

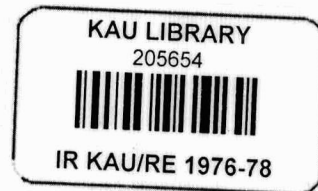
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REPORT ON PULSES CULTIVATION IN

FARMERS' FIELDS

1976--1978



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DIRECTORATE OF EXTENSION EDUCATION  
KERALA AGRICULTURAL UNIVERSITY  
VELLANIKKARA.



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## PULSES IN RICE FALLOWS

Next to cereals, pulses contribute the most widely used food material of the Indian diet and they offer perhaps the only and most practical means of solving protein malnutrition problems at the present stage of our economic development. As regards the developed countries, grain legumes are an important indirect source of protein, being animal feeds of good biological value. Production and consumption of more pulses is now widely recognised to be the cheapest and most practical way of improving nutrition of the common peoples. Further because of their unique capacity to fix free atmospheric nitrogen in symbiosis with soil bacteria, cultivation of pulses helps to enrich the soil with nitrogen and sustain soil fertility.

In Kerala the production of pulses with about 400 kg/ha remains far short of the actual requirement of the State. The present annual production of pulses in Kerala is roughly about 14,000 tonnes from the total area of 37,300 hectares cultivated. Imports from neighbouring states accounts for about 75,000 tonnes. High rainfall, low per capita availability of cultivated land, lack of high yielding varieties, lack of strenuous effort for presenting adoption of the prescribed package of practices for pulse crop, especially the use of fertilizers and plant protection measures are some of the reasons for such low productivity of this vital group of food crops.

Pulses can be grown in Kerala in all the three major crop seasons, viz., Kharif, Rabi and Summer. Almost all the entire Kharif pulses (36%) is cultivated in garden lands as an intercrop in coconut and tapioca gardens. Due to partial shade and excessive precipitation during Kharif season yield obtained are nominal. The bulk of Kerala's pulses (40%) is grown in summer, after harvest of the 2nd crop (Mundakan) paddy is over. This crop is raised utilizing the residual moisture available after harvest of the paddy and is wholly dependent for its success, on two or three pre-monsoon showers. The remaining 24% is grown during Rabi season either in single crop rice fallows or in palliyal lands of the old Malabar district. There is ample scope for bringing more area under this category of pulse cultivation. The main pulses grown in Kerala are Cowpea (Vigna sinensis), Black gram (Vigna mungo L), Green gram (Vigna radiata L), Horsegram (Delichos biflorus) and Red gram (Cajanus Cajan).

Dolichos lab lab is also grown to a small extent, mostly confined to homegardens. Redgram is mainly confined to Palghat and Kozhikode districts while all the other pulses find their places in all the districts. It is not possible to extend pulses cultivation in fresh areas and therefore increase in pulses production in Kerala can be achieved only by multiple cropping and intercropping.

About 2.5 lakh hectares of rice fallows (after the harvest of second crop of rice in December-January) will be available for pulses cultivation during Summer season. Cultivation of pulses in rice fallows is gaining popularity in the Command areas of irrigation projects, where it is not possible to take a third crop of rice.

Due to the shortage of irrigation water in Peechi reservoir, during 1976-77, the implementation committee of the Trichur Kole area suggested to reduce the area under paddy cultivation during the third crop season (January-April). Accordingly these cultivators approached the authorities for obtaining technical assistance in growing pulses in about 5000 hectares in Trichur Kole lands. In the absence of a recognised package of practice for growing pulse in 'Kole areas' specific measures could not be advised. Hence a tentative package of practice was drawn up in consultation with the officers of the Department of Agriculture, for implementation in farmers' field.

Work done in farmers' fields with cowpea by the Kerala Agricultural University.

With the objective of formulating a package of practices for benefitting the farmers of Trichur district, during Summer 1976-77 the Kerala Agricultural University launched an intensive pulses trial programme and laid out 48 demonstration plots in farmers' field. The package of practices drawn up and implemented are found to be well suited consists of the following items.

1. The field is ploughed twice when the field attain fluid capacity. Then lime is applied at the rate of 150 to 250 kg/ha depending upon the pH of the soil.
2. Urea, superphosphate and Muriate of potash are applied as basal at the rate of N:P:K 10:30:10 kg per hectare.
3. Cowpea seeds at the rate of 25 to 30 kg/ha are broadcast over the ploughed field.



COWPEA: High weed population Urea not sprayed.

