

Agricultural Research : A Review

By

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The Indian Council of Agricultural Research has now been in existence for well nigh 20 years. The Royal Commission on Agriculture recognised that the problem of improving agriculture was really the problem of improving the village life and this must be studied as a whole. The council kept this point in view and on the one side it organized widespread ramification of co-ordinated research and on the other it subsidized village project schemes embracing important aspects connected with agriculture and animal husbandry in the villages. These schemes on the one side emphasized the importance of scientific aid to agriculture and on the other were so conducted that they have led to a substantial increase in the income of the cultivator. As a matter of fact wherever these schemes have been tried the neighbouring cultivators have also been enthused to adopt many of the methods.

It is difficult to present in a small compass all the varied activities in which the Council has been engaged since 1929. Only a brief description taken at random of some of the more notable items will be given here just to present an idea of the nature and quality of the work that has been and is being conducted under its aegis.

RICE:

In the field of crop production rice occupies the foremost place. The Council gave great impetus to its improvement by subsidizing a chain of schemes at Berhampore, Cuttack, Chinsur, Nagina, Raipur, Habibganj, Bombay, Madras, Mysore, Kashmir, Travancore and Baroda. The major number of these schemes terminated between 1941 to 1945. As a result of investigations on the breeding side, a large number of varieties have been produced which are suitable for varying conditions, such as high and low-lying areas, suitable for resistance under flood, drought and saline conditions, resistant to the attack of insect pests, diseases and so forth.

In parts of Central Provinces and Bihar the evolution of purple-pigmented varieties has solved the menace of wild rice weed which was indistinguishable. This has led to a saving of about 20 lakhs of maunds of paddy equivalent to at least 60 lakhs of rupees in the Chattisgarh Division alone, whereas the cost of research was about a lakh of rupees.

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The percentage increase amongst the important varieties has been 20 to 25 per cent in Bihar, 30 to 52 per cent in Orissa, 17 to 23 per cent in Travancore and 55 to 70 per cent in Kashmir. The results in Bengal and Madras have also been of similar order.

WHEAT:

In wheat the most intriguing problem has been that of rust, which recently devastated a large area in Central India, Central Provinces and Berar, Bombay and Hyderabad, etc. during 1946—47. In Central Provinces and Central India the entire crop was lost leaving nothing even for seed purpose and in the former province, the Government had to import 40,000 tons of wheat for distribution as seed. The situation had become so serious that three meetings were called by the Government of India and held at Delhi to consider measures of control and a Wheat Rust Control Committee with the Agricultural Commissioner with the Government of India as a convener was formed. The Indian Council of Agricultural Research also convened a special Wheat Rust Committee in December 1947 in Delhi and again in the Crops and Soils Wing meeting held in April 1948 in Madras.

There are three types of rust, viz. black, red and yellow; each having several physiological races. These physiological races (for each type of rust) cannot be distinguished from their outward morphological characters. Their main difference lies in the power of attacking different varieties and strains of wheat or other cereals and/or plants. The problem here is to evolve by breeding, hybridization, etc. such strains as will be immune or resistant to one or more or, if possible, all of the physiological races. The Council has for the last 18 years (since 1930—31) been subsidizing a comprehensive scheme of research on this highly important work. Although the results have not reached the final stage yet it has been highly instructive. The study on the life-history of the different rusts along with their behaviour on alternate hosts, have thrown much light on their possible role. The work suggests that the persistence of rust from year to year is probably not due to alternate hosts but to the over-summering of the disease on volunteer (i. e. self-sown) crop and early-sown wheat in the hilly areas of Nepal in the North and Nilgiris in the South. The disease from there is carried by wind to the plains where the standing crop is infected resulting in bad years, the complete destruction of the entire crop. In normal years the loss may be about five per cent involving about six crores of rupees in both Indian Dominion and Pakistan. The ameliorating measures lie in breeding rust-resistant types and adoption of control measures. In both these Council is concentrating attention. In this connection work has been going on in Bombay, Central Provinces, Central India, Simla, Bhowali, Karnal and Agra.

