PADDY.

LOWER BURMA PADDY AND ITS IMPROVEMENT.

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Out of approximately 11¾ million acres of paddy land in Burma, 9 millions are in Lower Burma, and from this area are drawn the supplies for the large rice export trade which is such a feature of the province. Efforts to improve this crop, which occupies over 90 per cent. of the cultivated area, were commenced in 1912 when an Agricultural Experiment Station was opened at Hmawbi, 30 miles north of Rangoon, and the present article is a sketch of the work carried out at this centre so far as varietal improvement is concerned; the work done on cultivation and manurial problems has been left over to be dealt with on some future occasion.

So far Hmawbi has been the only centre dealing with the Lower Burma rice crop, but two new stations are now being opened, one at Myaungmya in the Delta and the other near Moulmein, to take up the work connected with the paddies of those tracts and arrangements have been completed for both stations to commence operations this year. No consideration has been paid here to the paddy of the Arakan Division which occupies one million acres, but an experimental station was opened at Akyab two years ago and should shortly be in a position to issue improved varieties for that area.

In an article in the *Agricultural Journal of India* in 1913 Mr. McKerral outlined some of the problems, and the steps it was proposed to take to improve Lower Burma paddy. This work has been carried out at the Hmawbi farm, and contact with the rice milling industry has been maintained through the Burma Chamber of Commerce to whom samples of improved seed have been sent from time to time for opinion and valuation. Reference was also made to the Imperial Institute in 1916-17 when the Indian Trade Enquiry was in progress, and samples submitted to the Special Committee enquiring into the rice trade. The report received indicated clearly the lines of improvement which should be followed with regard to Burma rice. Burma rice is a good all round rice for which there is a large and stable market, but it has faults which are best removed by improving the varieties already grown, rather than by the introduction of so-called superior varieties from other countries. The possibility of establishing varieties from other countries has not been lost sight of, however, and there is grown at Hmawbi a collection of the best rices from all the chief rice growing countries. These so far have not been very successful, and have failed to establish themselves satisfactorily under local conditions. They have been used for crossing indigenous paddies, and although many interesting products are even now under observation, nothing of definite value has yet emerged from this line of endeavour. The work of improving the local varieties *has* produced results, however, and there are

several improved strains in distribution which have met with favour in the eyes of the cultivator and miller, and which are yearly spreading into new and wider areas.

Types and Varieties of Lower Burma Paddy.

One result of the large milling and export trade in rice from Burma is that the number of varieties grown is comparatively small, and bears no comparison, for example, with the innumerable varieties grown and known in Bengal: names of varieties are numerous enough but many of these are synonymous and others are applied to paddies which differ little, if at all. There is quite a number of distinct paddy varieties, however, which vary in one important respect or another, and, as some form of classification was found essential, they have been divided into five main type groups to which nearly all the Lower Burma paddies can be referred. These types are known as Emata, Letywezin, Ngasein, Midon, Byat, and can in most cases be readily distinguished by inspection, the shape of the grain being more or less outstanding. In new or doubtful cases, actual measurement of the grain is made and the type decided according to the following table of dimensional limits.

Group Index	Group Name	Dimension of Grain			
		With Husk		Husked	
		Length mm.	$\frac{\text{Length}}{\text{Breadth}}$	Length mm.	$\frac{\text{Length}}{\text{Breadth}}$
		Over	Over	Over	Over
A.	Emata	9·40	3·30	7·00	3·00
B.	Letywezin	8·40 to 9·80	2·80 to 3.30	6·00 to 7·00	2·40 to 3·00
C.	Ngasein	7·75 to 9·00	2·40 to 2·80	5·60 to 6.40	2·00 to 2·40
D.	Midon	7·35 to 8·60	2·00 to 2·40	5·00 to 6·00	1·60 to 2·00
E.	Byat	9·00 to —	2·25 to 3·00	6·40 to 7·35	2·10 to Awnless 2·50
		— to 11·25	2·80 to 3·40	7·30 to 8·15	2·60 to Awned 3·00

A grain broad in proportion to its length is described by millers as a "bold" grain which suffers less breakage in milling, and this character is indicated by the $\frac{\text{Length}}{\text{Breadth}}$ factor: A and B are thin grains and the other three are "bold."

