Viswa Nath and Kasinath.—Effect of intensive use of fertilizers on soil complex. Agriculture and Livestock in India, Vol. I, 1931.

Norris.—Note on Permanent manurial plots. Memoirs of Department of Agriculture, India. Chemical Series. Vol. VI, No. 8.

McCarrison.—Indian Journal of Medical Research, October 1926

McCarrison.—British Medical Journal, March 29, 1924.

... ... Nature, Vol. 121, 1928.

Rowland and Wilkinson.—Bio-Chemical Journal, 1929.

Stoklasa.—Proceedings of the International Wheat Conference, Rome.

Venkataraman and Suryanarayana.—Report on Manurial Experiments, (Unpublished data.)

Planter's Chronicle.—Vol. 20, 1925.

Council of State debates.—Vol. II, No. 5.

Proceedings of the Board of Agriculture.—1917, 1919, 1922, 1924.

Chatterton, Sir Alfred.—Fertilizer Problem in India. Lecture delivered before the South Indian Science Association.

Vera Anstey.—The Economic Development of India. 1929 Longmans, Green & Co.

Report of the Royal Commission on Agriculture.—Government of India, Central Publication Branch, Calcutta.

Bulletin No. 90, Agricultural Department, Madras.

https://doi.org/10.29321/MAJ.10.A05028

THE PLACE OF SCIENCE IN THE DEVELOPMENT OF MYSORE AGRICULTURE[1]

By LESLIE C. COLEMAN, C.I.E., M.A., Ph.D.

Director of Agriculture in Mysore

I need hardly point out to you that Mysore is essentially an agricultural country and that, as far as we can now see, it is likely to remain so. I need perhaps also hardly remind you that nearly one-half of the State's revenue is derived directly from the agriculturist and that of the rest a very considerable proportion is derived either from the owners or tenants of land or from the labourers on it. If, therefore, this State is to take that place in the future Commonwealth of India which we believe she should occupy, it must be very largely through the development of this great industry. The steady progress of Mysore must be based on the increasing prosperity of her ryot population. To hope for a prosperous and enlightened Mysore, with, at the same time, a poverty-stricken ryot population would be absurd.

The Problems of Mysore.—While there are other parts of India which may be destined, in the future, to remain as essentially agricultural as Mysore, there are, I believe, few if any, other parts where the problems facing the agricultural investigator are so varied and where, through the

[1] Summary of the Sri Krishnarajendra Silver Jubilee Lecture 1931.

compactness of the area and the natural intelligence of the agricultural population, the conditions are so favourable for testing and introducing improvements resulting from scientific investigation. Let us consider the variety and complexity of the problems. These are conditioned primarily by the great variety of climate and soil. It is true we have not that marked variation in temperature which gives the agriculture of North India two marked crop-seasons in which tropical crops regularly alternate with those of the temperate zone. We have, however, a variation in rainfall both as regards amount and distribution which would be hard to duplicate in an area of similar size anywhere outside Mysore. We have in the western part of the State a rainfall going up to three hundred inches per annum while in certain of our eastern taluks it sinks below 20 inches per annum. There are areas of the State where the main sowing season for dry crops is the month of May, while in others less than twenty miles away, it is July or August. In fact there are areas such as those in Chitaldrug District where a range of hills in places less than five miles wide almost entirely changes the character of crops and the time of sowing on its two sides. The character of our soil varies not only over wide areas but also within short distances almost as greatly as does our climate.

All of this has brought about a very striking complexity of crop species and varieties and also of agricultural methods to suit more or less exactly these variations. This can be illustrated by the striking variations in our main food crop—*ragi*[1]—which covers an area of approximately 2¼ million acres in this State. In the *malnad* to the extreme west *ragi* is a crop of insignificant importance but evidence is not lacking that in the past it has occupied a much more important area than it has occupied, for there are many signs of former cultivation in the higher land above the area gardens and paddy fields which are the characteristic feature of our northern *malnad*, and undoubtedly a very much larger amount of food grains must have been grown in that area in those days to feed the much greater population that inhabited the *malnad*. There is also experimental evidence that as good crops of *ragi* can be grown in this region as in many other parts of Mysore.

