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Tarapur Atomic Power Station-3&4 Dedicated to the Nation

"...It is truly an outstanding effort, achieved in the face of adverse circumstances and challenges of the last few decades*..."

I am truly honoured to be here today for the dedication of Units 3&4 of the Tarapur Atomic Power Station to the Nation. Tarapur is where India's quest for developing nuclear energy began in 1969. Tarapur is a shining example that India can do it; that we can overcome hurdles. Tarapur, therefore, holds special significance for our country's journey towards the building of a strong and self-reliant economy. It stands as a tribute to the visionary leadership of Pandit Jawaharlal Nehru and Dr. Homi Bhabha and to all those nuclear scientists and engineers who have helped to translate that magnificent vision into reality. Their hard work has today earned us a place among the leading nations of the world in the area of nuclear technology. On behalf of a grateful nation, I salute all the scientists and engineers for this great national effort.

Prime Minister, Dr. Manmohan Singh, unveiling the plaque to mark the dedication of Tarapur Atomic Power Station-3&4 to the Nation at Tarapur, Maharashtra on August 31, 2007

I would particularly like to compliment the Nuclear Power Corporation of India and all those in the Department of Atomic Energy, Indian industry, our R&D facilities and Universities who have made the development of TAPS-3&4 possible. It is truly an outstanding effort, achieved in the face of adverse circumstances and challenges of the last few decades. I congratulate each and every one of you. This is a moment of pride for all Indians.

** Address by the Prime Minister, August 31, 2007, Tarapur, Maharashtra*

Welcome Address by Dr. Anil Kakodkar, Chairman, AEC

All of us in the atomic energy family are extremely delighted to welcome our Prime Minister Dr. Manmohan Singh here at Tarapur today. Tarapur has the proud privilege of hosting country's first nuclear power station as also the latest and largest power unit designed and built indigenously based on our own domestic technology. The two 540 MWe Pressurised Heavy Water Reactor Units that would be dedicated to the nation by our Prime Minister, are state-of-the-art nuclear power plants that compare well with the latest international bench marks. The same design with suitable modifications would become the 700 MWe unit, that would be the next PHWRs to be constructed in our country.

PHWRs constitute the first stage of our three stage nuclear power programme and feed the fuel to fast reactors in the second stage where alongwith power generation, we also would produce more fuel, propelling growth without dependence on mining or import of uranium. Fast reactors would, thus, enable large scale deployment of thorium based power generation systems which undoubtedly remain the key element in our search for long term energy independence based on energy resources available within the country.

We will continue to pursue our robust three stage development programme with accelerated pace and with full confidence to achieve the essential long term objective at the earliest possible time. We are, however, conscious of the pressing energy need today and we are fully prepared to bring in

Prime Minister visiting the Tarapur Atomic Power Station, in Tarapur, Maharashtra

The development of our indigenous capability in the area of nuclear power generation demonstrates that where there is a will there is a way.

Starting from humble beginnings in the 1960s, the country today has seventeen power reactors, largely Pressurized Heavy Water Reactor plants. Those that we have developed are state-of-the-art facilities. As we move forward on development of fast breeder reactors and thorium reactors, I have no doubt that we would in the future exercise global leadership in these technologies.

There can be no greater tribute to our capabilities than the fact that Units-3&4 of TAPS have been commissioned ahead of schedule and well within the sanctioned cost.

Why do we place so much importance on nuclear energy? I have no doubt whatsoever that the sustainability of our long-term economic growth is critically dependent on our ability to meet our energy requirements of the future. When a country of the size of India begins to grow at the rate of 9% per annum, with the prospect of even higher rates of growth, energy becomes a critical issue.

A lot has been written and said on what our energy requirements will be. A few simple truths stare us in the face. First, our proven resources of coal, oil, gas and hydropower are totally insufficient to meet our requirements. Second, we do not enjoy the luxury of an either or choice. India needs energy from all known and likely sources of energy. Third, the energy we generate has to be affordable, not only in terms of its financial cost, but in terms of the cost to our environment.

Nuclear power is recognised as an important and environmentally benign constituent of the overall energy mix. There is today talk the world over of a nuclear renaissance and we cannot afford to miss the bus or lag behind these global developments.

We are fortunate to have vast thorium resources, which we must harness. India's three-stage nuclear power programme thus forms the bedrock of our long-term strategy. This unique thorium-based technology will become an economically viable alternative over a period of time.

At the same time, our uranium resource base is limited. We have, therefore, consciously opted for a closed fuel cycle approach ever since the beginning of our nuclear power programme. We need to expeditiously develop fast reactor technologies and intensify efforts to locate additional uranium resources in the country. Government will extend its full support in this regard.

Even as we pursue our three-stage programme, it is necessary to look at augmenting our capabilities. We need to supplement our uranium supplies from elsewhere even as the DAE has taken a number of laudable steps to maximize output within the limited resources. We must take decisive steps to remove the additionalities through international civil nuclear cooperation. The possible unshackling of the technology embargo regime that has operated around us for decades without success, is a welcome opportunity which we should be able to exploit without any adverse impact on our autonomous domestic research and development and implementation of our three stage nuclear programme.

I would like to use this opportunity to thank our Prime Minister for his leadership role in efforts to secure for India a rightful place in Committee of Nations and I, on behalf of my colleagues, assure him that we would spare no efforts as always, to support these efforts by way of national technological capability and bring benefits to the nation through technology, energy and national security. In so doing, we will further consolidate ourselves as a responsible country with advanced nuclear technology.

Let me also use this opportunity to welcome H.E. Shri S.M.Krishna, Governor, Maharashtra, Shri Vilasrao Deshmukh, Chief Minister, Maharashtra, Shri Prithviraj Chavan, Minister of State in PMO, Shri M.K.Narayanan, National Security Adviser and all other dignitaries, colleagues and friends present here.

Finally, I would like to once again congratulate all my colleagues involved in Tarapur 3&4 projects on this important occasion when result of their outstanding and unique efforts is being dedicated to the service of the nation by the august hands of our Prime Minister.

Prime Minister receiving the memento from Dr. Anil Kakodkar, on the occasion of the dedication of the two reactors to the Nation.

uncertainties that result from shortfall in fuel supplies to avoid disruptions in our nuclear power production programme.

We need to pave the way for India to benefit from nuclear commerce without restrictions. We need to enable our industries to gain access to cutting edge technology, and we need to create opportunities for our scientists to participate in the international exchange of scientific ideas and technical know-how. We have set a modest target of 20,000 MW of nuclear power generation by the year 2020. This can be doubled with the opening up of international cooperation. This cooperation will not be dependent on any one country and we will source supplies from many of the countries in the Nuclear Suppliers Group including the United States, Russia, France and Japan. However, our international cooperation with these and other countries cannot become effective until the Nuclear Suppliers Group adapts its guidelines to enable nuclear commerce with India. The NSG itself has made it clear that they will not do so till the India specific Safeguards Agreement with the IAEA is finalized.

Once these and other steps are taken, India can commence civil nuclear cooperation with all the 45 members of the Nuclear Suppliers Group. This will signal the end of our international isolation of the past few decades. India is now too important a country to remain outside the international mainstream in this critical area.

I have full confidence in our scientists and engineers and believe that the removal of iniquitous restrictions and shackles on our programme will enhance our indigenous capabilities. We will do nothing to hurt our capacity to solve our problems ourselves. The pursuit of self-reliance will continue to be the key principle of our policy. A strong nuclear energy programme is in our vital interest and is important for our scientific development, energy needs and national security. It will add to our capabilities and strength as a united nation.

