work being done by the WTO on reducing impediments to trade, many countries continue to pursue bilateral approaches to facilitating trade. As described in the previous section, importation of organic products into the U.S. and the EU is primarily based on a nuanced bilateral approach.[23] Aside from direct authorization of private certifiers in foreign countries, two countries must negotiate the acceptance of each other's organic products. The results of these negotiations range from accepting individual products to formally accepting each other's regulations as being equivalent. This bilateral approach is convenient for the governments as it clarifies the tasks and goals of the negotiations, relative to a multilateral context. From the perspective of the producer who wishes to produce for multiple markets with non-equivalent organic regulations or certifiers who wish to address the needs of their clients who wish to produce for such markets, this approach is quite problematic. When a bilateral agreement of complete equivalency exists, then a single certification satisfies the production for both the domestic market and the particular export market. When no agreement exists then the cost of producing for both the domestic market and the particular export market is substantially increased. When a single certifier is accredited by both the domestic government and the government of a particular export market, there may be some cost savings to the producer. A certifier will often certify a client to two different standards by doing a "gap analysis" and determine the additional requirements made by the second set of regulations, thus taking advantage of any existing overlap. The transaction cost of accessing the export market is partially reflected in the cost of getting the additional certification. The more similar the regulations, the lower the cost of certifying to the second set of regulations. When a producer knows that they will be producing for two markets prior to getting the domestic organic certification, they can achieve a type of pecuniary economy by selecting a certifier accredited to both governments. Of course, this assumes that the fundamental nature of organic production is consistent with both sets of regulations. From the producer end, the more equivalence agreements there exist, the more potential export opportunities exist. From the certifier end, there are more marketing opportunities not just domestically but also in the particular export market since the equivalence agreement potentially allows that certifier to certify a foreign producer to both markets. As regulations between the two countries become less similar and are more difficult to achieve equivalency, the transaction costs of entering the other market increase – the cost of certification goes up and the cost of altering production to meet the other standards potentially go up.

When formal equivalency between two countries does not exist, the opportunities for producers and certifiers become more complicated. Assuming that all the organic regulations are transparent, it becomes increasingly more difficult for a certifier and, by extension, the organic producer, to keep track of the differences among sets of regulations. In addition, each certifier must be accredited and undergo regular inspections from the authorizing bodies of the governments to maintain their certifying status. Maintenance of certifier status can involve ongoing training of inspectors, changes to manuals and adjustment of policies. Failure to maintain such status can result in a client

[23] While the EU is a regional, multinational entity, it is being treated in a bilateral context here due to the nature of organic regulation in the EU.

of the certifier assuming greater transaction costs in order to become certified by a different accredited certifier of the particular foreign government.

Because of the problematic nature of establishing formal equivalence between different standards, private third-party organizations have endeavored to develop harmonization among different sets of organic standards. One of these approaches is being taken by the International Federation of Organic Agriculture Movements (IFOAM) which established its International Basic Standards (IBS) in 1980. The IBS is not a set of standards but, rather, a "meta-standard" against which other organic standards are evaluated. Bowen describes the IBS as an international norm and that standards should be consistent with the criteria laid out by the IBS. While this approach does not mean that standards meeting IFOAM's IBS are exactly alike, it does mean that "alternative methods of production and processing systems are compliant with the Principal Aims of the IBS …. Also, variations must represent distinguishable improvement over conventional production and processing systems…." (Bowen, p. 4) The IFOAM criteria are also flexible in that accredited certifying bodies of IFOAM discuss and vote on any changes. Essentially, IFOAM ensures that variations occurring among different standards are justified and reasonable as well as guaranteeing that all IFOAM-recognized certifiers extend mutual recognition. Hence, certifiers that confer IFOAM certification to their clients are communicating to any other certifier or to any other body recognizing IFOAM certification that the client's product has been grown, processed, and/or handled in a manner consistent with IFOAM's criteria and, therefore, consistent with the criteria of any other IFOAM-recognized certifier.

This private[24] approach to standards does not supplant national or regional organic standards but does provide a means by which other standards can be evaluated. In many ways, the IFOAM approach is similar to the EU approach to making the different organic standards consistent among its member states. As Courville, et al and Commin describe it, an EU member state cannot prevent the sale or marketing of a product that is legal in another member state, so the EU harmonizes its regulations at a broad level to ensure convergence at a broad level while still allowing diversity in regulation based on cultural or geographical considerations.[25]

In summary, then, the process of harmonizing standards is quite complicated but still in line with the general movement of global trade liberalization. What needs to be reiterated is that organic standards do not necessarily have to be identical. Given that many organic

[24] IFOAM is private in that it is made up of its certifiers and not made up of government representatives.

[25] It should be mentioned at this point that many papers discuss the role of the Codex Alimentarius (Codex) in the harmonization of organic standards. The Codex was established by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) of the U.N. to facilitate the creation of food standards and codes of practice. In 1992 the Codex Commission's Food Labeling Committee started developing the "Guidelines for Production, Processing, Marketing and Labeling of Organically Produced Foods" to facilitate international harmonization of organic standards. Commin indicates that its role in harmonization is tending toward the facilitative role because of existing trade rule adjudication by the WTO and other bodies.

standards are meant to reflect cultural or geographic considerations, it is highly unlikely that many standards will be identical. On the other hand, there are increasing efforts to review organic standards and ensure that the differences reflect real purposes and are not designed to serve as nontariff barriers to trade. The primary question is how much of the efforts to review will be multilateral or bilateral and how coordinated these efforts will be. The greater the degree the efforts are coordinated and the more dynamic the process is that allows future changes (a la the IFOAM approach), the lower the transaction costs are for growers, processors and handlers to getting certified for multiple markets.

In the next section of the paper, the reader will be introduced to the specifics of seed production. The importance of understanding the basics of production followed by an understanding of how certified organic seed production differs from conventional seed production will set the context for discussing the issue of moving beyond the certified organic seed loophole in the federal organic regulations.

III. Seed Production: A Primer

The commercial production of seed can be quite different from the commercial production of the market crop that is grown from the seed – in fact, they are completely separate commodities. Commercial seed production often takes place in locations different from the locations where most commercial production of the commodity takes place. The conditions for optimal growth of seed are often the conditions that are neither desirable nor profitable for the production of the commodity. Seed production can often involve greater constraints on quality than the commercial production of the commodity. In this section, a quick overview of conventional seed production will be provided followed by a description of the production of carrot and lettuce seeds.

Seed is a critical input into the production of any commodity. As an input, seed is subject to various standards regarding its viability, its freedom from disease and its purity, among other characteristics. Over the past century, various certification schemes as well as relatively more recent legislation aimed at promoting private development of plant varieties have emerged to better serve commercial producers of horticultural commodities. In essence, these developments have proven to increase the amount of information inherent in seed market transactions and allow growers of horticultural commodities to better serve their own markets and potentially improve their own profitability.

There is not necessarily a one-to-one correlation between seed and the commodity it produces. Product characteristics for horticultural crops tend to focus on such aspects of pest resistance, yield, taste, appearance, seasonality, and transportability. Generally, characteristics not relating to specific market characteristics or to enhancing profit are of lesser concern to growers.[26] Commercial seed producers are motivated to produce seeds for varieties that growers find desirable but the organization of their production is quite different. While the final grower certainly determines the preferred variety of the commodity desired, the seed producer must be able to profitably produce the seed of the desired crop variety. The grower of seed must use methods that produce an acceptable yield, quality and consistency. In the following paragraphs, this paper will outline some general methods for production of seed and then follow it with a more specific discussion of the particular methods for producing conventional carrot and lettuce seed.

A. Producing Commercial Seed

While crops often have very different characteristics in terms of production, there are a number of steps common to the production of many types of seed. Some of the common steps to producing seed are as follows[27]:

Field selection and preparation;

[26] An interesting note made by McDonald and Copeland, and in contrast to the production of commodities, is that "There is no direct relationship between quality of seed planted and either yield or quality of the [seed] crop produced." (p. 30).
[27] Much of this material is taken from McDonald and Copeland.

Seeding and stand establishment;
Soil fertility, irrigation and pollination
Weed, disease and insect control
Harvesting, drying and storage; and,
Conditioning and quality control.

The point in going through some of the basic steps of conventional seed production is to eventually compare it with constraints on producing certified organic seed.

Field selection and preparation In choosing a location for commercial production of seed, key issues that must be addressed include the ability of seeds to remain viable in the soil and it ability to efficiently and consistently germinate. At the same time, the site must also be free of viable weed seeds that could potentially contaminate the seed being grown thus lowering its quality and even making it impossible to market. Aside from avoiding locations where weeds tend to be a problem, the locations of production must also be sufficiently far from other crops (seed or otherwise) that might constitute a cross-pollination danger. Once the field is selected, preparation of it focuses on eliminating or controlling as much of the weed problem as possible. In conventional seed production, this is done primarily through the application of chemical herbicides. To promote good germination, growers often cultipack the soil to maximize soil-seed contact as well as till the soil to a fine level.

Seeding and stand establishment Growers often have to choose between planting rows or establishing solid stands of the crop. Whatever is chosen, the objective is to ensure that seedlings are well established and to generate as high a yield of seed as possible. While the grower wishes to promote the germination of the crop seed, it must be managed in such a way that it doesn't also promote weed seed germination. An example of a method to achieve these two objectives is as follows:

> … a liquid charcoal safener is sometimes sprayed in a band over the drilled row in which the crop is seeded. This procedure allows a contact herbicide to be used over the entire field to prevent germination of all seed (including weeds) between the rows while permitting germination below the charcoal band, which absorbs the herbicide and protects the emerging crop seedlings. (McDonald and Copeland, p. 31)

Soil fertility, irrigation and pollination The management of soil fertility is most important to establishing a good yield – according to McDonald and Copeland, fertility has no impact on the quality of the seed. At the same time, any seemingly minor deficiency in the mineral elements can cause some impacts on seed quality. Like fertility, irrigation plays an important role in yield. Generally, most seed crops require an abundant amount of water.[28] With respect to pollination, bees and other insects are often quite important to pollinating the crop. At the same time, for many crops there is a danger of cross-pollination occurring as a result of insect or wind pollination. If this is a concern, and if

[28] Which means, of course, that availability of water is a critical characteristic for locating seed production.

wind and insect pollination are still tools, then the crop must be adequately isolated from other crops that pose a cross-pollination threat.

Weed, disease and insect control Control of pests is critical to the successful production of commercial seed. As mentioned before, prevention and/or elimination of weeds is critical to preparing for seed production. During the course of growing seed, weeds compete for space, nutrients, moisture and sunlight and, thus, must be appropriately managed. Perennial weeds are a problem that is most likely dealt with at the crop location decision level, other weeds appearing are usually dealt with via traditional chemical methods or via cultural methods that include charcoal bands, manual roguing[29] and the burning of desiccated weeds. Controlling disease common to seeds is more problematic as typical seedborne diseases can be caused by bacteria, viruses and fungi and can generate problems in later generations of the seed. The primary control of some of these diseases lies in establishing production in disease-free areas and using disease-free planting stock. Since insects are often the vectors for some seedborne diseases, their control is often quite important. Often, insects will lay eggs in the seed as it develops. Typical control of such problems includes applying insecticides to the seed or fumigating the seed lot.

Harvesting, drying and storage When the seed crop has reached the desired maturity and the level of moisture is within acceptable bounds for safe storage, the crop is harvested either mechanically or manually. Oftentimes, the crop is windrowed until sufficiently dried and then threshed. If machines are used, there is often a concern for breakage of the seed. If a machine is used, it is also important that the machine be sufficiently cleaned to prevent contamination of future harvests.

