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GENETIC DESTRUCTION OF YIELD BARRIERS IN
CEREALS AND A NEW BREAK THROUGH IN THE
TRANSFER OF INFORMATION FROM SCIENTISTS
TO FARMERS

By

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The third death of anniversary of our late Prime Minister, Shri Jawaharlal Nehru, marked a significant milestone in India's agricultural advance. On May, 27, 1967, the Union Minister for Food and Agriculture, Shri Jagjivan Ram, released for general cultivation several new varieties of dwarf wheat and composites of maize. A description of these varieties is given in this article.

New dwarf wheats:-

The tall wheat varieties normally cultivated in our country are capable of yielding upto 30-40 quintals per hectare when grown with adequate quantities of manure and water. It is very difficult to get higher yields from such varieties because they tend to fall down, (i.e., lodge) when given fertilizer. Also, it is difficult to apply water to the tall varieties from March onwards when temperature rises and the plant needs water badly (Fig.1). Hence, for taking the maximum advantage of both fertilizer and water it became necessary to develop a new type of plant with short height. Such dwarf plants had been discovered in Japan after World War II and the genetic factors for dwarfing from the Japanese varieties called 'Norin' wheats had been transferred to winter wheat varieties in the United States and Spring wheat varieties in Mexico. In 1962, the Government of India at the instance of the Indian Agricultural Research Institute made a request to the Rockefeller Foundation for seeds of a wide range of

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dwarf wheat material developed in Mexico under the International wheat Improvement Project sponsored by the Mexican Ministry of Agriculture and the Rockefeller Foundation. A large variety of material was received in October, 1963. These were tested all over the Country under the All-India Wheat Improvement Project and two Mexican Commercial wheat varieties, named Lerma Rojo and Sonora 64, were approved for release in 1965. The Government of India made an import of 18,000 tonnes of seeds of Lerma Rojo in 1966 and it is expected that nearly a million acres would have been under the dwarf wheat varieties during the last rabi season

In addition to commercial varieties, breeding material of various types was also received from Mexico in 1963. These were grown at New Delhi, Ludhiana, Pusa, Kanpur, Pant Nagar and several other Centres. From the advanced generation material, four different selections have been made which not only show a very good response to fertilizer but also have the quality of grain liked by our consumers and farmers. The four selections which have now been tested and are ready for release are as follows:

1) SONA227 : This is a selection with a very high yield potential, amber grains and medium maturity derived from the Mexican cross (Fn x K 58N) (N10-B) Gb. 55-II 8156. It has already been released for cultivation in Uttar Pradesh and a similar selection made in Ludhiana has been released by the Punjab Agricultural University under the name KALYAN 227. Nearly 200 acres have been under seed production with this variety during the last rabi season in the Delhi State. A Delhi farmer, Kanwar Mohinder Pal Singh obtained with this variety an average yield of 85 quintals per hectare in a plot of 12 hectares. Sona 227 is a selection jointly made by the

wheat Scientists of I.A.R.I. and the U.P. Agricultural University, Pant Nagar.

ii) SONALIKA: This is a selection made at the I.A.R.I. from S 308 derived from the Mexican cross (II53-388-An) (Yt.54 x N10-B) Lr. 1118427. Sonalika resembles Indian varieties in grain appearance and Chapatee-making quality and has a high degree of resistance to black, brown and yellow rusts. It grows very well in most of the wheat areas.

iii) SAFED LERMA: This is a derivate of S 307 derived from the cross (Y50 x N10-B) L.52) Lr³. I It resembles Lerma Rojo very closely in height, maturity and plant appearance. While Lerma Rojo has soft and red seeds, Safed Lerma has white and semihard seeds. This variety is suitable for cultivation in Delhi, Punjab, Haryana, Uttar Pradesh and Bihar.

iv) CHHOTI LERMA : This is a selection from the Mexican culture S 331 derived from the cross LR 64 (Sib) x HUA.R. This variety has two genes for dwarfing, unlike Lerma Rojo which has one such gene. It has a high degree of resistance to black, brown and yellow rusts as well as loose smut.

