

is to benefit from the progress of modern science the attention of both the expert and the general agriculturist should be directed towards the solution of agricultural problems, with a singleness of purpose in view, and this can only be achieved when the conclusions are based on a sound foundation of facts and of experiment rigidly conducted under varied conditions.

In these days of Scientific alertness and development, no nation can afford to stand alone and it is not impossible for the local department with its capable staff to institute experiments on proper lines to satisfy the requirements of the modern farmer. Self interest as well as patriotism will, we hope, prompt the members of this department which is being steadily officered by Indians to keep to a high standard of efficiency and work out problems to the best advancement of the country. We reiterate that experiment should precede demonstration as it is the solid foundation on which the latter ought to rest.

Paddy work in Madras.—A Review.

Rice is the staple crop of the Madras Presidency. It occupies according to the latest statistics $11\frac{1}{2}$ millions of acres or roughly 40% of the total area under food crops. Rice is grown under more varied conditions than any other crop and hence probably the enormous number of varieties. There are varieties which are grown absolutely dry as in the West Coast and the uplands of Kistna and Godavari, There are varieties which are sown and treated dry in the earlier stages but changed into wet when tanks get filled after the break of the monsoon, as in Nellore and the Nandyal valley. There are again varieties which are grown under well irrigation. Lastly we

have the pure wet varieties which are grown in the deltaic regions, lowlands of Malabar and South Kanara and also under tanks. It is to the last of these that the activities of the Department have been mostly confined. The work of the Department can be classified under the following heads:—

1. Introduction of improvements in the methods of cultivation :
 - (a) economic sowing and economic transplanting,
 - (b) use of improved implements and
 - (c) cultivating the lands in summer.
2. Manures—(a) green manuring and
 - (b) other artificial manures.
3. Choice and introduction of better varieties.

4. Improvement of the local varieties by selection 1. (a) It was the custom in all the southern districts till about ten years ago to use a very heavy seed rate up to about 80 lbs. per acre and to transplant the seedlings in bunches. In 1907 experiments were started on all Government wet land farms to ascertain the number of seedlings to plant in a bunch and also to find the best spacing for planting. It was Mr. Sampson that started these experiments in the Sivagiri Home Farm. They were conducted for a number of years with the result that 20 lbs. of seed was found more than enough to transplant one acre, the seed was to be sown in an area of six to seven cents and the seedlings, to be transplanted singly about six inches apart. A vigorous campaign was soon started in the southern districts to demonstrate this to ryots. Subordinates were sent on lecturing tours with printed leaflets for distribution. The ryot soon realized the profitableness of the method and it soon began to spread. The chief trouble seems to have been the want of men to go about demonstrating this in all places. Otherwise probably the method would have spread much more rapidly than it actually did. Although records were kept about the progress of this work in the earlier years it has now spread beyond the capacity of the department to keep trace. It

does not by any means follow that this method has become universal. Even in the southern districts there are still tracts which follow the old method simply because the department has not been able to do any work there owing to want of staff. In the Telugu country although economic sowing and single planting was always practised in parts of the Kistna delta the practice did not spread to the north. Owing to departmental activities it is slowly spreading north into the Godavari and Vizagapatam districts though not so fast as in the Tamil country. It is only a question of time for the method to become universal in Madras. Even in Malabar although actual single planting is not recommended as the varieties do not tiller well, there is a tendency created to sow the seedbeds thinly and to transplant them in two's and three's. The adoption of this method means a clear saving of Rs. 7 per acre in seed alone exclusive of the saving in labour. The area annually transplanted in Madras is about five million acres and the universal adoption of the method would mean a saving of a very large sum to the country.

(b) Much has not been done in the way of introducing improved implements in the wet land cultivation. The only implement that has been found to be of some use and that has been taken up by the cultivator to some extent is the small iron plough (Sivagiri and Meston ploughs).

(c) While dry cultivation of wet lands is considered good and practised in some parts of the presidency, it is considered harmful in others. Experiments have been conducted for a number of years in Samalkota and Coimbatore farms to see whether the hot weather cultivation has any effect on the succeeding paddy crops. The Samalkota results for a year or two favour the practice while those of Coimbatore are inconclusive.