With your dedication and track record of accomplishments, I am confident that our domestic technological capability will only grow in strength. Our country is fortunate to have a person of the eminence and distinction of Dr. Anil Kakodkar to guide the development of the country's nuclear programme.

Finally, I must also compliment all of you for the impeccable safety record of our nuclear industry. With these words, I dedicate Units 3 and 4 of the Tarapur Atomic Power Station, India's first 540 MWe nuclear power plant, to the service of the Nation.

Graduation Function of 50th Batch of BARC Training School

Welcome address by
Dr. Anil Kakodkar,
Chairman AEC

I have the proud privilege to welcome you once again, this time to Bhabha Atomic Research Centre, for the Graduation Function of 50th batch of its training school. BARC Training School is no doubt the most important factor in determining the success of our atomic energy programme. Our very capable and large human resource pool owes its existence to BARC Training School, a brain child of Dr.Bhabha. BARC Training School when it began, was a very innovative idea.The 'hire & train' model with faculty drawn from among the practicing scientists and engineers has not only led to learning with greater insights but also to inculcation of confidence among young scientists and engineers to do new things. This has led to our R&D centres being technology power houses from where the technologies for PHWR, FBR, front and back end fuel cycle, heavy water, electronics and instrumentation and thorium utilization have emerged besides a large number of radiation and isotope technologies and several spin offs. That the industrial and commercial operations of DAE are performing in a robust manner and returning dividend to the tune of 400-500 crores every year is a good indicator of the sound and credible work of scientists and engineers trained at BARC Training School.

Pursuing advanced basic research and large technology projects together has been a hallmark of DAE R&D. We have nurtured this unique feature through a holistic value system

"...No words are enough to express our gratitude to the hard work put in by the faculty of the BARC Training School over these fifty years..."

(Address by the Prime Minister, August 31, 2007)

It gives me great pleasure to be here in the midst of some of our brightest scientists and engineers. For any young man or woman, a graduation ceremony is always a defining moment in his or her life. It becomes particularly poignant when you belong to the 50th graduating class.

No words are enough to express our gratitude to the hard work put in by the faculty of the BARC Training School over these fifty years. They have single-handedly contributed to the training of over 7,500 graduates during this period. It is these scientists and engineers who have laid the building blocks of self-reliance in the field of nuclear science and technology and of India's emergence as a knowledge economy. Today, we have honoured some of them.

The Training School has evolved into a model institute, which is recognised internationally as a school of excellence. It is because of your collective efforts that India is ranked among the top few countries to have mastered the entire Nuclear Fuel Cycle. I am specially glad that the Homi Bhabha National Institute has successfully started its academic programmes.

The creation, and successful operation of a wide variety of institutes of high quality fully conforms to our government's belief that education and human resource development is the best investment we can make for the future of our country.

I have approved the setting up of five new Indian Institutes of Science Education and Research, eight new Indian Institutes of Technology, seven new Indian Institutes of Management, and twenty new Indian Institutes of Information Technology.

On August 15, I said from the ramparts of the Red Fort that our nation is today ready for a New Revolution in Education. We seek a quantum leap in the

The Prime Minister addressing the 50th batch graduating from BARC, in Mumbai on August 31, 2007 with appropriate yardstick of excellence to cover all shades of activities. BARC Training School programme has played a very important role in nurturing such a value system through mutual understanding and respect among people from different disciplines who can work together as a team and solve problems. This is our unique heritage which we would preserve and strengthen further.

BARC is a strategic R&D organization and its research and development has given strategic strength to our country. This is an area where self-reliance is of paramount importance. We must preserve and enhance this capability undistracted by the lure of readily available external inputs which may bring constraints along with them. Safeguarding our domestic capability and programmes has to be the touch stone in dealing with international cooperation in nuclear area. BARC Training school trained scientists and engineers have a special responsibility in this regard.

The 50th Graduation Function is also an occasion to recognize the top rankers in previous batches of BARC Training School. I am grateful for their contributions and their presence here. I welcome them all.

To young graduates passing out today, I would like to say that you can expect a more exciting career on account of several scientific and technological challenges ahead of us. I welcome you to the DAE family and look forward to your contributions.

Prime Minister has been very supportive of our activities and has expressed constant support and encouragement to DAE scientific community. I wish to use this occasion to express our gratitude to him and our resolve to do even better fulfilling all

Prime Minister, presenting a medal to one of the students of the BARC Training School

availability of educational opportunities for our children and our youth at all levels of the pyramid of knowledge and training. We have effected a major increase in elementary and secondary education. We are now increasing the capacity of our higher education and research system. It is not just a quantitative leap forward that I seek in education, but also a qualitative leap forward.

I have earlier expressed concern at the declining enrolment in basic sciences in our colleges and universities. We are working to revitalize existing scientific institutions and creating modern new institutes of excellence. But at the end of the day the intellectual imagination of our youth will be fired by great names and great achievements. We need new role models in our scientific community. Our scientific community must create a culture of excellence that will attract the best talent. We should nurture, celebrate and reward merit and achievement.

One of the unique features of the BARC Training School, and indeed one of its great strengths, is that it has a faculty of professionals. This synergy between in-house research and development and its applications has contributed to our technological capacity to, for example, build and operate indigenously designed nuclear power plants.

The Government stands fully committed to strengthening the autonomy of our nuclear R&D programme. Our unique three-stage programme, which is predicated on the need to utilize our vast thorium deposits, is a logical response to the needs of our economy. We should expedite progress in the setting up of fast breeder reactors, after having successfully implemented the Pressurized Heavy Water Reactor programme.

I am told that the design of an Advanced Heavy Water Reactor is ready, and that BARC is also working on several-advanced reactor designs, including the development of a high temperature reactor, which would enable generation of hydrogen from nuclear energy.

New vistas for our scientists are opening up. India has received observer status in the European Centre for Nuclear Research in Geneva. India has also joined the International Thermonuclear Research Reactor or ITER project as a full and equal member along with a handful of technologically advanced countries.

I would urge you not to overlook the many other useful applications of

Some of the recipients of Homi Bhabha Medals in various subject streams of the 50th Batch, Training School, BARC.

nuclear technology. Our nation needs this technology in the areas of agriculture, food preservation, health care and industry. BARC has done outstanding work in these areas in collaboration with various universities and organisations. I look forward to greater contribution from you in these areas.

To our young graduates gathered here, indeed for all our youth across the country, I wish to make one appeal. Be bold, be brave, be innovative, be curious and be open to new ideas, new ways of thinking and new ways of doing things. This is the scientific method.

You are stepping into an India of exciting opportunities and limitless possibilities. In facing this brave new world, show the courage of your convictions, demonstrate your self-confidence, and be not afraid to strike out on new paths. For that is how knowledge has been acquired and assimilated.

There is a nuclear renaissance taking place the world over and exciting opportunities await you. Your skills, knowledge and creativity will be at a high premium as the industry revives.

This great national institution was built by men like Homi Bhabha, Homi Sethna, Raja Ramanna and many others who had the self-confidence to be bold in their thinking and brave in their action. They reached out to the world to learn from it. I believe they were inspired by the words of the Father of our Nation, Mahatma Gandhi, who said, and I quote:

"I do not want my house to be walled in on sides and my windows to be stuffed. I want the cultures of all the lands to be blown about my house as freely as possible. But I refuse to be blown off my feet by any."

Such is the self-confidence we Indians must have in ourselves. The world today has growing regard for the skills and the intellect of our people. We see so many global research organizations coming to India to make use of the talent of our young minds. When the world is willing to invest in India, in our future, we must also learn to invest in the world, and benefit from this two-way flow of ideas, of goods and services, of people and possibilities.

