order to increase the opportunities for research, to enable science to solve the peculiar agricultural problems of each district and to act as the local store house of all agricultural development and propaganda, it is essential that there should be one or more of Agricultural Farms in each district. Such farms may be run wherever practicable by the local Village Panchayats, Co-operative Societies or Agricultural Associations.

The possibilities of carrying home the latest developments in agriculture to the minds of young and old through movies and talkies should be explored and utilised.

In carrying on Agricultural propaganda one cannot afford to neglect the new vista of development opened up by broadcasting. Western countries true to their traditions have already made rapid strides in this line. Already some of our sister provinces like the Punjab are leading in this matter. When the Village Panchayats come to function all over the Presidency broadcasting will have to be increasingly resorted to, to educate the ryot.

SORGHUM FOR POPPING.

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Sorghum, *cholam* (Tam) or *jonna* (Tel.), is one of the staple food grains of the poor and backward classes in the presidency. One of the ways in which sorghum grain can be used as a food or delicacy both by the poor and by the rich is by converting it into pops. Pops (or puffed grains) are obtained by subjecting sorghum grains to sudden heat.

Popping is done by putting small quantities of grain on a hot pan kept over a steady fire. For popping large quantities mud pots are generally used, while for small quantities, small iron pans are found to be suitable. To get uniformly good pops the grains should be a layer thick at the bottom of the pan. To ensure the proper heating of all the grains they should be briskly stirred. A small brush made out of the midribs of the coconut leaf serves this purpose well.

As the grain gets heated by contact with the hot pan it swells slightly and a longitudinal crack is developed on the bulging endosperm of the grain. This crack widens, and irregular cracks are formed cross-wise and the white endosperm is thus exposed. The grain expands into a chalky white puff, which is usually hemispherical in shape with bits of the everted seed coat sticking to its bottom. A pop may be likened to a tiny cauliflower in general appearance. When the cracking is not regular, the pops assume various shapes; some expand lengthwise, while others expand breadthwise, thus giving rise to long narrow pops. The various stages leading to the ideal pop are presented in Fig. 1. Except the loss of vitality, the tiny embryo remains undisturbed in popping. Beyond being rent up in the process of popping, the seed coat remains structurally not much altered. The colour of the pericarp is also not affected. When coloured grains are popped the colour persists in the bits of adhering seed coat and is set off by the prominent white background on which they appear.

In maize the varieties suitable for popping go under a group called pop corns. In sorghum there is no such group or varietal name indicating suitability for popping as such. Trials were, therefore, made with different varieties and the results are given below. Table I gives the varieties in which good pops were obtained. Table II gives the list of varieties that do not pop and evert. They merely swell and crack.

Table I.

Sorghum Roxburghii var. *hians* Stapf.

No.	Varietal Name.	Place.	Grain colour.	Popping Expansion— With evertion.
M. S. 2265	Konda jonna	East Godavary Dt.	Red	X 17
A. S. 667	Muthyala jonnalu	Hindupur	White Pearly.	13
A. S. 1947	Selection from a cross		Brown	13
A. S. 668	Alankara cholam	Palakuppam	White Chalky	12
A. S. 572	Pedda jonna	Rajamundry	,, ,,	11½
A. S. 1899	Selection from a cross		,, Pearly	9½
A. S. 468	Pallaki jola	Kollegal	,, ,,	9
M. S. 1764	Alankara cholam	North Arcot	,, Chalky	9
A. S. 403	Talai virichan cholam	Goundanpalayam (Coimbatore)	,, ,,	9
A. S. 679	Jonna	Parlakimedi	,, Pearly	8½
A. S. 1093	Singara cholam	Nagari (Chittoor)	,, Chalky	8
A. S. 1006	Khed jonna	Nowrangpur (Vizagapatam Agency)	,, ,,	8
A. S. 1055	Talai virichan cholam	Palladam	,, Pearly	8.
A. S. 1086	Kaka cholam	Dharmapuri (Salem)	,, Chalky	7½
M. S. 1755	Alankara cholam	Tiruvannamalai	,, ,,	7½
A. S. 566	Pedda jonna	Berhampur	,, ,,	7½
A. S. 1902	Selection from a cross		,, ,,	7
A. S. 678	Jonna	Hiramandalam (Ganjam)	,, Pearly	6½
M. S. 1793	Kaka cholam	Gudiyatam	,, ,,	6
A. S. 1090	Talai virichan cholam	Katpadi	,, Chalky	6
M. S. 1797	Alankara cholam	Vellore	,, ,,	6
A. S. 1008	Khed jonna	Nowrangpur	Brown	6
M. S. 1563/c.	Sitamma jonna	Madanapalle	White Pearly	5½
A. S. 2160	Selction from a cross		,, Chalky	5½
M. S. 1760	Singara cholam	Tiruttani	,, Pearly	5
A. S. 1995	Selection from a cross		Red	5

