

Pesticides: une épée à double tranchant? Pesticides: a double-edged sword?

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Symposium / Symposium **Les pesticides chimiques : une lutte à finir?** **Chemical pesticides: a weapon to ban?**

Pesticides: a double-edged sword? **[Pesticides: une épée à double tranchant?]**

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INTRODUCTION

The title of this paper has been chosen to fall squarely in line with that of the Symposium "**Chemical pesticides: a weapon to ban?**" It allows me to look at both sides of the debate and still conclude somewhere on the continuum between the extremes. A few words about my background might be useful to let you where I am coming from for the presentation. Following initial agricultural studies in Scotland, I studied crop protection in the UK and then sold pesticides for Chipman Chemicals Ltd in Saskatchewan based in Saskatoon in 1969. I followed this with a few months of field research for a company, long since bought out, in England. Many of the activities that we carried out were done so in line with prevailing norms, which, looked back on today, seem at times quite bizarre. Some of us working in the industry wondered just how long pesticides would be used so widely. I think that this was more a case of our own self-interest rather than us taking any moral stance on the subject. Rachel Carson's book "Silent Spring", having been published in 1962, was still a subject for discussion and as an employee of firms "in the business", I was party to these discussions, often from just one side.

That said I attempt in this paper to provide a balanced view of the subject from, with no apology for doing so, an economic perspective. The balance might be provided at times from the extremes, like a teeter-totter, but this is done to be a little more controversial so that we can think about both sides of the problem. I attempt to end the presentation towards a central, and hopefully still balanced, position. My objective with this paper is not so much to justify the use or elimination of chemical pesticides; rather I attempt to raise cautionary comments on these choices in light of what we know at this time.

Pesticides: Use or Abuse?

The symposium title "demanded" that I at least address the issue of use and abuse, which allows me to consider both commercial and non-commercial uses of chemical pesticides. One such non-commercial use is by the military with perhaps the best-known example being that of Agent Orange. I am being perhaps confrontational in raising the issue of Agent Orange, as this is a touchy subject due primarily to the military connection. A search on the web (www) for Agent Orange, results in many sites dedicated to those who have suffered from exposure to this chemical cocktail. However, at the time of its use

during the Vietnam War, we were not that knowledgeable of its effects on human health. This is not an unusual situation where we act in the present, hopefully following the rules and guidelines acceptable at that time. However, the best intentions all too often come unglued when looked on after the fact. I am sure that in future years we will look back on our actions today and criticize these actions in light of the knowledge gained between now and that future date. Perhaps one of the most glaring examples of this was the Thalidomide tragedy during the late 1950s. Having hopefully learned from this lesson, it is once again being used under much stricter controls.

When I was an agricultural student in the 1960s, some of my friends had summer jobs as field markers for aerial spraying firms. Equipped with rain gear, their job was to pace out the field and mark the spray line using themselves as the target. Thus, they were drenched with spray on every pass of the plane over the target field. I suggest that we would look badly on this practice today but at that time, it was accepted as normal. When I was selling pesticides in Saskatchewan in 1969, a big seller was 2,4-D, which is still sold today, although in a different formulation. This chemical was part (approximately 50%) of the Agent Orange cocktail. So, when we look at something like Agent Orange, we can sometimes forget that its use or misuse may not be very far from our use of the chemical components in our commercial world.

When we talk about the use or abuse of such compounds, we must consider the position of the person making the claim. Thus, one person's use might in fact be another's abuse. It therefore depends greatly on who is making these comments. With respect to pesticides, we can focus on farmers, consumers, industry, and society and their views as to use and/or abuse. Each of these groups has a different "take" on chemical pesticides.

In economics, we often talk about externalities to describe situations where one person's actions can affect another person in an unplanned fash-

ion. These externalities can be either positive or negative. Alan Randall (1)¹ defines externalities as follows:

"Externalities can have beneficial or adverse effects, but it is the latter case, *external diseconomies*, that seems to draw the most attention. External diseconomy refers to situations in which one party creates an annoyance for others and does not take any account of that annoyance".

For example, assume that I spray my lawn to get rid of all weeds. The neighbour on one side of my house might feel that (s)he was the recipient of a negative externality (external diseconomy) if they felt that I had in fact deleteriously affected their environment. However, assume that the neighbour on the other side views this as a positive externality (external economy) if they enjoy looking at my weed-free lawn and if this helps to cut down their weed problem. This externality has come to them free of charge. Thus, one person's use can be another person's abuse.