4. A wooden plank is drawn out to level the ploughed surface.
5. Irrigation channels are to be provided 2 metre apart, to serve as efficient water source for irrigation.
6. Urea solution within 2.5 to 3% strength and Dimocron 250 ml. in 500 litres of water per hectare was sprayed twice during the growth period of the crop. First spray is given within 20 days after sowing and the second just before flowering (10 litre water + 250 gm. Urea + 5 ml. Dimocron). This method of application of Urea and insecticide was found to help in increasing the leaf area of the pulse crop quickly and thereby resulted in smothering the weeds. The systemic insecticide dimocron control the sucking insects and to an extent solved the stray cattle problem. The cattle owners were relectant to send out their cattle due to fear of food poisoning from the sprayed fields.
7. Choice of the varieties: In cowpea different duration groups are now available (Table I). According to the soil type and its moisture retension capacity the choice of the best suited varieties can be made.

From the trials conducted with different varieties it is observed that these varieties showed differences with regard to total number of days for maturity. The improved varieties P - 118, Pusa Barsathi, Mutant Red seeded, Brown seeded, P3-1 and 14-1-A were proved to be short duration varieties. These varieties if sown on April 15th will be ready for harvest by May 31st (45 days), while the varieties New Era and Ptb.4-1 (Kanakamani - Kunnankulam local) took 100 days for complete maturity. The details of observation recorded on different pulse varieties are given in table I. The yield data and the profit obtained are also given on Table No.II.

During 1976-77 43 trials were laid by the Kerala Agricultural University in the adopted villages. An average yield of 845 kg. of green pods and 408 kg. of dry seeds per hectare was obtained from 33 plots. Demonstration trials with short duration grain type of cowpea viz., Kozhinjipayar laid out in 10 plots gave an average of 770 kg. of dry seeds per hectare. The yield obtained from the trials conducted at various villages are given in the Table II.

The results of these trials indicate the production possibilities of pulses in rice fallows in certain areas of the State.

The following observations were made from this season trials of cowpea in rice fallows:

- (1) By adopting the package of practices drawn up for pulse cultivation in rice fallows and by selecting the suitable variety, a successful crop of cowpea can be raised during January-April season in Trichur district.
- (2) The duration of cowpea sown in December has been found to be 20% more than the same sown in January-February.
- (3) Where ever irrigation was found necessary only channel irrigation is recommended. Flood irrigation was found to lead to fungal attack of the crop.
- (4) In upper kole areas and in rice fallows in general when the soil moisture is depleted by the month of December, only short duration varieties of cowpea with 40 to 50 days are suitable. Varieties like mutant red seeded, brown seeded, P3-1, 24-1-A were found to belong to this category. They come to flower within 25 days and will be ready for harvest in 50 days.
- (5) In cowpea if green pods are harvested periodically the yield from the crop could be increased, substantially.
- (6) Another fact noticed was that the crop established with the residual moisture left in the field during January-February and grown for 20-30 days can survive further water stress condition till the end of harvest.
- (7) The crop sown in February can be harvested in April. Due to receipt of summer showers and consequent soil moisture availability these plants start to put forth new foliage and grows vigorously. This vegetative growth of the crop can be allowed to continue for making use of this as a green manure crop for the succeeding crop of paddy during 1st crop season.
- (8) Under irrigated conditions and if sufficient soil moisture is available in the field dual purpose varieties like New Era and Kunnankulam local (Ptb-1-Kunakamani) can be grown.
- (9) Phosphate limitation in the soil has been found to be disadvantageous to the crop and fruiting was found to be very low.
- (10) After pod formation, application of Tobacco decoction with soap has been found to be effective in controlling aphids and pod borers.





COWPEA: Pusa Bharsathi Mutant.

- Farmers who grow dual purpose or vegetable types were accepted this measure as it was not having any human poisoning even if the pods are harvested for consumption on the succeeding day of spraying.
- (11) The pulse crop that was sown during early December, had heavy attack of Mites and Aphids. The heavy eastern wind (Verchikakattu) prevailing during the period was responsible for fast depletions of the moisture in the soil.
- (12) It is felt that large number of mites and Aphids, that are wind borne, possibly might have established on the plants during this period, as large number of them could be seen all of a sudden on the plants.
- (13) The hot weather conditions prevailing during the period may be also responsible for the speedy multiplication of the pest especially the Aphids and mites.

