

(Soy Bean Trials in Madras.)

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Introduction. Soy bean plant (*Glycine max*, Merr.) has been known to, and cultivated by, the Mongoloid races for several centuries as one of their most important food crops and feed for their domestic stock, while it was not even widely known to the other races of mankind until so late as the 18th century. Manchuria, China, Korea and Japan were, and are still the chief countries of production and export of this most important leguminous crop to the other parts of the world. Soy bean seed is very rich in protein and fat of high biological value and contains vitamins A, B and D and is a good source of minerals like calcium, sodium, phosphorus and manganese. Its starch content is very low and is therefore of particular value as food for diabetics. The seed is used in a variety of ways as food by the Chinese and the Japanese. Soy bean meal and oil-cake are excellent feed for cattle, and the crop when cut and fed green or converted into hay forms a very valuable fodder rich in nitrogen comparable to alfalfa (lucerne) and clover in feed value.

The cultivation of soy bean was started in the United States of America more than one hundred years ago, but the area occupied by it was very small and was only 2,000 acres in extent till 1914. From that year onwards the expansion of the area under the crop was very rapid and at the present day it is reported to be occupying nearly six million acres in that country. Nearly 56 per cent of all the soy beans grown there is for use as hay. It is reported that soy bean hay cut at the proper time and well cured is almost equal, ton for ton, to alfalfa.

Trials in Madras. As far as is known to the writer, the first trial of soy bean in Madras was made in 1915-16 by Mr. R. Cecil Wood, then Principal of the Agricultural College, Coimbatore in one of the fields on the Central farm. The crop was a fair one but its cultivation was not continued in subsequent years.

Great interest in this crop was aroused in India about 1932-33 as a result of Major General Sir Robert McCarrison's advocacy for the inclusion of soy bean as a very cheap and valuable source of first class vegetable protein in the average Indian diet, which badly lacks it. Another contributory cause for the spurt of such enthusiasm of the people in this new food crop was the decision of Mahatma Gandhi to give it a trial by including it in his daily diet. It is not known whether soy bean still finds a place in the Mahatma's daily diet. A third reason for stimulating the interest of the people was the fact that soy bean was becoming a serious competitor in the overseas market with the Indian groundnut, the premier oil seed crop of the country. The result of all this at the time was a great demand for soy bean

seed and for information regarding its cultivation. But unfortunately, the Department of Agriculture could not help the public either with the seed or information regarding the cultivation of soy bean as it had not been grown or tried on any of the Agricultural Research Stations before, except once on the College Farm in 1915-16. The Department, however, lost no time in taking up the trial of this new crop. The Director of Agriculture, Madras obtained seeds of soy beans from various sources and distributed them to several Research Stations in the Presidency for trial and study of the crop under varying soil and climatic conditions. For the first two seasons, small samples of seed received were grown for seed multiplication. Field trials were carried out from 1935 onwards. The summary of the results obtained at the several Research Stations is given below.

Agricultural Research Station, Hagari (average rainfall 20 inches) Two varieties, *Kachin* and *Pe Ngype*, both from Burma were tried for two seasons as a dry crop and for one season under irrigation. The yields given by these two varieties as dry and irrigated crops are given below:—

Nature of Crop.	Yield of seed in lb.		Remarks.
	<i>Behrum.</i>	<i>Pe Ngype.</i>	
Dry crop	230	94	The crops were subject to the attack of <i>Surul</i> caterpillar. (<i>Stomopteria nerteria</i>).
Irrigated crop	59	333	

Five other varieties were also tried in $1\frac{1}{2}$ cent plots in 1937-38 season. Of these, variety No. 18 gave 375 lbs. of grain per acre.