Goals or "What do I want and why"?

Given the four groups just mentioned, let us take them one at a time to see how they may affect one another:

- (a) **Society Goals:** In general, we wish for an increase in society's welfare in terms of making everyone in our country better off. Simplistically this can mean fuller employment, and higher disposable income so that the standard of living improves along with tax revenues. We can now add to this an interest in improving the environment in which we live.
- (b) **Industry Goals:** Simply stated these are profit maximization and shareholder satisfaction. Easy as these are to criticize, without them we might have significantly less economic activity, employment, disposable income etc. Managers may add goals to secure for the firm the

¹ References are presented at the end of the paper in the order in which they appear in the text.

reputation of being good corporate citizens, but this will be done in the context of profit.

- (c) **Consumers' Goals:** Safe and affordable food might be the base level goal for most consumers. A higher-level goal would be an increased choice of foods, and we are now seeing these come together in the organic versus conventional food debate.
- (d) **Farmers' Goals:** The base level goal might be profit maximization for survival and eventual farm transfer to the next generation. Higher-level goals relate to such things as recognition as being a good farmer, etc. Generally, these higher-level goals become more attainable when the farm business has some financial stability.

I will try to show later in the paper how the move towards some degree of chemical-free agriculture will likely impact on each of these goals.

The above goals are, I think, reasonably general and applicable to "most" members of these groups. However, when we take these goals as a package we can see that conflicts may arise that can affect decisions such as the elimination of chemical pesticides. Therefore, if we are asked to generate a benefit-cost ratio for the elimination of chemical pesticides we will almost certainly arrive at a solution that could not be accepted by all of the above groups. Consumers might be made better off if, and this is an important if, they can afford any increase in the price of food that results from the elimination of chemical pesticides. This is addressed later in the paper. If we eliminate chemical pesticides, will jobs be lost in the chemical industry and does this matter? To the investor and the employee, the answer would seem to be "YES". Would farmers be affected and to what degree? The answer to this is complicated by the relationship between farmers and the other participants of the agri-food system. For those of us not members of the above groups (investors, employees, or farmers), it is easy for us to vote to eliminate something,

as we don't feel directly threatened by the elimination. However, when we are directly impacted by decisions such as this we might react quite differently and put our needs and desires first. This is a case of "Whose ox is being gored".

Economic students are taught very early in their studies the different market models that are assumed for the participants in the agri-food system. We assume that there are just a few large input supply firms (oligopolies), each with considerable market power. In other words, each is capable of setting the market price for their products. This is known as administered pricing in that they set prices to cover their costs and an acceptable profit. Thus, if their costs increase they can pass some or all of this cost along to their buyers, the farmers. Pesticides are by-products of the petroleum industry and therefore increases in the price of crude oil, if sustained, can have an upward pressure on the price of pesticides. The price is set to satisfy the pesticide producer and the farmer pays that price. On the other hand, farmers (the typical Canadian/Quebec family farms) are assumed to be perfectly competitive. This means that there are many of them, each relatively small compared to the system as a whole, and each one incapable of setting the price for their products. Instead they accept the price determined by global supply and demand.

Farmers sell their products to the PDR sector (Processing, Distribution and Retail) whose firms are again assumed to be oligopolies with a high degree of market power. Thus, the farmers find themselves squeezed between large firms wielding market power and the farmers must accept the prices (for buying and selling) that are given to them. Unfortunately this means that if costs rise to farmers they might not be able to pass this cost increase on to the next participant in the food chain. Finally, the PDR sector sells the food products to consumers who are assumed to be perfectly competitive buyers in that consumers must pay the price as set by the retailing firm due to their individual lack of market power. In this discussion, the farmers and the consumers

are the weak members in the system. Farmers and consumers can strengthen their market positions to a degree by grouping with others to create bargaining power through such groups as the Coopérative Fédérée.

Why use chemical pesticides?