A detailed survey of pests of cowpea was undertaken during this season and they are as detailed below:

Pests of Pulses

The cultivation of pulses is gradually gaining importance in Kerala. During the year 1976-77, sizable area was brought under pulses, particularly cowpea, in summer rice fallows. Taking the growing importance of pulses into consideration, 6 plots of 0.4 hect. each were laid out for pulse demonstration under N.D Project of Kerala Agricultural University in Trichur district during the third crop season. The Variety sown was cowpea C.152.

With a view to find out the pests associated with pulses, a survey was conducted in the cowpea demonstration plots. The results of the survey conducted show that the following pests cause damage to the crop grown in Trichur district during the third crop season.

(i) Pea aphid :- Aphis craccivora

Order :- Hemiptera

Family :- Aphididae

Pea aphid is the most serious pest attacking cowpea in all the plots surveyed. The adults are greenish black in colour. The adults and nymphs suck sap from the under surface of the tender leaves, growing tips, flower stalks and developing pods. They appear on the plant parts in clusters and cause very heavy damage. The growth of the plant is

retarded, the pods are malformed and the leaves turn light yellow due to the infestation of this pest.

(ii) Cow bug:- Anchon pilosum

Order :- Hemiptera

Family :- Membracidae.

This pest is also seen in very low population in all the plots. The cow bugs are not seen causing severe damage to the crop. But the adults and nymphs of this insect suck plant sap from the growing tender shoot, flower buds and stalks. As a result of the attack, the growth of the infected plant is slightly retarded and the stems are seen weakened.

(iii) Jassids:- Amrasca sp (Empoasca sp)

Order :- Hemiptera

Family:- Jassidae.

The adults and nymphs of this small green jassids are seen on the under surface of the tender leaves and flower primordia, in all the plots surveyed. They suck the juice from the leaves and this results in the development of an yellow colour to the infected leaves along with crinkling. The status of the pest can be said as medium.

(iv) Pentatomid bug:- Nezara viridula

Order :- Hemiptera

Family :- Pentatomidae

These green bugs are seen in very low population. The adults and nymphs are seen sucking sap from the tender shoots and developing pods. The damage caused by this bug is negligible, as the population is seen too low. But the infested plants face a general weakness due to the draining of sap.

(v) Lady bird beetles:- Epilachna - 12 - punctata

Order :- Coleoptera

Family :- Coccinellidae

The adults are brown in colour with 12 black spots on the elytra and the nymphs are spiny and yellow in colour. Both adults and nymphs of this beetles eat away the chlorophyll of the leaves. This results in the retarded growth of the infected plant and subsequent reduction in yield.

(vi) Spotted pod borer : Maruca testulalis

Order : Lepidoptera

Family : Pyralidae

The caterpillars of this moth bore into the pods and feed on the seeds. The caterpillars are brownish green in colour with black warts on the body. The bore holes made by the caterpillar on the pods are large, and faecal matter is seen accumulated in large quantities in such holes. Pupation of the larvae takes place inside the hole itself. The infected pods become unfit for consumption. The moth is generally dark brown in colour with a white cross band in the middle of each fore wing. The hind wings are white with dark borer. In certain cases the larvae may bore into the tender stems also. This pest is seen in all the plots surveyed. In some cases this caterpillar is suspected boring into the stem.

(vii) Leaf caterpillar :- Macoleia vulgaris

Order : Lepidoptera

Family : Pyralidae

The caterpillars of this moth are green in colour with brownish black head. In the early stages, the larvae feeds on the green matter of the tender leaves. Later the larvae web the leaves together and feed from within, causing damage to the foliage. The moth is yellowish brown with oblique black away lines on the wings.

(viii) Plue Butter fly:- (Lampydes) (Polyommatus boeticus)

Order :- Lepidoptera

Family :- Lycaenidae.

The pale violet coloured larvae of this butterfly burrow on the tender pods feeding on the seeds or into the buds destroying them completely. The adult is a light blue butterfly with a tail like projection on each hind wing.

This pest is seen in all the plots surveyed, in low population.

(ix) Pod fly :- Melanagromyza sp.

Order : Diptera

Family : Agromyzidae.

The adult is a small bluish black fly Melanagromyza sp. possibly phasedi. The maggots enter the pod and feed on the seeds causing a ring like track. The seeds dry away as a result of the attack. In a general observation made it is suspected that the maggots of this fly

here into the growing meristem and tender tip of cowpea at about two leaf stage on the crop.

Control of pests of pulse crops.