MILLETS:

In connection with the Council the results are as follows:

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(ii)

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In addition to the work already in progress, supplementary work is being done.

In respect of very important arrangements for the consideration of work on a committee initiated under the Research Institute. Some work has been done in Pakistan.

Co-ordinating etc. yielding in high a yield as recorded 30 per cent exotic *oodrile* (local varieties).

PULSES:

In the view of the fact that the urgent need of this source, a committee was initiated in the States, on grain pulses. Already obtained; for given 10 to 30 per cent one variety against 818 per cent shown that (23 per cent) brown-seeded

MILLETS:

In connection with investigation on millets under the aegis of the Council the results show in the case of *jowar*

- (i) an increase of 20 per cent yield of *jowar* in areas of scanty rainfall by dry farming methods,
- (ii) control of fungus attack of *jowar* by treating the seed with copper sulphate and powdered sulphur, and
- (iii) control of *jowar*-borer by mechanical methods of cleaning the stubbles after harvest and burning them.

In addition to these, investigations on control of *jowar* Striga is also in progress. *Jowar* malt has been produced and its use as a supplementary food for infants has been suggested.

In respect of maize which is a highly prolific crop, it can play a very important role in making good the deficit in our food supply if arrangements can be made for the production of hybrid maize seed. Considerable work, both of fundamental research and production of hybrid vigour on a commercial basis has been done in America. Work has been initiated under the grants of the Council at the Indian Agricultural Research Institute and in important maize-growing Provinces in India. Some work was also conducted under its grant at Lyallpur now in Pakistan.

Co-ordinated schemes have also been started on *bajra* and *ragi*, etc. yielding useful results. Trials in Baroda with *bajra* have yielded as high a yield as 731 lb. as against 531 lb. (local). In Mysore they have recorded 30 per cent more yield over the local variety. In Mysore some exotic *oodule* (millet) has yielded 1,520 lb. as compared to 360 lb. of local varieties.

PULSES:

In the case of pulses, India is very rich in species and varieties. In view of the bulk of the population being vegetarian and in order that the urgent protein requirements of the people can be met from this source, at the recommendation of Sir John Russel, the Council initiated a co-ordinated research scheme in almost all Provinces and States, on grams, horse-grams, *arhar*, *mung*, *guar*, peas, *urd* and other pulses. Already important results from different places have been obtained; for instance, in Poona eight selected varieties of gram have given 10 to 30 per cent increase over local type. In Central Provinces one variety gave 726 lb. per acre against 226 lb. and another 1,100 lb. against 818 lb. of the control. A study of the protein content has shown that the white-seeded gram has the highest percentage of protein (23 per cent) whereas the bold-seeded variety has 20 to 21 per cent and brown-seeded variety 16 to 17.5 per cent. Wilt is a severe disease which

causes considerable damage to this crop. Work has been in progress in many places to evolve varieties resistant to this disease. Successful results have been obtained in some centres. In the case of *arhar* which is also susceptible to wilt it has been found that when it is mixed with *jowar* the incidence of wilt was much reduced, the mortality in *arhar* being 32 per cent as against 88 per cent when *arhar* was sown alone as a single crop. Mixed sowing has thus proved of great advantage.

OILSEEDS:

In oilseeds high-yielding strains have been evolved in schemes sanctioned in different provinces and varieties with higher percentage of oil have been obtained.

In Madras in the case of groundnuts selection No. AH 678 yielded 10 per cent more than AH 25 and was found superior in shelling percentage and weight-volume relationship. It also gave a saving of 25 per cent in the seed rate as its kernels are smaller in size.

FRUITS:

The importance of fruits requires no emphasis in a country like India, and here the Council has been subsidizing schemes in Madras, the United Provinces, the Punjab (now East Punjab), Bihar, Bengal (now West Bengal), Central Provinces, Assam, Hyderabad, Mysore, Coorg, etc. Investigations are carried out on various types of fruits such as mangoes, papayas, peaches, banana, etc. Fruits require a long range investigation and sometimes years must lapse before practical results can be expected. The Council has a Fruit Development Adviser to advise on fruit research.