What applies to *ragi* applies to many other dry crops in the State. It applies to a lesser extent to our main irrigated crop, paddy, but here irrigation comes and naturally disturbs the play of climatic conditions.

To indicate the extent of soil variation in Mysore I need only point out to you that Dr. Narasimha Iyengar in his soil survey of the Irwin Canal area which he is now bringing to completion, has found it necessary to take soil borings on an average for every 15 to 20 acres of the 120,000 acres surveyed, in order to get a reliable picture of the soil conditions in the area. I doubt if such an intensive soil survey has ever before been made of any corresponding area.

I have used these illustrations to enable you to gain some small conception of the complexity of the problems which face the scientific workers of the future in this State. I shall now turn for a few minutes to a very general and imperfect survey of some of our main problems.

Improvement of crops and supply of seed.—One of the first problems to be tackled in connection with the improvement of agriculture in any country

[1] *Eleusine coracana*

must be the supply of seed of the best and highest yielding strains of the important economic plants grown. This is especially important in Mysore for there is no other agricultural improvement which can be introduced at so little cost to the cultivator. The seed required for one acre of *ragi* costs at present prices about 8 annas which is a very small part of the total cost of cultivation. I shall not go into the question of the technique used in the production of new varieties but shall simply point out that in a field of *ragi* as ordinarily grown by a ryot there are a large number of strains differing greatly in vigour, in yielding capacity, in the time required for coming to maturity, and in such other important points as freedom from grain shedding, amount and strength of straw, and resistance to disease. It is the work of the Botanist to select from this rather bewildering mass not in one field only, but in fields covering large areas those plants which he considers will combine the greatest number of desirable qualities placing yield at the front. It must be obvious that even this work can hardly have finality, for the selection of the very best plants from two million odd acres is a task upon which work can well continue almost indefinitely. Even were we confident that the very best strains now available had been found, we should have to have different strains suited to our different climatic and soil areas, which means the final selection not of one strain but of possibly a dozen. More than this we should almost certainly find that no one strain approached the ideal in all respects and that it would be only through the combination of the qualities of several different strains that the ideal could be approximated. This introduces the fascinating but complicated work of hybridization.

In this connection it is of great importance to have a very comprehensive collection of all the different varieties at present existing, to use as possible foundation stock, for these old varieties which have been grown probably for thousands of years have frequently qualities of hardiness and resistance to disease, which are in great danger of being lost in the process of increasing yield or quality. This has been only too frequently the result of breeding work in western countries and there is now a marked insistence on the necessity of retaining the old varieties on experiment stations so that they can at any time be used as foundation stock for future breeding. It may interest you to know that we have in the Hebbal farm a collection of no less than 300 varieties and strains of *ragi* representing not only the different climatic areas of Mysore but also regions in British India where ragi is being grown.

But *ragi* is only one crop. As a matter of fact there are listed in the Mysore *Season and Crop Report* no less than 36 important crops grown in Mysore State and these represent only a small part of the total. Of these we have been able to deal even in a preliminary manner, with less than ten crops and in the case of only five have we reached the stage of being able to give out seed for general growth or for preliminary testing by ryots of Mysore. I may point out that the results so far obtained have come almost entirely from the labours of two men, Dr. V. K. Badami and Mr. V. N. Ranganatha Rao. When I tell you that from five to seven years is looked upon as the shortest time required to bring a new selection of an annual crop to the stage for distribution and in the case of a perennial crop such as coffee this period must be multiplied by three or four, you will be able to understand something of the immense amount of careful scientific labour involved.

Other means of improving yields.—The production of new high yielding strains of economic plants while immensely important, cannot lead us very far in agricultural development if we stop here. As a matter of fact it has been estimated in Europe that this method of crop improvement has been responsible on an average for an increase in yield of about 10 per cent; although of course increases in individual cases have been much higher than this. The increases that have been registered in ryots' fields from our work in Mysore have varied between 10 and 25 per cent.

