RECENT RESEARCH AT THE IARI

By

M.S. Swaminathan

Science and Wheat Production:

Doubt still persists about the relative rôles of Science and weather in stepping up the yield of wheat. We should have the answer in the next few weeks. During the period October 1, 1967 to March 1, 1968, there was excess of rainfall ranging from 8 mm in western Uttar Pradesh to 52 mm in the Punjab, Haryana and Delhi area, while during the same period in 1968-69, there has been a deficit ranging from 18 mm in west Rajasthan to 60 mm in east Madhya Pradesh. The deficit in rainfall in the Punjab, Haryana, Delhi region during the present wheat season is 43 mm. Thus, the production this year will provide an index of our progress towards delinking our destiny with weather. If the unduly rapid rise of temperature now observed does not continue and if late rains or hailstorm or insects do not damage the wheat crop, our wheat production this year ought to be better than that of last year. The reason for this is not only that the crop is greener this year indicating that the soils are getting better fed and that more water is being tapped but also that the wheat revolution has extended itself to many other States ranging from West Bengal and Bihar to Mysore and Tamil Nadu. Because of its profound significance to our economic wellbeing, I would like to analyse briefly the scientific ingredients that have fostered progress towards achieving stability of production in wheat.

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First, the development of photo-insensitive and short duration varieties have opened up the possibility of extending wheat cultivation to numerous new areas like the Tungabadhra region in Andhra Pradesh and Mysore and several parts of West Bengal, Orissa and Tamil Nadu. Secondly, sowing wheat as late as January in the major wheat areas has been rendered possible through a combination of breeding and agronomic techniques, so that even if rains come late, sowing of wheat is still possible. Also, in irrigated areas, unusual new rotations such as sugarcane-wheat, potato-wheat, cotton-wheat and winter vegetables-wheat have become both possible and popular. In December, 1968 we launched an educational campaign to promote the adoption of the new agronomic techniques for the late sowing of wheat so as to compensate for the loss of area caused by failure of rainfall in the unirrigated regions and I am happy to report that thanks to the interest and prompt action taken by the Union Ministries of Agriculture and Information and Broadcasting and by the State Departments of Agriculture and Agricultural Universities, it seems possible that nearly 400,000 hectares might have been sown with wheat from late December to Late January. In our farm here, an yield of 45 quintals per hectare was obtained last year from the variety Sharbati Sonora sown on the 9th January, 1968. I consider the agronomic practices developed at this Institute for sowing wheat late and for taking 4 crops a year without detriment to the long-term productivity of the soil, as among the most significant of our recent research contributions. The 4-crop relay technique involving rotations such as wheat-Baisakhi Moong-hybrid Maize and

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potato is not now confined to our farm but has become the rage of Punjab agriculture. Where initiative has been shown in providing credit as was done by the State Bank of Patiala, entire villages such as the Garhi Ghulaman village in the Rohtak district, have taken to growing 4 crops in a year. Our new mixed cropping techniques enable the growing of two additional crops, wheat and moong, in the sugarcane fields of U.P., Bihar, Haryana, Punjab, Rajasthan and Delhi. Such techniques will not only help in stabilising wheat production but would also reduce marked price-conditioned fluctuations in sugarcane acreage, which are now so frequent. The Production Unit of our Extension Division has through a series of National Demonstrations shown how such practices can open up a new income horizon in the life of farmers having a holding of 1 or 2 hectares. Also, such labour intensive practices will help to banish both unemployment and underemployment in rural India.

Eliminating Rust Menace:

Another important cause of instability in the production of wheat is the incidence of diseases, particularly rusts. I reported last year that our Mycologists have initiated a systematic rust survey and surveilance programme. We have continued this programme during this season and fortnightly bulletins on the rust situation are sent out throughout the country and to co-operators abroad. So far black rust is absent from the northern plains but has been widespread in Peninsular India both in local varieties and in the high yielding strain, Kalyan Sona. Kalyan Sona is now the most widely cultivated dwarf variety both in India and Pakistan. While it is resistant to many races of all the rusts, the very

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spread of this variety has led to the selective build-up of the races to which it is susceptible like race 122 of black rust. Our work has also made it reasonably clear that the major source of black rust infection in the north is the wheat crop of south India. Hence special efforts will have to be made to ensure that varieties with the required resistance are grown in the South. Since breeding for resistance to specific races is a continuous and ceaseless process, we have also diverted attention to the identification of varieties with generalised resistance. Also, the search for new genes for resistance is on and I am glad to report that a new gene conferring resistance to race 122 of black rust has recently been identified.

