

Table 1. Trans-kingdom transfer of macromolecular pathogenicity structures

Pathogen	Disease	Macromolecule transferred
<i>Agrobacterium</i>	Crown gall	T-DNA
<i>Bartonella henselae</i>	Cat scratch	VirB protein
<i>Helicobacter pylori</i>	Mucosa associated lymphatic tissue-lymphoma	CagA protein
	Gastric adenocarcinoma	
	Peptic ulcer	
<i>Bordetella pertussis</i>	Whooping cough	Pil protein
<i>Listeria monocytogenes</i>	Listeriosis	Invasin???
<i>Yersinia enterocolitica</i>	Yersiniosis	Invasin???
<i>Brucella suis</i>	Brucellosis	VirB protein

Trans-kingdom transfer of effector proteins from bacteria to plants and animals including humans through the Type 4 secretion system may not be uncommon. There are a number of other human pathogenic microbes that do such transfers (Table 1)^{11,13}. But what is more striking is that the soil phytopathogen, *Agrobacterium*, is the only one example wherein trans-kingdom (T-)DNA transfer takes place in plants (and now in humans too) using the same Type 4 secretion system. Also, *Agrobacterium* represents the best characterized member in the group in terms of Type 4 secretion system (and, of course, best utilized for plant genetic engineering and transgenesis)¹⁴. The successful research attempts to make human cells also susceptible to *Agrobacterium* infection and T-DNA transfer opens up new interesting areas coupled with fresh batches of questions that demand greater validations and interpretations. Similarly, already there are expressed apprehensions by a few anti-genetic engineering groups, globally, regarding the biosafety

concerns of using *Agrobacterium*. As per the available information, these concerns are misplaced as there are no reports to indicate that humans (as opposed to cell lines) are transformable by *Agrobacterium*.

The research findings of Citovsky's group that only a few proteins may be necessary for human cells to uptake specific foreign DNA coupled with the ever-burgeoning information on *Agrobacterium* molecular biology, general biology of the Type 4 secretion system and molecular relatedness of *Agrobacterium* and other human pathogens including *Bartonella* – are all leading to a very exciting period. New breakthroughs can be anticipated in our understanding of the role of the Type 4 secretion system in microbial pathogenesis and its application in the genetic transformation of plant and human cells.

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COMMENTARY

HIV/AIDS in the developing world*

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During the past two decades, HIV/AIDS has had a devastating impact on the health and social and economic well-being of populations in many parts of the developing world.

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In 2003 alone, HIV/AIDS caused the death of more than three million people (All figures cited are based on UNAIDS, WHO and CDC data.). That made it the number-one killer among all infectious diseases.

The vast majority of the 40 million people living with HIV/AIDS – indeed some 34 million or nearly 85% of the total number of people afflicted with the

disease – are in Africa, Asia and Latin America, among countries that are least able to manage the epidemic or afford the costly combination of antiretroviral drugs which have dramatically reduced AIDS-related morbidity and mortality rates in developed countries.

Sub-Saharan Africa, on its own, accounts for about two-thirds of all HIV/AIDS-related deaths. The region also accounts

for about two-thirds of the number of people living with HIV/AIDS.

The number of people afflicted with HIV/AIDS in Africa, particularly in sub-Saharan Africa, is truly daunting. More than 26.5 million Africans currently live with HIV/AIDS – 3.2 million of whom were infected in 2003. The HIV/AIDS-related yearly death toll in sub-Saharan Africa had reached 2.3 million in 2003. Experts expect that the total number of deaths due to the disease will reach 55 million by 2020, unless aggressive measures are taken to prevent and treat the disease.

The HIV/AIDS epidemic, however, is by no means restricted to the African continent. South Africa has the highest number of HIV-infected people – some 5 million people or 20% of the population. But India has the second highest count in terms of absolute numbers (an estimated 2 to 5 million people) and the incidence of infection is also rising at an alarming rate in China. Failure to arrest the spread of the disease in the developing world, particularly in the world's two most populous countries that account for more than one-third of the world's population, could have disastrous consequences for the entire human race.