It must be obvious in a country such as Mysore, standing as it does on one of the oldest geological formations in the world and where conditions do not now allow and have not in the past probably for many centuries, allowed for enrichment through the deposit of silt except in restricted areas under canals and tanks, the soil must have reached an equilibrium such that about the same amount of plant-food material can be taken away in the crop as is added to the land in the form of manure. If therefore we introduce new strains which can feed more efficiently on the soil than those we are replacing, it stands to reason that there must be a gradual, if perhaps at first imperceptible, lowering of soil fertility unless we increase the amount of manure applied to the soil. The tendency of high yielding strains to exhaust the soil has already become apparent to the ryots in the Cauvery Channel area where a high yielding strain of paddy developed by the Madras Department of Agriculture has largely replaced local varieties. It is the general view of growers that this new variety, although it gives higher yields, also demands more manure.

Need for Co-operation.—From this it will be seen that work on the manurial requirements of Mysore soils must go hand in hand with work on the improvement of our crops through breeding. In other words the chemist and the trained agriculturist must work in close co-operation with the botanist. I have already pointed out the very marked diversity of Mysore soils and so the work required in connection with them and their manurial requirements is enormous. Then we have the special manurial requirements of the different economic plants grown in various parts not only as to quality but also as to quantity. Up to the present these investigations have been confined to only seven of our important crops.

The use of Fertilizers.—In regard to the manuring of even these comparatively few crops our knowledge is far from complete. It is true we do know to which particular plant-foods they react by increased yield and we are even able to advise in a general way on amounts and proportions of plant-foods which will under average conditions give a profitable return on the money invested. In most cases, however, we cannot say definitely what is the maximum amount of plant-food in the form of manure which can be profitably applied. An immense amount of experimental work in this direction is still required even on the few crops we have under experiment.

It seems certain that if we are to increase our production to anything like the standard of western countries we shall have to take much more largely to the use of artificial fertilizers and more especially nitrogenous and phosphatic ones. Our soils are in general very poor in the two important plant-foods, nitrogen and phosphates. Our local supplies are entirely inadequate and even then are decidedly more expensive, per unit of available plant-food, than the artificial fertilizers now available. No one, I think, seriously looks upon the so-called chemical fertilizers as more than

supplementary to the supplies of manures available to the ryots but there seems no doubt whatever that in this regard they can and should play a role of immense importance. There is evidence that as far as food-grains are concerned, samples from fields manured by the so-called natural fertilizers such as cattle manure do contain more of the essential vitamins than those from fields manured solely with artificials. Even if we accept the work already done by Mr. Viswanath of the Madras Agricultural Department in co-operation with Col. McCarrison as conclusive on this point, it may be pointed out that there are a very large number of our commercial crops in which vitamin content cannot come into the picture at all. This is the case with sugarcane, one of the crops on which fertilizers can be used with the greatest profit. I believe I am safe in saying that the final product from sugarcane whether it be jaggery or sugarcandy, hardly contain any vitamins. The same applies to such valuable crops as coffee, arecanut, and tobacco where the produce after preparation for consumption or in the form in which they are consumed, cannot provide to man any of the vitamins we now recognize as so necessary for growth and health. I could name many other important agricultural products which come under the same category but those I have mentioned should, I think, suffice. It seems to me necessary to emphasize the importance of realizing that in any consideration of the use of fertilizers in this country in the future, the needs of Indian agriculture should be considered as of paramount importance, and that merely political considerations should be carefully excluded.

If, as I anticipate, artificial fertilizers should increase greatly in importance in Mysore during the next quarter century the necessity for most careful scientific investigation in connection with their use must, I think, be obvious. Whereas in the case of such natural manures as cattle manure and green manures, the manure is obtained at small cost to the ryot and it is practically impossible to injure the crop or the soil by any application that is at all generally possible under existing conditions ; in the case of artificial manures very much more care must be exercised. We must know which of a number of different manures will give the best results and what particular amount of application will give the highest economic return. As many of these artificial fertilizers are made available to the plant almost immediately after application, the stage of the plant's growth at which they can most profitably be applied is another question of great importance. In all these directions, our present knowledge is extremely meagre.