Second crop trials:—In the Godavari delta the first crop is always of longer duration. It comes to harvest by the end of November or beginning of December. In the double crop lands the second crop is not planted before February on account of the belief that the crop

will not be successful if planted earlier in the cold weather. So the water in the canals is practically made no use of for two months. If the second crop could be planted as soon as the first crop is out of the ground there will be no water trouble towards the end of its growth as is often the case at present ; moreover this would enable a larger area to be double cropped with the water saved. So in the Samalkota farm there was an experiment going on for a number of years to find out a suitable variety which could be transplanted earlier but no satisfactory results were obtained. The Public Works Department authorities are reported to have independently started experiments in the delta with regard to the time of planting the second crop and the results are anxiously awaited.

In many places good cultivators often grow some leguminous crop on the paddy fields in the dry weather. Generally they allow the grain to ripen and harvest the crop but in some places they plough in the whole crop. It was in the year 1908 experiments were commenced in Government farms with several leguminous crops to see if this excellent system was capable of extension and improvement.

In Sivagiri Home Farm good results had been obtained with Wild Indigo (*Tephrosia purpurea*). The green manure crops gave good results in Coimbatore, Palur, Samalkota and Taliparamba Farms. In some cases the yield of paddy was doubled as the result of green manuring. The first campaign of the department about green manuring was started in Tanjore in 1909 with very good results. Ryots do always use some green leaves for manure either collected from adjacent forests if available or from adjacent dry waste lands. This demand for green leaves gradually went up as new lands were brought under wet cultivation as the result of new irrigation projects. The existing forests could not meet with the demand. This matter had come to a head in Madura on account of the opening up of the Periyar tract. In 1911 a committee sat at Madura and recommended the raising of the nominal fees which used to be charged for the removal of leaves from forests to something like the true market value of the manure and the encouraging of ryots to supply their own requirements by

growing crops of green manure on their lands between successive paddy crops. From that time onwards the department started a vigorous campaign of stocking large quantities of seeds of different green manure crops for selling to the ryots where demand for manure was heaviest. This work rapidly increased in the Southern districts, Tanjore, Madura, Tinnevely, South Arcot, Coimbatore, Malabar and Chengleput, and this still forms one of the important activities of the department. The chief green manure crops recommended by the department are wild Indigo, Sannhemp and Daincha, each of them being specially suitable to particular soils and conditions. The last one was introduced by the department from Bengal.

The following statement shows how this work has steadily increased from year to year :—

Year.	1909-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18.
Quantity of seed distributed by the Department in hundreds of pounds.	...	771	780	826	1586	1586	1508	1705	2344.

Besides, in recent years this work is being taken out of the hands of the department, since Co-operative Agricultural Societies and private agencies have taken up the sale of green manure seeds in the south. The department was always having some trouble about getting Daincha seed as it had to depend on the supply from Bengal. But now-a-days ryots are encouraged to arrange to get their own seed.

(d) *Artificial Manures* :—Paddy soils are generally found to be deficient in Nitrogen and Phosphoric acid. With the spread of the practice of economic planting and green manuring a demand for concentrated manures has been springing up in the south. The rise in price of food grains has also been an inducement to go in for expensive manures. Experiments conducted for several years in Samalkota, Manganallur and Coimbatore have definitely proved that an application of some phosphatic manure along with green leaves gives very good results. A small beginning in demonstration with superphosphate as manure for paddy was made in Tanjore and Madura three

years ago and good results have been obtained. At Sirvel, the application of super phosphate for paddy last year has increased the yield by 23%. A large scale demonstration was conducted in the Tanjore Delta in 1918, the manure distributed being a special mixture of fish guano, castor cake, super phosphate, ground phosphate etc., made by Mr. Sampson in the light of the results obtained from the manurial experiments conducted in the Manganallur farm. Although the campaign was not quite a success on account of the almost unheard-of failure of the floods in the Cauvery, which resulted in the failure of the mixture in most of the plots, in the few places where a crop was obtained the success of the manure was encouraging enough and 500 tons of the same manure was stocked last year for selling to the ryots.