Conditioning and quality control After harvesting, the seed crop must have any inert matter and weed and any other seeds removed in order to attain the highest possible quality level and appearance. Seed lots are also sampled to determine the quality level of the harvest.

It is important to note that location of seed production at a broader scale is quite flexible. A variety of a vegetable that is grown as a commodity in one area could have its seed commercially produced anywhere in the world or more than one place in the world. Generally, the location of seed production is determined by the costs of production as well as the climate for achieving optimal seed production. As George points out,

> "Seed companies continue to look for new production areas and new markets where not only climatic conditions but also the economic situation, including transfer of capital investment and local labour costs, are favorable. The cost of labour is an important consideration in the production of hybrid seed especially when hand emasculation and pollination are necessary. For these reasons there has been increased activity by seed companies to establish production contracts in countries such as India, Indonesia, Pakistan and Taiwan." (p. 15)

[29] The removal of diseased or abnormal plants from a group of plants of the same crop variety. (Dictionary.com)

In addition, issues such as tariffs, barriers to trade and the existence of embargoes or sanctions can also be quite important in determining where commercial seed production could take place. (George, p. 15) Also influencing commercial seed production is the concern over the use of agricultural chemicals. The existence of such chemicals to act as growth regulators, seed pelleting and seed coating has not kept some from calling for a reduction in the amount of chemical use and for the substitution of more benign substances which has often resulted in less pesticide applied per unit area of land. (George, pp. 9-10)

Having outlined the general issues surrounding commercial production of vegetable seeds, the paper will move on to some of the particulars surrounding the commercial production of carrots and lettuce.[30]

B. Carrot Seed Production

Carrots (*Daucus carota*) are an herbaceous biennial[31] characterized by an above ground rosette of leaves and a large deep taproot. Primarily consumed as a fresh product, the cultivation of carrots requires a relatively cool growing season and is easily grown in many different regions. During the winter, market carrots are best produced in Florida, Texas, California and Arizona and in the summer carrots are primarily grown in New York, Wisconsin and Michigan. While California was traditionally the primary location of commercial seed production, production has moved to areas such as the Columbia Basin in Washington state, the Madres area of Oregon and Idaho. Attainment of maximum quality and seed yield tends to occur in desert environments. (McDonald and Copeland, p. 633)

There are two methods of producing commercial carrot seed: the seed-to-seed method and the root-to-seed method. In general, the seed-to-seed method involves planting seed directly into the ground late in the summer, allowing the plant to vernalize in the winter and then flower in the spring and then harvest the seed in the late summer. The root-to-seed method is more involved in that it requires a higher degree of management but also ultimately allows a greater degree of control over the quality of the seed. In the root-to-seed method, the carrots are raised in beds during the summer, usually in a location different from market production, removed from the soil in the fall and examined for trueness to type and then stored for the winter in an environment of low temperature and high humidity. This environment reduces the incidence of storage rot during the winter. In the spring, the carrots are replanted in the soil and allowed to mature and subsequently the seed is harvested in the summer. This root-to-seed method is also used as a back-up system to the seed-to-seed method should a winterkill of the crop occur.

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[30] Much of the information on carrot and lettuce seed production is taken from McDonald and Copeland and from George.

[31] This means that in order for a carrot to flower, it requires two growing seasons and the plant must undergo vernalization or be exposed to a sufficiently low temperature to induce bolting.

As can be deduced from the description of the two methods, the root-to-seed method is quite labor intensive. On the other hand, the root-to-seed method allows a greater amount of quality control during the production process. As a result, "the root-to-seed method is required by most seed companies for new varieties, new inbreds, and stock seed to allow selection for root characteristics." (McDonald and Copeland, p. 634) The seed-to-seed method is often used when emphasis is placed on producing large quantities of commercial seed. (McDonald and Copeland, p. 634)

Prior to addressing the cultural methods for producing carrot seed, it should be noted that carrots are subject to a fair amount of cross-pollination between plants in the seed crop. Bees are often the promoter of the cross-pollination but if bees are used it is important that there is not competition with carrots from other flowering crops. Because of the cross-pollination process, carrots can cross-pollinate with other carrot species, including the wild carrot. According to George, the "[c]ontamination of seed crops by wild-carrot pollen is a major reason for genetic deterioration of seed stocks in some areas of the world." (George, p. 245) For this reason, it is common for commercial carrot seed crops to have isolation distance of 1600 meters or more.[32] (George, p. 245)

Carrots for seed production are best grown in sandy loams but the crop is tolerant to a wide range of pH levels. Because of the small size of carrot seeds, tillage is critical to the success of the crop. The ground into which the seed is sown must be "clean of weeds, well pulverized, compact to ensure ready flow of soil water to the seed and yet minimize puddling or crusting after a heavy rain." (McDonald and Copeland, p. 634)

Depending upon the growing method (see above) and because of the biennial nature of carrots, it is not necessarily the case that planting and harvesting will occur in the same location.[33] When the seeds are planted, there is a tendency to plant them at a high density in order to promote the development of the primary umbels over the secondary umbels.[34] This results in the majority of seed development occurring on the primary umbels. According to George,

> "The main advantage of the higher plant densities is the shortening of the overall flowering period, increased evenness of umbel ripening and a higher proportion of seed in the final seed lot derived from primary umbels; thus contributing to improvement of seed quality. A uniform carrot seed crop facilitates the application and timing of pre-harvest desiccant sprays or PVA adhesives where the weather conditions dictate their use." (p. 241)

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[32] Because cross-pollination is less of an issue in market carrot production, the isolation distance for market carrots is generally 1000 meters.

[33] For one carrot seed producer, planting is begun in the Imperial Valley and then, after vernalization, the crop is shifted to the Pacific Northwest and replanted.

[34] An umbel is the branch that comes out of the top of the carrot where the seed eventually develops. The primary umbel is the first branch at the center of the stalk, the secondary umbels are the branches that develop below, the tertiary umbels develop out of the secondary umbels, etc.

If lower planting densities are used, the seed on the primary umbel is generally ready earlier relative to the secondary umbels and may require hand harvesting. If mechanized harvesting is used, higher density of planting is preferred and a greater proportion of the seed is coming from the primary umbels. (George, p. 242) A drawback to the mechanical harvesting approach is the higher probability of losses due to seed shattering or losses from seed dropping from the primary umbels if mechanical cutting is delayed.[35] If there is concern about uneven seed development on the umbels and a resulting increased probability of seed shattering, the umbels can be sprayed with an adhesive like polyvinyl acetate to reduce the incidence of seed loss. (McDonald and Copeland, p. 636)

Once the seed is planted, the crop develops. As with any seed crop, management revolves around protecting the plant and reducing the amount of competition from weeds and pests as well as selecting for the plants that are most likely to produce high quality seed at an acceptable yield. As was the case with tillage, weed control must also take the small size of carrot seed into account. Because the seed should not be dislodged while in the bed and, thus, negatively affect emergence, weed control tends to be heavily focused on the use of chemicals. (McDonald and Copeland, p. 635) Examples of this include the use of herbicidal solvents on the seeds and herbicides. Cultural controls include crop rotations. Rotations are important in battling fungal diseases like leaf blight and black rot which are common to areas where carrots are grown. These diseases tend to survive in crop residue between crops and can also be carried on or in the seed. (McDonald and Copeland, p. 635) Roguing of the carrots is an ongoing, labor-intensive process. It tends to focus on removing plants that bolt earlier than the rest of the crop as well as removing discolored plants or poorly colored plants or plants having other undesirable characteristics. (George, p. 247)

Fertilization is also important and tends to be applied in a band and to the side of the seed at the time of planting. A second side-dressing is applied later in the summer and oftentimes nitrogen is applied in the spring of the second year of the crop. Irrigation is frequent and primarily made up of flood irrigation. If overhead irrigation is used, then additional fungicidal sprays are used. (McDonald and Copeland, p. 635) Typical pests include leaf hoppers, aphids and lygus bugs. The lygus bug tends to decrease the level of seed germination as a result of sucking germplasm from the seed.

Once the seeds are harvested, they are cleaned with an air-screen cleaner and indent cylinder. There is not much need for drying of the seed unless there is a wide variation in seed maturity in the crop. The harvested carrot seed is viable in storage for approximately 3-5 years. (McDonald and Copeland, p. 636) An acceptable yield is 600-1000 kg/ha for open-pollinated carrot cultivars grown in temperate regions. In hotter production areas where vernalization is more difficult, yields are 250-350 kg/ha. (George, p. 248)

C. Lettuce Seed Production

[35] Mechanical harvesting is a one-time activity since it involves cutting all the seed stalks at the same time. Hand harvesting is selective and can be done in stages.

Lettuce (*Lactuca sativa*) is an herbaceous annual that is unique among vegetables in that it is used almost exclusively as a fresh, relatively unprepared part of salads. It is made up of six morphological types: crisphead (iceberg), butterhead, cos (Romaine), leaf, stem and Latin. Lettuce is easily crossed with the common wild lettuce, *Lactuca serriola*.

Lettuce is characterized by a deep penetrating taproot that absorbs most of its nutrients in the top foot of soil. High temperatures promote the bolting of the plant (the change from a vegetative condition to the formation of the flower). When the plant bolts, the seed stalk emerges from the head. If the nature of the lettuce variety is such that the head is tightly packed, the seed stalk may require some assistance to emerge. Such methods include deheading (the removal of leaves from around the seed stalk), slashing and quartering (cutting an "X" at the top of the head to loosen the tight leaves) and the application of a regulating chemical such as gibberellic acid to promote bolting.

An important issue surrounding lettuce production and, by extension, lettuce seed production is the presence of the lettuce mosaic virus. This virus produces symptoms in which "a clearing between the veins when a portion of leaf from an infected plant is held up to the light." (George, p. 130). Plants which acquire the virus early in plant development end up stunted and frequently fail to heart which results in an unmarketable product. Lettuce plants that bolt and produce seed can have up to 15% of the seeds carrying the virus in the seed embryos and insects can act as vectors of the virus when they suck the germplasm out of the seed and transmit the virus to the same or other crops. Commercial lettuce seeds are generally indexed for the lettuce mosaic virus by sampling the lot and growing them out to the point where the virus should be observed if it is present. While there is no industry standard for indexing, the level can be around 0.5% but the standard is generally determined locally. (McDonald and Copeland, p. 624) Seed production is often located in insect-free structures or in areas where temperatures are too high for aphids, the common insect vector, to appear.