I feel heartened by the fact that more and more of our talented young people today wish to live in India, study in India and work in India. Even those who go abroad to study, are increasingly returning home to work. I want to also encourage a "reverse brain drain" so that Indians worldwide return home and contribute to our development.

Before I conclude, allow me to remind you of how JRD Tata once described Homi Jehangir Bhabha. He said, and I quote "Scientist, engineer, master-builder and administrator, steeped in humanities, in art and music, Homi was a truly complete man." I want each one of you to develop such a holistic personality, combining a scientific temper with a modern outlook.

"...Global nuclear energy renaissance which has become a necessity and appears to be well on cards, however, rests today on a very fragile foundation. We need to build robust inclusive partnerships on an objective, reliable and predictable basis with a holistic mutual understanding and trust. The need to adopt fuel recycle to maximize energy availability makes it even more necessary. We are all justifiably concerned about the risks related to safety, environment and proliferation arising out of irresponsible behaviour of state and non-state actors. However, we need to be even more concerned about the vastly enhanced security risk to which future generations would be exposed as a result of direct disposal of spent fuel leading to plutonium mines when a large part of radioactivity decays. There are, thus, risks and challenges. But they are within the professional competence of nuclear energy community..."

Mr. President,

Let me first of all congratulate you on behalf of my Government and on my own behalf, on your election as President of the 51st General Conference. I am sure, under your able Presidentship and with the support of your team and the Secretariat of the Agency; this General Conference will be able to accomplish the tasks before it.

I also take this opportunity to welcome the entry of Kingdom of Bahrain,Republic of Burundi, Nepal, Republic of Congo and Republic of Cape Verde to the membership of the International Atomic Energy Agency (IAEA).

Over the past half century, the growth of the Agency and India's nuclear energy programmes have evolved side by side. The Agency has contributed immensely to harness the benefits of nuclear energy and its applications for all mankind. India, home to a sixth of global population with a sound and time-tested philosophy of life, too has evolved its own nuclear technological capability, realised on the basis of self-reliant domestic development for the welfare of its people. Our Bhabha Atomic Research Centre Training School which has provided almost

the entire human resource for our nuclear programme has also completed fifty glorious years and our Prime Minister was with us only a fortnight ago for the graduation function of its 50th batch.

On the occasion of its 50th anniversary, it is gratifying to recognise the unique place that the IAEA has within the UN system. The prestige, credibility and authority of IAEA in this new century rests to a very good measure, on the consistent good work done by its Secretariat under the wise leadership of Dr El Baradei especially for the past critical decade. My delegation would like to pay handsome tributes to the Director General and the dedicated staff of IAEA for their professionalism, impartiality and core competence in serving the Member States in accordance with the Statute of the Agency. IAEA's achievements in the past half century have much to contribute to rekindled hopes for a peaceful atom in coming years.

Mr. President,

The world today is at the threshold of a paradigm shift. There is greater awareness today than ever before about the serious consequences to humanity as a whole arising out of the threat to global climate which seems to be at the cliff edge. This situation has come about as a result of unmindful and unsustainable use of fossil energy by a small fraction of world population in industrially advanced societies. On the other hand, a larger part of world population is now on a rapid economic development path. It would require enormous amounts of energy resources to bridge the deficit between the emerging demand and current supply which is very low in the developing world even compared to global average per capita energy consumption. It seems impossible to sustain a tension-free society with 20 or 30 times less per capita energy access in the current interdependent world so closely connected through modern-day communications. It is estimated that meeting development aspirations of these large populations which are now well capable of buying their necessities would raise serious energy sustainability issues and consequent escalation of fuel prices that would affect us all. One needs to look at nuclear energy in this context. Energy associated with processes involving the nucleus of an atom is several million-fold higher than the energy associated with processes that involve electrons that orbit around the nucleus. The latter forms the basis

Statement by
Dr. Anil Kakodkar, Chairman, Atomic Energy Commission and Leader of the Indian Delegation, 51st General Conference, IAEA, Vienna, September 19th 2007.

of energy through burning of fossil fuels. Thus, a kilogram of uranium can be a source of a million times more energy as compared to a kilogram of coal or a kilogram of hydrocarbons. Non-emission of greenhouse gases that have threatened the global climate is also a feature of nuclear energy that is catching the imagination of even some of those who earlier opposed it. As a matter of fact, nuclear energy released through fission or fusion of atomic nuclei and solar energy that we receive from the sun are the only two viable basic energy sources capable of meeting our long-term energy needs. We also cannot escape the fact that the sun derives its energy from nuclear fusion. There is, however, a serious fear of the unknown. Such concerns are natural and have been faced by humankind whenever there has been a paradigm shift in things around it. Whether it is in learning to live with fire or advancing from horse carriages to locomotives and automobiles, man has gone through similar dilemmas. But eventually, he has mastered the new technology and accessed its benefits, overcoming the fear of the unknown. In the absence of such foresight and conviction, we could not have made progress. In the case of nuclear energy we are, however, talking on an altogether different scale.Given the population pressure and the need to provide a good quality of life to all, we must evolve ourselves as a society that can benefit from this high-intensity energy source without the risk of its misuse.

Mr. President ,

India with its one billion plus aspiring population and one trillion dollar economy with steady 8% plus GNP growth requires enormous amounts of sustained and reliable energy supply. It is estimated that India would need around 7000 TWh of electricity annually and an additional and larger quantum of primary energy to meet requirements of fossil fluid fuel replacement. While accessing this huge energy supply is a major challenge, we are also fully conscious of the environmental impact of such growth in energy use particularly if it takes place in the business-as-usual mode. In this context, I would like to draw your attention to what our Prime Minister said at the recent Heiligendamm meeting and I quote, India 's GHG emissions are among the lowest in per-capita terms.

Moreover, being only around 4% of the world's emissions, action by us will have a marginal effect on overall emissions. Nonetheless, we recognize wholeheartedly our responsibilities as a developing country. We wish to engage constructively and productively with the international community and to add our weight to global efforts to preserve and protect the environment. We are determined that India 's per-capita GHG emissions are not going to exceed those of developed countries even while pursuing policies of development and economic growth. We must work together to find pragmatic, practical solutions, which are for the benefit of entire human kind. unquote

Mr. President ,

India has been pursuing its robust three stage nuclear programme designed to maximize the energy potential from its domestic uranium and thorium resources and contribute around 25% share of electricity generation in the country by the year 2050. The objective is to realize the huge energy potential that is realizable from these nuclear energy resources without having to add to the global carbondioxide burden. The programme is moving ahead steadily with the first stage consisting of indigenously developed Pressurised Heavy Water Reactors (PHWRs) well into a commercially successful programme. The second stage has commenced with the construction of 500 MWe Prototype Fast Breeder Reactor (PFBR) which is now fairly advanced. The third stage is about to begin with the start of construction of a technology demonstrator, the 300 MWe Advanced Heavy Water Reactor (AHWR). The three stages are being implemented sequentially to reach the goal of large scale thorium utilization and are linked through their respective fuel cycles which are also well underway.

Kaiga-3 (a 220 MWe PHWR) which achieved its first criticality on February 26, 2007 within 5 years from the first pour of concrete, was synchronized to the grid on April 11, 2007 and started commercial operations on May 6, 2007. With completion of Kaiga-3, there are now 17 nuclear power reactors in operation, the total installed capacity being 4120 MWe. The Indian nuclear power sector has achieved over 270 reactor years of safe, accident free operations. Major Ageing Management activities including Enmasse Coolant Channel Replacement (EMCCR) were completed in NAPS-1 and the reactor is expected to come back on-line shortly. With this, four PHWRs (RAPS-2, MAPS-1&2, NAPS-1) now have their coolant channels replaced.

