

varieties, suited to each tract, the group with pithy stalks and sweetness seems to have had the best survival value. In favoured areas, juiciness and sweetness have gone together. The other two groups lacking sweetness have practically gone to the wall. They might linger in odd unfavourable areas, or as stray plants in a bulk crop.

In the breeding work on this line it has been noted by Hilson, that pithy stalks (white midribs) are a simple dominant to juicy stalks (dull midribs). Experiences at the Millets Breeding Station are in conformity with this. The extraction of juice was 17 to 20 per cent. in pithy stalks, but 33 to 48 per cent. in juicy ones. In families pure for juiciness, simple monohybrid segregations have been obtained for insipidity and sweetness, the former being dominant. Similarly in pithy varieties simple monohybrid segregations for insipidity and sweetness have been experienced. Analyses, kindly made by the Chemist, showed that the difference in Brix value between sweet and insipid was about  $3\frac{1}{2}$  per cent. and the sucrose content kept up a similar difference. The insipid stalks had a greater amount of chlorine in their sap. In one instance, a di-hybrid segregation, proving the independent inheritance of these sets of characters, was also noted. It will thus be seen that there are two separate sets of factors determining juiciness and sweetness and they can be combined independently. Naturally, this genetic possibility of combining desirable characters will be conditioned by soil, climatic, and economic considerations, as grain production is also involved. Endeavours to build up both juiciness and sweetness into varieties that lack these characters, without impairing their grain yield, are in progress at the Millets Breeding Station.

### Discussion.

Rao Sahib T. V. Rajagopalachari referring to the author's remark that the pithy sorghum was predominant in dry areas, wanted to know why it was that in the Deccan, which was quite dry the sorghum found was juicy.

Rao Bahadur G. N. Rangaswamy Ayyangar replied that in the Deccan the proper climatic factors prevail for the good growth of *S. cernuum* which gives a good grain along with sweet juicy fodder. All areas can grow pithy stalks, but only select favoured areas can have juicy stalked grain sorghums.

## INCREASING THE YIELDS OF GROUNDNUTS.\*

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**Introduction.**—The groundnut crop in Madras occupied, in 1932-33, about 9 per cent. of the total cultivated area. Madras has the distinction of being the biggest producer of groundnuts not only in India,

\* Paper presented at the Twenty-fourth Agricultural College day and Conference, August 1935.

Contribution No. 7 from the Oil Seeds Section, Madras Department of Agriculture.

but also in the world. The average area under the groundnut in Madras is 33 lakhs of acres for the period 1928-29 to 1932-33.

During the same period, the exports of groundnuts from Madras Ports averaged to 4.96 lakhs of tons valued at 9.55 crores of rupees. Through the exports of groundnuts, the people in Madras obtained, on an average, Rs. 2 per head of population. Taking the average yield per acre as 7 cwt. of kernels and assuming that the market value is 25 per cent. less than the export price, the average production in Madras is worth about 16 crores of rupees, or equivalent to the budget amount for the Madras Government for a year.

The groundnut crop is one of the important money crops, and it provides cash to the producers in areas where other money crops cannot be grown easily. The capital required for the cultivation is small and, therefore, the crop is cultivated by the poor and the rich alike. In some areas, as in Kurnool, the groundnut is an alternative money crop with cotton. When the prices of cotton are low, the farmers grow more of groundnut.

**Varieties.**—The area under the groundnut in Madras expanded steadily between 1850 and 1890. By about 1898 the "indigenous" variety was said to have deteriorated, and a variety called *Mauritius* was introduced from Mozambique. This variety is even now largely cultivated. This *Mauritius* variety has a spreading habit and requires about 125 days to ripen from the time of sowing. The bunch variety which is commonly cultivated is about 30 days earlier in duration and can also be harvested more easily but it yields comparatively less. From 1899, the Department has been importing foreign varieties for trial but none of the imported varieties proved superior to those already cultivated in India. In the consignment of varieties obtained in 1930, a variety known as *Saloum* was obtained from West Africa. It has been, in subsequent years, carefully compared in yields with the local *Mauritius*. This *Saloum* (A. H. 25) variety yields on an average 25 per cent. more than the local *Mauritius*.