SHARBATI SONORA, a symbol of the age of algeny: Sonora 64 received from Mexico in 1963 is a very early variety and is ideally suited for late sowing and for initiating new crop rotations such as potato-wheat, sugarcane-wheat, cotton-wheat, rice-wheat etc. It has two genes for dwarfing and is the most lodging resistant variety so far produced. In 1963, this variety was subjected to gamma irradiation at the IARI Gamma Garden for the purpose of changing its seed colour from red to amber. This was achieved in 1964 and seeds of the amber mutant thus produced by the technique of genetic alchemy or algeny have been

multiplied and tested during the last two rabi seasons. The Central Variety Release Committee of ICAR recently approved the release of the amber mutant under the name Sharbati Sonora. This variety fulfills a very important need of Indian Agriculture namely to have a quick and high yielding wheat variety. Sharbati Sonora has also 25 percent more protein content than Sonora 64 (Fig.2).

Wheats of the future:

Over 10,000 crosses have been made at the Indian Agricultural Research Institute since 1962 between dwarf exotic varieties and tall Indian varieties. Some of the selections are now in an advanced stage of yield testing, and four strains have yielded more than all the released dwarf wheats. These new selections are expected to be released next year. Varieties are now under development which will yield as much as 150 maunds per acre.

Composite Maize varieties-their role in the immediate stepping up of maize production:

The demand for maize is growing and its availability in large quantities would also determine the rate of growth of the poultry and starch industry. Under the All-India Co-ordinated Maize Improvement Scheme initiated by the Indian Council of Agricultural Research in 1957 with the collaboration of the Rockefeller Foundation, Agricultural Universities and state Governments, the following maize hybrids have so far been released for cultivation.

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Sl. No.	Name of Hybrid.	Area for which suited.	Duration in days	Yield potential (quintals/Ha.
1.	Ganga 101.	Northern Plains.	95-100	45 to 60
2.	Ganga 3	Northern Plains.	85-90	50 to 65
3.	Ganga Safed 2.	Northern Plains.	95-100	50 to 60
4.	Rajjit.	Southern Rajasthan, Gujarat & Maharashtra.	100-105	50 to 60
5.	Deccan.	Peninsular India.	105-110	50 to 65
6.	Himalayan 123.	Himalayan hills upto 6000 feet.	110-120	65 to 75
7.	Hi-Starch.	All maize areas.	100-110	50 to 70

Seeds of these hybrids are being produced and distributed by the National Seeds Corporation and the target for the area to be covered by the hybrids during 1967 is about 0.6 million hectares.

In recent years, several composite varieties have also been developed under the Co-ordinated Maize Improvement Scheme and seven of them were recently approved for release by the Central Variety Release Committee. These composite varieties have given 40% more yield than the best local varieties. While in the case of hybrids, the farmers have to buy fresh seeds each year (this is because the hybrid vigour is manifested only in the first generation of crossing), farmers can keep their own seeds of composites. The details of the composites released are given below:

S.No.	Name of composite variety	Area for which suited	Duration in days	Yield potential (quintals/Ha
1.	Jawahar	Northern Plains and Peninsular India.	100-110	45-60
2.	Ambar	Himalayan hills.	110-120	50-81
3.	Vijay	Punjab, Haryana and Western U.P.	100-110	45-60

4.	Sona	Punjab, Haryana and Western U.P. and Rajasthan	100-110	50-60
5.	Vikram	Delhi, Gujarat, Punjab, Haryana, U.P. & Rajasthan	90-100	50-60
6.	Kissan	Eastern U.P., Bihar, Bengal & Orissa.	95-100	45-50

Thus, the composites are as high yielding as hybrids. They also possess a high degree of resistance to the principal diseases and considerable tolerance to drought. It is expected that seeds of these varieties enough to cover an area of 2,50,000 hectares would be available during 1968. As a result of the development and release of the composite varieties, it would now be possible to cover the entire area of about 5 million hectares under maize which high yielding hybrids and varieties within the next three years.