Soil moisture.—As far as our dry crops are concerned, the plant-foods in the soil are frequently not the limiting factor in crop production. Production is limited very largely by soil moisture which again depends upon the rainfall. Obviously drought resistance must be a most important character in our improved varieties. Recent work in the United States and Canada goes to show that the chemist can assist the plant-breeder greatly in connection with the elucidation of the characteristics upon which drought resistance depends. This question which has hardly been touched upon in India is a fascinating and important one for future study. The effect of manurial treatment on the moisture-holding capacity of soils and on the ability of plants to increase their root systems so as to utilize the soil moisture more efficiently, is another important question where the Chemist, the Physicist and the Physiological Botanist must join hands.

Problems of Cultivation.—We cannot turn from a consideration of soil problems without reference to the very important problems of cultivation. As you may be aware, our most important cultivating implement is the plough. The wooden plough which has been used in this country for many centuries has, it is true, the virtue of cheapness but it is anything but an efficient implement. Dozens of different types of plough have been imported into India but only a comparatively few have proved at all suitable for Indian conditions. Even among these there is, I venture to state, not a single one which is much more than an approximation to what is required. Probably the soils of Mysore place as large and as varied a demand on a plough as any in India, and we have, I believe, in this State, a larger number of improved ploughs *per capita* than in any other part of this great country. The question of materials to be used for efficiency and wear is as important as the question of design and in both directions there is an immense amount of scientific work to be done. It may interest you to learn that the Department of Industries and Commerce and the Department of Agriculture are working in close co-operation on this problem at present. I may say however, that young engineers and metallurgical chemists, if there are any of the latter in the University, need not fear that we shall have exhausted all the possibilities of improvement in this direction by the time they are ready to start their life's work. In any case I may point out to them that the plough is only one of many agricultural implements and I believe agricultural development will, in the future, demand changes both in design and materials in many, if not most, of these implements.

Insect Pests.—If we turn to the question of insect pests we have an equally large field. As in the case of plant diseases our ordinary field crops usually allow for only the cheapest methods of control. This, in turn, demands a most thorough investigation of the insects concerned from the biological and physiological standpoint, otherwise it will be impossible to decide upon the effective method and the effective time of application. The name of Dr. K. Kunhi Kannan whose recent death has been a very serious loss to the agriculture of this State will, I believe, find enduring association with entomological investigations in this State more especially with reference to the devising of methods of insect-control adapted to our conditions. Dr. Kunhi Kannan displayed a real genius and his is a shining example for the entomologist of the future. One of the last problems on which Dr. Kunhi Kannan was engaged was the utilisation of some of the many local fish poisons derived from wild plants in the control of injurious insects. Although we already know that some of these fish poisons furnish very efficient insecticides and that they are present in great abundance in our forests, a very great deal of work remains to be done on such important questions as the particular part or parts of these plants which will yield the effective poison in the greatest quantity, and the most efficient as well as the cheapest method of extraction. I may point out in this connection that an immense amount of work in this direction is at present being carried out by scientists in America.

The future of Agricultural Research.—I have touched upon only a very few of the multitude of scientific problems, that lie before us in connection with the development of agriculture through scientific investigation. If I have not failed utterly in my task, this short review must have impressed you with the fact that a very large number of scientific workers could be

engaged on these problems to the profit of Mysore agriculture. I am not a prophet and am not able to predict what will happen during the next ten years in this State. I think, however, it is safe to say that we shall not have workers at all comparable in numbers and ability to the importance of the problems which face us. This is a rather depressing thought but life has always seemed to me a struggle with almost impossible odds and still we keep struggling. There seems to be one ray of sunshine in the gloom and that is the possibility of mobilizing larger forces than are at present available. These forces need not be confined to the pitifully meagre army of men in the Agricultural Department. I can see no reason why the University should not play a noble part in this work. It may interest some of you to know that a beginning in this direction has already been made and that I hope we shall soon see the Scientific departments of the University through the staff and, also I hope, through graduate students, in steadily increasing numbers actively co-operating in the investigation of important scientific problems connected with agriculture. To the young men of this audience let me say that if you have not yet tasted the joys of adding to the world's sum of scientific knowledge, if you have not yet been thrilled by the thought that you have wrung from the heart of Nature some small secret which no one has heretofore known, you have something of great value to anticipate. To me a small contribution to knowledge upon which can be based a definite advance in the development of agriculture would be a more satisfying monument than any of gold or bronze or stone that has ever been erected.—*The Hindu.*

BRIEF NOTES ON SOME INDIGENOUS OILS

The following brief notes kindly supplied by the Superintendent, Kerala Soap Institute, Calicut, to the Principal, Agricultural College, who forwarded same to us for publication will be read with great interest.