Approximately 70% of lettuce seed production is located in California because of the combination of soils, climate, water and labor availability. (McDonald and Copeland, p. 622) Typical cultural practices begin with the tillage of beds to a depth of 12 inches as early in the season as possible after which the seedbed is smoothed and leveled. Seed is often planted at night and irrigated so that germination can occur before high daytime temperatures arise. In conventional production, pelleted seed is generally used and osmoconditioned in growth regulators and redried or pregerminated in a gel after which it is planted by fluid drilling. (McDonald and Copeland, p. 623)

Planting density eventually runs to about 30,000 plants per acre after thinning of plants occur at the 3-4 week stage. Lettuce is given nitrogen at planting, after thinning and at bolting. The plant is also given phosphorous and potassium since lettuce roots have difficulty absorbing these elements from the soil. (McDonald and Copeland, p. 623) Lettuce plants require much water in the form of sprinkler application (early in its life) and furrow irrigation (later in development) up until flowering. Irrigation promotes plant weight and may increase seed yield but it also delays maturation of the plant – George indicates that the benefits of an increased seed yield often make up for the delays to optimal harvest. (George, p. 126)

Cross-pollination between commercial lettuce varieties can occur and, critically, between a commercial variety and the wild lettuce variety, *Lactuca serriola*. More dangerous, though, is if there is mechanical contamination of the lettuce seed crop with the wild lettuce – when harvest occurs and wild lettuce seed is mixed in with commercial lettuce seed – then it becomes almost impossible to use the lettuce seed. (George, p. 126) To help prevent cross-pollination or mechanical contamination, lettuce seed production is conducted under temporal isolation in that it is suggested that there should be a 3-year interval between lettuce seed crops or a 2-year interval between market crop production and the lettuce seed crop. (George, p. 127) If the temporal isolation is not possible, a chemical isolation is possible,

> "Some authorities make an exception to this minimum isolation period when the soil or substrate has been effectively fumigated or partially sterilized. This exception is especially useful when lettuce seed is being produced in protected structures or glasshouses." (George, p. 127)

For the temporal isolation, crop rotations involving tomatoes, cucurbits, sweet corn, spinach, beets, and carrots are used. These crops make it easier to reduce the buildup of lettuce weeds and diseases. In addition, cultivation and the application of herbicides is used between crops but cultivation is becoming increasingly encouraged and practiced in place of herbicide application. (McDonald and Copeland, p. 623) Handweeding is a common means of weed control.

As the lettuce plant develops, roguing and selection occur at three different stages: the 4-6 leaf stage; maturity at the time of heading; and, after bolting has started. (George, p. 127) The second stage is considered the most important. The purpose of this activity is to ensure the highest quality, most desirable plants are the source of the seed to be harvested.

The harvesting process occurs after the 12-21 days in which the lettuce plant goes from flowering to mature seed formation. Higher ambient temperatures increase the general rate of development and ripening. Because not all seed develops at the same rate and because the seed developing first can pass its optimal harvest time by the time the rest of the seed reaches its own optimal maturity, the general practice in seed production is to harvest the seed when an estimated 50% of the seed heads are ready on a typical plant. (George, p. 129) The seed can be harvested manually or mechanically. When harvested manually, the seed stalks are cut and then shaken over a container. If the moisture content of the plant is relatively high, the cut seed stalks are left in windrows to dry for up to five days. The manual harvesting process can be repeated very 2-3 days to harvest the later maturing seed.

Seed is cleaned to remove chaff that results from mechanical harvesting. Starting with an air-screen cleaner and subsequently with a disk separator or an indent cylinder, the flowers and vegetative plant parts of the lettuce plant are removed to leave the marketable seed. An acceptable yield is considered 0.5-1 tons per hectare. (George, p. 130) Lettuce seed is considered viable for up to 4-5 years under proper storage where the moisture content is kept at 7% or less. (McDonald and Copeland, p. 625)

D. Issues Surrounding Certified Organic Seed Production

In the section previous to this one, a certain level of detail was presented with respect to how commercial seed is produced – both generally and specifically with respect to carrots and lettuce. The objective in doing this was to set up an illustration of how different commercial organic seed production must be from commercial production of conventional seed.[36] An earlier part of this paper discussed the general issues surrounding how organic certification is done in the United States but it should be reemphasized here that the USDA's organic regulations are process oriented. This means that in trying to transition from a conventional production system to an organic one, the letter and basic spirit of the federal organic regulations must be met.

First, commercial organic seed production must meet the general regulatory definition of "organic production" which is as follows:

> A production system that is managed in accordance with the Act and regulations in this part to respond to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity. (Subpart A – Definitions, § 205.2 Terms defined)

While nothing in this definition is inherently antithetical to commercial seed production as currently practiced, it does generate an additional, potentially binding, constraint on seed production in that any choice made by the commercial seed producer must satisfy the general definition. If it does not and the producer is committed to producing certified organic seed, then alternative methods, practices and/or substances must be substituted or developed.

Looking a little more closely at the regulation text addressing crop management, Section 205.203[37] indicates that

> (a) The producer must select and implement tillage and cultivation practices that maintain or improve the physical, chemical, and biological condition of soil and minimize soil erosion.
>
> (b) The producer must manage crop nutrients and soil fertility through rotations,

[36] For purposes of simplicity, the issue of seed saving will not be addressed in any detail in the paper. Seed saving, organic or conventional, is a situation in which a grower allows part of the market crop to go to seed and then collects the seed that will be used to grow the following season's crop. As mentioned earlier in the paper, organic regulations allow growers to produce their own organic seed without additional certification so long as the OSP identifies that seed is being produced on-farm in a manner consistent with organic production. Clearly, this form of organic seed production is fundamentally different from the methods described in the section on general commercial seed production.

[37] Soil fertility and crop nutrient management practice standard. (http://www.ams.usda.gov/nop/nop/standards/)

cover crops, and the application of plant and animal materials.

(c) The producer must manage plant and animal materials to maintain or improve soil organic matter content in a manner that does not contribute to contamination of crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances….
…
(d) A producer may manage crop nutrients and soil fertility to maintain or improve soil organic matter content in a manner that does not contribute to contamination of crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances by applying:

(1) A crop nutrient or soil amendment included on the National List of synthetic substances allowed for use in organic crop production;

(2) A mined substance of low solubility;

(3) A mined substance of high solubility, Provided, That, the substance is used in compliance with the conditions established on the National List of nonsynthetic materials prohibited for crop production;

(4) Ash obtained from the burning of a plant or animal material, except as prohibited in paragraph (e) of this section: Provided, That, the material burned has not been treated or combined with a prohibited substance or the ash is not included on the National List of nonsynthetic substances prohibited for use in organic crop production; and

(5) A plant or animal material that has been chemically altered by a manufacturing process: Provided, That, the material is included on the National List of synthetic substances allowed for use in organic crop production established in § 205.601.

Again, the regulations are indicating additional requirements that the commercial seed producer's OSP must monitor soil conditions and fertility and that any practices which fail to maintain condition and fertility or which contaminate crops, soil or water – even if they can be addressed with additional substances or practices after the fact – cannot be allowed under certified organic production.

Further on in the regulatory text,[38] the regulations address other practices relevant to commercial seed production:

(a) The producer must use management practices to prevent crop pests, weeds, and diseases including but not limited to:
(1) Crop rotation and soil and crop nutrient management practices, as provided for in §§ 205.203 [Soil fertility and crop nutrient management

[38] Section 205.206 Crop pest, weed, and disease management practice standard. (http://www.ams.usda.gov/nop/nop/standards/)

practice standard] and 205.205 [Crop rotation practice standard];
(2) Sanitation measures to remove disease vectors, weed seeds, and habitat for pest organisms; and
(3) Cultural practices that enhance crop health, including selection of plant species and varieties with regard to suitability to site-specific conditions and resistance to prevalent pests, weeds, and diseases.

(b) Pest problems may be controlled through mechanical or physical methods including but not limited to:
(1) Augmentation or introduction of predators or parasites of the pest species;
(2) Development of habitat for natural enemies of pests
(3) Nonsynthetic controls such as lures, traps, and repellents.

(c) Weed problems may be controlled through:
(1) Mulching with fully biodegradable materials;
(2) Mowing;
(3) Livestock grazing;
(4) Hand weeding and mechanical cultivation;
(5) Flame, heat, or electrical means; or
(6) Plastic or other synthetic mulches: Provided, That, they are removed from the field at the end of the growing or harvest season.

(d) Disease problems may be controlled through:
(1) Management practices which suppress the spread of disease organisms; or
(2) Application of nonsynthetic biological, botanical, or mineral inputs.

(e) When the practices provided for in paragraphs (a) through (d) of this section are insufficient to prevent or control crop pests, weeds, and diseases, a biological or botanical substance or a substance included on the National List of synthetic substances allowed for use in organic crop production may be applied to prevent, suppress, or control pests, weeds, or diseases: Provided, That, the conditions for using the substance are documented in the organic system plan.

In going through the text above, again there is nothing inherently inconsistent with commercial seed production. Nonetheless, the text does highlight certain issues. In 205.206(b), the text indicates that pest problems should be handled through mechanical or physical methods that can include nonsynthetic controls (part (b)). Further on 205.206(d)(2) suggests that disease problems may be controlled through nonsynthetic biological, botanical or mineral inputs. Other suggested practices such as mulching with fully biodegradable materials (205.205(c)(1)) are potentially problematic for seed producers unless the mulch is guaranteed to be free of contaminants that could negatively affect the quality of the seed. Even though plastic and synthetic mulches are allowed, they would still be unattractive to a commercial seed grower (or any grower, possibly) since it would require additional costs of removal at the end of the season (205.206(c)(6)). Of course, Section 205.206(e) does allow an out for the use of synthetic

materials when the allowed practices are not affective. Nonetheless, the synthetic substance must already be on the National List.[39]

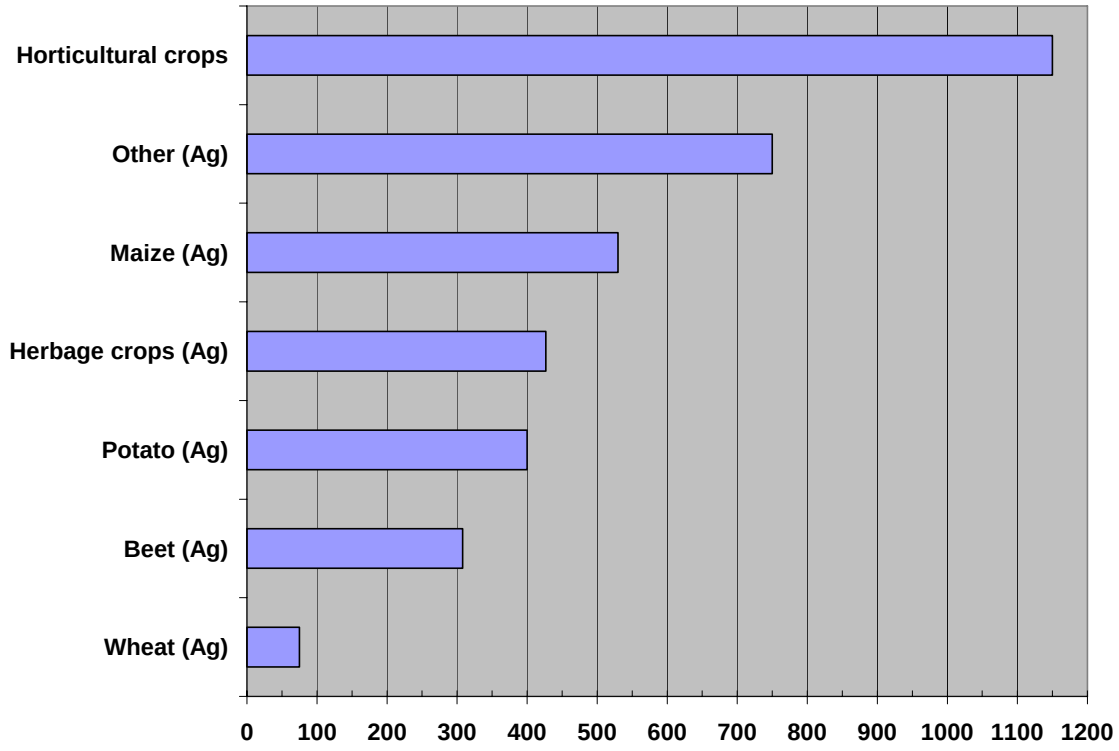
Ultimately, what the national organic regulations do is potentially remove many of the lowest-cost crop pest, weed, and disease management tools from organic producers that are normally available to commercial seed producers. This ultimately raises the minimum cost of organic commercial seed production in the short- to medium-run. This result is not that surprising or necessarily that worrisome for a number of reasons.