National Demonstrations-a break through
in the field of information transfer:

The National Demonstration Programme is an unique programme in the field of information transfer from Research Institutions to farmers since the demonstrations are laid out directly by the scientists in the fields of farmers. The programme was initiated in 1965 and nearly 3000 demonstrations have been organised during the last two years in rice, wheat, maize, bajra, and jowar. Each demonstration occupies a minimum area of one acre and has a specific yield target. During 1966, over 1500 demonstrations were organised throughout the country by research ^{and extension} workers of both state and Central Institutes and Agricultural Universities. In the case of rice, the highest yield recorded in the National Demonstrations organised during 1966 was 10770 Kgs., harvested in the fields of Sh. B. Samanta R of the Ganjam District in Orissa with the variety Taichung Native-1. The average yield obtained in nearly 1000 rice

demonstrations was 5000 Kgs. per hectare, the highest average being in the Delhi State which produced 6050 Kgs. per hectare. In the case of jowar, the highest yield of 5500 Kgs. per hectare was obtained in Andhra Pradesh with hybrid jowar CSH-1, the national average being 2400 Kgs. per hectare. In bajara, the highest yield of 6700 Kgs. per hectare was recorded in Haryana, the national average being 3250 Kgs. per hectare. In maize, the highest yield was 7400 Kgs. per hectare obtained in ^a farmer's field in Uttar Pradesh and the average was 4350 Kgs. per hectare. The data of the National Demonstrations organised in wheat have shown that the highest yield has been obtained with the dwarf wheat variety S. 227 in the Delhi State, wherein ^{an} ~~the~~ yield of 8430 Kgs. per hectare has been recorded.

The original purpose of the National Demonstration programme was to show the new vistas in yield which have been opened up by the development and release of high yielding varieties of crop plants. The impact of these demonstrations has been so great that they have catalyzed an enormous demand for seeds of high yielding varieties and fertilizers and stimulated the human motivation necessary for the farmers to take to a new agronomy. This programme has been considered by eminent experts from outside India as a major break-through in the field of information transfer and several other countries such as Ceylon and Thailand have evinced great interest in organising similar programmes.

Since the new strategy of agricultural development in India aims at making the maximum use of sunlight and water, it has now been decided that the national demonstrations which will be organised under the auspices of the I.C.A.R. would have within ^{their} ~~its~~ scope the cultivation of 2-3 crops per year in the same field. During this year, it has been decided at an All-India

Meeting held recently to organise about 2000 demonstrations with a minimum yield target of 9000 Kgs. per hectare per year where three crops are grown. Uttar Pradesh will organise the maximum number of demonstrations, numbering about 200. Rotations such as maize or jowar or bajra or rice during June to September, Potato between September to December, wheat between December and April and Moong (Black Gram) between April and June would be introduced in selected farmers fields. These demonstrations will be evaluated not only for yield but also for the economics of the practices introduced, for their effect on soil structure, flora and nutrients and the disease and pest implications. This is because crop ^{rotations} relations will have to be evolved which not only maximise production and profit but will also have no adverse effect on the long term productivity of the soil. Intensive agriculture to be successful over a long period of time should not be offensive to the soil.

The Indian Agricultural Research Institute at New Delhi will lay out 30 National Demonstrations in the Delhi State next in July, 1967. These demonstrations will help to introduce new land use and cropping patterns in the State and will aim at a minimum production of 12000 Kgs. per hectare per year from three crops. The crops to be sown during the kharif season are; the new composites of maize, hybrid and dwarf bajra varieties, hybrid jowar and a new variety of ~~the~~ dwarf jowar. These will be followed by the new dwarf wheat varieties Sonalika, Sona 227, Sharbati Sonora, Safed Lerma and Chhoti Lerma. The wheat variety Sharbati Sonora will also be grown after ^a the crop of potatoes in the field of hybrid bajra. In view of the shortage of hybrid bajra seeds, the I.A.R.I. has recommended transplanting of bajra since with transplanting a seed rate of 0.5 Kgs.

per acre would be sufficient in contrast to 1.5 Kgs. needed for direct sowing. Research at the Institute had shown that transplanting of ^hRajra not only helps to save seeds but also gives more yield.