The first cycle of Peer-reviews of all the operating stations by WANO has been completed. RAPP-5 unit has also undergone a Pre-Startup Peer Review by an expert team of WANO. This was the second review of its kind in India; after TAPP-3 which was reviewed last year. The next Biennial General Meeting (BGM) of WANO will be hosted by India , in 2010 at New Delhi .

Construction activities are underway in full swing at six other reactors three PHWRs, two LWRs and a 500 MWe PFBR. Of these, two reactors (RAPP-5 and Kaiga-4) would see start of fuel loading during the year. On completion of the reactors currently under construction, there will be 23 reactors in operation with installed capacity of 7280 MWe. The detailed design and engineering of the indigenous 700 MWe PHWR is progressing according to the set time schedule. The Government has given in-principle approval for setting-up of

4x700 MWe PHWRs at two sites and 4x1000 MWe LWRs at another two sites in the country. Establishment of a new Uranium mine and mill at Tummelepalle has also been approved by the Government.

For accelerating the growth of the fast reactors in the country, development of metallic fuel, which would offer high breeding capabilities is being carried out on priority with the aim of its deployment around the year 2020. The next four fast reactors after the PFBR, which are proposed to be commissioned by 2020 will however, continue to use oxide fuel. These future reactors will incorporate refinements in the design and construction, to achieve reduction in capital as well as operational costs, on the basis of experience with the PFBR. The objective is to bring down the unit energy cost substantially as compared to PFBR. Enhancement of the burn-up of the fuel from the present target of 100 GWd/t to 200 GWd/t is recognized as an important step for reduction in the fuel cycle cost. Towards achieving this target, the development of advanced cladding and structural materials including the oxide dispersion strengthened alloy have been initiated. The expertise generated and the experience gained in this development process will be further harnessed for developing structural materials for the Test Blanket Module being developed by the Institute of Plasma Research as part of the fusion energy programme.

Towards closing the fuel cycle of PFBR, a fast reactor fuel cycle facility (FRFCF) has been planned with its construction to commence next year. The facility is expected to be operational, in time to process the irradiated fuel discharged from the PFBR. The production of the mixed oxide fuel for PFBR has already commenced.

I had mentioned in my last year's address in this Conference about excellent performance of our indigenously designed mixed carbide fuel for FBTR and about our successful reprocessing of the high burn-up carbide fuel from FBTR after a short cooling period. I am happy to inform that fissile material recovered from reprocessing has now been fabricated into mixed carbide fuel. This fuel will be loaded into FBTR during the next reload schedule. Closing the mixed carbide fuel cycle has been an important milestone for us in our fuel cycle activities related to fast reactor program. I may also add here that we are now operating FBTR with an expanded hybrid core consisting of mixed carbide and mixed oxide fuel. The high Pu MOX now forms about 20% of the FBTR core.

Mr. President,

We are looking forward to the possibility of opening up of international civil nuclear cooperation. We expect such cooperation to be sustainable, free from interruptions and consistent with our national policy of closed fuel cycle. With a view to significantly augment nuclear power generation capacity in the near-term through imports, as an additionality to the ongoing indigenous programme, a Site Selection Committee has evaluated coastal sites in the country for the reactors to be set up in a convoy mode.

The initiatives also open up the possibility of export of reactors and services. India today is the only country to have a live technology, design and infrastructure for small PHWRs with a unit capacity of 220 MWe, which have a great potential for export, particularly to countries with small grids wishing to enter nuclear power generation, with relatively modest investments and infrastructure. Given the large manufacturing base and relatively low manufacturing costs, there is also a potential for India becoming a manufacturing hub for equipment and components for the global nuclear industry.

We have been actively pursuing the design and development of Advanced Heavy Water Reactor which will mainly use thorium based fuel and has several advanced safety features. In fact, this reactor would meet the objectives of a futuristic system that would have to meet higher safety, economics, sustainability, long term radioactive waste minimisation and proliferation resistance goals. Pre-licensing safety appraisal of this first-of-a-kind design was completed by the Indian Atomic Energy Regulatory Board.

A large Critical Facility for validating reactor physics design of the unique core of the AHWR is under commissioning at BARC. We expect this facility to provide important data that would further improve our understanding of the thorium based reactors.

In the Compact High Temperature Reactor (CHTR) being designed in India , it will be possible to extend the core life up to a period of fifteen years. A liquid metal natural circulation loop employing Lead Bismuth Eutectic alloy as the coolant has been installed to study the CHTR behaviour. Parallely, designs of 600 MWt High Temperature Reactor (HTR) for hydrogen production and 5 MWt Multi-purpose Nuclear Power Pack (MNPP) are also currently underway.

India has been exploiting research reactors for basic research, neuron radiography, shielding experiments, testing of reactor components including neutron detectors, trace element analysis, etc. We are currently planning to construct a 30 MWt Multi Purpose Research Reactor (MPRR) capable of providing a maximum thermal neutron flux of 6.7×10^{14} n/cm^2/sec and fast neutron flux of 1.7×10^{14} n/cm^2/sec. The new reactor will meet the increasing requirements of high specific activity radio-isotopes and would also provide enhanced facilities for basic research in frontier areas of science and for applied research related to development and testing of nuclear fuel and reactor materials. Further, the reactor will have features to enable its conversion to an Accelerator Driven System at a later date.

The superconducting heavy ion LINAC project has reached a major milestone in July, 2007 with all seven accelerator modules energized to accelerate 28Si beam to an energy of 209 MeV, highest achieved so far in the country.

We have indigenously developed another supercomputer named ANUPAM-AJEYA which has attained a sustained speed of 3.70 Teraflops, twice that of the speed of its earlier version ANUPAM-AMEYA system. The new system comprises 256 dual-core, dual CPU computing nodes, each processor running at 2.66 GHZ with 4 GByte of main memory. The system will be upgraded shortly to achieve speed exceeding 4 Teraflops.

Our contributions in the area of nuclear agriculture, biology and health have always been significant. As of now, 29 crop varieties have been gazette notified by the Ministry of Agriculture, Government of India for commercial cultivation in the country. For processing of biodegradable waste, 14 indigenously developed Nisargruna biogas plants have been set up in the country so far. On April 26, 2007, KRUSHAK Irradiator at Lasalgaon, Maharashtra became the first Cobalt-60 gamma irradiation facility to be certified by the United States Department of Agriculture-Animal & Plant Health Inspection Service (USDA-APHIS) for phytosanitary treatment of mangoes. Consequently, this year, the facility enabled export of 157 tons of mangoes, mainly of Alphonso and Kesar varieties, to the United States of America , after a gap of 18 years.

As in the past, we have been closely interacting with the Agency as partners in development. India was one of the founder members and a strong supporter of INPRO. We have noted with great satisfaction the progress made in this important activity of the Agency. In particular, the recent step to initiate, under Phase-2 of INPRO, several collaborative projects under Joint Initiative mode has a great potential to facilitate cost effective development of solutions relevant for global deployment of next generation advanced nuclear energy systems. We once again stress the need to provide full budgetary support to the INPRO activities, recognizing its immense potential to lead to global enhancement in the availability of safe and economical nuclear energy to meet the future demands.