The enormous challenges posed by the HIV/AIDS epidemic has aroused a rising chorus of global concern for combating the disease. In September 2000, representatives at the Millennium Summit of the United Nations classified HIV/AIDS as one of the world's most pressing problems. In June 2001, the United Nations Special Session of the General Assembly cited the fight against HIV/AIDS as a global priority and issued a 'Declaration of Commitment' in which member states pledged to vigorously address the public health and social issues engendered by the epidemic. In April 2001, at the African Summit on HIV/AIDS, Tuberculosis and Other Related Infectious Diseases, held in Abuja, Nigeria, Kofi Annan, the Secretary General of the United Nations, issued a global call for action in the fight against HIV/AIDS in which he implored political and business leaders to respond to the challenge. The Secretary General's urgent request led to the creation of the Global Fund Against AIDS, Tuberculosis and Malaria in 2001.

The Third World Academy of Sciences (TWAS; see Box 1) and the African Academy of Sciences (AAS) acknowledge the enormity of the problems caused by HIV/AIDS in the developing world and re-

cognize the pressing need to stem the spread of the epidemic through public awareness and education, universal access to both condoms and antiretroviral drugs, development of more effective, affordable and safer therapies, and the need for additional investment in the research and development of vaccines. In Africa, more than 4 million people would benefit from antiretroviral drugs, but only 50,000 people are receiving such therapies.

To help achieve these objectives, TWAS and AAS are eager to join UN agencies and government and non-government organizations in support of on-going research in the following areas:

1. Disease management and care of AIDS sufferers and HIV-infected individuals, including AIDS orphans.
2. Efforts to lower the cost of antiretroviral drugs and to make these drugs universally available to prevent mother-to-child transmission of HIV and to lower viral count in infected individuals.
3. Vaccine development through South-South and South-North research collaboration.
4. Public education and awareness of the disease process that would help reduce the incidence of HIV infection. Such campaigns should be intensified, together with efforts to increase universal access to condoms, as key preventative measures. Existing sources of indigenous knowledge, as well as in-depth assessments of prevailing cultural attitudes and beliefs concerning HIV/AIDS, should be identified as part of a larger effort to improve public aware-

ness of the disease and its consequences.

5. Examination of the use of traditional herbal medicines in HIV/AIDS management and analyses of indigenous flora and fauna as potential sources of less expensive antiretroviral drugs. The role of traditional healers in preventing and treating HIV/AIDS should also be examined. The South is richly endowed with natural products that contain potential immune-boosting ingredients. Such products may prove particularly valuable in HIV/AIDS treatments, particularly for infants and adults during early stages of infection.

TWAS and AAS are aware of the shortcomings of antiretroviral drugs currently in use and, therefore, recognize the need for additional research that could lead to the discovery and development of new drugs that are more effective, affordable and patient-friendly.

The enormous potential of the flora and fauna present in the developing world, combined with the pooling of expertise and resources within the South, could help promote the discovery and development of new antiretroviral and other drugs that prevent the destruction of the immune system or that boost existing immunity to arrest the progression of AIDS.

Vaccination is the cheapest and most effective way to prevent infection by HIV in the first place and to manage the disease over the long term. Despite two decades of intense international efforts, no effective vaccine has been produced and none is likely to be discovered in the

Box 1. About TWAS

The Third World Academy of Sciences (TWAS) is an autonomous international organization founded in Trieste, Italy in 1983 by a distinguished group of scientists from the South under the leadership of the late Nobel laureate Abdus Salam of Pakistan. It was officially launched by the then Secretary General of the United Nations in 1985. There are over 650 elected Fellows of TWAS from the countries in the South and India has more than 120 Fellows of TWAS. The present President of TWAS is C. N. R. Rao, a distinguished and eminent scientist from India.

TWAS Regional Office for Central and South Asia was established in the Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore under the Convenorship of V. Krishnan. e-mail: twasrocasa@jncasr.ac.in. The countries in this region include Kazakhstan, Krygyzstan, Turkmenistan, Tajikistan, Uzbekistan, Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Maldives and Sri Lanka. The TWAS Regional Office has been established to enhance the visibility of TWAS among young and promising scientists, policy-makers and the media through a variety of measures such as public lectures, meetings and conferences.

near future. The difficulty of producing effective vaccines is compounded by the enormous genetic diversity found among HIV strains. There is also an urgent need for therapeutic vaccines to arrest the progression of HIV in infected individuals. TWAS and AAS, therefore, encourage and support research leading to the development of cross-protective prophylactic vaccines to prevent new infections as well as therapeutic vaccines for the millions of individuals who have already contracted HIV.