First of all, for most crops, specialty or otherwise, there is often a not insubstantial price premium attached to organic production. Therefore, a higher cost of certified organic seed is not necessarily a large barrier. Secondly, over time it would be fair to expect that costs of certified organic commercial seed production would fall with increased experience and new technologies although this is unlikely to happen in the short run. Looking specifically at vegetable crops or horticultural crops (depending upon the availability of data and its breakdown), the expectations of lower costs may not be an unreasonable expectation. Looking at the global export of horticultural crops in 1998 (Figure 1), the value, compared to agricultural crops is high.[40]

Figure 1: Value of exported seed of major crops (in USD million), 1998

[39] Although this paper will not pursue this, it is worth noting that getting synthetics onto the National List is quite costly and problematic in non-monetary terms. If the synthetic is a generic substance, a full review of the substance must be done. On the other hand, if the desired synthetic substance is not generic, the producer of the substance is required to reveal all the ingredients in order for it to be reviewed and ultimately placed on the National List. In cases where the producer is unwilling to reveal all the substances, it becomes quite difficult to complete the review process and place the substance on the list. A brandname synthetic must appear on the National List if it is to be allowed, even if it is essentially equivalent to any generic synthetic substances.

[40] Of course, horticultural crops as a group comprise a very large number of crops and varieties but the point is to show that the level of trade is significant relative to agricultural crops.



Source: International Seed Federation (www.worldseed.org/statistics.htm), accessed 3/5/05.

Going from a global perspective to a U.S. perspective, the data on the trade of vegetable and flower and forage seed crops in the United States for the period 1982-1996 (Figures 2a and 2b) not only indicates a high level of value but also substantial growth. Looking more forward and trying to compare the "apples and oranges" of corn and fruit and vegetable crops,[41] Figure 3 and 4 show how the amount of manpower devoted to plant breeding for corn and for fruit and vegetable crops and the breakdown of those "scientist years" between public and private plant breeding for the same categories of crops could indicate that the specialty crop sector is poised for a substantial take-off which could positively influence the development of organic specialty crops.

[41] The reader will forgive a second pun.

Figure 2a: Exports and imports of U.S. vegetable seed for planting (millions of US$). 1982-1996

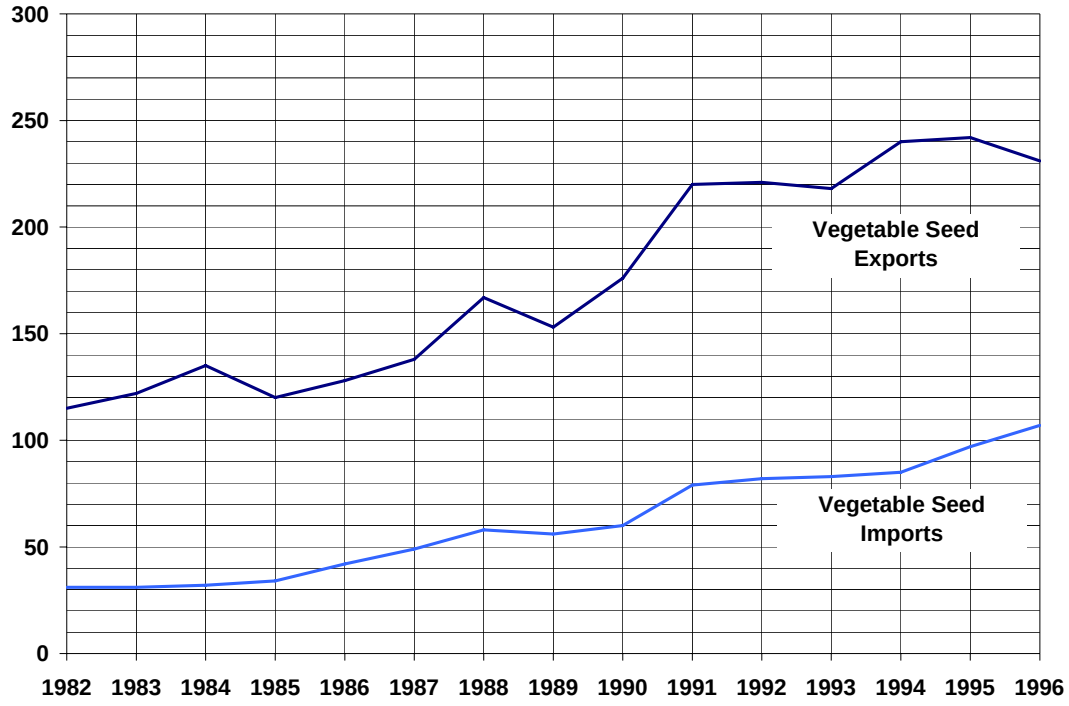
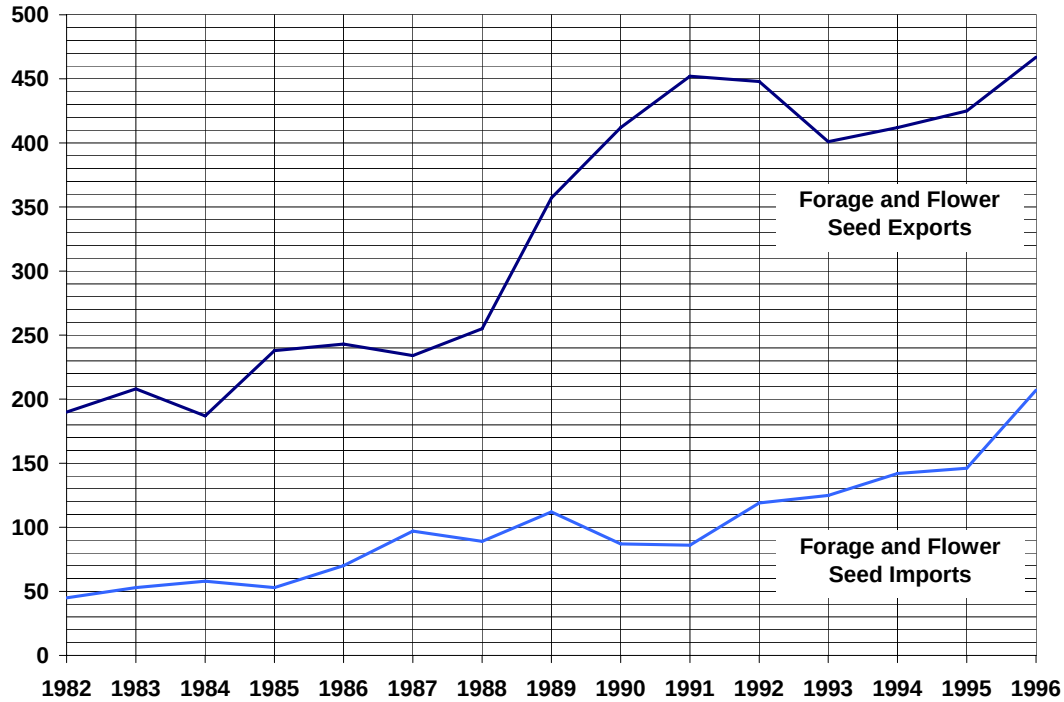
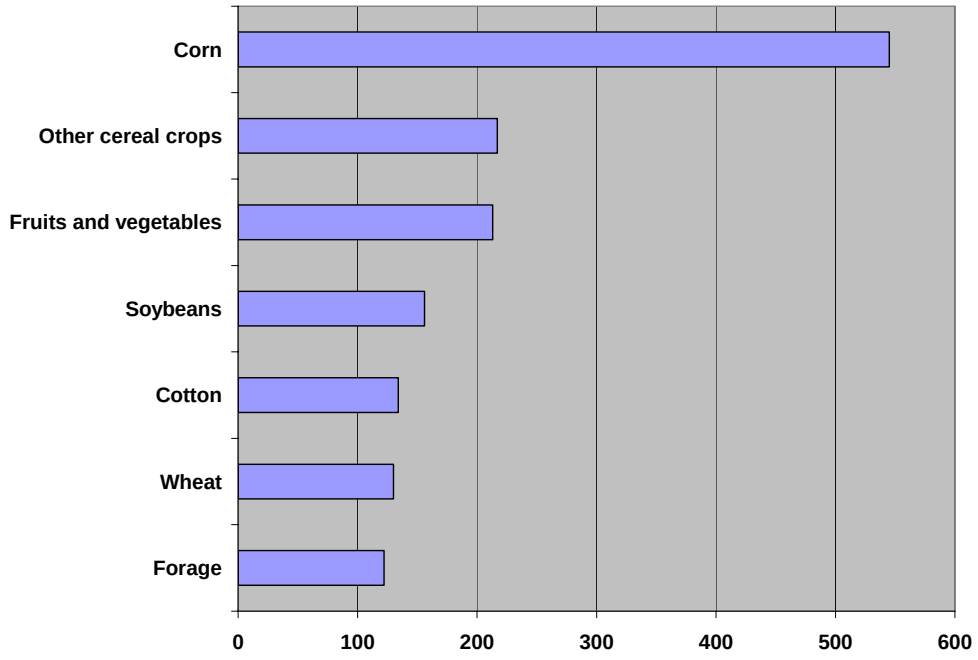


Figure 2b: Exports and imports of U.S. forage and flower seed for planting (millions of US$). 1982-1996



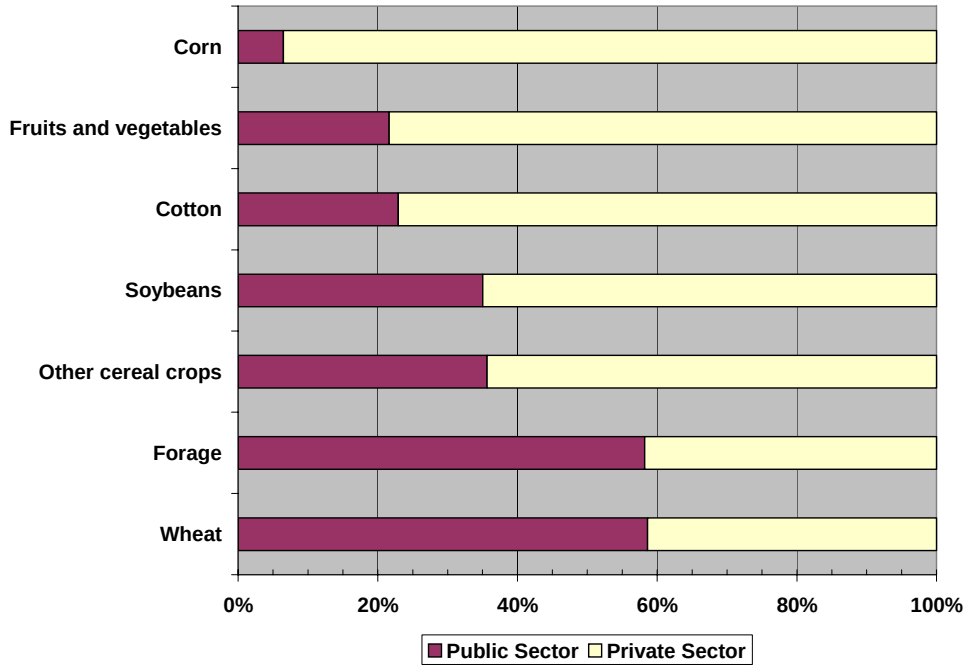
Source: Fernandez-Cornejo, Jorge. The seed industry in U.S. agriculture. (Agriculture information bulletin; no. 786), January 2004.