In the area of Nuclear Security & Physical protection, India along with IAEA has been organizing workshops/training courses for the Asia & Pacific region and serves as Regional Resource Centre. So far, we have conducted four Regional Training Courses on Physical Protection of Nuclear installations and also a Regional Training Course on the Physical Protection of Radioactive Sources. In addition, we have conducted Regional Training Courses on Advanced Detection Equipment and on Response to criminal or unauthorized acts involving nuclear or other radioactive material and also a Regulatory Authority Information System (RAIS) Training Course. We are about to deposit our instrument of ratification to the amendment to the CPPNM.

Mr. President,

Global nuclear energy renaissance which has become a necessity and appears to be well on cards, however, rests today on a very fragile foundation. We need to build robust inclusive partnerships on an objective, reliable and predictable basis with a holistic mutual understanding and trust. The need to adopt fuel recycle to maximize energy availability makes it even more necessary. We are all justifiably concerned about the risks related to safety, environment and proliferation arising out of irresponsible behaviour of state and non-state actors. However, we need to be even more concerned about the vastly enhanced security risk to which future generations would be exposed as a result of direct disposal of spent fuel leading to plutonium mines when a large part of radioactivity decays There are, thus, risks and challenges. But they are within the professional competence of nuclear energy community. A judicious combination of technology and institutional control with every responsible partner being a part of the solution, rather than being seen as a problem, can in fact provide the answer.

Thank you, Mr. President.

Glimpses of Graduation Ceremony:

A momento being presented to the Hon. PM by Dr. Anil Kakodkar, Chairman AEC

The Awards Function : On the dias - Dr. A. Kakodkar, Dr. S. Bannerjee, Dr. R.B. Grover, Dr. H.N. Sethna, Dr. M.R. Srinivasan and Dr. R.R. Puri

Dr. V.C. Sahni - 8th Batch Overall Topper reminiscing about his days at Training School

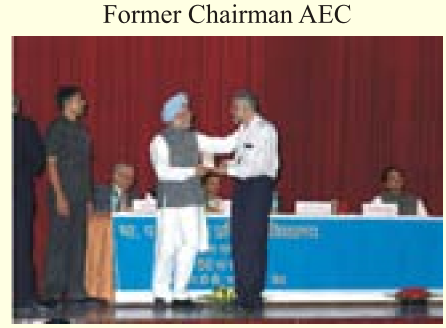
Dr. R.R. Puri, Head, HRDD, addressing the gathering

Mr. G. Rajasekaran - 1st Batch - Physics receiving Homi Bhabha Medal from PM

Mr. A. Gopalakrishnan - 2nd Batch - Electrical receiving Homi Bhabha Medal from Dr. H.N. Sethna, Former Chairman AEC

Dr. P.G. Kulkarni - 6th Batch - Mechanical - receiving Homi Bhabha Medal from H.N. Sethna, Former Chairman, AEC

Dr. A. Kakodkar, receiving Homi Bhabha Medal (7th Batch) from PM



Dr. V.C. Sahni receiving Homi Bhabha Medal (8th Batch) from PM

Ms. R. Martis, 9th Batch, Chemistry receiving Homi Bhabha Medal from Dr. H.N. Sethna, Former Chairman, AEC

Mr. Manjit Singh - 16th Batch - Electrical, receiving Homi Bhabha Medal from Dr. M.R. Srinivasan, former Chaiman, AEC

August 31, 2007

Mr. K.K. Vaze, 17th Batch (Mechanical Engineering) receiving Homi Bhabha Medal from Dr. M.R. Srinivasan, former Chairman, AEC

Mrs. S.V. Shrikhande - 27th Batch - Electrical, receiving Homi Bhabha Medal from Dr. P.K. Iyengar, former Chaiman, AEC

Mr. Neeraj Agrawal- 28th Batch - Instrumentation receiving Homi Bhabha Medal from Dr. P.K. Iyengar, former Chairman, AEC

Ms. Sherry Rosily - 50th Batch Trainee (Electronics) - receiving Certificate from Dr. S. Bannerjee, Director, BARC

Mr. Lalit Dagre - 50th Batch Trainee (Computer Science) - receiving Certificate from Dr. S. Bannerjee, Director, BARC

Ms. Priya Maheshwari - 50th Batch Trainee (Physics) - receiving Certicate from Dr. S. Bannerjee, Director, BARC

Dr. Shreyans Kumar Jain, Chairman and Managing Director, Nuclear Power Corporation of India Limited and BHAVINI has been elected the President of the WOrld Association of Nuclear Operators (WANO) during its 10th Bieennial General Meeting held at Chicago, USA during September 23 - 25 2007. Dr. Jain will hold the post of President, WANO till January 2010.

This honour is a recognition of NPCIL's constant efforts to improve the performance of its power plants and also its emergence as a utility with substantial growth plans.

India also achieved yet another world class distinction with Shri G. Nageswara Rao, Director (Operations), NPCIL being awarded the"WANO Nuclear Excellence Awards, 2007" for his significant contribution in enhancing nuclear safety and for facilitating improvements in Performance Indicators of the Nuclear Power Plants in India.

Impact of New Trombay Groundnut Varieties

G.S.S. Murty, A.M. Badigannavar and D.M. Kale
Nuclear Agriculture & Biotechnology Division, BARC

Groundnut is an important edible oilseed, food and feed crop grown in almost all the states in India. Genetic improvement of groundnut through sustained research efforts by using mutation and recombination breeding at the Bhabha Atomic Research Centre, resulted in the development of several new mutants having unique traits and breeding lines with desirable attributes. Among them, 12 Trombay groundnut (TG) varieties were released for commercial cultivation in different states across the country. Two of them, TG 37A and TPG 41 were released during the year 2004 and gazette notified by the Ministry of Agriculture, Government of India for different states (Table 1). The salient features of TG 37A and TPG 41 varieties, farmers' perception and response to these new varieties from different states across the country are described here.

Fig. 1: TG 37A

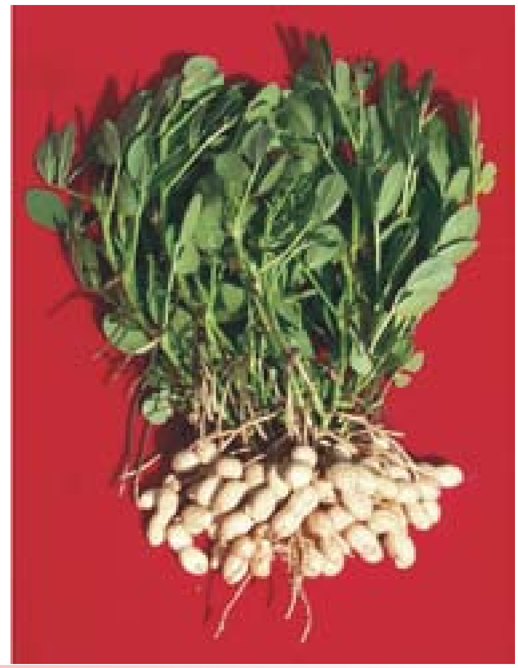


Fig. 2: TPG 41

New Trombay Groundnut Varieties

TPG 41 was released for Rabi/summer situation, while TG 37A was released for Haryana, North Rajasthan, Punjab, Uttar Pradesh for Kharif season. During 2006, based on the superior performance in the All India Coordinated Groundnut Varietal Trials organized by the Indian Council of Agricultural Research, the area of cultivation of TG 37A was further extended to Orissa, West Bengal, Bihar and North Eastern states in Rabi/Summer situation and in Southern Rajasthan and Gujarat for Kharif season. This variety has thus not only showed superior agronomic traits but also showed wider adaptability in majority of the groundnut growing states.