Agricultural Research Station, Nandyal (annual rainfall 28 inches) On this station also, *Pe Ngype* and *Behrum* were the varieties tried on a bulk scale, while, 5 other varieties were tried on a small scale. The yields given by all the varieties were very poor on this station also, as will be evident from the figures given below:—

Name of variety.	Area in acres.	Yield of grain per acre in lb.	Remarks.
<i>Pe Ngype.</i>	2.08	200	The crop was subject to the attack of leaf rollers and millipedes.
<i>Behrum.</i>	0.85	88	
<i>Laredo.</i>	0.09	50	
M. S. 28	0.10	90	
" 33	0.10	80	
" 26	0.09	140	
" 31	0.09	150	

A crop of *Pe Ngype* grown under irrigation was no better in grain yield as it gave only 135 lbs of grain per acre. But this variety grew well as a fodder crop, though it was badly damaged by caterpillars.

Central Farm, Agricultural College, Coimbatore. (annual rainfall 25 inches). The trials on this station were conducted during 1936-37 and 1937-38. In the year 1936-37, twenty four varieties were tried during the South-west monsoon season in garden land with red loamy soil. Of these, Kuala-lumpur 30 (Adt 32), black seeded variety gave the highest yield of 1,406

lb. while among the yellow seeded varieties, Mammoth Yellow gave 838 lb. of grain to the acre. In the same year, the above 24 varieties along with 33 new ones supplied by the Oil Seeds Specialist were tried during October in a black soil field. The results were not so good as those given by the crops sown during the south west monsoon season in the red soil area. The trial of soybean as a dry crop in red soil in July and in the black soil in October completely failed during the year for want of sufficient rains.

A more detailed work was attempted in 1937-38 (1) by sowing ten promising varieties for comparative trials in randomised blocks with 4 repetitions, (2) by testing the merits of four varieties as fodder crops and (3) by sowing 56 varieties in small areas side by side to study their comparative performances. The crop was sown in the hot weather on the 27th May 1937. It was subject to an attack of *surul* within a fortnight after sowing and the insect was controlled by spraying with calcium arsenate. This saved the crop to a great extent and it revived, but a second attack of *surul* in August almost destroyed the late varieties while the early and medium duration varieties suffered far less from this pest and yielded a fair crop. The yield figures from the comparative trials were so erratic as a result of the insect damage that no valid conclusions could be drawn. Out of the 56 varieties grown in study plots, the following four gave fair yields while the rest were far behind these in yield. Generally speaking the yields given were more an index of the severity of the damage caused by the *surul* than a true index of the normal yielding capacity of the varieties concerned. The varieties grown were classified into early, medium and late and it was found that generally speaking, the late varieties suffered from *surul* most.

No.	Variety.	Yield of grain in lb. per acre.
1.	Avoyelles	706
2.	Adt 4—Laredo	650
3.	„ 31 (Kualalumpur 16)	512½
4.	Otatootan	487½

Varieties for fodder. The yield figures given by the four varieties tried as fodder crops are given below from which it will be seen that Kualalumpur 30 (Adt 32) gave the highest yield of 12,800 lb. of green fodder per acre while the others were very poor. Here also, the yields were affected by the relative susceptibility of the varieties to the attack of *surul* caterpillar. Kualalumpur 30 was the most resistant to this insect.

No.	Variety.	Age of crop at cutting in days.	Yield of green fodder per acre in lb.
1.	Greenish yellow	100	3,600
2.	Lyallpur chocolate	103	2,400
3.	Adt 32 (Kualalumpur 30)	74	12,800
4.	Kachin	99	2,800

A sample of soybean fodder grown on the Central Farm was analysed by the Government Agricultural Chemist and the results of the analysis and his remarks on the fodder are given below:—

Heads of analysis	Percentage calculated on	
	Dry laboratory sample	Original material
Moisture	8.40	72.25
Ether extractives	1.31	0.40
Crude fibre	21.87	6.63
Ash	8.32	2.52
Crude proteids	20.65	6.26
Carbohydrates (by difference)	39.45	11.94
	100.00	100.00
Acid value	57.05	57.05
Lime (CaO)	2.12	0.64
Potash (K ₂ O)	1.80	0.55
Phosphoric acid (P ₂ O ₅)	0.67	0.20

Remarks: The sample of soy bean plant contains good amounts of proteins and forms a good cattle feed.