Among the pest complex infesting pulses in Kerala, the more important ones are the pea aphid Aphis craccivora, stem borer Melangronyza sp., blue butterfly Lampydes boeticus, Leaf hopper Amrasca sp., the epilachna beetles Epilachna 12 punctata. Aphid infestation is severe in the early stages of crop growth. Infestation is confined to tender shoot apices and this quite often leads to growth retardation and crop failure. The pea aphid infestation is also found to severely damage the pods by desapping. Effective management of aphids by comparatively cheaper methods is of vital importance in the successful pulses cultivation programmes.

The following prophylactic control measures are suggested:-

- (A) Application of a persistent systemic insecticide with moderate/strong contact action for broad spectrum pest control.

The following insecticides are to be sprayed 15-20 days after germination to ensure overall protection from sucking and chewing insects.

Bidrin (Dicrotophos) 20% EC	..	750 ml/ha
Nuvacron (Monocrotophos) 40% EC..		500 ml/ha
Dimecron(Phosphamidon)100% EC	..	250 ml/ha
Rogor (Dimethoate) 40% EC	..	1 lit/ha.

- (B) Application of non-persistent contact insecticides in the post-flowering stage.

The following insecticides are to be tried.

- (a) Fenitrothion  
(Folithion/Sumuthion) 50% EC .. 750 ml/ha
- (b) Fenthion (Lebaycid) 100% EC .. 500 ml/ha
- (c) Quinal-phos (Ekalux) 25% EC .. 750 ml/ha.

Note:- The suggested doses are on the basis of information available on other crops. The doses for pulses crops are to be standardised based on observational trials and on the basis of statistically laid out field experiments.

TABLE I

DETAILS OF THE SHORT DURATION COWPEA GROWN ALONG WITH THE LOCAL POPULAR VARIETIES ARE GIVEN BELOW. THE NUMBER OF DAYS FOR HARVEST HAS BEEN TAKEN WHEN 5 to 6 PODS ARE READY AND REMAINING IN GREEN CONDITION IN A PLANT.

Cowpea variety	Month of sowing				July	August September	October November December	January February March
	April	May	June	July				
New Era	100	100	90	80	80	60/75	65/75	
52	90	90	85	75	70	60/75	45/60	
Manankulam local (P30.1)	80	83	80	75	70	65/70	60/65	
P.118	45					50	50	
Leathi Mutant	43	60				48	43	
Red seeded	43	65				45	45	
Brown seeded	42	65				45	45	
P3.1	45	65				45	45	
24-1-4	40	55				43	43	

TABLE II

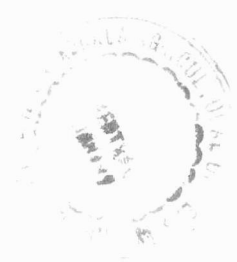
YIELD DATA OF THE PULSES TRIALS AND DEMONSTRATIONS CONDUCTED IN THE  
ADOPTED VILLAGES OF THE KERALA AGRICULTURAL  
UNIVERSITY DURING 76-77

Sl. No.	Location Village	Variety	Av Dry seed kg/ha	Av green pods kg/ha	Av. Profit Rs./ha.	Remarks No. of plots
1.	Tavanur	C.152	360	772	881.00	4 2000 sq.m. trial plots
2.	Kizhayoor Pattambi	New Era(1) C.152 (2)		2800	441.00	5
3.	Nadathara	C.152	785		740.00	5
4.	Ollukkara	C.152	329	969	490.00	4
5.	Panencherry	C.152	287	885	608.00	5
6.	Madakkathara	C.152	116	664	542.00	5
7.	Anbalavayal	C.152	615		845.00	5
8.	Vollayani	Kozhinjhit	770		910.00	10
Total Av			408	770	682.00	43
9.	Trichur	C.152	300	1395	845.00	5 (1 acre National Demonstration plots)

YIELD DATA OF THE PULSES TRIALS CONDUCTED IN THE ADOPTED VILLAGES  
OF THE KERALA AGRICULTURAL UNIVERSITY AND THE NATIONAL DEMONSTRATION  
PROJECT - TRICHUR DISTRICT - 1977-78

S.No.	Location	No.of plots	Variety	Av dry seed kg/ha.	Av green pod/kg/ ha.	Remarks.
1.	Adopted villages	15	C.152	148	1062 kg	2000 sq.m.plot
2.	Trichur District National Demonstration project.	6	C.152	335	731	4000 sq.m.plot

The tentative package of practices drawn out for pulse (grain) trials during 1976-77 was also utilised during 1977-78.



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Information on different aspects of Groundnut crop such as improved agronomic practices and production.

