

What Next in Millets and Pulses Research

by M. BHAVANISHANKER RAO &
B. W. X. PONNAIYA,
Millets Breeding Section, Agri-
cultural College and Research
Institute, Coimbatore

Introduction : Millets are grown mostly as unirrigated crops in areas of poor fertility. Being highly drought-resistant, they are the only staple food crops that could be grown in areas unsuited for the cultivation of paddy. Thus millets are complementary and not competitive to rice. Millets also provide fodder for cattle. It is estimated that they give nearly 6.5 million tons of straw to support 60 per cent of our cattle population. Cholan fodder, especially from the sweet juicy-stemmed varieties, is a prized fodder for the milch cattle of our State.

There are eight millet crops, of which Cholan, Cumbu and Ragi are known as the major millets and occupy nearly 75 per cent of the area while Tenai, Varagu, Samai, Kudiraivali and Panivaragu form the minor millets. These are cultivated over an area of nearly 5 million acres in the Madras State and the estimated production is 1.7 million tons of grain as against 6 million acres and 3 million tons of paddy.

Pulses, which are subsidiary food crops, are of great importance as the major source of protein supply in our diet. They occupy 1.2 lakhs of acres with an estimated production of 0.1 lakh ton of grain. This production meets only 10 per cent of our requirements viewed from nutritional standards. Large quantities are imported from other Indian States but the net available quantity for consumption in the State is still low.

Review of Work Done : Before formulating a plan of future work it is essential to take stock of our achievements so far.

Extensive collections of Indian and foreign varieties were built up from 1923, and the variations studied in the Millet Station, Coimbatore. Inheritance of most of the external characters and linkage groups were studied, as also factors affecting yield.

The second phase of work was directed towards isolation of pure lines from the local varieties. During the early years, grain yield alone was the criterion for selection. Subsequently, the yield of straw and quality of grain were also included as standards for selection work. Easy threshing ability in the strains was also another factor that entered into the picture. Since millets are grown mostly as rainfed crops, a fair degree of resistance to drought was insisted upon in the strains.

The third phase of millet improvement work consists of utilisation of knowledge of genetics in hybridisation work. For example, in the improvement of the quality of straw in *Cholam*, it was found that all the varieties of this State were pithy-stalked, while the *Patcha Jonna* of the Ceded districts was sweet and juicy-stemmed and was therefore well relished by cattle. Introduction of this desirable character in our varieties has been made by crossing these types and Co. 18 is the strain released. Work is in progress to introduce the sweet and juicy-stalked characters, which are governed by single genes, into all the strains. Short-duration strains have been evolved in *Cholam*, *Cumbu* and *Ragi* for cultivation during the irrigated season and these are liked for the smaller number of irrigations they require, as compared with the local varieties. In *Ragi*, a strain, K 3, which combines high yield, non-lodging character and resistance to *Piricularia* attack, has been recently released. A white-grained strain Co. 6, has been evolved by hybridisation combining high yield with white grains, rich in protein. Outstanding work on the utilisation of hybrid vigour has been accomplished in *cumbu* and good hybrids of medium duration are under distribution. This pioneering work of crop improvement in India is modelled after the well-known work on maize in America. The noteworthy feature of this work is the evolution of a cheap, yet efficient method for the large-scale production of hybrid seeds. In minor millets, a few high-yielding strains have been released, while in pulses the crop improvement work was taken up late and only one strain in each of redgram, greengram and Bengalgram have been released so far.

The following is a list of strains released so far :—

Cholam	...	23
Cumbu	...	7
Ragi	...	9
Tenai	...	3
Varagu	...	2
Panivaragu	...	1
Pulses	...	3
Total	...	48

Much progress has, however, not been made on the agronomic side. Manurial experiments recently started, indicate that only straw yield is increased in *cholam*, while in *cumbu*, increased yield of both grain and straw are noted. The results require confirmation, as also data on the economic aspects of fertilising. Raising of a nursery and transplanting the seedlings in the case of irrigated *cholam* and *cumbu* have been found useful under certain conditions.