The Superintendent, Central Farm has remarked that in soy bean cultivation on the Farm *surul* insect is a serious factor to deal with and to some extent, mosaic disease as well.

Agricultural Research Station, Anakapalle (rainfall 40 inches). The trials were conducted during 1936-37 and 1937-38 seasons on this station with two varieties *Pe Ngype* and *Behrum*. During 1936-37, 5-cent plots of the above two varieties were sown in June and the crops cut as fodder in October gave 10,010 lb. of fodder per acre. The plants were observed to have good root nodule formation.

A grain crop of *Pe Ngype* was grown in comparative trial plots with seed treated with a culture of root nodule organism, against untreated seed in 5 replicated plots. The treated crop developed more root nodules after flowering but the untreated plots gave a higher yield of grain than the treated plots, the average yield being 830 lbs. and 730 lb. of clean grain, respectively, per acre. A crop of *Pe Ngype* and *Behrum* sown in September of the same year was a failure due to low germination and unfavourable weather conditions. During the 1937-38 season, a bulk crop of soy bean was grown in 33 cents and it recorded a yield of 679 lbs. of clean grain per acre.

Agricultural Research Station, Maruteru (rainfall 42 inches). Soy beans were tried for 3 years from 1936 onwards on this station as a dry crop. *Pe Ngype* and *Behrum* were the varieties tried. The trials were done only on small plots not exceeding 5 cents in area. During 1936-37 the crop was sown in the middle of June. Each variety was grown in two plots, one manured with 25 cartloads of cattle manure per acre and the other without the manure. The manuring had no effect on the yield of

the crop as the yield figures given below show. There was good formation of root nodules on the plants

Name of variety.	Date of sowing.	Yield in lb. per acre.	
		Manured with 20 cartloads of cattle manure per acre.	Unmanured
Behrum.	15-6-36	1,564	1,500
Pe Ngype.	do	1,229	1,160

Trial during 'Pyru' season in wet lands. Both the varieties sown in a wetland plot towards the end of November suffered from excessive moisture in the soil and failed completely. During the 1937-38 season, the crop was raised without any manuring, again as a dry crop and it gave consistently good yields, as the figures given below show.

Name of variety.	Date of sowing.	Yield per acre in lb.
Behrum.	22-7-37.	1,900
do	17-6-38.	2,160
Pe Ngype.	22-7-37.	1,480
do	17-6-38.	1,800

Agricultural Research Station, Samalkota (rainfall 36 inches) Trials on this station were carried out during 1936-37 and 1937-38 seasons with *Pe Ngype* and *Behrum*. During 1936-37 season, sowing was done on the last day of June. *Behrum* did well and gave 1,200 lbs. of grain yield per acre while *Pe Ngype* yielded only 377 lb. Both the varieties were grown as fodder during the same season. The average yields of green fodder were 8,500 lb. from *Behrum* and 10,520 lb. from *Pe Ngype*. During 1937-38, the sowing date was delayed to 7-9-37 for both the varieties. *Behrum* failed to germinate. The field was resown to *Pe Ngype* and the latter variety yielded 1,200 lb. of grain per acre.

Agricultural Research Station, Guntur (annual rainfall 34 inches) Out of the seven varieties tried, five failed completely. *Behrum* was very poor in growth and yielded hardly any grain. *Laredo*, a black seeded variety yielded 350 lb. of grain per acre when tried in the early season and 200 lbs in the late season.