There is an ever increasing demand in the Circars for oilcakes. Bonemeal also is being used for paddy to an increasing extent. In 1918-19 over five tons of bonemeal was distributed to the ryots from the Anakapalli farm. The Tanjore Co-operative Manure Society at Nidamangalam has also been useful as it meets the demand to a certain extent for bone meal in the Tanjore delta. There are large deposits of manurial phosphates in the form of nodules in the Trichinopoly district. These nodules have been little used till now owing to the fact that they cannot profitably be converted into soluble superphosphates. But the experiments of the Assistant Agricultural Chemist at Coimbatore and field experiments in the Manganallur farm have shown that this form of phosphate is readily used by the paddy plant. The experiments conducted last year by the Assistant Director of Agriculture, V Circle, in 5 villages in the Attur and Musiri Taluks, have shown that the application of this flour phosphate to green manured fields results in a higher yield of grain. The plots which received the flour phosphate gave less chaff, produced better filled ears, and closerset grains. So there is a valuable supply of phosphates so near the delta, and the exploiting of this is a matter to be taken up seriously by capitalists. Fish manure, being rich in both Nitrogen and Phosphoric acid, has been demonstrated to be very good for the paddy crop. The demand for this manure is rapidly

increasing every year. In 1918 the department distributed 328 tons of this manure in the Fifth and Seventh circles. The increasing demand for this has led to a big development and several depots for storing the manure have been opened on the Malabar coast. Over 700 tons of guano and 22 tons of beach dried sardine were purchased and stored last year for being distributed all over South India.

In the Kistna Delta the ryots use Patimannu, i. e., the earth removed from the old village sites as a manure for paddy. The supply of this is gradually going down and the Department as early as 1909 took active steps to solve the difficulty. The mannu was analysed by the Chemist and suitable artificial fertilisers were made up, and these were demonstrated to the ryots in their fields for a number of years. Widespread interest was created by the demonstration plots and the Presidency Manure Works taking advantage of this, opened manure depots and ryots began to purchase from them. The demonstration experiment was finally closed in 1912.

3. *Choice and Introduction of varieties.* The department did some work in this even so early as 1902-03. Several short duration varieties were obtained from the Central Provinces, Bengal and Bombay, at the instance of the Inspector General of Agriculture in India and tried in Koilpatti and Saidapet farms and on Mr. Chidambaranatha Mudaliar's Estate in the Shiyali Taluk, Tanjore district. Of these the only one which we now find being cultivated to some extent in Madras is *Banku*. *Halki* another of the varieties appears to have been cultivated with success at Gobichettipalayam. Earlier reports of the Department mention *Banku* as a heavy yielder in Samalkota, Saidapet Coimbatore and Tanjore and as particularly suited to high level lands where there is likely to be water scarcity. Samalkota report 1910-11 mentions *Banku* as being a good yielder but having a tendency to split and requiring constant selection to keep it true to the type. Several short duration varieties from the Central Provinces were for a long time under trial in the Palur farm. One chief difficulty in introducing varieties from one place to another is that the change of conditions causes great variations in the crop. The Central Provinces

varieties gradually became longer duration varieties and hence could not stand the test with Sornavari, the local early variety which they were intended to displace. *Rascadam* is the only variety mentioned as one of the promising ones and this has spread to a certain extent as it is specially liked by Mahomedans for its scent. The only other extra-provincial variety besides Banku and Rascadam which has been found to be somewhat good both at Palur and Samalkota is *Sambalpur*, a variety from Bengal. An example from one of the Palur reports as to how a particular variety behaves when sown in different seasons will be of interest. This Sambalpur paddy, when sown in May took 170 days to come to harvest whereas when sown in July came to harvest in 126 days. Several examples may be mentioned from the early departmental reports of some varieties becoming shorter in duration and others longer in duration when introduced from one place to another.