Figure 3: Number of scientist years (combined public and private) devoted to plant breeding, by crop, 1994.



Source: Fernandez-Cornejo, Jorge. The seed industry in U.S. agriculture. (Agriculture information bulletin ; no. 786), January 2004.

Figure 4: Share of scientist years devoted to plant breeding, public and private, by crop, 1994



Source: Fernandez-Cornejo, Jorge. The seed industry in U.S. agriculture. (Agriculture information bulletin ; no. 786), January 2004.

It might be noted that, historically, much of the growth in seed development has been generated by the application of biotechnology to crops such as canola, corn, cotton and soybeans. This past January, though, Monsanto undertook to purchase Seminis Inc., the world's largest vegetable seed company, for US$1 billion. According to an article by Jerry Hirsch in the January 25, 2005 edition of the Los Angeles Times, Monsanto's chief executive, Hugh Grant, said that "The value in the agriculture industry has shifted dramatically away from chemicals and into seeds," and that Monsanto is expecting Seminis to concentrate on traditional breeding and has no plans for it to develop biotechnology-based vegetables.

Having established that there seems to be a positive future for vegetable and other specialty crops, in general, the question becomes what is the future for organic vegetable and specialty crops that must eventually be grown from certified organic seed? This discussion must come in two parts. The first question revolves around the specific changes required to make a commercial seed crop certified organic and some of the costs that are associated with that. The second question, which will be undertaken in the next major section of the paper, addresses the institutional constraints to making that sector viable.

Before discussing particular issues, it is worth highlighting the general structure of a seed company. Seed companies generally undertake research and development to develop seed varieties, production of seed and the marketing of the seed. Because of the very competitive nature of crop breeding, the need to capture all the rents accruing to innovation and marketing is critical to any decision to enter a particular sector of the seed market. Development of new varieties requires a considerable investment of time and money, especially when classical breeding is used as tends to be the case for specialty crops. These new varieties must perform in terms of quality, performance and yield. In addition, there either has to be an existing market or a potential market that can be stimulated at an acceptable cost. Seed companies must also address market and weather volatility like any other farming-based operation as well as monitor intellectual property and chemical regulations across many different countries. (Peerenboom, p. 6) If there is a substantial market, many of these constraints are worth overcoming. On the other hand, if a market is small, then the decision to enter a market is more difficult. By one estimate, the organic seed sector is less than 1% of the seed business. (Peerenboom, p. 6) Constraints to entering the organic seed market include the following:

> Small batches of production;
> Few certified producers of seed;
> Separate channels of transport and storage; and,
> High expense of marketing a product to a large number of small growers. (Peerenbom, p.6)

So, why are seed companies interested in producing organic seed? Much like those firms involved in organic commodity production, the reasons range from a belief in the organic philosophy, a desire to learn lessons from organic production that can help reduce cost of production in the conventional seed side, a need to address all important niches in the seed market, and, a need to address growing concerns of final consumers of organic

products who may be expected to demand the use of certified organic seed in the production of the organic products they consume. (Peerenbom, p. 6) So essentially, firms must be taking a forward-looking view of organic seed production in order to get involved. According to Haitsma, a survey of 18 seed companies in 2002 showed that the 55 of 77 species would have an availability of organic seed that was at 5% or more relative the amount of conventional seed for the same species. (Haitsma, p. 24)

In the previous discussion of seed production, a fair amount of detail was laid out in describing how seed is produced. At one level, someone could look into the process and start determining what substances or practices in conventional production must be substituted out due to the prohibition under the organic regulations. The difficulty in doing this is that there is a large amount of heterogeneity at many different levels of the market and regulation. At one extreme, many believe that simply replacing seed treatments and other inputs for developing organic seed is a mistake and that a new, more holistic process (oriented to the original organic philosophy highlighted in the USDA's definition of organic production) is required. (Proctor, 3) At the other end, a number of farmers growing for the organic market are strictly concerned about producing their crops at the lowest possible cost and given that organic seed costs range anywhere from 30% to 300% more than conventional seed (Proctor, p. 4; Groot *et al*, p. 9), this is not a minor concern when seed costs can have a 20% or greater share of total production costs and also given that organic yields are often lower than that for conventional varieties. Other growers might be concerned about closing the organic loop and might be willing to move out of a more profitable variety (a variety that meets most demand characteristics) that may not have organic seed available. Such growers might be looking for long-term adapted varieties or for more modern hybrid varieties that can be produced with organic seed. Other growers might be most interested in growing varieties that best meet the demands of their growing environment and are willing to choose the seed that best does this – regardless of the seed being organic or not.[42] (Rubitschek, pp. 59-60)

So, what organic seed development often comes down to is the issue of organic varieties. A seed company wanting to take a conventional variety it produces seed for and start producing an organic seed for that conventional variety can take advantage of its knowledge and experience. On the other hand, if the conventional variety is different from a desired organic variety, it becomes a harder sell for the seed company. A different view might be that the seed of a conventional variety cannot be grown without all the chemical protection allowed in conventional seed production. A variety that can withstand the naturally occurring pathogens in the soil may perform better under organic conditions than a preferred conventional variety grown under organic conditions.[43] As Proctor notes:

[42] It should be reemphasized that the underlying organic approach explicitly pushes for growing varieties that are "site-specific".

[43] Conventional seed production makes considerable use of chemicals and other seed treatments to promote germination for the specific reason that germination would take much longer or because the seed could not compete for critical elements that make germination possible.

> "When the organic seed from conventional stock is applied to an organic framing system that does not use prohibited materials, the crop can sometimes fail, even under the tutelage of the most experienced organic farmer. Successful organic farmers and some of the companies that presently provide organic seed have selected through this unpredictable stock and have found strong varieties than can produce well on organic farms. However, detailed and widespread breeding specifically for organic agriculture is required. Although this process is going to be time-consuming, it is entirely necessary." (p.3)

The issue of "vertical" disease resistance versus "horizontal" disease resistance also comes up in this context. Vertical disease resistance, which is normally associated with conventional seed production, addresses how a variety has resistance to a specific race of pathogens that is based on the properties of a single gene. "Horizontal" resistance, associated with the needs of organic seed production, is characterized by a need for "durable or polygenic resistance to deal with multiple stress conditions" which are associated across a variety of traits and genes. (Proctor, p. 3)

The issue of whether there is a need for specific "organic" varieties (as opposed to varieties whose organic or conventional designations is strictly determined by how it was produced) will not be investigated any further at this point as it is sufficiently complex to warrant its own exploration. So, assuming for the time being that the specific variety chosen for producing certified organic seed is not critical, the discussion will move on to the qualities of seed in general and how such qualities may be different for organic production.

According to Larinde, the following are a list of certain seed quality attributes that are important to seed producers:

> Purity of seed lot;
> Noxious weed incidence;
> Germination;
> Moisture content;
> Density;
> Varietal purity;
> Incidence of seed-borne disease;
> Vigour;
> Incidence of mechanical damage; and,
> Effectiveness of seed treatment. (p. 13)

Some of these characteristics are related to seed viability and others are related to the ability to produce a consistent crop. Characteristics such as noxious weed incidence, in conventional seed production, are dealt with by the use of herbicides during the production process. Germination, as mentioned in the immediately preceding footnote, is often aided by various chemical seed treatments. Ultimately, seed producers use chemical and synthetic methods to cost-effectively attain the best possible levels of the quality attributes listed. Organic seed production must also try to attain the best possible levels of these quality attributes but must do so using the processes and substances deemed

acceptable by organic regulations. In the short-run, then, it is likely that certified organic seed would not be able to attain the same performance in terms of quality nor in terms of yield. An additional attribute unique to organic seed and technically irrelevant to conventional seed is the absence of GMO contamination. (Larinde, p. 13)

Below are listed the determinants of the list quality attributes (listed above) that Larinde identified. Looking at these determinants will help clarify where the constraints are in terms of expanding organic seed production.

> Field contamination growing conditions;
> Post-maturation/pre-harvest conditions;
> Harvesting;
> Aeration and drying;
> Handling;
> Conditioning;
> Seed treatment; and,
> Storage. (Larinde, p. 13)

Of the determinants listed above, the most problematic for certified organic seed production are the field contamination and pre-harvest conditions, conditioning and seed treatment. The first item is primarily related to the use of chemical herbicides and pesticides and has been discussed in length already. Suffice it to say that these issues are really no different from the issues surrounding the production of organic crops and how chemical usage is replaced with nonsynthetic substances or cultural practices to achieve similar ends. One additional point that can be made with respect to replacing chemical use that is different between seed and crop production, though, is how seed companies may have to develop contamination thresholds in the absence of chemical use. More precisely, companies may have to determine what measured levels of seed contamination as a result of cropping practices are linked to potential disease spread. This may result in an increased emphasis put on sanitation and isolation.[44] (Groot, *et al*, pp. 10-11)

More unique to organic seed production are the conditioning and seed treatment determinants. While chemicals are also heavily emphasized in conditioning and treatment, the difference is that rather than applying chemicals to the seed's ambient environment, in the case of conditioning and treatment the chemical or synthetic substance is applied directly to the seed even before it is planted. In general, conditioning and treatment enhances machine planting of seed, germination and emergence, uptake of water, and balance of oxygen. Filmcoating of seed with chemical pesticides and micronutrients are generally more efficient, accurate and safe ways of applying chemical and synthetic substances in production when compared to soil and foliar applications. (Legro, pp. 108-109) Under certified organic growing conditions, though, these

[44] Groot *et al* also note that many sanitation-related approaches and treatments predated the use chemicals but were replaced often to reduce the level of seed damage that tended to result. (p. 11)

substances cannot be used. Nonetheless, the idea behind treatments such as priming[45] is important in concept to organic production because

> In the cold spring soil, microbial activity [which is important in the release of nutrients] is low and nutrients become less readily available in comparison with the use of synthetic fertilizers in conventional farming. A vigorous seedling with a fast growing root system may improve the uptake of minerals and improve the establishment of the crop. In this respect vigorous, healthy seedlings may be even more important for the organic farmer than for the conventional farmer…. We expect that under less optimal conditions, for instance when the crop is attacked by diseases during the season, the initial faster growth of primed seeds can have strong benefits for the organic farmer. (Groot *et al*, pp. 11-12)

Clearly, developing organic alternatives to standard seed treatments will be costly. According to Gregg, "Current requirements for use of organic pelleting for seed has resulted in pelleting cost increases from 10-25% depending on the supplier. The cost of organic seed will certainly be higher for some species due to higher risks in production." (p. 67) Nonetheless, some involved in the industry believe that pelleting and priming will improve over time and the organic methods developed will be of the same quality as the conventional methods. (Velema, p. 5)

If we look at the available information on carrots and lettuce, a better picture of costs and constraints emerge. In the case of carrots, the large number of varieties that are grown make it difficult to effectively address the market. In the EU as of 2004, 75,000 has of carrots are grown of which approximately 3,750 has are organic. On those 3,750 has are grown 30 different types of carrots each of which averages 125 has. For each of those segments an average of 240 kg of carrot seed is used. (van der Zeijden, p. 33) Clearly, these size segments are small and can make it problematic for a company to undertake the effort necessary to address these individual segments. According to van der Zeijden, carrot seed costs 2.3 times the cost of similar varieties of conventional carrot seed. (p. 34) What makes carrots even more risky is the fact that it is a biennial and in the ground twice as long as annuals which means it is generally exposed to twice as much danger of disease and predation by insects.