Agricultural Research Station, Palur (rainfall 51 inches). Soy bean was tried as a green manure crop on this station in wetlands in July during three years 1936 to 1938. In 1937 it completely failed while in 1936 and 1938, the green matter yielded was only 700 lb. and 800 lb. respectively. The germination of the crop was very low and the subsequent growth was also poor due to excessive moisture in the fields.

Agricultural Research Station, Aduturai (rainfall 43 inches). The trial of soy beans was started on this station in the 1932-33 season and a few of the varieties that were found promising are being grown year after year as bulk crops. *Pe Ngype*, *Behrum* and E. B. strain 3940 (Adt. 28) are the most promising varieties in the collection so far tried.

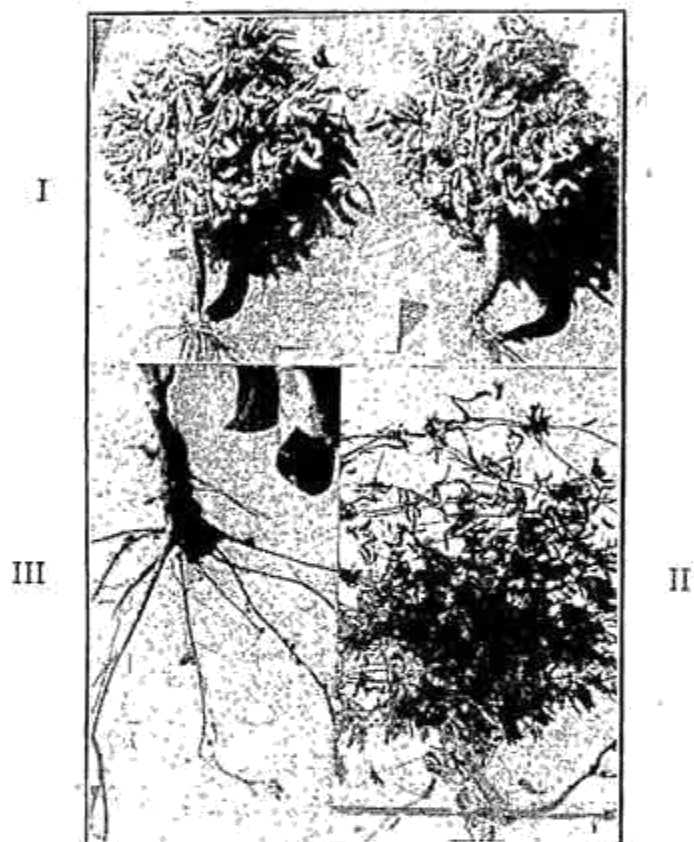
Collection of samples. Till the end of 1939, seeds of 46 different varieties from various sources were received and grown in single rows for study. But, unfortunately several of them failed to germinate during the year of introduction itself and were thus lost. Another cause of their failure to survive was due to the ripening of the pods of early and medium duration varieties in very wet weather during the heavy North East monsoon months of October and November and the consequent difficulty of giving the seeds thorough drying necessary for retaining the viability of the seeds. The wholesale destruction of the young plants by the *surul* caterpillar is yet another cause for the loss of many of the varieties in the collection.

Seasonal trials. Trials were conducted in three seasons June to December, September to February, and December to May. June to December season has been found to be the best for growing soy bean in the wetlands of Tanjore district but unfortunately short and mid-duration varieties ripen their pods in the heavy North east monsoon months of October and November with the result that the seeds harvested during the wet weather fail to be viable in the succeeding season. More viable seeds are obtained when the sowing is delayed to the middle of August to escape the bad effects of the rains on the ripening seed. September sown crop matures in fine weather in January and the seeds obtained are quite sound though the yield is not so heavy as that of June sown crop. But as both the June and September sown crops are affected by water stagnation in the fields during the heavy rains of the North East monsoon season the crop has to be sown on raised beds 10 feet in width with drainage channels of a foot in depth between in beds and all along the boundary of the fields to draw off the excess water. If this precaution is taken the crop grows quite normally.