Among the successes achieved by the department in introducing varieties from one district to another, mention may be made of Poombalai and Anaikomban varieties from Tinnevely into South Arcot. Both are definitely of slightly shorter duration than the local Garudan Samba and equally good in yielding capacity. The same Poombalai has done well in Coimbatore also and is definitely of shorter duration than the local Sadai Samba. Although much has not been done in this line, the introduction, acclimatisation and testing of new varieties will always remain a very useful line of work of the department. There are several definite problems which could be kept in view when introducing new varieties. For instance, there is always a cry for a variety which will withstand shortage of water. It is believed it was with this end in view that Banku was introduced into Madras and we should think the work has justified itself as we find Banku thriving as well under well irrigation as, or even better than, in typical wet lands. There is always a keen demand for varieties with special characteristics such as those that will stand a certain amount of alkalinity in the soil, those that will not lodge badly at the time of harvest etc. Their introduction is however complicated by the distinctions drawn by people of different districts between different kinds of rice. The

varieties readily taken by one set of people are unpalatable to another. The markets of different localities have also got to be studied.

4. *Lastly, we come to the question of improvement of local varieties by selection*:—Raising pedigree strains of varieties, the testing of them by careful field trials and growing the best selections on a large scale for sale to the ryots are sure to assume a more and more important place in the work of the department, as we have a Botanist who has been devoting all his time for the last seven years to the study of this one important crop. This is a work which the ryot cannot do for himself as it requires trained judgment and most minute attention to details, besides a thorough knowledge of the crop. Of all the work of the department this has the special advantage in that there is never any real difficulty in making the cultivators buy good seed. Selection of seed had been practised to some extent in all Government farms ever since they were started. A large number of single plant selections of the important varieties had been made and studied in the Samalkota farm for a number of years. Reports show that most of these had turned out splitters, being most probably natural crosses, while the few that proved constant, have, after some years' trial, been distributed broadcast to the people to their immense benefit. Similarly, in Palur also, single plant selections from Garudan Samba, the important local variety, were made and studied. One of these, named later Ramagarudan Samba, has after a series of trials proved very good and has been distributed to the ryots since 1914--15. This has spread so much that there is no other crop of Garudan Samba except of this strain in a number of villages round Palur. The Deputy Director of the circle mentioned in his report that farm supply having become inadequate, a beginning had been made to teach the ryots how to select their own seed. This year some members of the co-operative societies in four of the villages in his circle, have adopted this method with the result that five cart loads of Ramagarudan Samba seed have been selected and kept with the ryots for distribution in the coming season in addition to what has been stored in the Palur Farm.

The selection of single plants, studying them separately for a number of years and picking out the best for multiplication and distribution is, though slow, the surer and better method. Where we cannot afford to wait we can pick out good heads true to type in the standing crop before harvest, to give enough seed for the bulk crop of the next year. This is what was adopted in the Manganallur Farm although single plant selections were also done side by side, but most of the single plant selections did not prove in the end as good as the bulk selected seed. The demand for good seed is probably nowhere so keen as in Tanjore. The ryots who grew the Manganallur-Farm-seed have reported that the yield was heavier, the ripening more even and that a better price was obtained for it. The demand was so great that a system of seed farms for the multiplication of seed was taken up last year. The statement II gives an idea about the amount of work done by the department in this line:—

Years.	Samalkota.	Anakapalli.	Palur.	Manganallur.	Total.
1909-10	8000	...	8000
1910-11	13960	...	9140	...	23100
1911-12	16293	...	13960	...	30253
1912-13	21197	...	7072	...	28269
1913-14	20617	...	5957	...	26574
1914-15	21200	920	9595	...	31715
1915-16	20765	1476	20162	70990	113993
1916-17	28334	4032	11866	(over) 80000	124232
1917-18	55412	17009	21734	whole crop	94155
1918-19	68252	17944	20723	do.	106919

does not include seed distributed from the Manganallur Farm.

N. B. Quantities in pounds.

Besides the above large quantities of seed were sold out from the Coimbatore and Taliparamba farms. Of late, the quantity distributed in the Coimbatore District of the strains evolved at the Paddy Station has been rapidly increasing.