It is claimed that the use of chemical pesticides helps to keep the cost of food produced in North America at low levels (2). It is further claimed that the production of food (in North America) would decline by up to 40% and the costs of production would increase by up to 30% if we were to eliminate the use of chemical pesticides (2). If these figures are to be believed, it tends to imply that we would experience an increase in food prices and farm profits would decline if indeed chemical pesticides were to be eliminated. Along with these effects, we might see a decrease in the range of food products produced domestically. From a farmer's perspective, any decline in profits would likely result in changes to production patterns and if extreme enough (which is implied by a 30% increase in costs of production) could lead to a speeding up of the decline in number of farms, and a continuing increase in the size of farms. Also, land might be idled due to it having passed what is known as the "no-rent margin". Costs of production tend to rise as we move production further from the market due to transportation costs. The "no-rent margin" is the limit where land cannot be used for productive purposes, as the revenues to be gained in production are not enough to pay for the costs of production. Thus, agricultural land is idled and returned to bush. If economic activity then "heats up" again in agriculture, the "no-rent margin" is pushed out further from the market centre. Farmers are encouraged to bring the bush land back into production as they see it economically viable to do so. The same arguments can be used to show how cities develop and grow and why high towers are situated at the core and sprawling housing developments are found around the outside edges of cities.

If there is a rise in the cost of production for foods brought about with the

elimination of chemical pesticides it might lead to a reduction in the assortment of food products produced domestically or in the local area. From the consumer's perspective, any reduction in the assortment of foods available might lead to these foods being brought to the market from non-traditional (off-shore) sources. I will say more on this subject when I address some international issues associated with the elimination of chemical pesticides.

Based on the above discussion, it can be argued that by not eliminating chemical pesticides we can maintain employment in the industry, maintain farm production at the margin and keep farm profits supported (in the short run at least). If we look at where in Canada chemical pesticides are used, we see that the highest percentage of farms using them is in the Prairie Provinces. The explanation, I suggest, will be due to scale of farming operations in that region. Farms tend to be large with relatively low per hectare yields when compared to those in the more temperate regions closer to either coast. Thus, chemical pesticides allow farmers to cover a greater area than might be possible with non-chemical pest control technology. Also, if the productivity per unit of land in the Prairie Provinces is lower than here in Quebec, it is likely (assuming the same commodity price is in effect in both regions) that the costs of production must be lower in the Prairie Provinces to assure that they can make profits. Thus, I would argue that chemical pesticides at the moment provide the most cost effective control mechanism for the largest number of farms.

Elimination of chemical pesticides

Any discussion of the elimination of chemical pesticides must address the adoption of alternative control techniques. These alternatives might be the use of GMOs (Genetically Modified Organisms), bio-herbicides, or cultural techniques. Whichever is adopted will be a function of the existing regulations concerning their use and the benefit-cost to the participants in the agri-food system. For example, there is an interest in Canada in getting apple produc-

ers and processors involved in an IFP (Integrated Fruit Programme) that implies a reduction in the use of chemical pesticides. Farmers and other participants faced with this type of production programme should be interested in the costing impact of its adoption on their expected profit. The use of genetically engineered (GE) crops (GMO technology) may result in less pesticide use and thus is finding a place in developing countries (3). Why not here? It may depend on society's attitudes. Survey results from the UK showed that 54% of respondents believed strongly that GE crops should never be grown in the UK and just 8% of respondents felt comfortable with eating these foods² (4). These results are important in light of the ongoing debate in Canada between Monsanto and the Canadian Wheat Board (CWB) concerning the licensing of Roundup Ready® wheat. The concern expressed by opponents to the use of Roundup Ready® wheat is that the growing of such a crop would close our non-GE or non-GMO crops out of markets such as the UK and those countries that are at the present standing against this technology. Linking the two technologies, chemical pesticides and GE, creates a major headache for those opposed to either technology if they support, to any degree, the other technology. As more markets throughout the world allow GE foods, it makes it harder for countries to be holdouts against the technology as trade is now a fact throughout the world. Brazil, for quite a few years a holdout against GE foods and the GM technology, has now agreed to allow the use of this technology (5). An alternative to GE technology is the use of cultural practices to control weeds and thus reduce or eliminate the need for chemical herbicides.

We now have information that alternatives to chemical pesticides can provide satisfactory control but we do not yet have sufficient information as to their cost and potential payoff to the farmer. In the absence of government

regulation eliminating chemical pesticides, whether farmers continue to use them will be a function of the economics as well as their desire to farm with or without the use of these chemicals. It is therefore not so much a case of using chemicals out of a desire to use them, but it is a case of perceived necessity. As stated by David Granatstein of Washington State University (6), "I've yet to meet a farmer who likes to spray toxic pesticides."