Our latest reports show that brown rust is prevalent throughout the country and that yellow rust is heavy in isolated pockets in the foot hills of Himachal Pradesh and Uttar Pradesh. On the whole, rust is unlikely to do any serious damage to the wheat crop this year. I referred earlier to the possibility of wheat production being reduced through late rains and hailstorms. It was to eliminate this factor of instability that in 1964 we embarked upon a vigorous programme of breeding wheat strains possessing the three major genes for dwarfing located on chromosomes 2A, 4D and 6D. These are now popularly known as "Triple Dwarfs" and since interest in this class of new varieties is unfortunately mixed up with a desire on the part of businessmen-farmers to make undue profit from the sale of seed, I would prefer not to speak on this phase of our research programme.

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Dwarf varieties of durum or Malwi wheat are also now under testing. Varieties which are specially suited for biscuit and bread making have been identified and through Seminars and articles we have at last been able to generate varietal consciousness in the food industry.

Recent experience with wheat production should be adequate to illustrate the crucial importance of building up a strong research and training base before a field programme is initiated. When changes are made in production technology leading to alterations in crop ecology, new plant-pest-pathogen-man relationships develop. For example, we lay stress in wheat breeding on selecting plants with leaves which are broad and which age slowly so that the harvest of solar energy can be maximal. Such leaves apparently are good food for insects and last season, we found an invasion of armyworms and cutworms in the wheat plots for the first time in our long experience with this crop. But for the fact that we have many gifted entomologists on our staff, the crop would have been wiped out. We are also now engaged in an intensive battle against the spread of nematode diseases of wheat and other crops.

Rice Production:

The stagnation in rice yields is a good example of the impossibility of increasing production solely with the help of research carried out in other countries. When I first saw the grains of the exotic dwarf rice varieties upon which the hopes of the High Yielding Varieties Programme were erected, I was convinced

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that unless we evolve varieties which combine the good qualities of our widely grown cultivars with the ability to respond to fertilizers, we cannot make a significant advance in rice production. In retrospect, this inference has proved to be correct and we are proud to have developed at this Institute within 3 years some outstanding Basmati varieties with a high yield potential. We have also identified new sources of resistance to the bacterial blight disease in material collected from Assam. Many new varieties combining resistance to stem borer, fertilizer response and good quality are under testing. The irrigation-drainage cycle, the correct methods of application of fertilizers and the pest control schedules necessary for high yields have all been worked out and I am confident that a major advance in rice production in north India will take place in 1970 when seeds of the new strains will be available for large scale cultivation.

New Varieties of other crops:

The relentless pursuit of higher yields and better quality has continued in all the major food and commercial crops. Among the varieties released or multiplied last year are H.B. 4 Bajra, Swarna, a variety of Jowar which is as high yielding as the hybrid CSH 1, Aruna a castor variety which has a duration of only 110 days, the cotton strain Sujata, with a staple length of 1.25 inch and with a spinning value of 86 counts under mill conditions, several new plant types of rape and mustard and short duration varieties of Moong and Arhar. I have also good news for fruit and

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vegetable growers as well as for flower lovers. Four new mango varieties having Dasheri, Neelum, Totapuri and Chousa in their parentage selected out of nearly 40,000 crosses made during the last few years are likely to add soon to the rich diversity of mangoes available in north India. A unique property of these varieties is that they will show regular bearing, unlike our present varieties in the north which bear well only in alternate years. New varieties of brinjal, radish and turnip and a nematode-resistant variety of tomato have also been developed. Such work will gather further momentum when we establish a Division of Vegetable crops during the IV Plan. Sonia, a new variety of Tea Rose and Himangini, Suryodaya and Swati, new strains of Floribundas were released last year. We also have the privilege of multiplying and distributing several outstanding new rose varieties bred by Dr. B.P. Pal including Tea roses, Homi Bhabha, Aruna, Kanakangi and white Nun and the floribunda rose, Golconda.

Nutrient Supply:

New avenues of nutrient supply have been explored and it has been estimated that on an average 25 Kg. of nitrogen would be needed to produce a tonne of wheat, while 15 Kgs. would be needed to get a tonne of rice. The soil fertility map of India has been revised incorporating the data from 1.3 million soil tests. The development of efficient strains of Rhizobia to increase nitrogen availability from biological sources as well as the standardisation of techniques for using basic slag, which is currently an unused by-product of the steel industry, in

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6.5 million hectares of strongly acid soils, are research contributions of significant value in nutrient supply. These findings do not involve huge capital investments for exploitation but are based on either making nature work for us or on the conversion of wastes into plant food. In the context of the budget presented yesterday, our research on tapping biological nitrogen and on increasing the return from the fertilizer applied assumes particular significance.