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In Kerala, Groundnut is cultivated in about 15,510 hectares yielding on average of 1322 kg of dry pods per hectare. The major groundnut growing area in the State is Chittoor in the Palghat District.

The Package of practices recommended for the groundnut crop by the Kerala Agricultural University is given in page 14

The weather conditions prevailing during April to October are congenial for raising groundnut as a rainfed crop. The cultivators in general are not aware of this fact. Hence this crop has not been included in the crop rotations. Cultivable waste lands are very much limited in the State. No separate area has been set apart for growing groundnut. Eventhough research data are available for successful cultivation of groundnut as an intercrop with tapioca, these have not been effectively communicated to the farmers through a process of trials and demonstrations. In order to fill up this extension gap the Kerala Agricultural University took up a programme of trials and demonstrations on farmers' fields in Trichur District during 1976-1978 by following a tentative package of practices. In these demonstrations, an average yield of 1263 kg of dry groundnut pods as well as 2481 kg of green haulms (fodder) were obtained. The average income and expenditure per hectare were Rs.2778/- and Rs.1467/- respectively. (Details see page 21 )

Since groundnut is intercropped at the time of planting tapioca the cost of seeds and the harvest charges would be the main items of expenditure that the cultivator has to incur. The cost benefit ratio is worked out to be 1:2. It is also observed that in comparison to the pure crop, the yield of tapioca has not decreased due to this type of companion cropping. The package of practice followed for this companion cropping programme is given in page 15

This cultivation practice is getting popular among the cultivators in Trichur District. This cropping pattern was discussed in the National symposium on the appropriate Technology for Rural Development held at the T.K.M.College, Quilon on 19.10.1978. A paper was presented on companion cropping of groundnut with tapioca by Dr.V.S.S.Potti, Director of Extension Education and Sri.A.I.Thomas, Associate Professor, National Demonstration

Project, Kerala Agricultural University. A copy of the paper presented is also given in page No.18

Another possibility of extensive cultivation of groundnut is in rice fallows in the State. Trials conducted by the Kerala Agricultural University, through the village adoption programme were a great success. The twelve multilocational trials on groundnut in rice fallows recorded an average yield of 881 kg. of groundnut pods and 1346 kg of green haulms. The paddy-paddy-groundnut crop rotation in areas where the water is high and soil is sandy, have opened new vistas in the production of groundnut in this state. The package of practices adopted for raising groundnut in rice fallows is given in page 17.

The following bottle-necks have been observed in the large scale cultivation of groundnut in the State.

1. Non availability of short duration groundnut seeds such as TMV2, TMV7, Pollachi I and Pollachi II.
2. The average farmers has no space to store groundnut in bulk.
3. Decorticators and oil expellers are not available in the State.
4. Oil based agro industries are wanting for processing the produce.

#### Development programme.

The trials and demonstrations conducted during the last three years have given encouraging results.

Operational Research projects for intensification of research, and development programmes will have to be organised co-ordinating the concerned extension and research personnels so that a cooperative endeavour can be started for the development of the industry in Kerala.

#### Scope

Tapioca is now cultivated in about 3 lakh hectares. Besides there are about 5 lakh hectares under rice fallows in Kerala. Out of these 2 lakh hectares can immediately be brought under groundnut. An intensive drive through operational Research Programmes can be taken up, in the line of a "pulse district" proposed by the ICAR for intensification of groundnut cultivation.

PACKAGE OF PRACTICES RECOMMENDATIONS - KERALA AGRICULTURAL UNIVERSITY  
1978 - GROUNDNUT CROP.

Groundnut can be cultivated as an intercrop in coconut gardens, as a mixed crop with tapioca, and as a catch crop after second crop paddy with irrigation. The crop grows best in sandy loam and loamy soils.

Season

Rainfed crop April-May to August-September.

Irrigated crop - December-January to April-May.

Varieties

TMV 1 - Spreading - 140 days duration

TMV 2 - bunch type - 110 days "

TMV 7 - bunch type - 110 days "

Seeds and sowing

75 kg of Kernel for pure crop .. TMV 1.  
60 kg of kernel for mixed and  
inter crops.

100 kg of Kernel for pure crop .. TMV.2  
80 kg of Kernel for mixed and  
intercrop.

Same .. TMV.7

Manures and fertilizers

Cattle manure or compost 2 tonnes/per hect.

Lime - 1 - 1.5 tonne per hectare.

Fertilizer - N, P, K. 10:50:40 kg/ha.