TG 37A is a high yielding Spanish bunch variety derived from the cross between TG 25 and TG 26 (Fig. 1). It has an erect growth habit with sequential flowering, semi-dwarf height, medium-size leaflets, compact pod setting and smooth pod surface. Seeds are with spherical shape and rose colour, containing 48% oil, 23% protein, 19.3% carbohydrate, 4.5% sucrose and 2.8% crude fibre. Its oil contains 40.7% oleic, 39.8% linoleic and 12.3% palmitic acid. TG 37A has field tolerance to collar rot and peanut bud necrosis diseases and moisture stress.

TPG 41 is a confectionery, large seed groundnut variety derived from a cross between TG 28A and TG 22 (Fig. 2). TPG 41 is erect with semi-dwarf plant height and sequential flowering (Spanish bunch). Seed contains 48.6% oil, 25% protein, 20.3% carbohydrate and 3.9% sucrose. Its oil contains 62.4% oleic and 19.3% linoleic acid. TPG 41 has a fresh dormancy of 25 days, an

Table 1: Trombay groundnut varieties released for different states along with average seed yields in respective seasons

States	Season	Average seed yield (kg/ha)	Superiority over best check variety (%)
TG 37A			
Haryana, N-Rajasthan, Punjab, Uttar Pradesh	Rainy (*Kharif*)	1246	40
Gujarat, S-Rajasthan	Rainy (*Kharif*)	2173	22
Bihar, Orissa, West Bengal, North-Eastern states	*Rabi*/Summer	2231	20
TPG 41			
All India	*Rabi*/Summer	2313	19

important trait, which prevents in situ seed germination due to end-season rains when crop is ready for harvest.

It is mandatory on the part of the institute, which develops a new variety to produce sufficient genetically pure seed, namely, breeder seed and supply the same for further multiplication and to distribute to the farming community. Besides, breeder seed will have maximum physical purity, high germination and shelling percentage as per the seed certification standards. Although BARC has been multiplying breeder seed on its own at Gauribidanur, there remained a gap between demand and supply of TG breeder seed. Policy decision taken to produce breeder seed through contract farming gave an impetus for the seed production. As a first step to transfer the benefits of these new varieties to the farmers, large-scale breeder seed production was undertaken. Between 2004 and 2007, 100 tonnes of breeder seed of TG 37A and TPG 41 was produced and supplied to the State Agricultural Universities in Rajasthan, Gujarat, Madhya Pradesh, Maharashtra and Karnataka and NGOs to conduct frontline demonstrations/adaptive trial and National and State Seed Corporations for further seed multiplication. Feedback received from some of the agencies on the performance of new varieties is reported here.

Yield potentials of new Trombay groundnut varieties are as follows:

Rajasthan:

Maharana Pratap University of Agriculture and Technology, Udaipur had conducted 51 frontline demonstrations of TG 37A in 27 villages and 15 with TPG 41 in eight villages along with local varieties during 2005 rainy season. The villages were spread across Chittorgarh, Tonk, Udaipur, Bhilwara and Rajsamond districts. In the 51 demonstrations, TG 37A registered an average pod yield of 2,111 kg/ha with 48% increase over local variety (Fig. 3). Similarly, TPG 41 recorded an average pod yield of 2,447 kg/ha with 59% superiority (Fig. 4). By cultivating TG 37A and TPG 41 varieties, farmers grossed an average net profit of Rs. 10,707/ha and Rs. 13,819/ha, respectively.

Rajasthan Agricultural University, Bikaner had also conducted frontline demonstrations

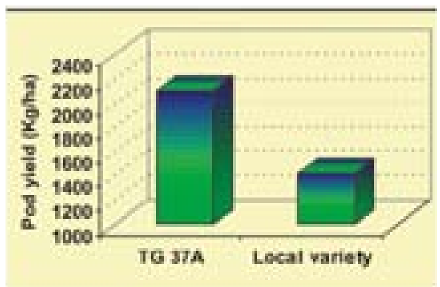


Fig. 3: Superiority of TG 37A in Rajasthan

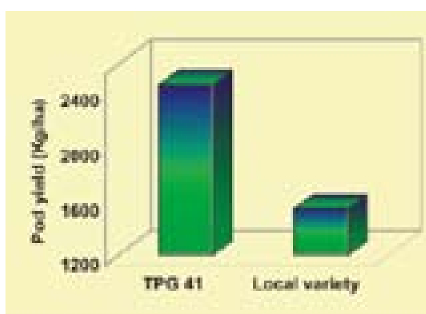


Fig. 4: Superiority of TPG 41 in Rajasthan

Fig. 5: Farmer from Rajasthan enthusiastically displaying superiority of TG 37A over local variety

using TG 37A on 23 farmers' fields at Bikaner, Jaisalmer, Jaipur, Sikar and Hanumangarh districts during 2005 rainy season. Farmers had harvested an average yield ranging from 1301 to 2359 kg/ha with gross average of 1,906 kg/ha. At Hanumangarh, two farmers recorded 20% more yield of TG 37A compared to their local variety. Further, the University had also undertaken breeder seed multiplication with a target of more than 200 quintals and several front line demonstrations in farmers' fields. during 2006 rainy season.

One farmer, Sh. Mohanlal from Aslampur, Bikaner district has all praise for TG 37A. Based on its yielding ability, he rated local varieties Rajdan and M 13, 40% and 60%, respectively, compared to 100% of TG 37A (Fig. 5). He observed 20-30 pods per plant as compared to 5-10 in local varieties, besides superior seed size and seed filling in TG 37A. Similar experience was of another farmer, Sh. Harikisan Jat of Aslampur. Sh. Sundaram Verma from Village Danta, Sikar District observed that irrigation frequency for TG 37A was less than the local varieties. All of them informed that there is a lot of demand for quality seed of TG 37A in their neighborhood.

Maharashtra:

Earlier Mahatma Phule Krishi Vidyapeeth, Digraj had conducted adaptive trials of TPG 41 on 26 farmers' fields in Pune, Nashik, Dhule, Jalgaon, Solapur, Raigadh, Yawatmal, Parbhani, Latur, Sangli, Kolhapur and Satara districts. TPG 41 yielded an average yield of 4,551 kg/ha with 49% increase over local variety (Fig. 6). Further, in the adaptive trials conducted with TG 37A on 15 farmers' fields in Sangli, Kolhapur and Satara Districts, farmers had harvested pod yields with an average of 3,622 kg/ha with 15% superiority (Fig. 7). Looking at the tremendous demand for seed, Mahatma Phule Krishi Vidyapeeth, Rahuri had undertaken an ambitious breeder seed multiplication programme of TPG 41 during 2006 in 8.5 ha area and expecting about 250 quintals seed produce.

Krishi Vigyan Kendra (KVK), Nandurbar initially conducted adaptive trials with TG 37A on fields of seven tribal farmers in Nandurbar District during summer 2005 wherein farmers had harvested an average pod yield of 2,500 kg/ha with 46% increase over local variety (Fig. 8). Further, during 2005 rainy season adaptive trials of TG 37A extended to 17 tribal farmers resulting an average productivity of 1,512 kg/ha with 71% superiority. During summer, 2006 an average productivity of 3,500 kg/ha with 48% superiority was reported on 19 farmers' fields. Farmers reported that TG 37A has high yielding potential. It has shorter plant height than the erstwhile local variety SB XI. TG 37A had more three seeded pods with tolerance to the attack of leaf roller and late leaf spot disease. Looking at the response from farmers, KVK had multiplied about 300 kg seed of TG 37A.