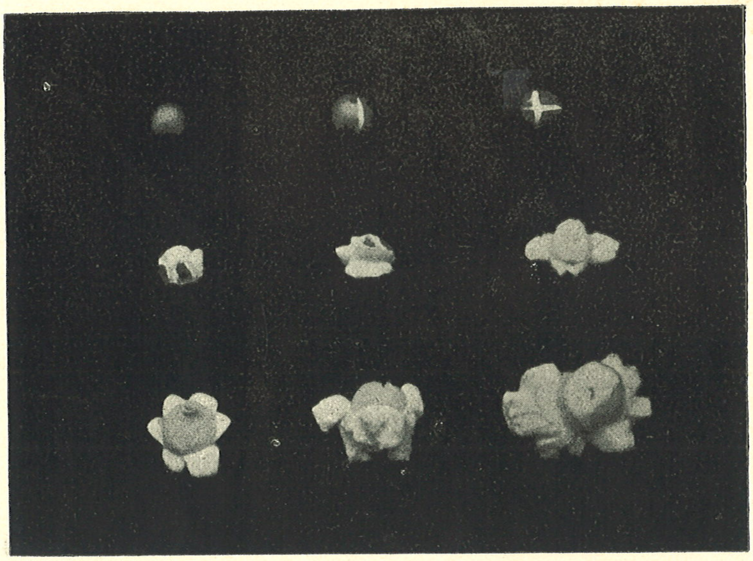

Fig. 1. STAGES IN POPPING

Fig. 2. CORNEOUS TO FLOURY ENDOSPERM

Table II.

Durra group.

No.	Varietal Name.	Place.	Grain colour.	Swelling & cracking—without evertion.
Sorghum Durra Stapf				
T-6	Patcha jonna	Nandyal	Yellow	X 4
A. S. 29	Peria manjal cholam	Coimbatore	,,	3½
A. S. 1098	do.	,,	,,	3
M. S. 1689	Makkattai cholam	Salem	Pink	2½
M. S. 1690	do.	South Arcot	,,	2½
Sorghum subglabrescens Schweinf. et Aschers.				
A. S. 792	Uppam cholam	Coimbatore	White chalky	3½
A. S. 190	Peria vellai cholam	,,	,, ,,	3
A. S. 189	do.	,,	,, ,,	2½
A. S. 127	Sen cholam	,,	Red	2½
A. S. 131	do	,,	,,	2½
A. S. 818	Chinna manjal cholam	,,	Yellow	2½
A. S. 378	Uppu vellai	Jellipatti (Coimbatore)	White chalky	2½
A. S. 389	Sen choalm	Kodaikanal Road	Red	2½
A, S. 841	do	Erode	,,	2½
A. S. 727	Chitrai vellai cholam,	Coimbatore	White chalky	2½
A. S. 723	do	,,	,, ,,	2
A. S. 732	do	,,	,, ,,	2
A. S. 1151	Chinna manjal cholam	,,	Yellow	2
A. S. 367	Vellai cholam	Dindigul	White pearly	2
A. S. 809	Chinna manjal cholam	Coimbatore	Yellow	1½
A. S. 1575	Selection from vellai cholam,	Salem	White chlky	1½
A. S. 2095	do	Dindigul	,, Pearly	1½
Sorghum cernuum Host				
T-12	Tella jonna	Bellary	White pearly	3
T-1	do	,,	,, ,,	2½
Sorghum dochna Snowden				
M. S. 2244	Irungu cholam	Kovilpatti	Brown	3

