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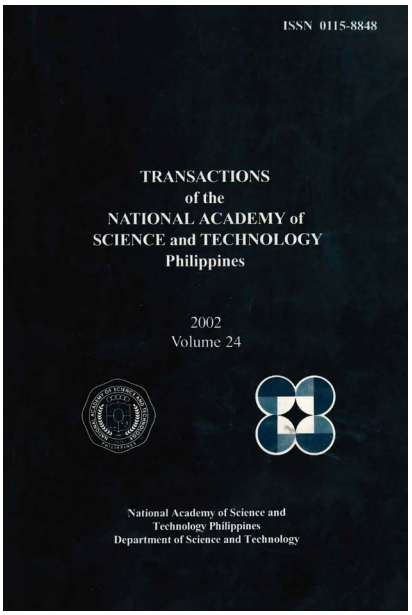

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THE COMPATIBILITY OF GMOS TO SUSTAINABLE AGRICULTURE

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ABSTRACT

GMOs or genetically modified organisms offer opportunities to support sustainable agriculture. The GM technology can be harnessed so that crops rather than the farm environment are altered to suit their environment. Experience with GM crops shows promising trends. Recent studies indicate that GM crops substantially reduce pesticide use and incidence of pesticide poisoning in farms. Farmers rapidly adopted GM crops because of perceived economic benefits. Bt crops compared with application of pesticides promote more biodiversity. Herbicide tolerant crops reduce soil cultivation. The current practice of transferring a single trait into as many popular varieties as possible ensures crop diversity at the farm level. In the pipeline are GMOs being designed to grow better on existing environments with fewer or zero inputs. Naturally occurring microbes and viruses are being designed to help crops and aquaculture species fend off pathogens and pests without affecting other components of the ecosystem. However, public sector R & D must be fully supported to develop environment friendly crops suitable to stressed environments where most of our farmers practice and to ensure the safety of the GM technology. Public education and information in biotechnology must be enhanced to support biotechnology R & D and GM technology diffusion.

Keywords: GMOs, sustainable agriculture, environment-friendly

INTRODUCTION

Many practices in conventional agriculture are found to cause damage to the environment and could not sustain long term productivity. Soil cultivation leads to

loss of top soil. The use of broad spectrum pesticides results in loss of biodiversity. The limited number of improved crop varieties being planted in farmers' field leads to loss of agricultural biodiversity at the farm level. Improper fertilization leads to the contamination of ground water and death of water bodies. Toxicity of chemical pesticides to farm workers and hazardous effects of pesticide residues to consumers are well documented. On the other hand, farming in degraded and unsuitable areas continues with very low productivities. These observations led to the concept of sustainable agriculture – an economically viable, safe and environment-friendly food and crop production system that will continue to exist in the long term.

Given the current practices of conventional agriculture attaining sustainable agriculture is quite a formidable task. Any new technology that replaces or improves upon an old one must comply with these conditions: high productivity, high profitability and safety to farm workers to sustain farmers' interest and health in farming. And to sustain a productive environment, any change in the environment must be readily reversible. With the advent of the WTO, one must add global competitiveness as well. One approach proposed to attain sustainable agriculture is to develop a farming system based on sound ecological principles. Farm ecology, however, is a new science. We have yet to establish the principles although we know as earlier stated the many practices that disturb and permanently change the farming environment or interfere with the natural processes that sustain soil productivity.

A first step therefore to sustainable agriculture is to adopt measures that do not put pressure to the environment. One such measure is the development of crops that adapt to rather than require changes in the environment.

GMOs or genetically modified organisms offer opportunities to support sustainable agriculture. Genetically modified organisms refer to organisms genetically improved through genetic engineering, a group of procedures that introduces a desirable trait into an organism by directly transferring the DNA controlling the trait into a selected variety. The source of the DNA could be any organism be it related or unrelated. This capacity of sourcing traits from any organism allows more flexibility in designing new crops, microorganisms or farm animals not offered by traditional breeding. In traditional breeding the sources of genes are other individuals of the species or related species. Traits are transferred by mating individuals. In genetic engineering, genes from any organism like bacteria or viruses can be transferred with ease to plants or animals. Thus, the chances of finding the favorable genes to alter crops to suit their environment are very high.

Experience with GM Crops Shows Promising Trends

Recent studies indicate that GM crops substantially reduce pesticide use and incidence of pesticide poisoning in farms. In Year 2000, the global planting of GM soybean, canola, cotton and corn was estimated to have reduced pesticide use by as much as 22.5 million kg of formulated product. In the European Union alone, if 50% of their agricultural area were planted with GM corn, rape seed oil, sugar beet and cotton, another reduction of 14.5 million kg of formulated pesticide product has been

estimated. ISAAA reported that Bt crops substantially reduce pesticide use and incidence of farm poisoning (Table 1).

Table 1. Reduction in insecticide use

Variety	Insecticide load(kg /ha)	Insecticide poisoning reported (% of farmers)
Only Bt	10.3	4.7
Bt + non-Bt	29.4	10.8
Only non-Bt	57.8	22.2

From: ISAAA 2001

Bt crops compared with application of pesticides promote more biodiversity. Field observations show that the Bt protein in Bt crops can be so specific as to cause death only to target insects. Whereas most pesticides commonly in use are broad spectrum, that is, they kill almost all the insects they come in contact with when applied in the field. Local observations in Bt corn field trials show the presence of non-target and beneficial insects in Bt corn plants. The issue of the Bt corn pollen adversely affecting butterflies has been settled with the findings that of the nine Bt transformation events in corn, all except one are safe for butterflies. The exception, Bt176, has been found to adversely affect swallowtail butterflies (Halos, 2002). This experience indicates however, the need to expand studies on the effects of GM crops in the field.