Further progress has been made in focussing attention on the qualitative aspects of water use. A can evaporimeter costing one rupee has been fabricated with which a farmer can regulate water supply according to the needs of the crop. We hope that during this year we will be able to establish a Water Technology Centre with the help of the Ford Foundation and the University of California for intensifying research and training onall aspects of water use.

New Needs:

With the growing realisation of the pivotal role played by plant population in regulating yield and income, farmers are increasingly investing in more efficient farm implements. Our Division of Agricultural Engineering has devised an efficient seeder and several tillage implements and is currently working on a reaper and thresher. The Entomology Division has intensified research on grain storage and has developed a Pusa Cubicle for bulk storage. All aspects of post-harvest technology need greater

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attention. I also feel there is immense scope now for imaginative designs in rural housing. I see a large number of new houses coming up in the villages of the wheat belt and I am bewildered at the lack of interest among our architects in developing and popularising new house designs among farming families.

New pests and diseases are spreading. Virus diseases have started becoming important for the first time in the history of our rice culture. Field pests as well as storage pests are on the rise. Many of our present day social and economic problems can be traced to our taking advantage of scientific discoveries in preventive and curative medicine, thus, helping the death rate to drop dramatically, while refusing to take interest in the application of science to agriculture. The same situation will arise if we do not make a simultaneous advance in all sub-disciplines of agriculture. The concept of integrated disease and pest control advocated by the plant protection scientists of this Institute, if accepted and implemented, would ensure that we enter the new era of intensive agriculture without upsetting adversely the symbiotic balance between man and his biological environment.

Genetic upgrading of Protein Quality:

Our research on the genetic betterment of nutritional quality of cereals has made further progress and our aim of raising the quality of wheat and maize proteins towards that of skim milk is getting closer to realisation. Maize hybrids with

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12% protein and 3.9% lysine in contrast to only 1.8% lysine present in Ganga 3 and Ganga 101 are under testing. These new hybrids and composites will help to build a prosperous poultry industry. Substantial progress has also been made in the development of high quality fodder grasses so as to render the use of concentrates unnecessary in the Dairy industry. There is ample data to show that through better feeding, the milk yield of even nondescript cows and buffaloes can be increased by 50% and with suitable alternative crop use and land use patterns, the 50 million underutilised milch animals in the country can be made to yield substantially higher quantities of milk. If genetic improvement is also undertaken on a wide scale, the scope for increasing the availability of milk and milk products would be immense. One of our Friesian cows obtained from Australia has in her second lactation given 7,393 Kg. of milk in 10 months. The genetic upgrading of protein quality, increased production and consumption of pulses and the exploitation of the vast neglected cattle wealth of the country will help both to eliminate protein malnutrition, particularly in the young and to make farming assuredly remunerative.

New Vistas in Dry Farming:

I have so far spoken chiefly about the happy prospects opened up for irrigated farms. Equally exciting is recent research and its implications for the betterment of production in unirrigated and chronic moisture deficit areas. The approaches broadly revolve round the use of simple but efficient methods

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of harvesting of rain and subsoil water, the cultivation of crops and varieties which are physiologically more efficient under conditions of moisture deficiency and the application of fertilizers at deeper layers of the soil and through leaves. The development of short duration varieties and the exploitation of the buffering effect of genetic heterozygosity on adverse environments have helped to evolve new cropping patterns for unirrigated areas and if nutrient supply can be assured, the production potential of such areas can be vastly improved. In an experiment with Kalyan Sona, the application of 10 Kg. of N through leaves helped to increase the yield of barani wheat from 3.6 quintals per hectare to 10.2 quintals per hectare. Techniques have been developed for spraying over 30% urea solution through the use of low volume sprayers. This technique has rendered aerial spraying of urea economically feasible and a cost-benefit analysis of foliar application of fertilizer to unirrigated wheat is currently under progress.

Basic Research:

One of the cardinal duties of this Institute is to carry out research not only for today but for tomorrow. An institution like this should be a centre for the origination of many original discoveries and unconventional ideas and approaches. It is the innovative spirit and a healthy distrust of dogma that needs to be fostered among both staff and students. The numerous imaginative experiments that are now underway include the

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