Sometimes when farmers are criticized for using a technique that may be viewed as having deleterious impacts on the environment, they are identified as having no interest for the environment and thus are said to not be good "stewards of the land". I think that this is an unfair criticism in that farmers have nothing to gain by wilfully destroying their land base. Unfortunately, government policy might encourage farmers to carry out certain practices or to produce certain commodities that end up creating environmental concerns. Thus, if criticism is warranted it should be directed to those setting the policies rather than just to those implementing the policies.

Whether you like it or not economics will for most farmers dictate the way in which they conduct their businesses. When I was working on a farm in the UK in 1964 before going to agricultural college, many farmers tended to spray broadleaved weeds in cereal crops as a matter of course. In other words, the decision to spray every year was as automatic as the decision to seed the crop. Over the next few years it became more common for farmers to walk their fields to determine whether there was in fact a need to spray or not. Thus, they were looking for the benefit-cost of spraying. In Saskatchewan in 1969, farmers were experiencing their worst year since the 1930s for net farm income, due to very low grain prices. Selling pre-emergent herbicides became more difficult as farmers started to think in terms of "I will spray when I know what sort of weed problem I have".

The above examples are of individuals making a personal choice concerning the use of chemical pesticides, a

² The survey comprised over 650 public hearings and over 37 000 questionnaires (4).

choice motivated to a great degree by their goal of farm profit. Legislation, however, can force decisions on us that in the absence of the legislation might not be made. On the 24th July 2003, it became illegal to sell about 10% of garden pesticides in the UK (7). This move is being made to ensure that there is harmony across the European Union (EU) with regard to home use of pesticides.

Home use is obviously a non-commercial use and thus regulatory arguments can be different than for the commercial markets. However, it is likely that restrictions will only increase for farmers and other commercial users of chemical pesticides. However, not all countries act in the same way. On 6th October 2003, it was announced that the Bush administration in the US had put in place a policy that forbids farmers from suing pesticide companies based on claims of either non-performance or crop damage (8). This may have implications for farmers in Canada and their relationship with US based multinational companies involved in the pesticide trade. It also seems to clearly position pesticide companies, and thus the use of chemical pesticides, in the mainstream in US agriculture for at least the length of the present presidency.

Is organic farming the answer?

This is a very sensitive subject. Any debate can find opponents and proponents taking extreme positions to support their case. Proponents of organic farming may argue that the price to eliminate chemicals in agriculture is worth it at any price. On the other hand, opponents argue that society cannot afford the cost. An extreme view from the opponent camp is that espoused by Dennis Avery who has been quoted as follows (9):

"... high-yield farming since World War II has saved 16 million square acres for wildlife. The global forest is 16 million square miles. High-yield farming is a conservation triumph."

"Organic agriculture just doesn't have the yields," Avery said. "To feed itself organically, Europe would have to cut down forests equal in size to

France and the UK combined. Wildlife would suffer. . ."

There may be some (how much?) truth to what Avery is saying if it is assumed that production levels would decline under organic production techniques. It is understood that proponents of organic farming disagree vehemently with Avery and argue that his assumptions concerning organic production are wrong. Opponents would also likely argue that wildlife suffers from conventional (chemical) agriculture due to pollution of land, water and air. Might there be a "middle" ground here? I think that most informed people agree that during the transition phase from conventional farming with chemical pesticides to organic production without chemicals, farm production is expected to decline. However, following transition it is expected that production levels can be (a) the same as before, (b) less than before, or (c) more than before. There is no guarantee as to which of these three situations will hold. The answer lies with the management skill of the farm operator. It therefore seems that the use of chemical pesticides might be more forgiving of poor management than the non-use of these compounds. Are they then a "lazy man's crutch"? What seems more readily agreed upon is that the costs of production for many farm commodities might be (slightly) higher under the organic scenario as compared to the conventional approach. Whether farm profits are higher or lower after transition is a function of costs of production and the price received for the commodity.

Consumer prices are often higher for organic foods than those produced conventionally. How much higher may be a function of "what the market will bear". Interestingly, the price premium for organic foods can vary greatly by country and not all countries view price as being a particularly important determinant of consumers choosing organic foods. In Australia, research into what drives consumer behaviour has found that health is cited as being very important in buying organic food by 79% and price by just 40% (10). Interestingly, the protection of the environment was cit-

ed as being very important by just 42% (10). This tends to highlight self-interest in consumers. I presume that Australian consumers are little different than consumers in other developed countries.

