

RECENT AGRICULTURAL RESEARCH

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The magic wand of science, has led within a span of two years, to a revolutionary change in the outlook, yield and income of farmers with holdings of 1 to 2 hectares in size all over the country. The 1967-68 crop year is a most significant one in India's economic history, since during this year there will be a ~~substantial increase in feed production~~ and a doubling in wheat production from about 7.0 million tonnes in 1951, to over 15 million tonnes ^{likely to be harvested} ~~expected~~ this year. Even in Mexico, which is rightly cited for its rapid agricultural progress, it took over 15 years to double the wheat production, but only about 5 years more for trebling ^{it}. I have little doubt that the same will happen in our country, although we have 10 times more area under wheat than Mexico.

Every one knows that a scientific innovation alone is not enough to change agriculture. To have an impact on production, the first requisite is appropriate and adequate administrative action to render the widespread adoption of the innovation possible. India is sometimes cited abroad as one where research and extension function without proper co-ordination and interaction. While there is basis for this comment, very few are aware that India today holds the world record for the speed with which a significant research finding has been applied in the field. During rabi 1963-64, this Institute introduced wheat varieties containing the 'Norin' dwarfing genes

from Mexico on the basis of my theoretical analysis that dwarf varieties are essential for destroying the barriers to high yields in this crop. These were thoroughly tested all over the country during 1963-64 and 1964-65 and data adequate to taking the decision of importing large quantities of seeds of two varieties were presented in June, 1965. 250 tonnes of seeds were imported in 1965 and 18,000 tonnes in 1966. As a result, we had nearly 400,000 hectares under dwarf wheats during the last winter season and we have nearly 200,000 hectares under them now. There is no parallel for such rapid spread of new varieties in the world and this great achievement has stimulated Turkey and Pakistan to take similar action this year.

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During this year, a Nuclear Research Laboratory is being set up at the Indian Agricultural Research Institute. This Laboratory will help us to harness nuclear tools in finding solutions to many complex problems in plant nutrition, root development, soil fertility, the movement and use of surface and underground water, the control of pests and diseases and the breeding of new varieties of economic plants. This Laboratory would also help us to forge new bridges in inter-institutional collaboration, since this project will become a focus of cooperative activity between this Institute and the Bhabha Atomic Research Institute, the National Dairy Research Institute and the Indian Veterinary Research Institute in cooperative research programmes. I firmly believe that the development of new agronomic and genetic techniques for the better harvest of solar and chemical energy through the use of nuclear and conventional research tools, the installation of nuclear reactors which produce low-cost energy and technological

refinements that would enable the synthesis of ammonia fertilizer from air and electricity, would open up vast vistas in agricultural production which few scientists can even visualise now.

The late Shri Jawaharlal Nehru once said, "I do not see any way out of our vicious circle of poverty except by utilizing the new sources of power which science has placed at our disposal". I shall give you a glimpse of this new source of power which agricultural science has provided by taking a few examples from recent research work. Several outstanding strains of crop plants came out of the breeders' assembly line during the year. These include dwarf wheat varieties Sonalika, Safed Lerma and Chhoti Lerma which are selections from material received from Mexico, Kalyan Sona developed through the joint efforts of scientists at Ludhiana, Pant Nagar and the I.A.R.I. and Sharbati Sonora developed through the use of gamma radiation, the barley variety Kailash, the maize composites Jawahar and Kissan, a new jowar variety capable of yielding 6 tonnes per hectare in 100 days, several bajra varieties and hybrids, Pusa Baisakhi Moong, capable of yielding 1 ton per hectare in 60 days, and the vegetable varieties Pusa Reshmi Radish, Pusa Do-fasli Cowpea and Tomato Serial 120, which is resistant to root-knot nematodes. A barley variety suitable for Ladakh has been developed. Genetic engineering has helped to raise the yield potential of our crops as measured in Kgs per hectare per day rather than per season. As a result, the duration of Red gram has been brought down from 300 to 150 days, of castor from 240 to 130 days and to cotton from 180 to 120 days. The wheat varieties Sharbati Sonora, Sonora 64 and Sonalika have made sowing of wheat possible even in January and have thus facilitated

unusual crop rotations like cotton-wheat and sugarcane-wheat. We have just harvested 3.4 tonnes of Sharbati Sonora in 85 days at our Regional Research Centre at Coimbatore. Sharbati Sonora has also 20% more protein and 30% more lysine than the parent strain Sonora 64, from which it was developed through the use of atomic radiations. In the first set of feeding trials conducted at our Division of Biochemistry the rats ~~xxxx~~ fed with Sharbati Sonora gained 19% more weight than those fed with Sonora 64. Fertilizer application increases protein content considerably in all crops and in rice the protein percentage can be raised to 13-14% from 7-8% through the application of nitrogenous fertilizer. The time is ripe now for introducing a protein premium in our pricing policy since in my view this will be a very effective way of arousing protein consciousness in our rural areas.