These five types have other distinguishing characters which are equally important, and a few are given below.

A. Emata has a long slender grain with the apiculus prominent and often curved. The grain is linear in shape and the kernel translucent.

B. Letywezin has a slender grain with the apiculus prominent but not curved. The kernel is slender and translucent.

C. Ngasein is a bold short medium grain with a prominent apiculus not curved. The shape is obovate and the kernel translucent, but often with abdominal white.

D. Midon is a short round bold grain with a rounded apiculus and no beak. It is usually more or less hairy and the kernel is opaque and chalky.

E. Byat is a large broad grain with a rounded apiculus, no beak and usually hairy. The kernel is opaque and chalky.

Each of the above groups is divided into early, medium, and late maturing classes, with life periods of under 150 days, 150 to 170 days, and over 170 days, respectively. There are differences in the morphological characters of the plants themselves which need not be detailed here, and it may also be noted that all the above rices are non-glutinous: glutinous rices mostly of the Emata type form a class by themselves.

These groups correspond more or less with the distinctions recognised in milling practice, although there are varieties of rices in each of these groups with special characteristics, and their own commercial names.

Faults of Burma Paddy.

The faults in Burma rice which require remedying have been detailed often enough and need only be briefly summarized.

The chief of these are (1) presence of red grain among the white, (2) lack of uniformity in size of grains, (3) excessive breakage, and (4) the presence of awns.

From the miller's point of view what is required is a bold grain of regular size, free from red grain and awns, and which gives a high percentage of whole unbroken rice when milled. In a country where more than half the rice crop is exported, the grower's requirements coincide with the miller's, but in addition, the cultivator wants a hardy crop which will resist weather and insects, and produce a high yield of grain per acre.

Red Grain.—There are varieties of rice in which the outer coat or testa of the kernel is wholly red, and since the average white crop consists of a mixture of varieties, red grain is usually found present from about six per cent. upwards. To remove this red colour, excessive milling is necessary, and the white grain suffers breakage in the process: the effect of this is shown by the following figures supplied by the Burma Chamber of Commerce.

(1) Outturn from 100 baskets mixed red and white paddy milled into No. 2 quality white rice.

21·83 baskets	... ...	No. 2 white rice
17·72 baskets	... ...	Broken rice
10·77 baskets	... ...	Bran

* The village basket used throughout the country is a variable measure but is approximately of nine gallon capacity and contains from 48 to 51 lb. unhusked grain or paddy. The basket used by Rangoon millers is a standard 9-gallon measure with a basic weight of 46 lb.; paddy weighing more than 46 lb. is paid a poundage premium. The basket of husked rice is a fixed weight of 75 lb.

(2) 100 baskets good Delta paddy nearly all white milled into No. 2 quality white rice.

29·16 baskets	... ...	No. 2 white rice
11·49 baskets	... ...	Brown rice
8·5 baskets	... ...	Bran

The mixture of red grain with the white has led here to a loss of 7·33 baskets of white rice.

Even when all the red skin has been milled off, a pink tinge is retained by most of the red rices, and although there is a limited market for red rice, white rice is the main requirement of the home and export trade. In some countries, red rice is definitely regarded as a weed and treated as such.

Uniformity.—Unevenness of grain size is another serious drawback from the miller's point of view: to mill the small grains the large grains must be over-milled and needlessly broken. Here again the trouble is traceable to the mixed nature of the crop as ordinarily grown. Absolute uniformity of grain size is not attainable; because on the same plant the grains vary slightly in size at the top, middle, and bottom of the ear; but these variations are not important and the real trouble arises when grains of widely differing sizes have to be milled together.