Apply entire quantity of Cattle manure or compost as basal dressing and incorporate well into the soil. Apply lime at the time of flowering of the crop and mix with the soil by light hoeing or raking.

Irrigation and interculture

Irrigate the crop once in 7 days weed the crop 10 to 5 days after germination of seed by light hoeing. Give another light hoeing or raking at the time of application of line. Do not disturb the soil after 45 days of sowing.

Plant Protection

Red hairy caterpillar and leaf roller are the two major pests which attack irrigated crop. Dust with BHC.10% to control the pests.

ROLE OF CALCIUM IN THE PRODUCTION OF GROUNDNUT

The distribution of Calcium in the soil profile is of considerable importance to groundnut because without adequate supply of this element, developing seeds abort. The calcium requirements of the developing seed are absorbed, not by the roots, but by the surface of the developing pods.

The mobility of calcium in groundnut is such that, although this element may be abundant in the root zone, unless it is also present in adequate concentration in the fruiting zone, seeds in the pods will abort producing "Pops". The importance of ensuring adequate calcium content particularly in superficial soil layers has been recognised. However there may not be any apparent signs in halms due to non availability of calcium.

Source : Tropical Pulses: J.Smartt 1976

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Longman publication.

Tikka leaf spot disease attack both the rainfed and irrigated crops. Prophylactic spraying with Bordeaux mixture before flowering will control the disease.

#### Harvesting.

The crop will be ready for harvest when the leaves start yellowing and drying up. Development of brown colour inside the pods also indicates maturity of the crop.

*from the same*

#### PACKAGE OF PRACTICES - GROUNDNUT AS A COMPANION CROP WITH TAPIOCA

Prepare the land and form ridges or mounds depending upon the soil type and topography of the land in order to ensure good drainage. The ridges may be prepared at a distance of 1 metre apart and 0.75 metre from top to top in the case of mounds.

#### Sowing.

Tapioca sets may be planted 0.5 metre apart on the ridges on the top of the mounds. Groundnut seeds are dibbled on the same day on both sides of the ridges in two rows at a distance of 20 cm. between plants and 20 cms. between rows. 16 to 20 seeds are to be planted in case of mounds. i.e. 6 seeds at 20 cms. below the top of the mounds and 10 to 14 seeds at the lower circle. Sufficient space has to be left at the lower side of the mounds as well as at the top portion of the ridges and mounds. 65 to 75 kg. of decorticated groundnut seeds are necessary to dibble one hectare.

Quality seeds should be used in order to ensure early establishment of groundnut.

#### Manures and fertilizers.

At the time of preparation of land organic manure at the rate of 5 tonnes and fertilizers at the rate of 34 kg each of NPK per hectare are added before the ridges or mounds are formed for tapioca.

#### Season

May to June is the best time for planting tapioca and groundnut.

#### Varieties.

- A. Tapioca - M4 is highly suited for this cropping pattern.
- B. Groundnut - Erect varieties such as TMV2, TMV7, Pollachi 1 and Pollachi 2 are suited for dibbling.



Groundnut as an intercrop with Tapioca.

### 1st top dressing.

At the time of flowering groundnut i.e. 30 days after sowing apply 500 kg of each of fresh lime, and ash per hectare and earth up. Weeding may also be done, if necessary. Do not disturb the soil 45 days after sowing.

### 2nd top dressing (For tapioca alone)

After the harvest of groundnut, tapioca may be earthed up incorporating N, P and K at the rate of 17 kg. each per hectare.

### Pest and disease of groundnut.

#### Pest control.

Incidence of leaf caterpillar may occur. The pests can be controlled by dusting Lindane.

#### Rats and rodents.

For the control of rodents, baits with zinc phosphide or any other rodenticide. When it is mixed with fresh coconut kernel peelings, zinc phosphide is an excellent rat killer.

#### Disease control.

Tikka leaf spot may appear at the late maturity period of the crop. Usually, no control measures are taken as this disease generally is noted towards the time of maturity.

#### Harvest.

Groundnut can be harvested when the crown foliage turns yellow. The crop should be harvested within a period of 100 days from sowing. Otherwise the crop will be affected by Tikka disease. The pods also will be affected by pod borers.

Immediately after the harvest the nuts should be dried in the sun for five to six days.

#### Haulms.

It is a nutritive fodder for cattle.

#### Yield

An average yield of 1250 kg of groundnut pods as well as 2,000 kg. of fodder per hectare can be obtained from the intercrop. The yield and quality of tapioca has not been found to deteriorate due to this intercropping pattern.

