

GM-rice and the scramble to own genes

By Jagath Gunawardana

Rice is the most important food crop in the world, feeding about half of the world's population. In Asia, more than 80% of the calories needed by people come from rice. The farmers dependent on cultivating rice as the main livelihood is about 1100 million, comprising 225 million families. In Asia alone, rice is grown in more than 150 million hectares and produces about 90% of the harvest in the world. Although rice is of such great importance as a major food crop and the main mode of livelihood for so many, there was very little initial enthusiasm to do genetic engineering to improve the rice crop, except by Japan, itself a major rice producer and consumer. This initial reluctance was because, rice was, and still is mainly a poor men's crop.

In contrast to the corn [maize] and soya farmers in developed countries, a majority of the rice farmers are in developing countries and a significant proportion is still at a subsistence level. About 95% of the rice produced by these countries is consumed directly and less than 5% is used to make processed foods and alcoholic beverages. About 96% of the rice is consumed domestically by the producers. Exports total to about 4% of the production, making rice the least mobile of the major food crops.

Therefore, as expected, no large private companies invested in genetic engineering of the rice crop in the early 1980s. The first investor on genetic engineering of rice was the Rockefeller Foundation, a public interest body that aims to promote science and technologies to improve the living standards and food production in developing countries. This programme, named "The International Programme on Rice Bio-technology" was launched in 1984. The provided grants to a large number of bio-technological institutes in developing countries to acquire the capacity and to conduct research and sponsored necessary training to scientists of these countries to conduct research.

These financial assistance and training helped boost genetic-engineering of rice in a big way and by 1991, rice has become a model for the genetic-engineering of cereal crops. The Rockefeller Institute is still the largest financial contributor to the genetic-engineering of rice. Even the production of Golden Rice was started with the money provided by a grant from Rockefeller Foundation. The interest in the genetic-manipulation of rice has created the demand for these genes that confer certain favoured characteristics. This on the other hand had made companies to claim monopolies to these genes which is being done by patenting them.

Patents on living organisms and their parts, or life patents are still provided in only a small number of countries. A majority of countries, not only reject life patents but are opposed to them as well. Notable among these who grant life patents is Japan, which pioneered genetic engineering of rice independently many Japanese companies who were successful in other fields like construction, vehicles and electrical goods went into the science and business of genetic engineering during the early 1980s. The patenting of a gene gives exclusive ownership rights for a company and provides them the freedom to make new varieties using such genes without any problems of others using the same gene and coming up with other similar forms or even better versions. The other main advantage of patenting a gene is that it enables a company to earn royalties by licensing the rights to use "their genes" by others in their research and development and the shares of any successful plant that have these genes.

An analysis of the genes that had been already patented shows that they fall into

several different categories, by the type of characteristics expressed by these genes. One very useful type are those genes that confer a better quality to the rice grains by making them more nutritious or more palatable. The patent JP 06153963 obtained by Mitsui Company of Japan is for the rice protein Kinase gene that can be used to enhance protein production in the grain. Rice is usually poor in proteins and those who consume rice have to get the necessary proteins from other foodstuffs. A large number of people who consume rice as the staple food are poor and cannot afford protein-rich foods and therefore any rice variety with enhanced protein contents would be a great help to them. However, the passing of ownership of such useful genes to private entities may have the opposite effect of hindering the making of such varieties of GM-rice that

situations. For instance, since this is a utility patent, anyone who wishes to use this gene in any plant breeding exercise and not only in genetic-engineering would need permission in countries which recognizes life patents and could be even used to hinder any free exchange of germplasm between Sri Lanka and those listed in the patent co-operation Treaty (PCT) document that lists these countries in which the university wishes to get this patent registered. In any event, it is interesting to note that a useful gene has suddenly become a "property" that is "exclusively owned" by one body against the others, who had been using it without trying to own it.

The race to patent genes that confer resistance to diseases have still more successes on the part of companies. For example, Mitsui Company holds two patents, JP 04094687 and JP 06225774 that cover

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could cater to specific needs of the poor.

The Pioneer Hi-bred International is the largest producer of crop seeds in the world [and is now owned by DuPont]. This company has obtained a world patent under WO 9741239 at the World Intellectual Property Office [WIPO] for a gene that improves the quality of proteins in rice. This gene makes more of the useful types of proteins in the grain but does not increase the percentage. A combination of this gene with the previous one could result in having a larger amount of more useful proteins but then, it is made more tricky as the two genes are owned by two different companies in two continents. Another patent WO 9911800 is registered jointly by the Hokko Chemical Industries of Japan and the Japanese Ministry of Agriculture, Forestry and Fisheries [MAFF] for a gene that can be used to increase the amount of triptophan [a protein] that can enhance the nutritional value of rice.

Another trait covered by several patents is resistance to diseases. There are serious crop losses due to several rice diseases and pests and the breeding of resistant varieties that are also able to give high-yields is a top priority among rice breeders. These efforts are made through conventional breeding methods, but could be greatly helped by genetic-engineering. For example, Rice Blast is a serious disease that causes major crop losses. It is to the credit of Sri Lankan rice breeders that they managed to breed blast-resistant high-yielding varieties more than quarter of a century ago, through conventional plant breeding methods. These include BG 11-11 (released in 1970), BG 34-6 (1971), AT 16 (1978) and BW 266-7 (1981).