**Table I**  
*Yields of Saloum.*  
(Agricultural Research Station, Palakuppam)

Years	Acre yields of pods		Percentage increase over local <i>Mauritius</i>
	local <i>Mauritius</i>	<i>Saloum</i>	
	lb.	lb.	
1931—32	1,151	1,752	52.3
1932—33	1,410	1,784	26.4
1933—34	1,187	1,495	26.0
1934—35	1,650	2,000	21.0

In 1933—34 & 1934—35 seasons district trials were carried out with the *Saloum* variety at 33 centres. The results of these trials show that it has yielded much more than the local *Mauritius* in 22 centres. The increase in yield in the majority of centres has been over 20 per cent

(Table II). Moreover, it was reported to be drought-resistant. The kernels of the *Saloum* variety are plump and "bold" and generally better in appearance than the kernels of the local *Mauritius*. On the basis of these trials, the *Saloum* variety may be said to suit the conditions in the districts of South and North Arcot, Salem, Chittoor, Trichinopoly and Guntur. So far, in the districts of Bellary, Kurnool and Anantapur, it has not given any definite increase over the local *Mauritius*.

**Table II**  
Results of district trials with *Saloum*.

District.	Percentage yield increase over local <i>Mauritius</i>	
	1933-34	1934-35
	From To	From To
Salem	31-40	12-66
Chittoor	147	...
North Arcot	28-50	...
South Arcot	16-26	29-61
Guntur	20	23
Trichinopoly	24	...

So far no other bunch variety or any selected pure line has proved superior to the local bunch variety. The available variation in the bunch varieties appears to be less, and therefore a programme of hybridization has been taken up with this.

**Seed rate.** The quantity of seed required to sow an acre, varies with the nature of the soil, the season and the variety. Generally the rainfed crop requires more seed than the irrigated crop. The sowings on red soils require more seed than on black cotton soils. Late sowings require more seed than the early sowings. More seed is required for the bunch variety than for the spreading variety. The results of the experiments carried out during five years at the Agricultural Research Station, Palakuppam, show that where the crop is sown in July-August, the proper seed rate for the spreading variety would appear to be about 60 lb. of kernels per acre and for the bunch variety 100 lb. of kernels per acre. The results are tabulated below:—

**Table III.**

Yield in pods per acre for various spacings (in lb.)

Years.	Spreading variety—Madagascar variety.					Bunch variety.			
	12" x 12"	12" x 9"	9" x 9"	9" x 6"	6" x 6"	9" x 9"	9" x 6"	6" x 6"	6" x 4"
1928-29	1278	1361	1375	1361	1358	1436	1517	1594	—
1929-30	837	963	1025	1137	1108	443	567	717	777
1930-31	679	750	867	1021	1133	790	1023	1197	1300
1931-32	1241	1374	1419	1436	1593	368	348	325	357
1932-33	1309	1467	1545	1521	1585	901	1108	1289	1375
Average	1069	1183	1246	1295	1355	768	913	1024	952
Difference from control	-226	-112	-49	Control	69	-256	-111	Control	-72
Seed rate—kernels per acre—lb.	28	37	50	74	112	46	69	103	155

In an experiment conducted on the black cotton soil at Guntur it was found that 40 lb. per acre was the correct seed rate for the spreading variety.

**Manuring.** Groundnuts are cultivated as a rule without the application of much manure. On the roots of the groundnut, as in other leguminous plants, nitrogen-fixing bacteria lead a symbiotic life. The bacteria fix the nitrogen from the air and make it available to the plant. Thus the chief fertilizer requirements of the crop are only phosphate and potash. The manurial experiments carried out at Palur failed to show any beneficial effect either on the rainfed or irrigated crop. Similar experiments in the United States of America and Rhodesia have shown that unless the soil is very poor, the groundnut crop does not respond to manuring. It is a common practice in foreign countries to apply the manure to the previous crop and to allow the groundnut crop to utilize the residue of the manure.