TWAS and AAS believe that research, leading to the discovery and development of new drugs and vaccines to combat HIV/AIDS, should be conducted not only through collaboration with institutions in developed countries, but also through South-South collaboration, especially among centres of excellence in the developing world that possess complementary expertise. The latter efforts would not only help promote relevant and focused multidisciplinary research, but would contribute to building scientific capacity in

the developing world and thus serve to counter the 'brain drain' phenomenon. Such efforts could provide a unique opportunity for TWAS and AAS to become involved in efforts that have long-lasting benefits for people living in HIV/AIDS-affected areas both in sub-Saharan Africa and throughout the developing world.

Transfusion of unscreened blood that may be contaminated with HIV represents an insidious yet efficient method of HIV transmission. Although countries in the South are aware of this problem, the transfusion of unscreened blood is still a common occurrence in many developing countries. TWAS and AAS urge all governments in the South to ensure that only properly screened blood is used in transfusions and that all medical laboratories in the developing world have the necessary equipment and skilled personnel to perform safe and reliable transfusion procedures.

TWAS and AAS should involve the Network of African Science Academies to fully engage the entire scientific com-

munity in Africa in research on HIV/AIDS. AAS and TWAS should also work closely with national governments in Africa, the New Partnership for Africa's Development, the African Union and all relevant UN agencies – UNAIDS, the World Health Organization, the United Nations Development Programme, and the United Nations Children's Fund – in developing a pan-African strategy to combat an epidemic that now threatens the well-being not only of Africa but, increasingly, all other parts of the developing world. Similar organizations in Asia and Latin America should also be engaged.

TWAS and AAS should examine ongoing efforts in countries throughout the South for potential opportunities to collaborate as the basis of a larger effort to promote joint action to combat the HIV/AIDS epidemic in the South.

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Pulse yields: Feeling the pulse

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Pulses are perhaps the most neglected components of our food grains during the green revolution and if we need to stabilize our nutritional base in the most eco-friendly and energy-efficient manner, we ought to alter our mindset from treating pulses as 'marginalized' crops. We argue here that the pulses are not as low in their yield performance as is generally projected and that this perception of lower yields is owing to a set of confounding issues. Nonetheless, we show that pulses are poor in harvesting the solar energy and in converting it to biological yield. We dissect the reasons for this inefficiency and trace that the inputs supplied to pulses is one of the major factors limiting the pulse yields. Accordingly, we call for an attitude change in our breeding protocols, production system and policy structure for pulse cultivation.

With the growing demand for nutritional security, pulses are becoming ever more important as a plant-based source of protein in human nutrition. Besides, the newly emerging, strong consciousness for health among the human populations is creating a genuine need for adopting a nutritionally complete but a predominantly vegetarian-based diet. This trend, conspicuous among the affluent countries is spreading to other human societies as well owing to the realization that a predominantly plant-based food system is healthy, eco-friendly and energetically

less expensive. Consequently, the vegetarian-based food profile with pulses as the major protein source is likely to become more widely adopted leading to a greater demand for plant-based nutrients.

Unfortunately, unlike those of cereals, the existing production levels of pulses cannot meet the emerging demands. Pulse production is low worldwide and more so in the developing countries. The low production levels of pulses has been very frequently attributed to the inherently low levels of productivity in the pulse crops¹.

Pulse yields during Green Revolution

In fact throughout the Green Revolution (GR) period, the productivity levels in pulses have not increased *vis-a-vis* cereals and oilseeds; rather they have stabilized at almost the levels that existed before the green revolution^{1,2}. Indeed there are no significant breakthroughs in the yield levels of pulses and this has been viewed as an embarrassing failure of the GR and of the scientists. Unfortunately such comparisons of pulses with other