In the Punjab in regard to the quality of Malta orange it was noted that the quality of the fruit in respect of soluble sugars and acidity was greatly improved by the application of ammonium sulphate and farmyard manure.

At Chaubattia phosphates increased the vigour of apples significantly.

Some mention should also be made of the work on cold storage, preparation of recipes and syrups, cordials, juices, candy products, etc. Canning of fruit and preservation of fruits, is conducted in Madras and at the Indian Institute of Fruit Technology in the Punjab, now at Delhi.

POTATOES:

Due to the initiative taken by the Council there has been valuable collection of potato varieties in Simla. Many of them have been brought from their original home in South America (Chile, Peru and Bolivia). These have formed material for evolving improved types of hybridization. Work on potato has been conducted from various points of view, one of

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which deserves special attention, viz. the development of the tuberless sowing, by which immense saving of seed can be possible. Each tuber is capable of producing 20 to 40 plants by this method. The investigation of potato will be passed on to the Indian Central Potato Institute.

In view of the recommendations of the Famine Inquiry Commission the Council has also initiated measures to develop other root crops like sweet potato, tapioca, etc.

FODDER CROPS AND GRASSES:

For improvements of these crops the Council has sanctioned combined Agricultural and Animal Husbandry Research Schemes in different Provinces and States.

MANURIAL EXPERIMENTS:

On the manurial and cultural side the investigations initiated by the Council have led to results of enduring value. One of the first that the Council undertook soon after it came into being was the examination of the previous manurial experiments conducted all over India. These have since been embodied in voluminous publications and also bulletins and papers. These experiments however suffered from the fact that in those days the modern statistical methods were not known and the designs of experiments did not permit critical examination. Since then at the initiative of the Council manurial experiments on statistical basis have been undertaken in all the Provinces and States thus giving more reliable basis of information. In this connection investigations have been conducted with organic and inorganic manures, farmyard manure, cattle-dung, compost, oilcakes, etc. Along with these, chemical fertilizers have been tried and in all some 5,000 manurial trials have been conducted, on various crops including paddy, wheat, *jowar*, groundnuts, millets and other oilseeds and pulses. The most important conclusion is the great need for the application of nitrogen in some form or other. There is no place where the application of nitrogen has failed. Under irrigated conditions, wheat showed a universal response to nitrogenous fertilizers and manures. Under unirrigated conditions there were fluctuations but in spite of these the tendency was for a general response. In the case of paddy 20 lb. of nitrogen per acre appears to be minimum dose and there are indications that the doses can be profitably increased to 60 or 80 lb. in areas where the level of fertility is high. Oilcakes have been found as good as or often better than ammonium sulphate. The increased yield through ammonium sulphate has varied from 21 to 24 per cent in Bengal to 70 per cent in the United Provinces and Kashmir. With oilcakes the maximum increase has been as high as 110 per cent, 120 per cent, 150 per cent and even 190 per cent.

Considering that in green manuring the cost of nitrogen is only a fraction of its cost as compared to other manures like inorganic fertilizers or oilcakes, the practice of green manuring has been encouraged in all areas where water supply is assured and particularly in irrigated areas. An application of 30 to 40 lb. of nitrogen through green leaves is likely to increase the yield by 22 to 30 per cent whereas heavier doses of 60 to 80 lb. of nitrogen have given in certain cases over 100 per cent increase.

The investigations further point that there is no critical evidence to show that repeated application of the fertilizer without organic manure does harm to the soil or that repeated applications of ammonium sulphate alone over a series of years cause a fall in the yield.

In Bengal a manurial schedule has been worked out at six different price levels of paddy and four levels of ammonium sulphate. The schedule shows that manuring is paying even at the peak price of ammonium sulphate at Rs. 250 per ton if the price of paddy at Rs. 5 per maund is assured and moreover, of the two doses, viz. 20 lb. and 40 lb. of nitrogen per acre the double dose is more remunerative. In the case of some of the other provinces statistical equations have been worked out for forecasting the possible return under certain sets of conditions.