In 1999, the University of Singapore got a world patent, WO 9914350, for a gene named "RANK-1 protein gene" that confers resistance to rice blast. This patent raises several issues that are relevant to Sri Lanka. It is not known whether our improved, Blast resistant varieties have this RANK-1 gene or another one that gives the same trait. If our rice varieties have this gene, it may give rice to outword

lipoxygenase genes that can be used to make disease-resistant forms. The University of California in USA has got a world patent [W09909151] that covers RKK genes which makes rice plants resistant to diseases. Unlike the RANK-1 patent, these three cover genes that provide resistance to a number of important diseases and are thus more valuable to the owners. It is still not known how many of the disease resistant types of rice bred by research institutes have these genes and how these patents may effect future prospects of breeding and genetic-engineering.

Rice is a crop that self-pollinates and the rate is about 95%. This has on one hand helped farmers to propagate and save seeds for the next season and to select, breed and maintain new lines. On the other hand, it effectively prevented commercial hybrid seed production. This changed since 1976, when Chinese scientists managed to impart cytoplasmic male sterility [CMS] that makes male parts of flowers to become sterile into the paddy crop thereby making it possible to create hybrid paddy. These hybrids give an increased yield [up to 20% increase] but this effect disappears if seeds were planted from the hybrids. Therefore, farmers cannot save seed and seed-paddy has to be bought every season, making it a profitable venture for seed companies. The advent of hybrid paddy in Asia has opened up new markets for seed businesses. The production of hybrid seed paddy needs to have a CMS-line, a maintainer line that keeps the CMS-line and then a suitable male line to make hybrids. The making of CMS-lines and maintainer lines is costly, cumbersome and time consuming. Therefore, they have often resorted to maintain a small number of forms that can be hybridized with any suitable male lines.

It is therefore predictable that private companies would be interested in owning any genes that can import male sterility into rice. Genetic-manipulation would help them to circumvent all problems in selecting breeding and maintaining such

line. Another useful addition, from a companies point of view, is to fix an inducible promoter to genes that confer male sterility. An inducible promoter can be induced by the presence or absence of a chemical and therefore, male sterility can be induced when necessary and the line can be maintained by keeping the sterility gene silent until needed, either by adding or not adding a chemical. This will do away the need to have maintainer lines, would make it possible to have any number of male sterile lines and further boost the prospect of seed companies which also often make agro-chemicals by opening up new markets for their inducer chemicals.

The Plant Genetic Systems, based in Belgium [now owned by Agr. Evo] registered the world patent WO 9213956 in 1992 for a rice stamen specific promoters and all recombinant genes that contain this promoter [the title of the patent calls these recombinant genes as "Chimeric genes" so named because of the unnatural relationship between the parts]. The patent discloses that this can be used to make male-sterile rice plants useful in breeding hybrid seed. Another gene that causes male-sterility in rice is owned by Mitsui Chemical Industry by patent JP 05137581. Another gene is owned by Norinsutan by patent JP 0619776 that also causes male sterility. These two genes can be employed to interfere with the respiration in pollen cells and pollen-mother cells, causing their death.

There are in addition, a number of genes that confer a trait or control a trait that have been patented in order to derive benefits from any future potential uses. This has become a race where so many companies, firms, research institutes, universities and even public interest research bodies are claiming ownership for various rice genes. For example, the Max Plank Institute a public-interest research body in Germany had got a patent in Germany [DE 4222407] for a promoter from the rice plant that enhances expression of genes. Not to be outdone, the Carnell Research Foundation [a body that had been in the centre of a bio-piracy scandal in Sri Lanka] has obtained a world patent WO 9109948 for another promoter from the rice plant that can enhance the expression of other genes.

Several lines of GM-rice have been developed, both by the private sector and public bodies. One form of GM-rice had been developed by International Rice Research Institute [IRRI] has a gene that makes it able to resist Bacterial Blight and is therefore known as BB-rice. Although IRRI tried to portray this as a major achievement, Sri Lankan rice breeders have achieved the same more than a quarter of a century ago through conventional breeding. High-yielding varieties that are resistant to Bacterial Blight include BG 94-1 [released in 1975,] BG 276-5 [1979] and BG 380 [1980]. It would have been better if these bodies could try to confer useful traits that are impossible to be brought in by conventional breeding.

In contrast, making of GM-rice by the private sector directly caters to corporate needs. For instance, Syngene [the largest agro-chemical and biotech company and the third largest seed producer] is working with IRRI to make varieties that can produce its own pesticide [known as Bt — rice] and to see that they are grown widely in Asia. There are now efforts to commercially produce herbicide tolerant rice that can withstand glyphosate [Round-Ready Rice] and glufosinate [Liberty-Link Rice]. There are also efforts by some companies to make GM-crops and then give them to third world countries by entering into "royalty-free agreements". Such agreements make it necessary for the beneficiary country to respect and accept the intellectual property rights of the company including the patents on genes, which means the acceptance of life patents.

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