(Ed. M.A.J.)

No.	Name of Oil	Botanical Name	Percentage of oil contents	Uses	Tracts where found
1	Cloves oil.	Eugenia carophyllata	14 to 21% of the dried buds.	Medicine and Perfumery.	In the foothills of the Western Ghats.
2	Mowrah oil.	Bassia longifolia B. latifolia, B. butyracca.	50–55% of seeds.	In soap, candle and chocolate industries.	B. longifolia in Madras and Hyderabad; B. latifolia in Central Provinces, Bengal and Western India; and B. butyracca in Northern India.
3	Pongam oil.	Pongamia glabra	27% of seeds.	For medicinal and illuminating purposes.	Malabar and Mysore.
4	Margosa oil, (Neem oil)	Melia azadirachta	23–30% seeds.	In medicine (anthelmintic and antiseptic) and soap-making.	Malabar, certain parts of Deccan, Bengal and Burma

No.	Name of Oil	Botanical Name	Percentage of oil contents	Uses	Tracts where found
5	Mustard oil.	Sinapis nigra	31–33% of seeds.	As an edible oil and in soap-making.	Bengal, Assam, United Provinces, the Punjab and Sind.
6	Castor oil.	Ricinus communis	46–53% of seeds.	In medicine, soap-making, as a lubricant and for burning purposes.	Madras Presidency (particularly the Ceded Districts), Hyderabad, Bombay and Central Provinces.
7	Maroti oil.	Hydnocarpus wightiana	22 to 30% of seeds.	Soap-making and medicinal (for skin diseases).	Western Ghats.
8	Cashew rind oil	Anacardium occidentale	35–40% of rind.	For preserving carved woodwork books, etc., against insects and white ants.	In the coastal districts of India.
9	Kojum Butter.	Garcinia indica	...	Edible, soap-making and medicinal purposes.	Southern districts of Bombay Presidency, and in the forests of Konkan, Kanara and Coorg.
10	Coconut oil.	Cocos nucifera	63–65% of dried kernel (copra)	An edible oil, illuminant and for soap-making.	Ceylon, the Malabar and Coromandel coasts, Bengal and Burma.
11	Groundnut oil.	Arachis hypogaea	42–44% of the decorticated seeds.	For edible purposes, illumination and soap-making.	Bombay Presidency and the Central districts of Madras Presidency.
12	Sesame oil.	Sesamum indicum	44–50% of seeds.	Do.	Grown generally throughout India, but chiefly in Bombay, Madras, Central Provinces and Burma.
13	Punna oil (Alexandrian Laurel).	Calophyllum inophyllum	50–53% of kernel	In medicine (for rheumatism) for illumination and soap-making.	Western Ghats. Orissa, Ceylon and Burma.
14	Macassar oil (Kusum or Poovath).	Schleichera trijuga	42% of seeds.	As an illuminant and in medicinal and toilet preparations.	In dry and deciduous forests of India, Burma and in Chota Nagpur.
15	Ganja seed oil	Cannabis sativa	15 to 25% of seeds.	For paints, varnish and soap-making and as a lamp oil.	N.-W. Himalayas, Nepal, Simla, Kashmir and Sind
16	Linseed oil.	Linum usitatissimum	37 to 43% of seeds.	For paints, varnishes and soft soaps and as an edible oil.	Behar, United Provinces, Bengal and Central Provinces.
17	Cottonseed oil	Gossypium spp.	16 to 24% of seeds.	For edible purposes and for manufacture of soaps and margarine.	Various parts of India, chiefly, Bombay, Central districts of Madras, Bengal and Assam.