The December-sown crop puts on good vegetative growth in the initial stages but as it has to spend the second half of its life in hot weather and without irrigation facilities from the channels which are closed on the 31st of January, the crop fails to set seeds normally. However, a *Pe Ngype* crop grown in about 2 acres during this season gave nearly 20,000 lbs. of excellent fodder per acre, though it failed to set seed. This indicates the possibility of growing this variety of soy bean as a fodder crop in fields from which samba paddy is removed during December. Paddy varieties G. E. B. 24 Adt 8 and *Vadaa samba* are generally harvested during December when grown as a *samba* crop in the Tanjore district, and the fields occupied by these may be sown to soy bean for fodder.

In the absence of *surul* attack, the following average and maximum yields may be expected from the three varieties found suitable to this delta.

	Average yield per acre in lb.	Maximum yield per acre in lb.
Pe Ngype	1,200	2,000
Behrum)	800	1,000
E. B strain 3940 (Adt 38)	500	650



- I. Soybean — Behrum plant with mature pods but without leaves.
- II. Soybean — Pe Ngype plant with mature pods but without leaves.
- III. Soybean plant showing root nodules.

In the dry lands of Tanjore, the best season for sowing the soy bean crop is with the break of the North east monsoon in September—October as a purely rainfed crop. *Pe Ngype* has been found to be the best variety for growing in dry lands during this period, yielding upto 1,500 lb. of clean grain per acre. Soy bean plants develop root nodules profusely when grown both in the dry and wet lands of Aduturai.

The soil seems to be well stocked with the root nodule organism, and artificial inoculation with the organism appears to be unnecessary. [Vide Plate].

Seeds and sowing, and cost of cultivation. The fields meant for soy beans should receive four dry ploughings to produce very fine tilth. The wetland fields should be thrown into 10 feet wide beds with channels between, to avoid water stagnation during the North East monsoon season. The crop can be either broadcast or sown in lines. When sown in rows the seeds may be spaced 1 foot in lines and 1 to 2 feet between lines depending on the growth habits of the variety concerned. Spreading types are to be given the wider and the erect types the narrower spacing. In the case of spreading types, the seed rate per acre is 6 to 10 lb. and in the case of erect types, 10 to 15 lb. depending on the size of the seeds of each variety sown. The depth of sowing should not be more than 2 inches as seeds buried deeper show poor germination.

The following figures give the average cost of cultivation for an acre of soy bean crop.

Ploughing 4 times	...	...	Rs. 5 0 0
Seed and sowing	...	...	" 2 0 0
Hoeing and weeding twice, at 12 women per acre each time	...	...	" 3 0 0
Harvesting and cattle threshing	...	...	" 5 0 0
			<hr/> 15 0 0 <hr/>

Harvesting time. One peculiar characteristic of the soy been plant is that it sheds all its leaves by the time the pods are mature on the plant. [Vide Plate]. So it is very easy to judge the correct time for the harvest of the crop. The crop should be harvested immediately it has shed its foliage completely, as any delay beyond this would make the pods burst and scatter away the seeds.

Varietal characters. Soy bean plants may be classified into different groups according to their duration, habit of growth, character of the foliage, the shape and colour of the seeds.

Duration. 1. Short duration of 80 days 2. Medium duration of 100 to 120 days, and 3. Late duration of 140 days and over.

Habit of growth. 1. Dwarf plants with clusters of pods 2. Lean, lanky plants with zig, zig internodes with sparsely arranged pods and 3. Bushy, branching and trailing plants like horsegram.

Leaf shape. 1. Broad leaved. 2. Linear lanceolate, and 3. Ovate lanceolate.

Shape of seed. 1. Flat grains, kidney shaped, of various sizes, and 2. round grains of various sizes.

Colour of seed. 1. Pale yellow. 2. Deep yellow. 3. Chocolate. 4. Black. 5. Mottled.