**Rotation.** The rotation experiments at Palur show that where cereals and groundnuts are grown as pure crops in alternate years, *tenai* (*Setaria italica*) and *ragi* (*Eleusine coracana*) are found better than *cumbu* (*Pennisetum typhoides*), for the returns from *cumbu*-groundnut rotation are less. There was no difference between *tenai*-groundnut and *ragi*-groundnut rotations. It has been found in Mysore State that a groundnut-*ragi* rotation is superior to groundnut-*avarai* (*Dolichos lablab*) rotation. *Ragi* when rotated with groundnut yields much more than either *ragi* after *ragi* or *ragi* after *avarai*. The Cotton Specialist has tried a number of crops in rotation with irrigated cotton and found that the yield of cotton is the highest when it is sown on the land which had groundnut in the previous season.

Mixed cropping in dry lands is a common and well-established feature of Indian agriculture. It replaces considerably the system of annual rotation which is widely practised in the West. To examine the efficacy of different types of mixtures and also to see whether the rotations of mixed crops were better than the continuous growing of a particular mixture year after year, the following seven experiments were laid down:—

1. Groundnut + *cumbu* every year.
2. Groundnut + *tenai* every year.
3. The rotation of item (1) with item (2).
4. The rotation of item (1) with *ragi* + groundnut.
5. The rotation of item (2) with *ragi* + groundnut.
6. A mixture of groundnut + *tenai* + *cumbu*.
7. A mixture of groundnut + *tenai* + *ragi*.

The mixture (1) (groundnut-*cumbu*) is more economical than the mixture (2) (Groundnut + *tenai*), on account of the higher yields of groundnut. The annual returns from the mixture of groundnut + *cumbu* are equal to the annual returns from rotation under item (3). The

income for the rotation under item (3) is, however, more than the income from the mixture (2) (Groundnut + *tenai*). When *ragi* + groundnut is rotated with groundnut + *cumbu* (item 4) the yield is better than when *ragi* + groundnut is rotated with groundnut + *tenai*. When more than one cereal is grown with the groundnut, a mixture of *tenai* and *cumbu* appears superior to the *tenai* and *ragi* mixture:

These results indicate that for the groundnut, *cumbu* is the ideal partner from among the various cereals which are widely grown, but why this is so is not apparent.

**Summary.**—The superior performance of the *Saloum* variety is shown. The correct spacing for the spreading variety is 9" × 9" and that for the bunch 6" × 6". The optimum seed rate for the spreading variety is about 60 lb. of kernels per acre and for the bunch 100 lb. per acre in red soils.

It is suggested that the crop previous to the groundnut should be manured instead of manuring the groundnut directly.

*Tenai*-groundnut, *ragi*-groundnut and groundnut-cotton are beneficial rotations. Mixed cultivation of groundnut and cereals is more economical than to rotate a cereal with the groundnut. *Cumbu*-groundnut is a better mixture than *tenai*-groundnut.

## PRODUCTION AND MARKETING OF GROUNDNUT IN THE MADRAS PRESIDENCY.\*

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Of the several crops introduced at various times into India, the groundnut must be said to have been of the greatest benefit to the South Indian farmers. All the world over, the United States of America not excepted, it is found, that the groundnut cultivation is only in the hands of the small farmer. The main commercial product, namely the oil, removes no plant food, and, being a legume, the crop has been found to get all its nitrogen, about 90 lb. on the average per acre, entirely from the air. Recent research (unpublished) of Mr. T. Rajagopala Iyengar, M. Sc., has proved beyond doubt that by inoculation with a special organism it is not only possible to increase the nitrogen fixation but also to definitely increase the yield of the crop and improve the quality. This discovery opens up a vast field for increasing the acre-yield of the crop which in Madras, is much above the world average. Madras produces over 1,000 lb. of pods per acre, while the world average is only 700 lb. To get the benefit of the increased production, we should, in addition to widening our market,

\* Paper presented at the Twenty-fourth Agricultural College Day and Conference, August 1935.