

Concurrent with the segregation for spikelet size, the stigma and anther sizes also varied. The smaller spikelets had smaller stigmas (4.0 mm.) and smaller anthers (2.5 mm.) and the bigger spikelets had bigger stigmas (6.0 mm) and bigger anthers (3.5 mm). Even the size of the lodicules responded likewise.

Summary. In sorghum it could be stated in general terms that awns, when present (in whatever strength of expression) increase in length and keep pace roughly to spikelet size. In Mendelian segregations small ovate glumes with short awns have proved a monogenic dominant to big elliptic spikelets with long awns. The stigma, anther and lodicules kept pace with spikelet size.

SELECTED ARTICLE

Nutrition and Agriculture

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If human beings are to be properly nourished they must have enough food to eat and the right kind of food to eat. In India we are faced with the problems of obtaining enough food for the people and the right kind of food. The former takes precedence over the latter. A considerable part of the population is underfed in the quantitative sense—as the nutrition workers say, food intake falls short of calorie requirements. What proportion lacks sufficient food we do not exactly know, but recent dietary investigations suggest that it is no small one. In some parts of the country the danger of famine is always imminent.

Enough Food. It follows that the *principal* aim of agriculture must be to increase production of *all kinds of food*. It is essential, as we shall see, that the quality of diets should be improved, but in attempting to achieve something in this direction we should never lose sight of the primary need for more food. At present this must be produced in the country itself, because India cannot afford to import food in large quantities. All activities which will increase food production are therefore of the utmost importance. The development of fisheries, the extension of irrigation, the use of efficient manuring methods, the introduction of improved or high-yielding strains of common food crops—all come under this head. The value of the last may be particularly emphasized. Improved strains may give a yield from 10 to 30 times in excess of those they replace. In the Madras presidency in 1937, 1.78 million acres were under improved varieties of rice, representing about 18 per cent of the total area under rice; while in the Punjab 4.26 million acres were sown with similar varieties of wheat, which amounts to nearly half the total acreage under wheat in that province. This represents an achievement on which agricultural research institutes and departments are to be congratulated.

One of the advantages of increasing the production per acre of staple food grains is that it releases land for the production of other kinds of food. India is a densely populated country, and at present most of the good land must be used to grow cereal crops. Otherwise there would not be enough food to go round. Land so cultivated gives a higher return of solid food than land used, let us say, for producing fruit, vegetables or milk.

The right kind of food. The chief defect of Indian diets, on the qualitative side, is that they contain too much grain and too little else. Diets of this kind

are "un-balanced" because of the preponderance of cereals. Sir Robert McCarrison, in his little book *Food** describes a balanced diet as follows:—

The right kind of food for Indian children and, indeed, for children in any country is one made up of the following, simple things:—(1) any whole cereal grain or mixture of cereal grains; (2) plenty of milk and the products of milk—curds, buttermilk, butter, ghee; (3) sprouted pulses; (4) eggs or liver, or meat, or fish, occasionally, if religion permits their use; (5) tuber and root vegetables; (6) abundance of green leafy vegetables and (7) fruit. These are the things with which the appetite should be satisfied; the things that should be eaten for health's sake. What else is eaten does not greatly matter so long as it is simple, clean, easily digestible, well prepared and not in excess of the body's needs.

Diet Surveys. We have today a good deal of knowledge about the kind of diet which people eat in many parts of India. This has been obtained by what are called *diet surveys*. If you ask a man what kind of diet he eats he will tell you vaguely that he sometimes eats this and sometimes that and even after careful questioning you will remain in doubt as to what his diet really consists of. He may want to show how well he feeds or perhaps the opposite, and in either case he will make exaggerated statements. In a diet survey a trained investigator visits families twice daily for a number of weeks and weighs all the foods which they are going to eat so that exact data are obtained. It is sometimes hard to persuade poor families to cooperate in such investigation: they are naturally suspicious of the motives of the investigator. But this difficulty can be overcome by tact and patience. The result of diet surveys of this nature has been to provide a clear picture of Indian dietary habits, and one of the points which has been demonstrated is the insufficient intake of foods other than cereals. The average Indian diet contains too little milk, pulses, vegetables, fats of various kind, and fruits. It does not approach the kind of diet which Sir Robert McCarrison recommends.

The cereals. The cereals, which include wheat, rice, the various millets, barley, rye, oats and maize are as a group approximately similar in food value. They do not contain a sufficiency of various food constituents, including vitamins which are needed by human beings. The rice grain is designed by nature to feed the rice germ or embryo, and no doubt it is well adapted for this purpose. But it is not well adapted to fulfil human food requirements in every respect. Still less is it suited to this end when it has been milled. The outer layers of cereal grains are richer in various nutritive materials than the starchy inner part or endosperm. Milling removes the outer layers and leaves the grain impoverished. In India it is the chief food crop—rice which suffers most by milling, rice being a grain which is particularly easy to mill. Wheat as a rule is eaten "whole" in the form of *atta*—a very healthy habit. The various millets which follow rice and wheat in order of importance are not usually milled. The grains are so small that removal of the outer layers would be difficult.

Supplementary Foods. But whatever the state in which cereals are eaten, a sufficient intake of other foods is essential. Nutrition research workers have studied the value of the various supplementary foods consumed in India and have gained a very fair idea how much of each is desirable and how far typical Indian diets fail to contain the desirable amounts. We are therefore in a position to suggest, the broad lines which agricultural policy should follow in order to improve the quality and balance of Indian diets. A greater intake of milk and milk products, eggs, fish, pulses, vegetables and fruit, is particularly necessary. Every attempt should therefore be made to encourage the production of these foods.