Breakage.—All rice kernels are brittle to some extent but some are much more so than others, and since whole rice is more valuable than broken rice, the grain is required to be as tough as possible to resist breakage. In testing new strains, some are found which crumble and break very badly under impact, and others which withstand the husking and polishing processes exceedingly well. Considerable importance is attached to this feature.

Awns.—Awned varieties are not popular in Lower Burma with either the miller or the cultivator and they are not nearly so common as awnless varieties: they are awkward to handle, and the awns impede the milling processes

Improved Varieties.

While, as has already been mentioned, crossing and the introduction of exotic varieties have not been neglected, the method of improvement adopted at Hmawbi has been principally single line selection. There is a large amount of material to work on in the mixed paddies of the country and the results achieved so far have been distinctly encouraging: a large number of strains has been handled, as many as five hundred in a single year; and a series of superior strains has been evolved adapted to suit varying conditions.

In Lower Burma, rice is almost entirely rain fed with little or no irrigation, and on an average holding of 25 acres the cultivator finds it necessary to sow two or often more varieties of rice, to suit high, medium, and low lying fields, respectively, although the difference in levels may only be a matter of inches.

The higher lying fields are planted with the shorter lived varieties such as Letywezin; the medium fields with varieties of Ngasein; and the low lying fields with the longer lived Ngaseins, Midons and Byats.

There is no need for a very large number of varieties, however, and the seven which are now distributed from Hmawbi are suitable for most conditions. The following table gives their life periods and other useful data. The life periods vary slightly from year to year and place to place according to conditions, but are averaged out here and show the relative positions of the strains to one another:

Variety	Life in days.	Dimensions						Grains per year	8 gallons bushel weight of paddy	Per cent. whole rice ex paddy	Weight of 100 Grains		Husk
		Paddy			Rice						Paddy	Rice	
		Lth	Bth.	Thk.	Lth.	Bth.	Thk.						
		mm.	mm.	mm.	mm.	mm.	mm.		lb.		grm.	grm.	%
A. 16-34	150	9·78	2·74	2·40	7·09	2·25	1·79	231	43	45	2·88	2·21	23·3
B. 15 1	160	8·90	3·05	2·19	6·48	2·63	1·95	230	47	53	2·68	2·15	19·8
C. 14 31	150	8·56	3·27	2·32	5·95	2·77	2·05	344	46	42	3·09	2·45	20·7
C. 19-26	170	8·98	3·32	2·20	6·33	2·83	2·04	177	48	52	3·00	2·38	20·8
C. 14-8	180	8·38	3·30	2·20	6·07	2·78	1·91	299	48	59	2·93	2·33	20·5
C. 15-10	190	8·85	3·37	2·39	6·36	2·91	2·09	175	48	50	3·16	2·50	21·1
D. 17-88	170	8·40	3·77	2·47	6·27	3·32	2·13	177	49	59	3·61	2·87	20·5

Emata is practically confined to one district, Prome, with a rainfall of 45 to 50 inches, but it grows very well further south at Hmawbi with a rainfall of 95 ins. It is a fine long grain and the demand for it in Rangoon is said to be growing, especially for parboiling. There are seven local varieties of Emata, but A. 16-34 is a representative of the heaviest yielding and most robust type, which, if required, can be grown over a much bigger area than at present.

Letywezin is a type of paddy which is widely grown in Insein, Tharrawaddy, and parts of Pegu Districts, and B. 15-1 is a good example of the best type. It is not so strong in the straw as it might be, but is a good hardy plant, yields well, and mills into a good quality rice. In the localities where it is grown the rainfall is usually between 70 and 90 inches.

Ngasein is grown all over Lower Burma and is the principal variety of rice exported, especially to western markets. It has a bold translucent kernel and is mostly milled into white rice. For local consumption the softer varieties of Midon are preferred, and Ngasein rice sells cheaper in the bazaar. There is a larger number of varieties of Ngasein than of any other type, and they vary widely in appearance and length of growing period. They predominate, however, in the wetter parts of the country with a rainfall of 80 to 130 inches, although they are also found in the dry zone irrigated tracts, and some of the shorter lived varieties in districts of lesser rainfall.