Sh. Ganapath Harimakar and Sh. Hyderkhan Pathan from Pusad, Yawatmal district harvested 5,000 kg/ha pods by cultivating TPG 41 with a net profit of Rs. 50,000/ha (Fig 9). Similarly, Sh. Sanjay Nade from Latur district obtained 5,000 kg/ha pod yield with TPG 41. A group of farmers from Gayatri Shetkari Mandal under the Krishi Vigyan Kendra, Baramati reported 3,500 to 4,000 kg/ha pod yields with TPG 41 since last two summer seasons.

A progressive farmer Sh. Jaykumar Gunde from Pattankodoli, Kolhapur district has been consistently getting 3,500 to 5,000 kg/ha from TG 37A during summer 2004 to 2007. Sh. Ajitkumar Nadagadalli from Nool village, Kolhapur district had harvested 7,000 kg/ha pods of TG 37A. Another progressive farmer Sh. Madhukar Ghuge from Kehal village, Parbhani district has been producing an average yield of 3,500 kg/ha in Rabi and 6,000 kg/ha in summer from both TG 37A and TPG 41. It is pertinent to mention here that farmers from far and near visit his fields when the crop is in field and make advance bookings for the seed of TPG 41 and TG 37A. By the end of the Rabi season of 2006, he had distributed more than 100 quintals seed of TG 37A and TPG 41.

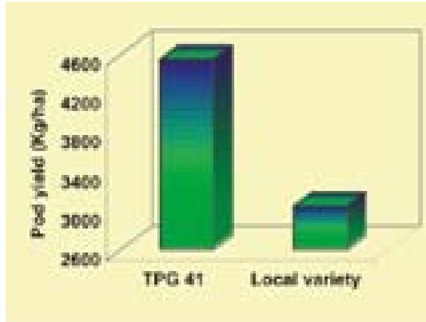


Fig. 6: Superiority of TPG 41 in Maharashtra

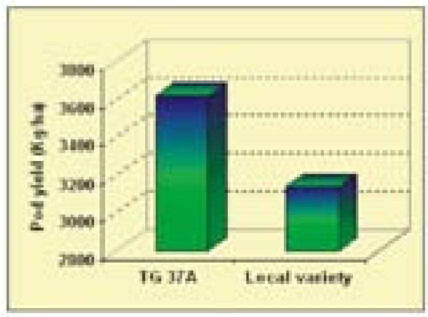


Fig. 7: Superiority of TG 37A in Maharashtra

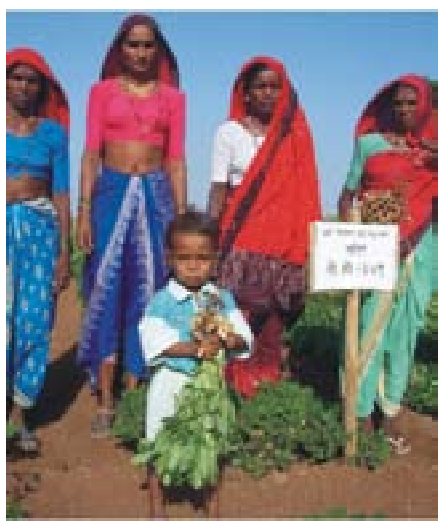


Fig. 8: Adaptive trial with TG 37A on fields of tribal farmers near Nandurbar

Fig. 9: Field of TPG 41 near Yawatmal, Maharashtra

Madhya Pradesh:

Under the Indira Gandhi Gareebi Hatao Yojana, Department of Rural Development, Chhatarpur, 54 quintals of TG 37A breeder seed was supplied to cover around 40 hectares area spread over three villages. More than 100 farmers cultivated TG 37A during 2005 rainy season and produced about 700 quintals seed with an average productivity of 1,680 kg/ha. Looking into the productivity levels and superiority of TG 37A over local varieties, the department had requested over 600 quintals of seed of TG 37A in 2006 rainy season.

TG 37A was also cultivated under the “Adivasi Sewashram Trust”, Jhabua, during 2005 rainy season, on around four hectares area with a total production of 45 quintals and productivity of 1,260 kg/ha, which was encouraging compared to what local varieties grown by the farmers. Further to encourage spread of TG varieties, 30 quintals of seeds were supplied during 2006.

Gujarat:

Both TG 37A and TPG 41 varieties were introduced in Bhuj, Junagadh and Rajkot Districts. From the initial field demonstrations, Sh. Bharatbhai Patel from Gondal, Rajkot District obtained around 3,500 kg/ha from TG 37A. During summer, 2006 very encouraging results were reported from the fields of Sh. Rathilal Bhimani from Bhachau, Bhuj District (Fig. 10). Looking into the results, he had sown 25 ha with TG 37A and TPG 41 and

Fig. 10: Farmer from Gujarat explaining the benefits of TG 37A to fellow farmers

harvested more than 700 quintal pods. Of which, he sold more than 500 quintals to seed companies and some quantity to Orissa University of Agriculture and Technology and also distributed seeds to more than 100 fellow farmers at Bhachau, Nakatrana and Mandvi Talukas. This summer season, he alone planted around 30 ha with TG 37A variety and harvested around 900 quintals which is already purchased by the seed companies and farmers. In Junagadh District, several farmers cultivated both the varieties and obtained promising yields compared to local varieties. Sh. Hajabhai Sindal from Dhadhusar, Junagadh District experimented by intercropping TPG 41 with Bt cotton hybrid, which adds bonus to his profits (Fig. 11). Already few seed companies in Junagadh and Ahmedabad started seed multiplication of these varieties in a big way to facilitate seed availability to the farmers.

Fig. 11: Intercropping of TPG 41 with Bt cotton hybrid near Junagadh

Andhra Pradesh:

Sh. L. Venkateswara Reddy from village Balisingayapalli, Cuddappa District collected 10 kg seed each of TG 37A and TPG 41 directly from BARC during the year 2004. He grew both the varieties season after season in summer and rainy seasons. During 2006 summer, he had cultivated TG 37A in 6 ha and TPG 41 in 4.4 ha and obtained an average pod yields of 4,500 and 7,200 kg/ha, respectively. He sold the entire produce to the fellow farmers who in turn reported him an average yield of around 3,000 kg/ha and in one case upo 5,000 kg/ha during 2006 rainy season. Sh. B.P. Reddy from Jangalapalle village harvested 3,960 4,400 kg/ha pods of TG 37A in 105 days and 4,400 5,280 kg pods of TPG 41 in 115 days compared to 1,760 2640 kg in local groundnut variety.

Karnataka:

University of Agricultural Sciences, Dharwad initiated breeder seed multiplication programme of TPG 41 in summer, 2005 in order to facilitate the seed availability and disseminate the new variety among farming community. With an aim to popularize the new varieties under the “Seed Village Concept”, 17 quintals of TPG 41 was produced under farmers' participation during 2004-05. Next year, by roping in their own seed farms and farmers at Dharwad, Nippani and Haveri, the University had multiplied 100 quintals of TPG 41. A planned seed production programme for TPG 41 is targeted during 2006-07 for about 150 quintals of breeder seed, 100 quintals of foundation seed and 600 quintals of certified seed. This was expected to help to meet the seed demand by different seed agencies, corporations and farmers by maintaining active seed chain for TPG 41. Shri H.S. Shendage harvested 55 quintals of TG 37A and 50 quintals/ha of TPG 41 in his first year cultivation of these varieties near Nippani.