A carrot grower in the western U.S. is working with a seed company to test untreated organic carrot seeds. Currently, the grower is using untreated conventional seed but is looking for an organic seed that has sufficient germplasm and high vigor. If the germplasm issue is successfully addressed, the company needs to address the problem of lygus bugs that go after the germplasm in the carrot seed. According to the company, organic carrot seed is running at 2.5 times the conventional seed cost (in line with the European estimate) and that using organic seed in the production of organic carrots translates to an additional production cost of $1,000 per acre. While the share of organic seed in the cost of conventional production runs 15-20%, the share for untreated conventional seed in organic production is lower – but only because the cost of handweeding in organic production is so significant. Nonetheless, the incorporation of

[45] Seed priming is when a seed is enhanced to improve its ability to germinate.

certified organic seed would no doubt increase the cost and the share of seed in organic production.

According to Smith, the New Zealand experience with organic carrot seed has also resulted in initially less than optimal results especially in terms of eventual vigor and the expense of hand labor:

> We started off growing carrots on beds and then lifting and transplanting in the spring. This enabled us more time to fallow the seedbed for weeds and introduce a bigger plant which increased on which options were available for weeding. This seemed to work extremely well with some of the parent lines but we noticed that some of the parent lines lost a large amount of vigour after transplanting. Transplanting took around 60 hours/ha and was done all by hand. After transplanting the carrots were ridged or covered and these ridges were pulled back with tine weeding and re-ridged afterwards. (p. 97)

For Langerak *et al*, a non-chemical means of improving organic carrot production using organic seed was the use of the critical control points approach. The objective was to use critical control points as a disease management strategy for monitoring disease and applying treatments using acceptable materials. (p. 113) As was mentioned earlier, the emphasis on thresholds in the use of critical control points is important in managing disease transmission. (p. 113) Finally, some companies have taken more untraditional approaches to addressing quality issues in organic carrot seed production.
In Europe, some producers have moved organic carrot seed production south to France and Italy to take advantage of earlier ripening (based on latitude) and to hold off the effects of fungi. In Denmark, some organic carrot seed producers have moved production to tunnels to better maintain genetic purity. (Boelt *et al*, p. 164)

In terms of organic lettuce seed production, the cost of organic lettuce seed is generally twice that of conventional lettuce seed. According to Gregg, "Cost per acre for lettuce seed and pelleting is estimated to jump from US$260 per acre ($620/hectare) conventional to $420 per acre ($1000/hectare) organic." (p. 67) The current status of organic lettuce seed is such that organic lettuce varieties are having some difficulties meeting the lettuce mosaic indexing level of 0/30,000 seeds. (p. 66)

As the industry addresses organic requirements, it is clear that major changes in how seed is produced must be considered. As Gregg describes his own experience with Mission Ranches and its joint venture with Natural Selection Foods growing 13,000 certified organic acres (and more in transition),

> Good seed production requires a suitable climate, experienced growers and seed handling infrastructure. It may be further limited by self-imposed districts, crop separation requirements and finally, availability of organic ground and the need for long term rotation to help avoid seed borne diseases. In the Pacific Northwest region, Mission Ranches estimates a current annual need of 200 organic acreage (80 hectares) for seed production in a limited geographical area with a minimum 8-year rotation. (p. 66)

He also says that

> Successful large scale organic seed production may need new growing locations, new strategies of managing insects and seed borne diseases, new business relationship between growers and seed producers. (p. 67)

In summary, then, the commercial seed industry is clearly in the process of addressing the changes necessary and moving forward, some more slowly than others, in developing organic seed. One important issue that lies outside their control, though, is the institutional nature of organic regulation. In particular, the loophole on the use of organic seed is what many in the industry consider the major constraint on the adoption of certified organic seed. The next section in the paper will discuss this in greater detail.

IV. Moving Towards Commercial Availability of Seed: the Institutional Constraints and the Outlook for Future Change

Having just addressed some of the technical and general cost issues underlying certified organic seed production – issues over which seed companies have some degree of control through research and development, production and marketing – the next issue that needs to be addressed are the institutional issues which are, in many respects, forcing many companies to delay supplying certified organic in as complete a way as possible. These institutional issues ultimately come back to the regulation and harmonization issues outlined earlier in the paper.

The institutional constraints have the most impact on those commercial organic seed producers wishing to sell large amounts of seed to the larger scale producers of organic crops. As Peerenboom noted, there are three types of organic seeds, those produced by growers themselves under organic conditions for on-farm use, those for bulk-item fodder and forage crops, and those for smaller crops like vegetables. Of these three types, the organic seed for vegetables is the most difficult because a seed producer must develop seed for multiple varieties grown under an array of different growing conditions around the world.[46] (pp. 17-18) As a result, producers of organic vegetable seeds must not only consider environmental and agricultural variation, they must also consider an array of different organic regulations that growers who produce their own seed on-farm do not have to address. Compounding the issue of multiple national regulations is the previously discussed issue of the organic seed loophole in the U.S. and the EU in which growers are allowed to use (and more frequently than not take advantage of) conventional untreated seed when there is a purported lack of "commercial availability" of certified organic seed. Under these uncertain circumstances, Peerenboom frames an important question and provides an answer:

> *What is needed for the seed-industry to continue and invest in the further development … of the organic seed market?*
> Two things:

[46] This often means that the actual production of the organic seed must also occur in different locations around the world.

1. True commitment of all parties in the chain
2. Unambiguous and clear regulations. (p. 8)

Haitsma notes in the results to a 2002 survey of European vegetable seed companies that "the earlier there will be clarity on the rules and regulations after 2004 [an unmet goal of establishing the certified organic seed requirement of growers in Europe], the more chance there is that there will be sufficient organic seed in a wide enough choice for the growers." (p. 24) At the same time, both the USDA's NOP and the EU are expecting that the seed industry will "provide a well balanced and sufficiently large range in the right quantities at the right time of organically produced seeds of suitable varieties." (Peerenboom, p. 18) As Peerenboom points out, though, it is difficult to interpret what constitutes "well-balanced", "sufficiently large", "right quantities", etc., especially when the loophole persists.

Remember, both the U.S. and European organic regulations require the use of organic seed in certified organic crop production but those same regulations do identify circumstances when the certified organic seed requirement need not be satisfied (see the earlier section of this paper for that discussion). As a means of reducing the use of the organic seed loophole, the EU (and later the U.S.) has required the establishment of national databases that list the availability of certified organic seed. The idea is that with a formal database, certifiers would have a more concrete mechanism with which to ensure that organic growers are not simply asserting the lack of "commercial availability" excuse in order to avoid having to pay the high cost of certified organic seed. Also, the database is expected to provide a good faith message to the commercial seed industry that, over time, growers will move to using more organic seed and, thus, a better market for organic seed will be created. Sundstrom indicates that the EU national databases require the following information:

1. The scientific name of the species and the variety name;
2. The name and contact details of the organic seed supplier;
3. The area where the seed supplier can deliver seed to the user within a normal delivery time;
4. The country or region in which the variety was tested;
5. The date organic seed will be available; and,
6. The name of the certifier. (p. 27)

At the same time that certifiers will require that the database be consulted by growers and will require growers to use certified organic seed when it is available, the EU regulations still allow the granting of a derogation.[47] Sundstrom notes that organic producers do not have to use certified organic seed if one of the following conditions is met:

1. The seed of a variety that the grower wants is not listed on the database;
2. Alternative registered varieties of the same species that the grower wants to produce is not appropriate for grower's production system;
3. No supplier is able to deliver seed before the grower requires it (for sowing) when the grower has ordered it with a reasonable lead time; and,

[47] Derogation is an authorized deviation from a regulation.

4. The grower is conducting approved research trials. (p. 27)

Moving beyond the database idea, the EU is considering an annex to its organic regulations that would list the species that would not be allowed to be derogated by certifiers. Species appearing on this list would be those with a sufficient number of organic varieties and a sufficient availability of seed. (Sundstrom, p. 27) Essentially, it appears that there would be a process in which certified organic seed would move from the database to the annex list and that over time the market would develop and there would be less incidence of the use of conventional seed.

Nonetheless, the commercial seed industry is still concerned about the insufficiently slow progress towards market development of certified organic seed. A principle critique is that the lack of clarity and lack of coherency across countries (in Europe) will still make it easy to derogate.[48] (Haitsma, p. 25) In fact, it is likely that, within Europe, there could be situations in which an organic carrot grower in one country that is forced to use certified organic seed while a similar grower in another country receives a derogation and can use a lower cost conventional untreated seed for his/her organic carrot production. In addition, these two growers could be selling their production in the same market. Both would have a certified organic product but one would be operating at a distinct cost advantage based on the application of regulations rather than based on the management of the operation. The situation just described, as well as other important reasons, motivate the commercial seed industry to push for the harmonization of organic regulations across countries and continents. Peerenboom lists some of the reasons for simplification and harmonization of organic regulations:

1. To create a level playing field for the organic growers;
2. To avoid confusion and loss of interest with the conscious consumer;
3. To stimulate more seed companies to invest in organic seed production;
4. To lower the administrative burden; and,
5. To avoid having to set up expensive control mechanisms. (p. 19)

Noting the inclusion of consumer perceptions in that list, many in the commercial seed industry believe that there should be a call from organic producers for such simplification and clarification. As Haitsma says,

> The seed industry isn't and never will be the primary stakeholder for organically produced seeds. They, as has been stated before, want to fulfill the newly risen demand of organic seeds according to the formulated and subscribed principles of the organic seed production.
>
> The primary interest has to come from the organic movement and then has to be laid down in clear governmental regulations. (p. 25)

The experience of Europe with respect to addressing the commercial availability issue has influenced the regulatory process in the U.S. In the past, commercial availability has

[48] The list of exemptions shows that there still remains a lot of "wiggle room" for growers.

been crudely satisfied by growers producing three examples of organic seed catalogs or records of phone calls to suppliers that indicate that the desired organic variety was not available or not available in sufficient quantity. In early 2005, the Crops Committee of the National Organics Standards Board drafted a recommendation for guidance on commercial availability of organic seed. According to the draft, the objective of the recommendation is to "establish appropriate practices to be followed by certification applicants, certified operators, and ACAs [accredited certifying agents] for consistent, transparent, and predictable determinations of commercial availability that provide regulatory certainty." (Crops Committee, p. 1) The recommendations are as follows:

1. The establishment of a national database by an independent party to provide public access to current information on the availability of organic seed varieties.
2. An organic variety is considered to be equivalent to a specific non-organic variety if it meets the operation's required site-specific agronomic and marketing characteristics.
3. For an organic producer to receive an allowance to use non-organic seed or planting stock to produce a crop that can be sold or labeled "organic," the producer must provide records to the certifying agent as a part of the organic system plan demonstrating lack of "commercial availability."[49]
4. Buyers of organic agricultural products who contractually require organic growers to grow selected varieties should require or provide organic seed or planting stock. When a producer is contractually obligated by a buyer of organic agricultural products to use a variety or varieties that are not currently available as organically grown seed or planting stock, the producer must receive written documentation from the buyer describing:
    a. the unique characteristics sought by the buyer; and
    b. the non-availability or non-equivalency of organic varieties.
5. In granting an allowance that organically produced seed or planting stock is not commercially available, the accredited certifying agent shall:
    a. Evaluate the applicant's claim that no organic seed or planting stock was commercially available in the equivalent variety, form, quality, or quantity needed;
    b. Validate that the applicant has properly and completely documented that the organic seed or planting stock was not commercially available. This includes validation of the documentation producers receive from buyers who require the use of non-organic varieties;
    c. Maintain and annually submit to the National Organic Program an up-to-date list of specific non-organic crop varieties permitted by each agency for posting to a national organic seed database;
    d. Require certified operators to update commercial availability information in each organic system plan update; and
    e. Require that operations not meeting commercial availability requirements not be certified organic and that products produced by such operations not be sold or labeled as "organic." (pp.1-3)

[49] These records must provide a justification for use, a description of the agronomic or marketing requirements, written evidence of efforts to locate and source organic seed, and written description of planting trials.