In the US, between 1992 and 1996 the farm-gate price premium for various fruits and vegetables exceeded, in some cases, 100% (11). For the same period, the price premium for grains and soybeans exceeded 50% (11). Although high, these price premiums have fallen since 1999. In Canada, research has shown that although retail price premiums have often been in excess of 10% (a figure of 30% is often quoted), consumers seem reluctant to pay more than 10% over the retail price for conventional foods (12). In Holland, consumers are known as being price conscious and it is felt that large volume sales through supermarkets will bring the price premium down enough to make the consumer interested in buying organic foods (13).

Surveys have been taken of consumers in supermarket parking lots before shopping to find out their interest in purchasing organic food. The consumers were then re-surveyed after shopping to find out what they purchased. There was often a marked difference between their stated desire to purchase organic food and their actual purchases, with purchases being less than stated before shopping. The difference was attributed to the price premium and their available disposable income on that day. We should never forget that food is not always cheap to all consumers and thus price premiums, however justifiable to producers, wholesalers and retailers, can be a barrier to purchase. When we professionals make predictions about food consumption our views can be clouded by what we feel is a fair price and not perhaps what the average consumer feels is a fair price.

The comment about the Dutch consumers might be very telling about the future of organic (chemical-free) agricultural production. Although one senses that the smaller agricultural producer in Canada has spearheaded the movement to organic production, the

future for widespread acceptance of food produced organically will likely depend on large scale producing units. I say this as I think that price premiums will have to come down to make organic food attractive to the majority of consumers. Others agree with this comment (14). This can also be argued in that the organic price premiums are at present attached to the smaller alternate or niche market. As this niche market becomes the *de facto* main market, how could price premiums be supported? This will create economic pressure on smaller producers if they have higher costs of production.

Let me make a final comment on organic production. The term "organic" is often vigorously defended when people ask what it is. I am using it in this presentation in the perhaps narrow sense of being "without chemicals". Thus, if we were to eliminate chemical pesticides we would, I suggest, have moved to an organic system of production. Many proponents of the "organic movement" do not agree as to them organic is more than being chemical-free. They often add "requirements" such as farm size (smaller preferred to large) and lifestyle characteristics. I have heard the comment "organic suits" used as a derogatory descriptor for representatives of corporate organic firms (and farms) to differentiate them from smaller family-sized organic farms. We know that large corporate farms in California are now producing organic food. I suspect that the sheer scale and commercialism of these units will help to drive the price premium down and lead to organic food becoming closer to the mainstream. This has huge consequences for the Canadian/Quebec family farm.

International concerns

I will assume that the symposium title means that we, in Canada, might ban chemical pesticides. However, this does not necessarily mean that other countries would follow suit. Given the previous comments on the US stand recently taken to protect pesticide companies, let us assume that the US does not ban chemical pesticides. Could we keep produce out of Canada that had

been produced using chemical pesticides? If we test foods and don't find chemical residues, will this suffice and satisfy those who want to see chemical pesticides banned? A few years ago, I read in the press of a comparison (not statistical) of meats produced organically and conventionally that were sent to the Federal testing laboratory in Saskatoon. Tests were carried out to determine levels of chemical in the meat. No significant differences were determined for meat from either source. This result **should** be the case if rules of chemical use are strictly followed. If we could not keep these foods out of Canada, and if we assume that our domestic costs of production were now (slightly) higher after we ceased the use of chemical pesticides, would our farmers be put at a competitive disadvantage against imported food products? This is not an easy question to answer. This brings us back to the subject of goals of the participants of our agri-food system.

Now let us assume that we could in fact keep food products out of Canada that were produced using chemical pesticides. Could our policy of banning these pesticides have any negative impacts on the exporting country, and should that be of concern to us? Research carried out at the University Greenwich in England has determined that countries exporting products to the EU (produced using chemical pesticides) might suffer in being shut out of the chemical-free importing country in the EU (15). I suggest that the same concerns might be expressed for countries exporting to Canada. There could be a reduction in the number of products imported as those produced using chemical pesticides would be banned and if these could not be produced by non-chemical means, then they would not be produced for that market. The same argument could be made for the Canadian market. There could be an increase in the costs of production in the short run and this could lead to the product becoming less competitive on the importing market. The risk of crop failure could increase, thus putting financial stress on the exporting country. Could this affect us in Canada? Yes, if

we are importing from a developing country that relies on exports for earnings. Smaller producers might not be able to continue to export the food commodity if they were incapable of putting non-chemical controls in place. Again, we might not want this to happen. Finally, because of the above concerns smaller countries might be excluded from international trade. This could be devastating for those countries that rely on this trade for major earnings.