Future Work: It is the inherent quality of research that however extensive the achievement to date is, what remains to be accomplished is vast. Millets and pulses improvement work is no exception to this general rule.

In cholam, the great millet, there are three distinct varieties cultivated under rainfed conditions. The Periamanjil Cholam of the Coimbatore district is valued for its grain as well as its straw. Further improvement in the quality of straw is possible in this type and is proposed to be achieved by infusing sweetness and juiciness into the stem which is pithy. The straw of the high-yielding types is characterised by blackish-purple colour but cattle relish better the reddish-purple straw. To improve the quality of straw still further without affecting the grain yield, this linkage has to be separated. This variety yields best when sown in July-August and if the sowings are delayed there is a progressive decline in yield of both grain and straw. Evolution of a high-yielding, short-duration type which will suit the late season sowings is an urgent necessity. The *Talaivirichan* type is preferred for cultivation in areas of high rainfall, because of its loose-panicled nature. But this variety has the smallest grain among our cultivated types and its fodder quality also is very poor. These two main defects call for immediate improvement. In the southern districts of Tirunelveli, *Irungu*, almost a wild variety, is exclusively cultivated for fodder purposes. The grain of this variety is brown and is unfit for human consumption. Although the new strain K. 3 (extracted type of Periamanjil-Irungu cross) is useful as a fodder-cum-grain type, further improvement of the pithy straw by introducing juiciness is important. A white-grained variety of *Irungu* is grown in the adjacent districts of Madurai and Ramanathapuram for grain as well as fodder. The quality of fodder and the grain size of this type have to be improved. In the irrigated season, *Vellai Cholam* is commonly cultivated even though *Sen Cholam* is preferred in parts of Salem and Tiruchirapalli districts. A dozen strains have been released to suit the various tracts. Evolving a few cosmopolitan types combining high yield with quality straw will go a long way in assuring uniformity of produce as well as ease in multiplication, distribution and maintenance of seed purity.

Pests and diseases commonly found attacking the cholam crop in the State are the cholam ear-head bug (*Calocoris angustatus*) and the smuts (*Sphacelotheca Sorghii*) and *S. reiliana*). Although effective insecticides and fungicides are available, it will be cheaper in the long run to cultivate resistant types. This will forestal any chance of the insects and pests becoming immune to the existing insecticides. For example we are led to believe that physiological strains of the ear-head bug immune to BHC. have already developed. *Striga*, a root parasite, is found in certain years to heavily infest the cholam crop. Preliminary

studies have revealed that resistance to this parasite occurs in an introduced sorghum variety which can be infused into many of our economic types.

Cumbu is cultivated over 1.2 million acres, but unfortunately it yields a fodder of very poor quality. If the ryots have any choice at all, this straw is not fed to animals, but is used only for thatching and such other purposes. Therefore, improvement in the palatability of cumbu straw is a matter of urgent investigation. Reducing the duration of hybrid strains without affecting the yield of grain is a possibility that deserves to be pursued. Spotting out of rust-resistant varieties has shown the possibility of infusing this desirable character into our strains.

Ragi, which ranks third in acreage under millets, is important for the reason that nearly 50 per cent of the area is raised under irrigation. It responds well to manuring and heavy yields upto 4,000 lb. of grain per acre are obtained. Evolution of a high yielding, short-duration, cosmopolitan strain combining non-lodging character and resistance to *Piricularia* is the immediate step in view. It has been found possible to infuse high protein content in Ragi and since the grain is consumed by middle and even upper-class people, because of its health-giving properties, further improvement in enhancing its nutritive value is desirable.

In minor millets, evolution of high-yielding types resistant to pests and diseases, with better fodder quality deserves immediate consideration. As already stated, intensive work on agronomic aspects is yet to be done. The optimum manurial and cultural practices, as also rotation and mixed cropping methods, that will suit different tracts have to be found out. Evolution of strains to suit different fertility levels is a necessary adjunct.