Herbicide tolerant crops reduce the need for extensive soil cultivation. The major technology being disseminated to address the loss of top soil due to cultivation is conservation tillage. Conservation tillage minimizes soil cultivation and requires the use of farm residues to help control weeds and reduce soil water evaporation. Since tillage is used actually to control weeds, both conservation tillage methods recommend the use of broad spectrum herbicide to control weeds instead. There are 2 variations: Zero tillage and minimum tillage. Zero tillage includes the current practice of planting garlic bulbs on uncultivated soil mulched with rice straw is also considered zero tillage. Minimum tillage involves cultivation of the row wherein seeds will be planted. Depending upon the level of weed population, herbicides maybe applied before planting. However, as the crop grows so do weeds. The simplest method to kill the weeds is to apply herbicide again. However, this is not possible unless the crop is resistant to the herbicide that can kill all the weeds growing in the field. This problem is currently solved with genetically modified herbicide tolerant crops. Herbicide tolerant crops do not suffer adverse effects of the herbicide hence enabling the farmer to control the weeds anytime during the growing season. Herbicide tolerant crops make weed management in conservation tillage systems economical and convenient for farmers. This explains the popularity among farmers

of herbicide tolerant crops which today occupy the largest area among GM-crops in the world (James, 2001).

GM technology allows for the continued use of old but desirable varieties thereby maintaining crop biodiversity at the farm level. The current practice with the development of GM crops is to transfer a single, well-characterized transformation event to as many of the popular varieties as possible thereby preserving the use of many varieties. For example, the lone transformation event – GTS40-3-2, that confers tolerance to the herbicide, glyphosate, has been transferred into more than one thousand commercial soybean varieties by traditional breeding techniques (AGBIOS, 2002). The nine Bt transformation events have been transferred to more than 200 corn hybrids.

Farmers have rapidly adopted GM crops because of perceived economic, health and environmental benefits. Lesser use of pesticides increased their profits in addition to requiring less labor and lessening the exposure of farm workers and other farm organisms to these toxic substances. Farmers have adopted GM crops at the highest rate known in the history of agriculture.

The Need for More Public R & D

GM crops developed by multinational companies (MNCs) occupy the majority of areas devoted to these crops. There are only 4 major GM crops, soybean, corn, cotton, canola occupying the 44.2 Million hectares of GM crops planted in the year 2000 with two transgenic traits: herbicide tolerance and insect resistance (Bt). The latest survey shows that MNCs in the USA and Europe continue to focus their R & D on a few commercial crops: corn, soybean, rapeseed, potatoes, sugar beet and on a few traits: herbicide tolerance, pest resistance, product quality. The public institutions with comparatively less investments should work on traits that could be of more relevance to developing country agriculture such as stress tolerance (drought tolerant, saline resistant) designed to grow better on adverse environments with fewer or zero inputs. Research is also on-going on naturally occurring microbes and viruses designed to help crops and aquaculture species fend off pathogens and pests without affecting other components of the ecosystem.

Thus, this state of affairs emphasizes the need to strongly support public sector R & D especially in developing countries where small farmers often do not have access to varieties developed by MNCs because of the higher prices. But more importantly, it is the public sector R & D that develops environment friendly crops suitable to stressed environments where most of our farmers practice. Also, too little is known about farming ecology. If we are to develop farming practices based on ecological principles, then R & D must be implemented to discover these principles. The dissemination of information about GM crops is fraught with inflammatory rhetoric. A strong negative public reaction against GM crops engendered by such rhetoric could keep Philippine agriculture from using a technology that intergovernmental agencies like the Food and Agriculture Organization of the United Nations (FAO, UN) have identified as a major tool in agricultural development. As

more and more research results continue to show the environmental protection afforded by GM crops, this negative reaction must be prevented to grow. This can be done with public education and information campaign about modern biotechnology.

The concept of sustainable agriculture is one of the goals of the Agriculture and Fisheries Modernization Act (AFMA). By specifically providing support for biotechnology R & D, AFMA recognizes the potential of the technology for attaining sustainable agriculture. Therefore, one of the major RDE networks established by BAR is the National RDE Network in Biotechnology led by BIOTECH, UPLB. To allay public fears, in the past two years, the Department has held public consultations and is now putting in place the guidelines for the commercialization of GM crops. These guidelines provide for science-based regulations, thereby requiring continuing research to help us develop the measures that ensure the safety of the GM technology.

Like many government efforts, however, our plans and programs fall short in timely and full implementation due to budgetary constraints. This encourages us to seek collaboration with other entities to support our biotechnology program. Fortunately, not only international aid agencies have special biotechnology programs, even MNCs who control the majority of the enabling technologies for modern biotechnology are willing to share these resources to help us develop the environment-friendly crops we need. Thus, we are hopeful that we will be able to fully harness the GM technology for sustainable agriculture.

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