PACKAGE OF PRACTICES FOR GROWING GROUNDNUT IN RICE FALLOWS

Soil will drained, and soils having high water table will be useful for raising groundnut as an unirrigated crop. In other soil type, irrigation will have to be provided as and when required. The field is ploughed three to four times. Two tons of well rotten cattle manure along with N.P.K at the rate of 10:50:40 is applied and final ploughing and levelling are done. Furrows and beds are formed at 30 cms and 1 metre apart, respectively.

Seeds

Groundnut seeds-Pollachi I, Pollachi II, TMV2, TMV7, varieties can be used for planting.

Seed rate

80 to 100 kg of groundnut kernels are required for planting one hectare.

Spacing.

20 cms x 10 cms from plant to plant and row to row. The sowing may be done in such a manner that the entire beds should be covered with groundnut foliage within twenty days of planting of the seed. Otherwise weed growth will have to be controlled by hand weeding.

Irrigation

Irrigation may be given as and when necessary.

Top dressing with lime.

The crop requires ample amount of lime especially at the time of pod formation. Lime and ash at the rate of 500 kg each per hectare may be applied as top dressing within 25 to 30 days after sowing.

Harvest

The crop under rice fallow conditions will be ready for harvest within 100 days. Harvesting may be done immediately. Otherwise the crop will be attacked by Tikka and leaves will be wilted or the pods will be eaten away by pod borers.



Tapioca is the second major annual crop cultivated in an area of 316,000 hectares in Kerala, both for food and for commercial purposes. It is planted either on individual mounds or on ridges. Usually it takes about two months for its establishment and development of a leafy canopy. The crop is harvested in about ten months time.

In order to take advantage of this situation, various multiple cropping patterns were tried at various Research Stations in the State. The Central Tuber Crop Research Institute, Sreekaryan, Trivandrum has recorded that among the intercrops tried in tapioca, groundnut fits unwell in the cropping pattern. This will increase the net profit for the farmer.

Investigations conducted at the Rice Research Station, Pattambi in 1975-76 has indicated that groundnut can be grown with tapioca as a companion crop where the groundnut was sown in two rows on each side of the ridges on which the tapioca was planted on the same day itself. In Indonesia, groundnut is intercropped in large scale for obtaining oil seeds as well as for the purpose of production of haulms (leaf and stem) as fodder for cattle.

Even though research data are available for the development of groundnut cultivation, these have not been effectively communicated to the farmers.

In order to fill up this extension gap, the Kerala Agricultural University took up a programme of trials and demonstrations on farmers' fields in Trichur district during 1976-78. This was on marginal and submarginal uplands under rainfed conditions during May-June.

In these demonstrations conducted under the National Demonstration Project, an average yield of 1263 kg. of dry groundnut pods and 2481 kg of haulms (Fodder) could be obtained at an average cost of Rs.1,467/- per hectare within a period of hundred days. The gross income from groundnut pods and haulms was estimated at Rs.2,778/- per hectare. Since the groundnut is intercropped at the time of planting tapioca, the cost of seed and harvest charges alone are the main items of additional expenditure that the cultivator has to incur the cost benefit ratio being about 1:2. It is also observed that in comparison with

the crop, the yield of tapioca has not decreased due to this companion cropping system. The average yield data recorded from the demonstration on companion cropping of groundnut with tapioca conducted during 1976 to 1978 are given in the table No.1.

These demonstrations have indicated the immense possibilities and potentialities for increasing the income of the farmer from the marginal and sub marginal uplands under rainfed conditions. This companion cropping pattern has the following advantages.

1. The companion cropping programme suggested is only a simple adoption of a sowing practice by which the farmer needs only to dibble the groundnut seeds at the time of planting tapioca.
2. The crop is raised as a companion crop, no new land need be set apart for the crop.
3. In the monoculture of tapioca the time lag factor is as much as ten months. This new cropping pattern has the advantage of earlier returns.
4. The production of pulses in the State is being reduced year after year. By the adoption of the present technique of intercropping, at least one lakh hectares can be brought under groundnut in the near future. Thereby the present production can be augmented several times.
5. Pulses are cheap form of proteins. The availability of these protein rich food in the country side will go a long way in meeting the protein requirements.
6. The production of haulms during the lean period for green fodder (August-September) - is a boon for the farmer.
7. This cropping system will create additional employment potential in the villages which is estimated to be 60 unskilled work days per hectare. It will be therefore be highly advantageous for the un-employed labourers of the villages. Even at a rough estimate one lakh hectare can immediately be utilised for the companion cropping programme, which will generate 60 lakh work days during the crop season.