Let us now see what the Government Economic Botanist has done to this crop. He is in charge of a Paddy Breeding Station at Coimbatore. The work here began with the study of the inheritance of characters in rice. The results of his work have been of great scientific importance and some of these results have already been published as memoir. As a result of this study several important connections between the vegetative characters and such economic factors as size and shape of the grain, colour of rice, duration, etc., are being brought to light. Side by side with the study of characters he is doing single plant selections in some of the important varieties and comparing them for yield. As a result of several years' experiments on the probable error involved in making comparisons for yield, a system has been adopted in which the several strains under comparison are sown in strips 50 feet long and 4 feet wide with one foot between strains, each series being repeated not less than eight times. This means reduces the probable error of comparing any two strains to 2 to 4 per cent. Two of the strains Nos. 24 and 91 passed the stage of final trial and are being distributed in the Coimbatore district. The strain No. 91 is a selection from Poombalai. In yield this has been found to be as good as the local varieties, and is definitely of shorter duration. Its spread would mean a cutting off of the paddy season to the Coimbatore, ryot by nearly a fortnight. The strain No. 24 is only a 4½ month's variety, has a very fine white rice, gives a higher percentage of rice to paddy than other varieties and does not at all shed even after it is dead ripe. It has this further advantage in that the Mycologist has pronounced it to be a Blast resistant variety. Further selections have been derived from a cross with No. 24, one of which No. 1303 was found to be even 16% better than No. 24 last year. It is hoped that after further trials this will be available for distribution. Besides these numerous varieties from all over the presidency are also grown in the Paddy breeding Station, and pure lines of this collection are far from complete yet. This line of work is no less important, as the greater the number of pure cultures of known characters the easier it is to select what is wanted for different purposes.

In addition to the work at Coimbatore he has been doing selection work for the Tanjore Delta in the Manganallur Farm. One of his strains of Red Samba has, as a result of three years' very careful trials, shown itself to be consistently 16% better than the farm seed which itself is probably superior to the ordinary seed used in the delta. This was grown by the department last year over 40 acres under seed farm conditions and the Assistant Director mentions in his 1919 report that 32,000 lbs. of good seed have been secured for distribution during the coming season.

The work of the Botanist does not by any means stop with evolving good strains and making these available for distribution. When once a strain is distributed broadcast, it is sure to deteriorate after some years owing to natural crossings and mixing up with different varieties. Moreover when once a strain has been obtained it does not follow that it will always remain the best. Further selections might bring out a strain even better than this. So, this work of selection has got to go on continuously and a steady stream of fresh seed, to pass out every year from the breeding center to the seed farms.

In this connection any work done in Coimbatore is only preliminary and strains evolved there would be suitable only for the locality round about. The fact cannot be lost sight of that any work intended for a particular tract should be done in that tract. The yields in one place under particular soil conditions are no criterion that the crop will prove as satisfactory in another place with different conditions. So when the work of soil and climate of the Botanist expands, as it has already shown signs of doing, we expect there will be opened paddy sub-stations, one in each of the representative paddy tracts and selection work undertaken. It is there that the study of definite problems connected with the locality can best be undertaken.

Improvement of varieties by hybridization is another useful line of the Botanist's work. Artificial crossing in paddy is a very difficult and delicate operation. A beginning has already been made in this direction and valuable results are expected.

The potential worth of the Botanist's work can be realized when one remembers that the value of the paddy crop in Madras is over 60 crores of rupees.

Oryza.

Extracts.

A Hundred Acres.

WHAT I WOULD DO WITH IT.

AN F. M. S. PLANTER'S VIEW.

In setting forth the following observations I have in mind, of course, the case of the fortunate son of Mars to whom a grateful country has apportioned on easy terms a grant of a hundred acres of agricultural land, together with sufficient funds to plant it up and keep it in good order until it brings in an income. My remarks however, apply equally to any one intending to plant up a piece of land in Malaya, and either a single hundred or many hundreds of acres in extent.

BAR SWAMPS.

Let us take it that the returned warrior is privileged to select his holding himself. If he is a wise man, he will avoid flat, swampy ground, realising that, even after spending much money on drains and their everlasting upkeep, the rubber trees that land of this nature grudgingly supports are not generally unhealthy but, having insufficient root-hold, are liable to be blown over by a capful of wind. There is already far too much swamp land in Malaya planted with Hevea, and it is distressing to see acres and acres of trees that have been planted on land that is suitable for nothing but paddy growing, propped up with poles to prevent them from toppling over. Not only are rubber trees planted in swampy ground unhealthy themselves, but they are the prime cause of disease and deterioration throughout the Peninsula.