Four varieties of Ngasein are distributed from Hmawbi suited to different conditions. C. 15-10 is a long lived variety which does best in the Delta districts of Myaungmya, Maubin and Pyapon: it has a fine large clear kernel and produces the best rice of any of the Ngasein varieties, fetching also a better premium. The demand for it, however, is limited, since owing to its long growing period, it does not produce a full crop if the late rains are poor. Given suitable conditions it is capable of higher yields than any other variety and averaged at Hmawbi one year 75 baskets per acre over 20 acres. One grower in Hanthawaddy District reported a few years ago a yield of 93 baskets per acre from this variety. This, however, is exceptional, and, as already stated, the variety is only in limited demand since it requires specially favourable conditions for its successful growth.

C. 14-8 is a more adaptable paddy, and is more widely grown than any other variety. The growing plant is erect and compact in habit, and grows slowly in its earlier stages. This latter feature probably accounts for its being attacked in some districts by the stem borer. The yield is good, however, and the rice excellent although not so large as No. 10.

C. 19-26 is a new variety which was only distributed in any quantity for the first time last year. It meets the ever growing demand for earlier maturity, and it combines this with a yield which is higher even than No. 8 and a rice which is equally good. The plant itself is tall and handsome, with a strong straw, and grows well all over Lower Burma. Tests in all districts in the Southern Circle have given consistently high yields, and this strain is likely to become the most popular in the near future of all the varieties being distributed.

The last variety of Ngasein is C. 14-31, an older variety which matures very early but produces a rice inferior in quality to that of the others mentioned: it is comparatively soft and breaks more readily in milling. The plant grows strongly, and is much appreciated in Henzada District where it is still distributed in fair quantities, although in other districts it is now no longer recommended.

The old Midon varieties such as Bawyut were mostly awned and fairly long lived. Of recent years shorter lived varieties have been coming into favour and D. 17-88 is an example of the best type called Kamakyi. It is awnless, early maturing, a good yielder, and mills into a fine white opaque rice. The distribution of this seed is confined to Delta districts and has not made as much progress as that of other varieties.

General Characters of the Improved Paddies.

Yield.—From the cultivator's point of view the chief value of a variety of paddy depends upon its yield per acre, and in the second place, on the price he can get for it compared with others. In selection work this consideration is kept very largely in view, but where the quality of the grain is very inferior even high yielding strains are discarded for those which have better all round qualities. The varieties now in distribution are all good yielders, and are better in this respect than the ordinary varieties grown by the cultivator. The following is a typical example of the difference in yield between the local and improved seed. One of the commonest Ngaseins grown by cultivators round Hmawbi farm was Ngakyauk; tested against C. 19-26 of similar life period last year, the average result of a number of plots was—

	Outturn per acre		Whole rice in milling
Ngakyauk	lb. 2,519	...	39 per cent.
Ngasein, C. 19-26	lb. 2,854	...	53 ,,

This shows an increase in yield of over 6½ baskets per acre and although much higher increases have been recorded frequently, it is fair to assume that in cultivators' hands the improved varieties yield 4 or 5 baskets per acre more than their own.

Milling qualities.—Having secured a good yield the next thing is to satisfy the miller. The method of improvement followed corrects most of the faults; red grain and awns have been eliminated; and fairly even uniform grain has been produced which does not break excessively in milling. The practical effect of these improvements is indicated by the following extract of a letter from Mr. Edwards of Steel Brothers, one of the largest milling firms in Rangoon:—

"I milled 2,963 baskets of 46 lb. each into No. 2 rice obtaining 36·4 baskets of rice of 75 lb. The average milling result on No. 2 rice is about 32 baskets of rice. This shows that No. 10 paddy is a very fine milling grain due to the fact that it is pure and white." The paddy referred to was C. 15-10.