During recent years, we have laid particular stress on the development of high and quick yielding strains of pulses. Under a project sponsored by the Indian Council of Agricultural Research in collaboration with U.S. Department of Agriculture and the USAID, we have been able to assemble over 15,000 types of Bengal gram, Red gram, Moong, beans and other crops. The duration of crops like Moong and Red gram has been reduced and tailored to the needs of rotations in irrigated areas. Several outstanding Soybean varieties have been selected and a notable recent selection is the strain Acme which can be sown in the spring. The scientific ingredients necessary for making a major advance in pulse production will be available by the end of this year.

We have intensified our efforts to improve the yield and quality of fruit trees and soon a hybrid mango variety with the quality of Dashehari and the regular bearing habit of Totapuri will become available.

Striking success has been achieved in the improvement of cotton. An early cotton strain PRS-72 developed at our Regional Research Centre, Coimbatore has found a place in rotation with rice in the delta areas of South India. In the Tanjavur District of Madras State where this strain is being sown this season in 2500 acres, yields of 25.2 quintals of kapas per hectare were obtained by farmers last year. An extra-long staple cotton selection, designated Co-Pusa Egyptian, which has the same fibre properties as the imported Menoufi cotton, has also been evolved at our Centre at Coimbatore.

Genetic improvement has been extended to bacteria and algae and efficient bacterial strains capable of increasing the availability of phosphates to the plants have been developed. This is a very significant finding in view of the shortage of phosphatic fertilizers in our country and in view of the definite agronomic evidence that phosphorus is critical for obtaining a good response from the nitrogen applied to high yielding varieties. The Pusa Institute has long been famous for its Sahiwal herd and the recent introduction of Friesian cows from the tropical parts of Australia, which have yielded as much as 5830 litres in 306 days, has opened a new approach to increasing milk production in the plains.

More than 70 years ago, Kipling wrote that the Indian farmer's life was 'a long-drawn question between a crop and a crop', thus implying that the man behind the bullock had


neither surplus nor security. In irrigated and assured rainfall areas, this is no longer true. In fact, the farmers want to take as many crops in a year as possible and there has been enormous interest in the multiple cropping systems based on a relay sequence developed at this Institute.

Our research on increasing the production potential of dry farming areas has revealed that as much as 4 tonnes of maize per hectare can be harvested through the adoption of suitable conservation and manurial techniques. A rotation of barley, jowar and gram has yielded in trials in barani areas about 3.1 tonnes of grain and 18.6 tonnes of fodder per hectare. Deep ploughing has been found to help in achieving the type of soil structure conducive to the retention of moisture. The growth and morphological criteria favourable for better performance in dry areas have been determined. We would welcome an opportunity for helping to extend these findings in selected areas characterised by chronic drought condition.

I spoke so far only about research of applied value. It should be obvious that results of such great value could not have been obtained, had there been a void in the field of basic research. Our scientists have made outstanding contributions to our knowledge of the mechanisms underlying biological productivity and the behaviour of plants in health and disease. Knowledge on the construction of purposeful sentences using the basic genetic alphabets, namely the base pairs of DNA, is being rapidly accumulated and we are approaching a major breakthrough in the technique of algeny or genetic alchemy. A gene has been discovered in Sorghum which would soon enable our farmers to keep their own seeds of hybrids. All those who listened to the accounts given by our outgoing students during this week were struck by

their contributions to the pool of human knowledge.

those is us who have been privileged to work in the field of agricultural research
 When ~~we~~ embarked on the relentless pursuit of

Motivation for change


higher yields in crop plants about 6 years ago, we had hoped that the high yielding varieties of wheat and other crops would help not only in increasing the yield of these crops, but would also act as catalysts in bringing about a total transformation in the outlook and agronomic methodology of our rural community. Where sights are limited, action is equally circumscribed and cynicism is the only reaction which new ideas receive. Mahatma Gandhi referred to this situation over 30 years ago, when he addressed volunteers who were to go to villages for rural uplift work and I quote 'The fact is the villagers have lost all hope. The suspect^{er} that every stranger's hand is at their throats and that he goes to them only to exploit them. The divorce between intellect and labour has paralysed their thinking capacity. The worker should enter villages full of love and hope, feeling sure that where men and women labour unintelligently and remain unemployed half the year round, ~~the~~^{he} working all the year round and combining labour with intelligence cannot fail to win the confidence of the villagers'. The new varieties and ~~in~~^{ed} the new agronomy currently available both for irrigation and barani areas, have provided *extension* excellent opportunities ^{for} of winning the confidence of the farmers quickly and ^{for} of providing them with the motivation needed for change. This is in fact what has happened in several parts of our country during the last two years. What is equally significant is that the recent research findings have stimulated educated urban classes to return

workers with

to the villages and take to farming. Agriculture has acquired a new status and the sociological and psychological base necessary for building a new agriculture in our country has been truly laid.