* Published by Macmillan and Co., Ltd, Madras.

A considerable amount of detailed knowledge about food value, etc., is available to guide food production in the right direction. A few examples may be given; all kinds of milk—including cow's, buffalo's, and goat's milk—are of high nutritive value, as is the evaporated milk product of North India (*K'non*) which is largely used in making sweets. Skimmed or separated milk is very good food. Most of the pulses are roughly similar in nutritive value, so that it does not much matter which variety is encouraged. The soya bean has in the past been considered an exceptionally valuable food which should be made popular in India. Experiments have however shown that it is no better than many other common pulses and there is not much point in spending a great deal of time and money in increasing its cultivation. Among the vegetables, the green leafy kind is particularly rich in vitamins and other necessary food constituents. The food value of most fruits grown in India has been investigated and the results are available. These show, for example, that two kinds of fruits the cultivation of which is spreading—the tomato and the orange are rich in certain vitamins and are worth further encouragements. There are fish available in Indian waters which can provide liver oil richer in vitamin A than cod liver oil and the development of fisheries might allow local industries for the production of such liver oils to be established. Many other examples of useful data about food values might be given.

Sugar. Within comparatively recent times the peoples of Europe and America have begun consuming sugar in large quantities. This habit has been made possible by the large-scale development of sugarcane production in the tropics and beet production in Europe. The only concentrated form of sugar known in European antiquity was honey, a relatively rare and costly product, for bees, however industrious, cannot rival sugar factories in their output. In India sugar has been manufactured from cane for many centuries. The sugarcane originated in the Ganges basin and it is said that about the year A. D. 648 the Chinese Government sent officials to India to study its cultivation and methods of extracting the juice. In the last few years the sugar industry has shown rapid development in its original home as the result of protection and imports of sugar have fallen. *Per capita* consumption of sugar in India is however, small in comparison with consumption in Europe and America.

An increase in the supply of sugar in India is all to the good; as has been said any increase in total food production is of the utmost importance. But it must be remembered that sugar whether refined or unrefined, is a food of limited value. While it is a concentrated source of food energy, it contains no protein or vitamins and an increased intake of sugar will not help to balance Indian diets. In England nutrition experts have objected to the Government subsidy to the beet sugar industry on the ground that the money might have been better spent in improving the supply of milk or other highly nutritious foods.

Cash crops. Another subject about which nutrition workers have something to say is that of cash crops. It is of course desirable that the production of valuable non-food crops, such as cotton, tobacco, etc. should be encouraged up to a certain point. The wealth of the country is thereby increased. But there may be danger in paying too much attention to cash crops at the expense of food crops. Prices fluctuate according to the level of world markets and an area in which the cultivation of a paying crop has been taken up with enthusiasm may experience a disastrous slump. When this occurs the population suffers because it is no longer producing food for its own use. The recent report *Nutrition in the Colonial Empire* published by the Economic Advisory Council* contains a

* Committee on nutrition in the Colonial Empire. First Report. Parts I and II, 1939.

good deal about this question which is probably more urgent and important in Africa and the West Indies than in India.

The report sums up the position as follows :—

" The aim should be the establishment of a *balanced agriculture* for the production of commodities produced to be used either for direct consumption by the producer and his family or for sale for consumption elsewhere in the country or for sale in overseas markets. As regards commodities produced for export it appears that the producer must continue to expect wide variation in his income from money crops. Family production of foods to meet family needs is a great safeguard against some of the worst social and economic effects of fluctuations in the income from money crops."

In the southern United States a serious food deficiency disease called *pellagra* is prevalent. This is usually caused by a diet which contains too much maize and too little else. Maize is a dangerous food for very poor people and this fact should be remembered should there be signs of its becoming an important crop in India. The southern United States are a great cotton-producing area, and the small farmer may devote his land almost exclusively to cotton and buy his food, chiefly maize, in the local market. When the price of cotton slumped in the bad years around 1930—33, the incidence of pellagra did not rise; rather it tended to fall. The reason for this was that the farmer, instead of growing cotton which no longer paid, began to produce vegetables and other foods for his own use. Though he had less money in his pocket, he was actually better fed.

This example illustrates the disadvantages of relying too much on a single crop. It can also be used to illustrate the advantages of growing vegetables for home consumption. In many parts of India much more vegetables could be grown in the village, if people would take the trouble to do so. Every house should have a little vegetable garden, or else vegetables should be grown on some suitable piece of ground near a well or wherever water is available. Waste water from the house can be used to water vegetables. It is surprising what a large amount can be raised from a small plot.

Farming and Diet. The improvement of farming and the improvement of diet are so closely inter-related as to be almost the same problem. An increase in the production of certain kinds of food may create new habits of diet. Thus, the consumption in England of tropical and sub-tropical fruits, such as bananas and oranges has risen enormously during the last 30 years, because of their cheapness and availability which followed the development of fruit farming in the West Indies and elsewhere. In India the increasing supply of excellent home-grown oranges is visibly creating a taste for this fruit. Conversely, a demand for certain kinds of food which can be stimulated by educating the people about nutrition, may influence agricultural production. For example in America the insistence of nutrition experts on the value of milk and milk products has raised national milk consumption and brought prosperity to certain states largely occupied in the dairy industry. An interesting review of such questions will be found in the League of Nations report, *The Relation of Nutrition to Health, Agriculture and Economic Policy*.* This report shows how agriculture in Europe has been able to adapt itself to a change in food habits in the direction of more dairy products, vegetables and fruit—i. e. a change for the better. We may hope that in time Indian agriculture will be able to make the adaptations which are necessary to improve the nutrition of the people.—*Indian Farming*.

* Final Report of the mixed committee 1937.