In the case of wheat manurial experiments have given increased yield varying from 6 to 63 per cent.

The experiments were not generally confined to the limited objective of only finding out the nature of response under different doses. Investigations in many cases included other important matters. Thus it was found in Central Provinces, in the case of wheat, that ammonium sulphate was very effective when applied with seed whereas sodium nitrate was best at top-dressing. The drilling of fertilizers further showed that the response per unit of fertilizer was double as compared to broadcasting. In the case of *jowar* the trials at Poona suggest that the application of nitrogen at sowing time is preferable to latter application. Trials at Coimbatore on *jowar* showed that there was a depression in yield by the application of inorganic nitrogen or phosphate singly but there was a phenomenal increase obtained by joint application of nitrogen and phosphate, the increase being largest on poor land. In the case of *ragi* also it has been found that phosphate is an essential supplement to nitrogen under rain-fed condition in Mysore. At Dharwar in the case of *jowar* the response to oilcakes was increased threefold or more when they were applied on a basal dressing of farmyard manure. In Bihar where the soil is generally deficient in phosphate the response to phosphate under wheat takes place only when it is added as a supplement to nitrogen. In the black soil tract as well as in the Gangetic alluvium under irrigated

conditions on wheat, August has been found to be the best month for applying farmyard manure and is to be preferred to October. It has been further found that a combination of organic and inorganic nitrogen is more effective than either applied singly and that bulky manures like farmyard manure cattle-dung, compost, etc. have a lower efficiency of nitrogen as compared to that of oilcakes.

Green manuring experiments on wheat in the United Provinces show that ploughing of sand after seven to eight weeks' growth and *guara* after twelve week's growth was better than burying earlier and that if sand was allowed to manure by burying there was a depression in yield. Experiments at Lyallpur showed that green manuring supplemented by 10 lb. of nitrogen as ammonium sulphate gave per acre more grain than green manuring plus 10 lb. of nitrogen as sodium nitrate. In the case of groundnut there was an appreciable response to nitrogen from ammonium sulphate but its application at showing time yields better results than divided application. It has been found in the Punjab that correct spacing may increase the yield by 25 per cent. The response of groundnut to a combination of nitrogen and phosphate was considerable in Madras, Bombay and Central Provinces.

An interesting feature has been found in the case of linseed both in Central Provinces and the United Provinces. There was little or no response to nitrogen or phosphate singly or in combination with cattle manure. It is proposed to investigate the cause of this. In the case of *toria* it has been found in the Punjab that ammonium sulphate at 40 lb. of nitrogen per acre applied half at sowing time and half at flowering produced 1,026 lb. against 700 lb. in unmanured plot. It has been further found that if in the normal rotation in which *toria* follows wheat, the land is green manured with *guara* before sowing wheat the yield of *toria* is considerably increased due to the residue of green manure.

In the case of fruits it has been found at Sabour that ammonium sulphate and farm-yard manure applied on mangoes after harvest gave significant increase in flowering in the following season and that nitrogen significantly increased growth.

It has been found in Madras that biennial bearing in mangoes is not the inherent feature of most of the varieties and optimum crops can be secured every year provided the tree in the preceding season has made normally vegetative growth.

OTHER WORK :

The other work of the Council includes soil survey, investigation on dry farming agricultural meteorology, village project scheme. All-India Compost Scheme, investigations on medicinal and other miscellaneous plants, etc.

As regards soil survey the Council decided that before a comprehensive soil investigation was undertaken all existing information on the different soil types occurring in India should be collected and collated. Accordingly the All-India Soil Survey work was started in 1942 and the information thus collected is now ready for publication. In agricultural meteorology the Crop Weather Co-ordination Scheme deserves special mention. This work contemplates organization of a net work of stations for detailed observations of crop growth, yield and environmental and weather factors to build up crop weather statistics on scientific lines. Questionnaires were circulated to the districts and according to the replies received, crop weather calendars have been prepared for each important crop. These are of great value to the weather forecasters in issuing the *Farmers Weather Bulletin*. On this basis the weather services for agriculture have commenced with the issue of daily *Farmers Weather Bulletin* in Indian languages through All-India Radio.