Up-country, where a small 15 acres seed farm run by the Agricultural Department has been distributing pure seed since 1918, a questionnaire was sent to the four small mills operating in the town near by. The replies received show that there has been a grading up in the quality of the paddy sent in for milling from the district served by the seed farm. The outturn of white rice per 100 baskets of paddy of the quality milled by these small mills used to be 40 to 41 baskets, and is now 42 to 43 baskets (75 lb.). The paddy sent in is not pure improved paddy, but is still diluted with a considerable quantity of the older varieties. These examples are typical and might be multiplied *ad lib.*

In cultivators' hands, the new varieties become mixed with the older in the transplanted fields and on the threshing floors, but the grading up process is continuous and progressive.

Premiums of from Rs. 5 to Rs. 20 per 100 baskets are paid for improved paddies by the small mills, depending upon the state of purity for admixture of the paddy as it reaches the mill.

Adaptability.—Varieties of paddy which only grow well in special localities would be useless for the purpose of a general improvement of the crop throughout the country. Life period is a most important factor, and, as already mentioned, different varieties have to be selected to suit water conditions and length of the growing season. When this has been done, however, other conditions are of comparatively little importance. Ngasein 10, for example, grows well in acid soils in Lower Burma with a pH value of 6·1; in the dry zone district of Minbu under irrigation, where it is the only improved seed distributed; and in Mandalay on alkaline soils with a pH value of 8·1. There are certain broad distinctions which must be observed; Emata is practically confined to Prome District; Midon varieties are only grown extensively in Delta districts; and Byat varieties do not flourish outside the district around Moulmein. Apart from these considerations, however, the few improved varieties at present distributed from Hmawbi are suitable for the whole of Lower Burma; they have been carefully tested in every district and have invariably done well.

Methods of Seed Distribution.

The central farm at Hmawbi is the original source of all improved seed in Lower Burma. In each district, there are either Government seed farms, private seed farms or both, and these, drawing their seed from Hmawbi, multiply it for local distribution. The Government seed farm is either worked by an Assistant or rented out to a tenant on terms which ensure the production of first class seed only; this seed is distributed to private seed farms, co-operative societies, and individual cultivators. Private seed farms are owned by private individuals who take their seed from the central farm, and if, after examination, their crop is sufficiently pure, it is certified, and they sell it as seed to other cultivators. There are no seedmen in the western sense of the term, and the difficulty of maintaining seed pure in the cultivators' hands is a real one. Through carelessness, pure seed is mixed with others on the threshing floors; groundkeepers of the previous crops come up and contaminate the new seed; and in brokers' hands pure and impure paddy is mixed indiscriminately.

One way out of the difficulty is to make pure seed more readily available, and in larger quantities. With this object in view a number of new Government seed farms are being opened this year. In the Southern Circle, thirty-one of these farms of from 40 to 100 acres each, and totalling 1,500 acres, are being established throughout the districts, and these should form new and really reliable centres from which pure seed can be obtained. A further scheme has been sanctioned whereby at the more important centres larger seed farms of 200 acres each with seed storage accommodation are being opened, to be worked by tenants under the direct supervision of a Senior Agricultural Assistant: there are 10 of these farms projected for the province of which 5 are in Lower Burma.

By these means larger and still larger supplies of improved seed will be made available in the districts with a consequent continuous grading up in the quality of the main crop. Cultivators throughout the country are coming to realize the advantages of planting better seed, and the amount of seed sent out from the Hmawbi farm has grown steadily in recent years.

	Baskets
1921	2,406
1922	3,063
1923	3,783
1924	3,972
1925	7,369
1926 (Indents)	8,350

The total recorded distribution last year, including seed farms in the Southern Circle, was 24,652 baskets. One basket is sufficient to plant out one acre. The limit of pure seed production at Hmawbi has nearly been reached, and, as already indicated, effort is being concentrated on creating larger supplies in the districts themselves, where also distribution costs are less.