It will be noticed that the first group, namely *S. Roxburghii* var. *hians* (Table I.) is the group which pops best. The group is wide spread and its varieties are cultivated all over the presidency. This group has loose streaming panicles and many of the varietal names are connotative of this. This group will hereafter be referred to as the *Talai virichan* group. It is characterised by small horny grains which do not cook well. These grains are borne in glumes which gape out and leave the grain to develop and mature quite exposed in the late cold weather. The colour of the grain is mostly white. It may be pearly or chalky. Red and brown grains are rare in this group, though they also pop equally well. In Table II it will be noticed that typical grain sorghums like *Peria manjal cholam*, *Tella jonna* and *Pacha jonna* and others belonging to the big Durra group and also the *Irungu cholam* of Tinnevelly do not pop well.

Among foreign varieties tested, a sample of Guinea corn from Jamaica was found to pop very well and equalled the best local variety (*Konda jonna* of the Godavary Agency).

Of others, varieties with dimpled grains do not pop at all. In these the dimple swells and the grains become rounded. The seed coat merely cracks. Grains with waxy endosperm do not pop; in these the grains crack and burst open but do not evert.

The varieties that pop well being thus determined, the study of popping was examined in greater detail. Grain size was examined. This was done by measuring the grains in a 20 c c. glass cylinder and counting the number in that volume. The number of grains per 20 c. c. in popping varieties is given below in their decending order.

Table III.

Popping Varieties (The *Talai virichan* group).

No.	Varietal name.	Place.	No. of grains in 20 c. c.	Popping Expansion
A. S. 1006	Khed jonna	Nowrangpur	1471	8
M. S. 1764	Alankara cholam	North Arcot	1429	9
M. S. 1755	-do-	Tiruvannamalai	1398	7½
M. S. 1793	Kaka cholam	Gudiyattam	1396	6
M. S. 1563/c	Sitamma jonna	Madanapalle	1377	5½
M. S. 1797	Alankara cholam	Vellore	1361	6
A. S. 1093	Singara cholam	Nagari	1355	8½
A. S. 2160	Selection from cross		1328	5½
A. S. 1090	Talai virichan cholam	Katpadi	1306	6
A. S. 1008	Khed jonna	Nowrangpur	1217	9½
A. S. 468	Pallaki jola	Kollegal	1124	9
A. S. 1055	Talai virichan cholam	Palladam	1087	8
A. S. 679	Jonna	Parlakimedi	1055	8½
A. S. 1086	Kaka cholam	Dharmapuri	957	7½
A. S. 678	Jonna	Ganjam	947	6½
A. S. 668	Alankara cholam	Palakuppam	937	12
A. S. 1902	Selection from a cross		918	7
A. S. 566	Pedda jonna	Berhampur	908	7½
A. S. 572	-do-	Rajahmundry	908	13½
A. S. 667	Muthyala jonnalu	Hindupur	908	13½
M. S. 2257/a	Sitamma jonna	Madanapalle	845	5½
A. S. 1899	Selection from a cross		813	9½
A. S. 403	Talai virichan cholam	Coimbatore	801	9
M. S. 2265	Konda jonna	East Godavary	709	17
M. S. 1760	Singara cholam	Tiruttani	688	5

From the above table it will be noticed that the number of grains in 20 c. c. in this *Talai virichan* group ranges from 700 to 1,400. Similar counts were taken in 30 grain sorghum varieties of the Durra group and they ranged from 400 to 800 only thereby indicating the smallness of the grain as one of the attributes of a popping variety. It may be added that the fluctuation in the grain number of the popping varieties is not keeping parallel to the fluctuation in popping expansion thus giving a hint about the existence of factors other than mere size, determining popping quality.

The density of the grain was therefore gone into. This was determined as follows. A known weight of grain was taken in each variety. Its volume was determined by the displacement of kerosine oil in a graduated measuring cylinder. The use of the kerosine oil was to avoid the soaking of the grain which will happen if water were used. The results are given in the following Tables, IV and V.