While these recommendations are still in draft form,[50] a list of organic seed sources has been established by the Organic Materials Review Institute (OMRI) and by the National Sustainable Agriculture Information Service (formerly Appropriate Technology Transfer for Rural Areas – ATTRA).[51] An innovation in closing the organic loop is the suggestion that the buyers of organic agricultural products who contract growers become involved in the use of conventional seed. This appears to remove some of the grower flexibility for opting out of using certified organic seed. Nonetheless, it seems clear that the database approach is merely a stopgap and that many, including commercial seed producers are not happy with it. At the March 2005 meeting of the NOSB, Brian Baker of OMRI said

> OMRI has an organic seed database. It's mentioned in your proposal. It's one of a growing number of databases out there and you know, in some ways it's -- it's not really clear if it's ever going to -- if we're ever going to have a single comprehensive database that will be able to provide the real-time inventories that can give the information needed to determine commercial availability…. We've got a database, ATTRA's got a database, OTA's got a database, OCA has a database, … none of these databases are being used to their full potential. They are not being of service to the seed suppliers, they're not being of service to the certifiers and they're not being of service to the organic farmers. We need to come up with something that's going to work for everybody. …[W]e're going to need to have a more clear procedure of what's expected of an organic farmer who wants an exemption from that. The lines need to be drawn very clear. Asking three suppliers and getting three answers, we've found that that is arbitrary. That is also subject to manipulation in some cases; an allegation that's been made by the suppliers who use our listing service. So the other thing is that this question of equivalent varieties, we believe that's best undertaken by a jury of people who have experience with breeding and selection and development. (NOSB Transcript, pp. 97-98)

Other than this latest draft proposal, nothing else new is happening to formally address the loophole in the U.S. Most likely, U.S. regulators will wait to see the progress of change in the EU as well as address seed issues as part of the harmonization discussions between the U.S. and the EU. Why is it more likely that the EU will move first? In terms of trade, horticultural seed has a larger relative and absolute value in the EU (see Figures 5a and 5b). Secondly, growers in Europe are already paying higher seed prices and are able to absorb those costs because food prices are higher. (Proctor, pp. 4-5) Hence, commercial seed producers are more likely to apply pressure where there is relatively greater emphasis on horticultural crops and where there is likely to be greater acceptance of higher prices.

Figure 5a Seed exports (agricultural and horticultural) of selected European countries (million US$), 2003

[50] The recommendations must still be considered and accepted by the NOSB that, in turn, must pass on the recommendations to the NOP. The NOP evaluates the recommendations and decides whether or not to implement the recommendations.
[51] The URLs are www.omri.org and attra.ncat.org.

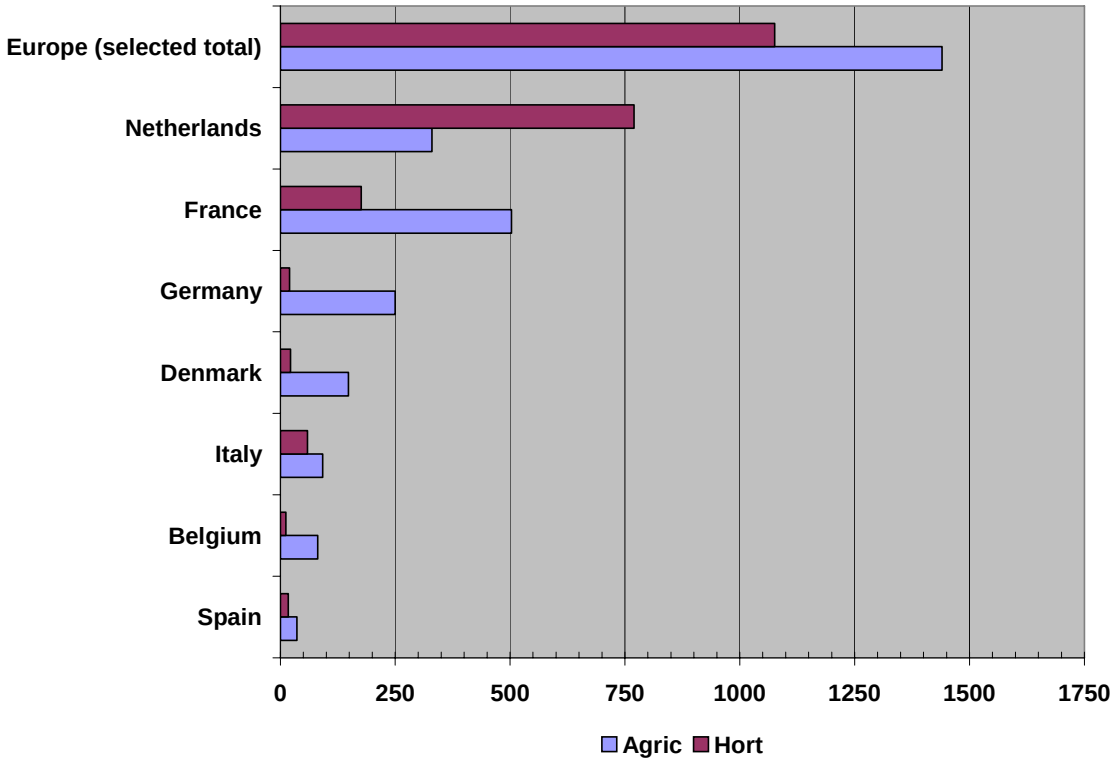
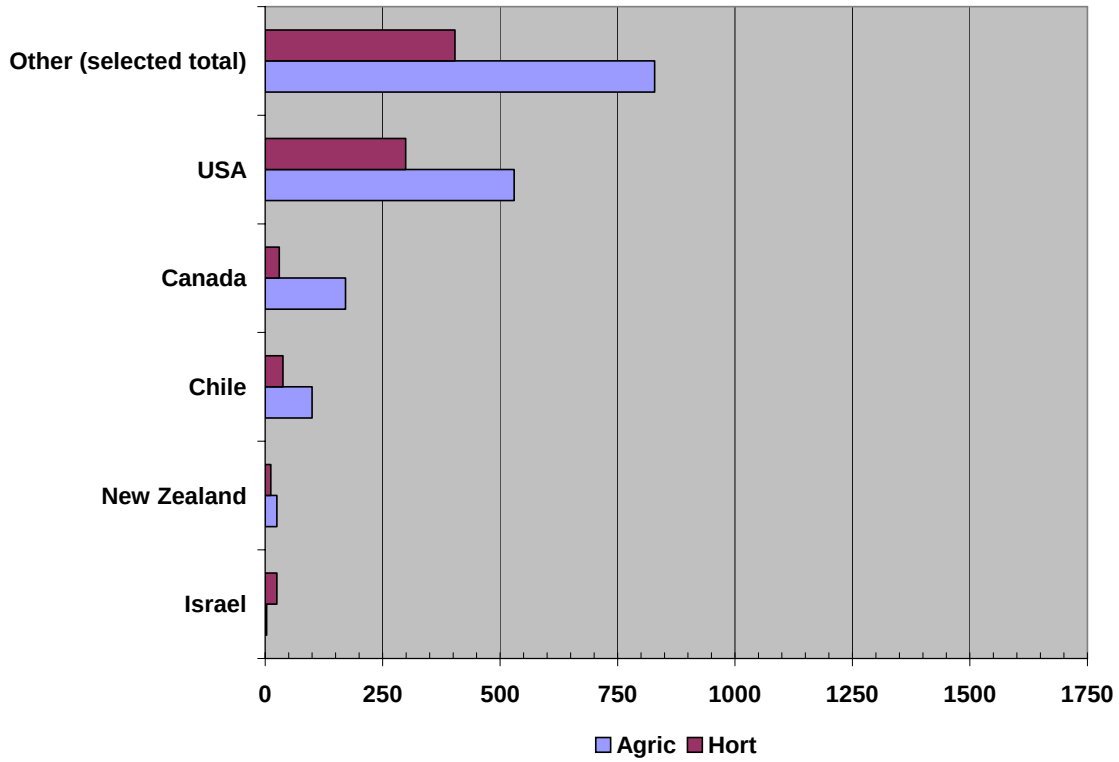

Europe (selected total)
Netherlands
France
Germany
Denmark
Italy
Belgium
Spain
0
250
500
750
1000
1250
1500
1750
Agric
Hort

Figure 5b Seed exports (agricultural and horticultural) of selected non-European countries (million US$), 2003



Source: International Seed Federation (www.worldseed.org/statistics.htm), accessed 3/5/05.

So, what are the implications for the U.S. following the EU? For the time being, the stakes are relatively low so long as the regulatory status quo for organic agriculture in both areas are muddled. As the market niche of organic production grows, both domestically and internationally, and as organic production becomes increasingly globalized in terms of its supply chain, the stakes will increase. According to the OECD, the value of sales of organic food in 2000 was US$11 billion and US$13 billion for Europe and the U.S., respectively. These made up a 2% and a 2.3% share of total food sales in the Europe and the U.S., respectively. (European Action Plan for Organic Food and Farming, Commission Staff Working Document, p. 8) With the rapid growth in organic food sales, the expectation is that the supply chain for many of these products will become increasingly globalized.

Looking at the nature of organic food growth towards the end of the supply chain, certain changes are occurring that will probably force a change in the use of certified organic seed in the U.S. sooner rather than later. Keith Edberg, USDA's Executive Director of Cooperative Development Services, noted at the 2004 Agricultural Outlook Forum that in 2000 mainstream retailers accounted for 40% of all organic sales and that it is expected to increase to 60% by end of decade. (Edberg, p. 3) Edberg also pointed out that part of the reason for this continued growth in the mainstream retailer's share in organic sales is that the existence of a national organic standard has reduced the risk for multi-national food

companies to enter into the organic marketplace and that the national standards will also increase international exports of U.S produced organic products which, in turn, will favor the larger manufacturers and processors. More importantly, though, "These standards will also facilitate the import of foreign-produced organic raw products, further increasing the supply and competition for U.S. producers." (p. 3) As the relative weight of organic influence moves away from the producer of the raw agricultural good and towards the producer of the final certified organic product containing that raw good, there is probably going to be an increasing concern for consumer perceptions regarding the final good. Should the debate concerning the organic seed loophole reach the level of the organic consuming public, it would not be out of the realm of possibility that manufacturers of the processed value-added organic food products would start pressing for or even requiring the use of certified organic seed.[52] Nonetheless, movement on the U.S. side is currently quite low even though the concerns may be present at various parts of the supply chain.

If the USDA is not going to lead and there is still a lack of consensus in the U.S. organic community, how might the EU lead in this issue? At the very minimum, the issue is more on the European radar compared to the U.S. It is true that the EU has imposed deadlines for using certified organic seed twice and then removed them twice. And it is true that the EU has moved towards the use of national databases of organic seed availability which is proving to be a half-step at best. Is there any expectation of change in the near future in Europe? This is hard to say but documentation from the EU seems to indicate that there will be no general change in its approach.