Goa:

Cultivation of groundnut has gained a lot of scope in Goa, particularly in rice fallows after kharif season. In this situation, groundnut can make use of residual moisture for its growth. Among the groundnut varieties, large seed varieties are preferred as they are utilized for table and confectionery purposes and fetch premium prices. The large seed variety, TPG 41 was supplied to ICAR Research Complex, Goa for conducting frontline demonstrations on farmers' fields in 2004 and 2007. Farmers were impressed with the high yields and larger seed size of TPG 41.

Minikit trials

In order to popularize new TG varieties, Directorate of Oilseeds Development, Hyderabad has allocated 7,000 minikits (each with 20 kg) of TG 37A and 2,700 of TPG 41 among the farmers across the country for the rainy season 2007. For TG 37A, allocation of 2,000 minikits was to Karnataka, 1,500 each to Andhra Pradesh and Chhattisgarh, 1,000 each to Madhya Pradesh and Maharashtra. Similarly for TPG 41, allocation of 1,000 each was to Andhra Pradesh and Gujarat, 500 to Madhya Pradesh and 200 to Karnataka. For this purpose, National Seed Corporation Limited supplying 1,400 quintals of TG 37A and 500 quintals of TPG 41 and State Farms Corporation of India supplying 40 quintals of TPG 41.

Epilogue

The above account is an indication that farmers are ready to accept new varieties once they show higher yield potential in their own fields. As soon as it is proved that it is profitable to grow a new variety, adoption of a variety by the other farmers follow, crossing the boundaries of villages, districts and states as happened in the case of TG 37A and TPG 41. In view of the development and availability of high yielding Trombay groundnut varieties by BARC, coupled with a high demand from farming community, several private companies stepped into the seed business for multiplying, procuring and selling several tonnes of seed of TG varieties, which has helped in speedy dissemination of TG 37A and TPG 41 in several states. This is a welcoming trend to achieve the objective to increase the groundnut production and productivity in the country.

Dr A P J Abdul Kalam, at the DAE Pavilion

Dr. A P J Abdul Kalam, at the DAE Pavilion during the 58th International Astronautical Congress 2007 held at Hyderabad during September 24 -28, 2007. BARC and ECIL have developed the Indian Deep Space Antenna System (IDSN 32) that is required for providing TTC and science data reception support for ISRO's Moon Mission "Chandrayaan-I" and other future deep space missions.

Trombay Crop Varieties Released and Notified for Commercial Cultivation

Crop	Variety	Year of Release	M: Maturity (days) Y: Yield (kg/ha) YI: Yield increase (%)	Released for	Remarks
Groundnut	TLG-45	2007	M: 114 Y: 1506 YI: 28	Maharashtra	Large seed, Kharif season
	TG-38	2006	M: 115 Y: 2500 YI: 20	W.Bengal, Orissa Assam/N.E. States	High yield potential in residual moisture situation Rabi/Summer
	TG-37A	2004	M: 110 Y: Kharif 1993 YI: 26-38	Rajasthan, UP, Punjab, Haryana, Gujarat, W.Bengal, Orissa, Assam/N.E. States	Fresh seed dormancy Oil 51%
	TPG-41	2004	M: 120 Y: Summer 2407 YI: 26	All India	Large seed (70g/100 seeds) Fresh seed dormancy On farm trials 4551kg/ha 49% increase
	TG-26	1995	M: 110-120 Y: summer 2500 YI: 23-39	Gujarat Maharashtra, MP	Semi-dwarf, early maturity, high harvest index, high partitioning efficiency, fresh seed dormancy Second popular TG variety, high yielding ability (9000-10000kg/ha), wider adaptability
	TAG-24	1991	M: Kharif 100-105 Summer 112-117 Y: kharif 1300 Summer 2500 YI: Kharif 24 Summer 50	Maharashtra West Bengal Rajasthan Karnataka	Identified as national variety, Most popular in all groundnut growing states, High yield potential (9000-10000kg/ha), Semi dwarf habit, early maturity, high harvest index, high partitioning efficiency, wider adaptability
	TKG-19A	1994	M: 120-125 Y: 2000-2500 YI: 12-13	Maharashtra	Large seed, fresh seed dormancy
	TG-22	1992	M: Kharif 115-120	Bihar	Medium-large seed, fresh seed dormancy
			Y: Kharif 1677 YI: 30		
	Somnath (TGS-1)	1989	M: 110-125 Y: Kharif 2000 YI: 23	Gujarat	Large seed Spreading habit
	TG-3	1987	M: 110 Y: 2000-2500	Kerala	More branches
	TG-17	1985	M: 115-120 Y: 1700-2000 YI: 15-20	Maharashtra	Less branches
	TG-1	1973	M: 130-135 Y: 2400-2500 YI: 15-20	Maharashtra, Gujarat	Large seed
Soybean	TAMS 98-21	2007	M: 103 Y: 2318 YI: 20	Maharashtra	High yielding Resistant to bacterial pustules, myrothecium leaf spot and soybean mosaic virus diseases
	TAMS-38	2005	M: 90-95 Y: 1800-2000 YI: 20	Maharashtra	Early maturing, resistant to bacterial pustule, *Myrothecium* leaf spot

Trombay Crop Varieties Released and Notified for Commercial Cultivation

Mustard	TM-2	1987	M: 90 Y: 1370 YI: 25	Assam	Appressed pod
	TM-4	1987	M: 95 Y: 1470 YI: 35	Assam	Yellow seed
Greengram	TMB-37	2005	M: 64 Y: 1100 YI: 20	Eastern UP, Bihar, Jharkhand, Assam, West Bengal	Tolerant to yellow mosaic virus
	TARM-18	1995	M: 65 - 70 Y: 1051	Maharashtra	Resistant to powdery mildew
	TARM-1	1995	M: 80 Y: 765 YI: 45	Maharashtra, Gujarat, MP, AP, Kerala Karnataka, Tamil Nadu, Orissa	Resistant to powdery mildew
	TARM-2	1992	M: Rabi: 90 Y: 1000-1100 YI: 80	Maharashtra	Resistant to powdery mildew
	TAP-7	1983	M: 60 Y: 700-800 YI: 23	Maharashtra, Karnataka	Tolerant to powdery mildew
	TJM-3	2007	M: – Y: – YI: High	Madhya Pradesh	Resistant to powdery mildew,
	TM-96-2	2007	M: – Y: – YI: High	Andhra Pradesh	Synchronous variety and resistant to powdery mildew
Blackgram	TU 94-2	1999	M: 70 Y: 900-1000 YI: 19-37	Andhra Pradesh, Karnataka, Kerala, Tamil Nadu	Resistant to Yellow Mosaic Virus
	TAU-2	1992	M: 70-75 Y: 900-1000 YI: 18	Maharashtra	High yielding
	TPU-4	1992	M: 70-75 Y: 900-1000 YI: 22	Maharashtra, Madhya Pradesh	Large seed
	TAU-1	1985	M: 70-75 Y: 800 –1000 YI: 24	Maharashtra	Large seed Most popular variety in Maharashtra
Pigeonpea	TAT-10	1985	M: 110-115 Y: 900-1000	Maharashtra	Early maturing
	TT-6	1983	M: 135-140 Y: 1200-1300 YI: 15	MP, Maharashtra, Gujarat, AP, Karnataka, Kerala	Large seed
Cow Pea	TRC 77 - 4	2007	M: 90 Y: 2007 YI: 20	Andhra Pradesh	Slender grain type
Rice	Hari	1988	M: 135-140 Y: 6000 YI: 9 g/h	Chattisgarh	Slender grain type
Jute	TKJ-40	1983	M: 125-130 Y: 2800-3100 YI: 10-13	Orissa	High yielding

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