Table IV.

Density of Popping Varieties.

No.	Density gm/cc.	Popping Expansion.
A. S. 468	1·42	X 9
M. S. 2257/a.	1·42	5½
A. S. 667	1·40	13
M. S. 1563/c.	1·40	5½
A. S. 1899	1·38	9½
A. S. 2160	1·38	5½
M. S. 1797	1·38	6
M. S. 1760	1·35	5
A. S. 668	1·33	12
A. S. 572	1·33	11½
A. S. 1090	1·33	6
A. S. 403	1·31	9
Average	1·37	

Table V.

Density of Non-popping Varieties.

No.	Density gm/cc.
A. S. 189	1·31
A. S. 1098	1·31
A. S. 29	1·29
A. S. 1575	1·29
A. S. 389	1·29
T-1	1·27
A. S. 367	1·27
A. S. 809	1·23
A. S. 732	1·20
Average	1·27

It will be seen that the popping varieties have a slightly higher density than non-popping varieties. Relatively to size, the weight of the grain of the popping varieties is greater. In popping varieties, degrees of density do not correspond to popping expansion.

A number of grains were cut open and their examination showed that the endosperm of sorghum grains may be either wholly mealy or often with a mealy centre surrounded by a corneous exterior. The amount of this corneous layer varies between varieties (Fig. 2). In the good popping ones the endosperm is entirely corneous or occasionally with a very little floury endosperm at the core. Non-popping varieties are characterised by a thin horny exterior and plenty of meal inside the grain.

In *Sorghum margaritiferum*, a group of sorghums from Africa with very small lustrous, horny grains, the popping expansion was small (x2½ to 3½). An examination of the grain sections revealed that the seed coat of this variety was thin compared to *Sorghum Roxburgii*. In *Sorghum margaritiferum* it was about 35 μ while in *Sorghum Roxburgii* var. *hians* it ranged from 70 to 125 μ. It will thus be noticed that in addition to a horny endosperm, a thick pericarp is necessary to produce good pops.

Moisture determinations were made in eight *Talai virichan* varieties and found to be between 10 and 11 per cent. Analyses of grain and pops from a variety of *Talai virichan cholum* were kindly made by the Agricultural Chemist, who remarks, "No difference could be noticed as a result of popping in respect of (1) food values, (2) mineral values and (3) total sugars and starch contents. During popping the starch may undergo certain amount of dextrination which might make it more easily digestible."

From the above examination it will be seen that popping varieties belong to the *Talai virichan* group of sorghums (*S. Roxburghii* var. *hians*). They are characterised by small grains with a corneous endosperm. Their seed coats are somewhat thick. Discussing the causes of the popping in maize, one of the reasons for popping is set down by Willier and Brunson* to the presence of enough moisture in the grain which when converted by heat into steam results in a violent expansion and the evertion of the endosperm. A similar cause seems to be responsible in sorghum also as the analysis of pops shows no differences other than loss of moisture.

Enquiries through District Officers into the popping of sorghum as a cottage industry show that this industry exists in isolated places, the product being consumed locally as balls mixed with jaggery, especially during fairs and festivals. It is reputed for its fine flavour and good digestive qualities. When the suitable type of grain is not available locally, the grain is imported from the Coimbatore and Cocanada areas of the presidency. There are reports of importations from Burma also. Whether this indicates a more favourable freight position, compared with local movements by rail, is a subject of investigation by the Marketting Officers.

In sorghum pops, the poor and the rich have a cheap and wholesome luxury.

Summary. Popping varieties of sorghum belong to the *Talai virichan* group (*Sorghum Roxburghii* var. *hians*). They are characterised by small grains with a corneous endosperm which is very dense. The seed coats of the grains are comparatively thick. The grains have a moisture content of about 10 per cent. In popping this moisture is converted into steam. This steam seems to find a resistance in its escape from the thick seed coat with the result that there is a sudden bursting and expansion and the packed starch grains expand with a violence, and give pops.

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* Factors affecting the popping quality of Pop-corn by T. G. Willier and A. M. Brunson. Journal of Agricultural Research Vol. 35 page 615—627. 1927.