According to the Commission of the European Communities' June 2004 European Action Plan for Organic Food and Farming, the general strategy for organic food and farming is essentially promotion, education and harmonization. More so than the U.S., the EU is actively promoting organic farming as a means of achieving certain environmental and social objectives. Also, again more so than the U.S., the EU wants to develop the organic market by addressing consumer expectations and by educating the consumer about the principles and objectives of organic farming. Finally, as a means of harmonizing standards and procedures within the EU and outside the EU, the Commission is pushing for increased harmonization of standards to minimize problems surrounding organic production, processing and handling. (pp. 2-3) One of the plan's stated action points is to ensure "the integrity of organic agriculture by reinforcing the standards and maintaining the foreseen end dates of the transitional periods." (p. 5) While the plan does not directly address organic seed it does lay out a general approach that makes it unlikely that a deadline is out of the question for moving the EU towards reliance on certified organic seed for organic production.

With respect to educating the consumer, the Commission Staff Working Document (an annex to the Action Plan document) indicates that the strategy is to focus on the occasional organic buyer so as to increase the number of organic items purchased in the market. As part of this focus, the plan has suggested that educating the consumer about the organic philosophy is important.

[52] Keep in mind that the share of raw commodities in final food goods is generally quite low, especially with respect to the marketing costs.

> Defining the basic principles is expected to contribute to transparency and consumer confidence and would make its public services explicit. At the same time, by defining the purpose of the measures and not the means by which to achieve these purposes, flexibility is introduced to allow for regional solutions based on the best local practices to achieve these purposes. (p. 20)

Again, increasing consumer education and understanding may result in the organic industry having to address inconsistencies earlier than later. Just like manufacturers of final organic food products, the EU may have to push adoption of certified organic seed so as to protect the integrity of the organic market and maintain the growth potential of that market.

Thirdly, pushing for successful harmonization of organic regulations will most likely force the issue of certified organic seed. It is true that harmonization of standards is not the same as imposing a single standard. As Sundstrom puts it, "Equivalency seeks a commonality of objectives and not development of identical regulatory standards." (p. 26) The equivalency approach (an outcome of harmonization) allows for differences among standards to address regional and local organic solutions and practices but the idea is that the objectives of organic agriculture are met in all standards. In both the EU and in the U.S., the use of certified organic seed has always been a clear objective. The problem has been how to get the certified organic seed market there in such a way as to minimize disruption on the farming side. Under the process of harmonization, the certified organic seed issue cannot be avoided. One outcome might be a coordinated development of the organic seed market[53] in which there was a common deadline for certified organic seed use or a coordinated strategy for making certified organic seed more available. Such an approach would reduce transaction costs for organic growers and for suppliers of certified organic seed but most likely at more of a cost to the growers.

Finally, what happens if the EU simply successfully implements a deadline mandating the use of organic seed (and sticks to it) and the U.S. does nothing? There would most likely be a differential impact based on the degree to which a firm or a commodity is involved in exporting to the EU or to countries who have adopted regulations modeled on the EU (including the seed regulation). Those growers, handlers or processors involved in exports to the EU would have to be certified to the EU standard as before. The complications arise if the same product is being produced for the domestic market where the use of certified organic seed can be derogated. The same product produced for both markets must meet the higher standard which makes it more expensive to produce and less competitive on the domestic market. So long as the returns on the export side can cover any losses on the domestic side, a grower may choose to continue participating in the export market. On the other hand, if the returns from exporting do not cover the losses, the grower's rational decision would be to abandon production for export until the regulatory or the market situation changes. It is highly unlikely that a producer would maintain two separate organic growing operations given the rigidity of organic regulations and the high cost of certified organic seed. The expensive, exportable organic product could be substituted for the less expensive domestic organic product but it would

[53] Which would reflect the global nature of the commercial seed industry.

be at the cost of the differential in production costs. On the other hand, an organic product produced for the domestic market and meeting the domestic organic regulations (and not meeting the organic regulations of the export market) could not be substituted for the exportable organic product. So long as a discrepancy exists in the organic standard, it is likely that the effect would be to retard the development of organic exports from the US to Europe. This could happen in the face of the export trend underlying recent growth of the organic market. What would processors and handlers do if such a situation would arise? Most likely, they would source the organic products from countries where the organic standard is consistent with the EU standard – which is not an uncommon practice in our globalized economy.

So, how likely is it that Europe will act unilaterally? This is impossible to say but, assuming that a change in the mandatory use of certified organic seed will happen, it seems more likely that it will happen in Europe first and that the U.S. organic growers, processor and handlers will bear much of the cost and those growers, processors and handlers most heavily involved in organic vegetable exports will suffer most. Most likely growers in states like California, Arizona, Texas, Florida, Washington and Oregon will suffer most. The degree of impact cannot be said at this time but it can be investigated in research that will follow up this report.

If a California-based case study approach is used, it most likely will focus on carrots and lettuce. Given the degree to which California dominates production in these sectors, it would be worthwhile to assess the costs of organic production by interviewing major organic carrot and lettuce producers. Specifically, the question of how differing organic seed standards would affect those production costs would be addressed. In addition, interviews would have to be undertaken with developers of organic carrot and lettuce seeds and determine their specific strategies for developing certified organic seed for the California market and how it fits with their strategies to develop certified organic seed for markets outside California and outside the U.S. Much of the work for this case study will involve determining the growth of organic carrot and lettuce exports to the EU that is currently small relative to organic production geared for the domestic market. The most likely focus of the case studies will be Grimmway Farms for carrot production and the joint venture between Tanimura & Antle and Natural Selection Foods which produces organic lettuce under the Earthbound Farms label.

References

Documents

Boelt, Birte, Anne Mette, Dahl Jensen, and Gitte Kjeldsen Bjorn. "Seed quality in organic carrot seed production: does tunnel production in Denmark provide sufficient seed quality?," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Bowen, Diane. "Current Mechanisms That Enable International Trade In Organic Products", Discussion Paper International Task Force on Harmonization and Equivalence in Organic Agriculture, International Task Force On Harmonization And Equivalence In Organic Agriculture, IFOAM, UNCTAD, FAO, March 2004.

Commins, Ken. "Overview Of Current Status Of Standards And Conformity Assessment Systems", Discussion Paper International Task Force on Harmonization and Equivalence in Organic Agriculture, International Task Force On Harmonization And Equivalence In Organic Agriculture, IFOAM, UNCTAD, FAO, July 2004

Commission of the European Communities, "Communication from the Commission to the Council and the European Parliament: European Action Plan for Organic Food and Farming", COM(2004)415 final, June 10, 2004.

Commission of the European Communities, "European Action Plan for Organic Food and Farming: Commission Staff Working Document (Annex to the Communication from the Commission {COM(2004)415 final}", SEC(2004) 739, June 10, 2004.

Copeland, Larry O. and Miller B. McDonald. **Seed Science and Technology**. 3rd edition. Chapman & Hall, New York, 1995.

Courville, Sasha and David Crucefix. "Existing And Potential Models And Mechanisms For Harmonization, Equivalency And Mutual Recognition", Discussion Paper International Task Force on Harmonization and Equivalence in Organic Agriculture, International Task Force On Harmonization And Equivalence In Organic Agriculture, IFOAM, UNCTAD, FAO, March 2004.

Crops Committee, National Organic Standards Board, "Recommendation for Guidance Commercial Availability of Organic Seed," Draft 1 – January 18, 2005, via Jim Riddle.

Edberg, Keith. "The Growth of the Organic Market: Producers' Perspectives". Presentation at the Agricultural Outlook Forum "Ensuring a Healthy Food Supply", Thursday February 19, 2004.

Fernandez-Cornejo, Jorge. **The Seed Industry in U.S. Agriculture: An Exploration of Data and Information on Crop Seed Markets, Regulation, Industry Structure, and Research and Development**. Resource Economics Division, Economic Research Service, U.S. Department of Agriculture. Agriculture Information Bulletin Number 786. January 2004.

George, Raymond A.T. **Vegetable Seed Production**. 2nd edition. CABI Publishing, United Kingdom, 1999.

Gregg, Dean. "Grower perspective on organic seed production," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Groot, Steven P.C., Pieter Oosterveld, Jan W.M. van der Wolf, Henk Jalink, Cees J. Langerak, and Ruud W. van den Bulk. "The role of ISTA and seed science in assuring organic farmers with high quality seeds," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Haitsma, Henk. "From opportunity to commitment to dilemma," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Hirsch, Jerry. "Monsanto Is Ripe for Growth", **Los Angeles Times**, January 25, 2005, p. C1.

Langerak, Kees, Carin van Tongeren, Ronald Driessen, and Ruud van den Bulk. "Critical control points in organic seed production," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Larinde, Michael Abimbola. "Seed quality: an important aspect of organic seed production and seed trade," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Legro, R.J. "Organic seed & coating technology: a challenge and opportunity," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

McDonald, Miller B. and Larry O. Copeland, **Seed Production: Principles and Practices**. Chapman & Hall, New York, 1997.

National Organics Standards Board, March 3, 2005, Washington, D.C., Transcript, http://www.ams.usda.gov/nosb/transcripts/Feb2005/02_28_05.pdf.

Peerenboom, Roland. "Putting organic seed production in perspective," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Peerenboom, Roland. "The need for harmonization," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Proctor, Keith L., "Organic Seed: Completing the Circle of Organic Life", **CCOF Magazine**, Spring 2004.

Rubitschek, Paul. "Use and availability of organic vegetable seed," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Smith, James. "Challenges in organic carrot & white clover seed production," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Sundstrom, Frederick J. "Progress on harmonization of EU and US organic seed regulation," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

van der Zeijden, Dick. "The economic challenge of organic seed," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Velema, Jan. "Challenges and opportunities in organic seed production," **Proceedings of the First World Conference on Organic Seed**, Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM) and the International Seed Federation (ISF), July 5-7, 2004, Rome.

Selected legislation and regulatory documents

Codex Alimentarius Commission, Codex Alimentarius, www.codexalimentarius.net.

Commission of the European Communities, EU Council Regulation (EEC) No. 2092/91, www.exporganica.com.ar/docs/2092-91_en.pdf.

International Federation of Organic Agriculture Movements, IFOAM Basic Standards Draft 2, www.ifoam.org/standard/ibs_draft2_2002_b.html.

USDA, Agricultural Marketing Service, National Organic Program, National Organic Program Regulations (Standards), www.ams.usda.gov/nop/nop/standards.

USDA, Agricultural Marketing Service, National Oranic Program, Organic Foods Production Act of 1990, www.ams.usda.gov/nop/archive/OFPA.html.

USDA, Agricultural Marketing Service, Plant Variety Protection Act, www.ams.usda.gov/science/PVPO/PVPO_Act/whole.pdf.

World Trade Organization, Sanitary and Phytosanitary Measures Agreement, www.wto.org/english/docs_e/legal_e/15sps_01_e.htm.

World Trade Organization, Technical Barriers to Trade Agreement, www.wto.org/english/docs_e/legal_e/17-tbt_e.htm.

Organizations

California Certified Organic Farmers (CCOF), www.ccof.org.

International Seed Federation, www.worldseed.org.

National Sustainable Agriculture Information Service, attra.ncat.org.

Oregon Tilth, www.tilth.org

Organic Materials Review Institute, www.omri.org.

USDA National Organic Program (NOP), www.ams.usda.gov/nop.

USDA National Organics Standards Board (NOSB), www.ams.usda.gov/nosb.