It will be seen from the above that since the inception of the Council, work of far-reaching magnitude has been undertaken and the results so far achieved have been of a very high order. It may of course be asked as to how far results achieved have been adopted in the country. Here also the Council has tried within its limited funds to initiate organizations for work like seed multiplication but the major part of this work devolves on the Provinces and States and it can be reasonably expected that as days pass this will be taken up more and more vigorously. A large number of newer problems are also awaiting solution and the schemes on some of them are already under consideration of the Council.

In order to keep the work up-to-date the Council has been inviting experts from abroad to review the work in progress and lay down lines for future guidance. Sir John Russel visited the country in 1936-'37 and his report has since served as a useful guide to the Council for sanctioning schemes in different parts. Dr. Shuhart was invited in 1944 to advise on soil conservation of the country. Now Dr. A. B. Stewart of the Macaulay Institute for Soil Research, Aberdeen, who was invited to make a report on the soil fertility investigations in India with special reference to manuring, has suggested ways and means of bridging the gap between research and practice and the Council is considering a scheme to implement his recommendations.

The Council has also launched a model scheme to develop 20 villages in Delhi Province by co-ordinating work of different aspects on agriculture and animal husbandry. This is likely to serve as a guide as to how by the development of agriculture other aspects of rural life which are so intimately linked up with it, can be improved.

The total number of schemes which have been so far financed by the Council exceeds 200. On the agricultural side the total amount involved is 1.02 crore rupees.

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It may as well be asked as to what value has been obtained from the expenditure of such an amount. It will however be seen from the description given in the foregoing that improved strains to suit different conditions of soil and climate have been evolved in rice, wheat and other crops. In view of the limited funds allotted to the agricultural research compared to some of the more progressive countries of the world, the work here could not be as much as should have been, but in spite of it the results have been really considerable.

The increased yield due to improved varieties have varied broadly up to 25 per cent. But even if we make a conservative estimate of only 10 to 15 per cent of return, it will show how much it has been possible to achieve within the limited funds spent. The total estimated acreage of cereals and millets in the undivided India was of the order of over 200 million acres, out of which rice and wheat in the then India occupied about 81 million acres and 35 million acres respectively. If we take the case of only these two areas the estimated production is 27 million tons of rice equal to 739 million maunds and 9 million tons of wheat equal to 243 million maunds. If we assume only a very small increase, viz. only $\frac{1}{4}$ of a maund per acre due to improved varieties (actually it is considerably more in some cases it exceeds double the normal yield) it works out to an extra yield of about 29 million maunds which even at Rs. 10 per maund offers a return of 29 crores of rupees. Compared with this the amount spent annually by the Council has been 0.56 crores and is expected to reach 1.025 crores when the schemes terminate.

As a matter of fact the amount annually spent on agricultural research in India has been very little, viz. about $\frac{1}{4}$ of an anna *per capita* per annum of 1/10th of an anna per acre of the total area. The total sum thus spent was less than two-thirds of that spent on agricultural research in the United Kingdom where the population is $\frac{1}{3}$ th and area only 1/20th of that of undivided India. It may be stated here that the Central Government of the present Indian Union in its budget for 1948-'49 have allotted a much larger sum of about Rs. 2,02,50,000 for agricultural work and improvement. This works out at 11 pies *per capita* as compared to Rs. 2 for United Kingdom, Rs. 20-14-5 for Canada and Rs. 77-9-11 for the United States of America and the amount is only 0.8 per cent of the total budget expenditure of the centre. The provinces too have allotted a higher sum and it is indeed a happy sign that the improvement of agriculture is being gradually recognized. But in order that the problems can be tackled from all angles greater scope and larger funds are an urgent necessity.