Analysis of Pe Ngype. A sample of Pe Ngype grain produced on the Aduturai station was analysed by the Government Agricultural Chemist and found to contain 13 percent of oil and 40 percent proteid.

An attempt to extract soy bean oil in a *chekku* (country mill) at Aduturai by the writer and in a power crusher by the Government Soap Expert and Oil, Chemist at Calicut was a failure. Good *poonac* was obtained but no oil. Perhaps, the soy bean oil has to be extracted by the use of powerful chemical solvents.

Pests and diseases. The insects pests affecting soya beans in South India with details of the nature of the damage done and the control measures adopted as per information supplied by Sri Bramahachari, Assistant in Entomology, are given below:—

(1) **Surulpuchi.** *Stomopteryx nerteria* M. (Family Gelechiade). This is the most destructive pest of soy beans in Aduturai and Coimbatore. It may be stated that the success or failure of the crop depends more upon this insect than on any other single factor. The small caterpillars feed by mining the leaves and cause white patches. After a few days the caterpillars emerge from the mines and web together small leaflets and continue to feed on the green leaf tissue. This is the same insect which appears on the groundnut crop. As the insects are attracted to light, light traps have been found to reduce pest infestation.

(2) Noctuid caterpillars (*Prodenia litura* F., *Cosmophila* sp., *Plusia* sp.) feed on the leaves of both young and old plants; these are more serious on young plants. Spraying with calcium arsenate is found to control the pests.

(3) **Yerpuchi.** *Sphenoptera pectoetis* G. (Family Buprestidae). The beetle grubs bore into the lower portion of the stem and roots. The affected plants become stunted in growth and withered in appearance and ultimately dry up. This is the same insect found in groundnut, and in *daincha* and other green manure plants. Affected plants may be removed to stop the spread of the pest.

(4) In addition to the pests noted above, flea beetles (*Longitarsus* sp.) thrips, coccids, grasshoppers, and mites are found causing damage to the crop occasionally. Spraying with contact poisons was found useful against the first three insects, spraying of calcium arsenate was effective against grasshoppers, and dusting with flowers of sulphur checked the mites completely. Mosaic was noted on a few plants in some varieties each year. In one season a crop Pe Ngype was found to be attacked by a weak *Fusarium* fungus. This fungus, was not noted in other seasons.

Summary. From a study of the results of the trials conducted on the various Research Stations having different soil types and climates, it is found that soy beans have done best in the Godavary and the Cauvery deltas with deep alluvial soil and an annual rainfall of 40 inches or over. It was a fair success in Coimbatore in garden lands as an irrigated crop

but failed when grown as a purely rainfed crop. The crop seems to be unsuited both as a rainfed and irrigated crop in the Ceded districts. It is only a partial success in Guntur. The crop seems to be free from insect damages in Anakapalle, Maruteru and Samalkot but is subject to severe attack from insects, particularly of *surul* in Coimbatore and Tanjore districts and to mild attack in the Ceded districts.

P. S. It may be mentioned that of late the enthusiasm of the people for soy bean has cooled down, in view of the opinion expressed by Dr. Aykroyd, the Director of the Nutrition Research Institute, Coonoor, that he is unable to say that soy bean is in any way superior, as a proteid food, to the ordinary pulses grown largely in India and consumed by the people. □

A Hearth for the use of Groundnut Husk as Fuel.

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Madras grows 3.5 million acres of groundnuts. Seventeen, out of 24 districts in the province grow over 50,000 acres. Hence groundnut husk is available in large quantities and at cheap rates in several localities. The use of groundnut husk as fuel for the household is restricted because of its poor burning qualities. But with the aid of a suitable furnace, this defect is overcome and it becomes a very convenient fuel for cooking food in the kitchen. A hearth suitable for the South Indian household has been designed on the principle of the Sindhvahi furnace that is in use for boiling cane juice and making jaggery. [Vide illustration].