Some products traded internationally use huge amounts of chemical pesticides in their production with a consequently high level of waste and thus environmental degradation. Bananas might be one of the extreme cases. Figures from Costa Rica clearly indicate both the amount of chemicals used on bananas and the waste involved. Thus of the estimated 11 million litres of fungicide, water and oil emulsion applied to this crop annually, approximately 90% is wasted (16). There may be little to argue about these statistics, but how many people would be willing to give up bananas to reduce this waste? For many, unfortunately, this might be a case of NIMBY (not in my backyard) but in a developing country, it may be acceptable. For the developing country, in fact, it might be a necessity if this crop is their only source of revenue. To the corporations involved in the banana trade it is safe to say that now it is a justifiable cost to generate their profit from this crop.

Many agricultural commodities produced in Canada are destined for export markets. If we assume that following the elimination of chemical pesticides the cost of production for our commodities increased, even by a small amount, it is reasonable to argue that we would be less competitive in those export markets. Some might argue that our chemical-free commodities would find export markets. This might be true but at what price? That will depend on the ability of our trading competitors to put chemical-free food products into export markets at competitive prices.

Concluding comments — the future?

Most of my comments in this presentation address the move to organic if the move is being made by choice on all participants in the system. So long as there is choice for farmers between using chemical pesticides and farming without chemical pesticides they will choose the option that they prefer **so long as it is an economically sensible** option. Quite a number of years ago, I watched an agricultural programme on organic grain farming in Manitoba and one organic farmer said that farming organically was not a problem “if they (the farmer) could afford to do so”. By this, he meant that they could cover their (likely increased) costs of production with the organic price premium. However, the subject of this symposium clearly addresses the question of banning chemical pesticides, thus forcing farmers to seek alternative production techniques. It seems reasonable to assume that if these chemicals were to be banned, farmers would be faced with a difficult period of adjustment during which some would choose to cease farming activities. Thus, chemical-free agriculture would become the norm and price premiums would, I think, decline over time. The question is now “could the average family farm survive?” I think that they could, but at a considerable cost of adjustment. To make up for this cost, I would suggest that the scale of farming would increase. This is somewhat contrary to what is assumed the typical Canadian or Quebec family farm.

It might be argued that banning chemical pesticides would be too draconian if there were a belief that too many farms might suffer adverse economic impacts. We should be careful not to say “never”. We have only to look to our neighbour to the south for a glimpse of what the future might be. In Iowa, a city of 125 people by the name of Vedic City was started in 2001. What makes Vedic City unique is that it is illegal to sell non-organic food in the city, both in stores and in restaurants. My guess is that followers of the organic movement started Vedic City. Given the size of this city it is hard to see this situation becoming accepted for large cities. How-

ever, if communities (boroughs) of Montreal are moving to ban chemical herbicides for weed control in lawns, are we already moving inexorably towards a total ban of chemical pesticides? I tend to think that our future regarding the use of chemical pesticides will be one of limited and controlled use. In this I agree with May Berenbaum who has said (17):

“Chemical pesticides should remain part of a larger toolbox of diverse pest management tactics in the foreseeable future,” said May Berenbaum, professor of entomology at the University of Illinois-Urbana and head of the committee that wrote the report. “No single pest-management strategy will work in all ecosystems, so chemicals need to be part of an ecologically-based framework that can safely increase crop yields.”

Is this close enough to the “middle”? I hope so as I think that polar opposites are not likely in the near future. Societal pressure will continue to control the use of pesticides but will it totally remove them from use? Perhaps yes, when we talk about aesthetic uses such as lawn herbicides in urban communities. However, as stated earlier in this paper, I think that for economic reasons we may not see for quite some time a total ban of chemical pesticides in commercial agriculture. Therefore, I see chemical pesticides as a **Double-edged Sword** in the sense that there are advantages to their use and disadvantages. Whether we see them eliminated in our country will, I hope, be based on an educated study of both of the sword’s edges.

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