In advanced countries like the United States of America and Canada, with surplus food production, millets are mainly cultivated for feeding livestock. In the present drive for stepping up production, with emphasis on the spread of improved strains of cereals, better fertilising practices, assured water supply and with efficient plant protection measures, we may confidently hope to have a surplus production in the near future. It will be wise to foresee this eventuality and be prepared to face the situation. Fortunately the possibilities of using the additional production in numerous ways for the benefit of the country are already recognisable. Preparations of cereal breakfast foods, nutritive animal concentrates and industrial products like starch (by wet milling) readily suggest themselves. Breeding of strains suited for these specialised uses may however appear rather ambitious at this stage.

Pulses: Pulses are the main source of proteinaceous food for us, mainly because most of us are vegetarians, either by choice or out of economic necessity. But, the production of these in this State is very low. Immediate steps to augment the production by evolving suitable strains and efficient cultural and agronomic practices are problems awaiting solution.

On the extension side, much headway has yet to be made. The fruits of research like the evolution of strains, better methods of manuring, etc., have to be taken to the doors of the farmers and popularised. For example the improved strains of millets have barely covered 10 per cent of the total area. In the second five-year plan now being formulated it is programmed to cover 50 per cent of the area. An all-round effort in organising seed farms and in arranging seed distribution is necessary. The recently introduced method of village seed farms and voluntary seed exchange, tried in paddy and found successful, deserves to be extended for the spread of the strains of millets and pulses also.

Table showing nutritive value of grains of Rice, Wheat, Millets and Pulses.

	Protein	Fat	Mineral matter	Crude fibre	Carbo-hydrates
	%	%	%	%	%
1. Rice					
(a) raw, hand-pounded ..	8.5	0.6	0.7	..	78.0
(b) raw, milled ..	6.9	0.4	0.5	..	79.2
(c) raw, boiled and milled	6.4	0.4	0.8	..	79.1
2. Wheat ..	11.8	1.5	1.5	1.2	71.2
3. Chulam ..	10.4	1.9	1.8	..	74.0
4. Cumbu ..	11.6	5.0	2.7	1.2	67.1
5. Ragi ..	7.1	1.3	2.2	..	76.3
6. Tenai ..	12.3	4.7	3.2	8.0	60.6
7. Varagu ..	8.3	1.4	2.9	9.0	65.6
8. Kudiraivali ..	6.2	2.2	4.4	9.8	65.5
9. Panivaragu ..	12.5	1.1	3.4	2.2	68.9
10. Samai ..	7.7	4.7	4.8	7.6	63.7
11. Redgram ..	22.3	1.7	3.6	..	57.2
12. Blackgram ..	24.0	1.4	3.4	..	60.3
13. Greengram ..	24.0	1.3	3.6	4.1	56.6
14. Horsogram ..	22.0	0.5	3.1	5.3	57.3
15. Bengalgram ..	17.1	5.3	2.7	3.9	61.2
16. Cowpea ..	24.6	0.7	3.2	3.8	58.7
17. Lablab ..	24.9	0.8	3.2	1.4	60.1

From "Health Bulletin No. 23". The nutritive values of Indian foods and the planni⁴ of satisfactory diets—(1938) by W. R. АУКРОУД.

Table showing the analysis of the straw of Paddy and major Millets.

	Ash	Protein	Oil	Fibre	Carbo- hydrates
	%	%	%	%	%
Paddy ..	16.3	3.3	1.5	30.5	37.8
Cholam ..	7.1	3.1	2.2	34.0	44.3
Ragi ..	12.1	2.2	2.4	28.2	44.9
Cumbu ..	8.1	1.9	1.3	37.6	43.7

(From Bulletin No. 33, South Indian fodders 1932 by P. V. RAMIAH.)