As pure seed distribution continues the task of keeping it pure in the districts becomes progressively easier as the old mixed varieties are gradually replaced; but there is a long way to go before the whole crop is brought up to the standard possible, and red and uneven grains eliminated.

It is impossible to give accurate figures for the acreage at present sown with improved seed, for a considerable amount of distribution of seed takes place among the cultivators themselves of which no record is available. Estimates from the districts, however, show that there is an area of 100,000 acres planted with almost pure seed, and a greater area with seed which has been mixed to a greater or lesser extent with local varieties.

Small mills, of which there is a large and increasing number in country districts, invariably pay premiums for even small quantities of pure paddy, but for paddy bought and mixed by travelling brokers for the big mills in Rangoon, Bassein, etc., it is more difficult to get full value for a good sample. Big mills maintain that they cannot afford to pay premiums for lots of less than 10,000 baskets, but even here there is a growing differentiation between the prices paid for ordinary and improved paddies. Efforts are being made to encourage the joint sale of their improved produce by co-operative societies direct to the big mills, cutting out the brokers entirely, and a successful beginning has been made with the societies around Hmawbi farm where a joint sale was carried out this year to a Rangoon mill with complete satisfaction to all concerned.

With such a large area under rice in the province, the present area sown with pure seed is a comparatively small proportion of the whole, but the progress of improvement which was at first slow is gradually gaining strength; district staffs are being strengthened and new seed farms are being opened in all directions; millers and cultivators are growing in their appreciation of the new and improved varieties being placed at their command.

Nothing encourages the production of improved paddy so much as the certainty that a higher price will be paid for it, and buyers of paddy can do much to encourage improvement in this way.

A great deal of steady progress has already been made towards the general improvement of the Lower Burma paddy crop, and although much more still remains to be done, the measures now being undertaken to increase the supply of pure seed should result in greatly accelerated progress in the future. The search for new and still better varieties of paddy is being actively continued and many problems connected with the cultivation of the crop still remain to be solved; but given time, there appears no reason why the whole of the Lower Burma crop should not reach a higher standard than it at present attains.—*Agricultural Journal of India, Vol. XXI., Part IV.*

DISEASES AND PESTS OF RICE IN THE NETHERLANDS EAST INDIES IN 1925.

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Atjeh and Dependencies.

In Geumpang so much damage was caused by rats that the crop failed almost completely, and the importation of rice from Sigli and Tangse was necessary. The second plantation too, of fast-growing varieties, was severely threatened. Only by organised driving and poisoning on a large scale was it possible to protect the major portion of the crop. The total damage, estimated at about 56 hectares may perhaps not be great, but, for an outlying and thinly populated area such as Geumpang is, the damage is very considerable.

Besides, in the whole of Pidie and the North Coast much inconvenience was caused by rats and wild boar. Against both these pests the cultivators used phosphorus paste which is supplied to them through the Agricultural Intelligence Service.

In December 'hama-wereng' (*Cicadillidae*) infestation was identified in the young plantations on Sumatra's East Coast and also in Indi and Perlak. Eight days later this infestation assumed the proportions of a severe pest that spread over the whole East coast and a portion of the North coast.

On the East coast of Atjeh, as a result of severe floods occurring in the sub-divisions of Tamiang, Langea and Indi, many plantations were destroyed.

Sumatra's East Coast.

In the lowland marsh fields of Sisir Goentoeng and Pangkalan Brandan *Cicadillidae* appeared, but not so heavily as in Atjeh.

The very wet autumn caused flood damage in the Tebing-Tinggi area.

Tapanoeli.

Root rot was generally prevalent, but nowhere was the damage of importance.

'Hama-poetih' (fam. *Pyralidae*) too was widespread. In most sub-divisions the infection was not serious; the Plateau of Toba sub-division was,