8. Production of oil seeds within the State will lead to the establishment of oil based agro-industries in the State. At present for groundnut oil and cake we are completely dependent upon other States.
9. The development of oil based Agro-Industries in the State can also absorb large number of skilled labour.
10. The groundnut cake obtainable from this industry is a nutritive cattle food and also an organic manure which is in great demand in this State for the above purposes.

Due to this intercrop being latter the yield of tapioca as the base crop, is not affected. Being a leguminous crop the fertility status of the soil is also enhanced due to the cultivation of groundnut.

TABLE I

Data obtained from the cultivation of groundnut as a companion crop with tapioca under the National Demonstration Project, In Trichur District during 1977-78 - average data obtained from seven demonstrations are given.

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No. of locations.	Average yield of dry groundnut pods.(kg/ha)	Average yield of haulms (kg/ha)	Average additional income (Rs./ha)	Average additional expenditure (Rs./ha)
1	2	3	4	5
7	1263	2481	2,778.00	1467.00
Profit from the inter crop of groundnut (Rs./ha)	Average yield of tapioca as pure crop. (Tonne/ha)	Average yield of Tapioca where it was intercropped (Tonne/ha)		
6	7	8		
1311.00	12.280	12.250		

Cost benefit Ratio = 1.2

The demonstrations were conducted on submarginal lands. Hence the yield of tapioca tuber was comparatively low.

Tapioca variety - M4

Groundnut variety: TMV 2

Costs

Groundnut seeds Rs.4/- kg  
 Groundnut pods Rs.2/- kg  
 Tapioca tuber Rs.0.25/kg.  
 Men at Rs.8/- per day  
 Women at Rs.6/- per day.

HORSEGRAM (DOLICHOS BIFLORUS) AS A COMPANION CROP WITH TAPIOCA

Tapioca is grown in September-October season invariably in the hilly areas under rainfed conditions. The crop takes about eleven months for the harvest. Horsegram also can be cultivated during September-October season under Kerala conditions. In order to take advantage of the slow initial establishment of tapioca, horsegram was intercropped in tapioca, with an additional supply of 25 kg. of  $P_2O_5$  per hectare as basal dose.

After formation of ridges for tapioca, horsegram was sown broadcast. Then the final earthing up was done. The tapioca was also planted on the same day itself on the top of the ridges. 360 kg of horsegram could be harvested per hectare within 100 days, without affecting the yield of tapioca.

From the National Demonstration conducted at Vellikulangara, a sub marginal forest area in Trichur District, on horsegram as a companion crop with tapioca, 15 tons of tapioca roots could be harvested from a hectare area. While only 14.5 tons of tapioca could be obtained when it was raised as a pure crop.

Experiments on dry farming at Muthenpathy.

Kerala Agricultural University initiated Experiments on dry farming at Muthenpathy, Kozhinjampara area, with a view to evolve suitable cropping pattern for the drought prone areas, from 1977 onwards. The observations on groundnut crop are, eventhough for eighteen months, it has brought to the light some of the radical causes for crop failures. The following observations have been noted at these experiments, conducted at five centres on farmers fields in Muthenpathy and Moongalnada areas.

1. The groundnut crop that is sown in April, will give satisfactory yield by the middle of August. But the same crop sown in May will have to be harvested prematurely in August itself due to the attack of Tikka disease. During 1977-78, and 1978-79 the crop affected due to Tikka disease in July and the farmer forced to harvest the crop by the middle of August.
2. In case the rain is delayed upto middle of May it is better to grow short duration paddy varieties such as cul.28, ARC.11775, or even Chennellu or its culture. In case the rain is delayed beyond May, it is also not good for sowing even paddy as dry crop.
3. Relay cropping of Tapioca in groundnut crop, one month after the groundnut crop is sown will give early establishment of tapioca, At the time of the harvest of the groundnut crop, the tapioca will have only four to six leaf stage but will have established root system and this procedure has not decreased the yield of groundnut substantially.

After the harvest of the groundnut 34 kg each of N:P:K is given as 17-17-17 mixtures by broadcast and the ridges are taken for the tapioca. This crop gave an average yield of 10.5 tonnes of tapioca with eight month after planting the sets.

COU-PEA (Vigna sinensis) AS INTERCROP WITH TAPIOCA

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A short duration Tapioca is being cultivated in Kerala in rice fallows under rainfed conditions. The crop takes about six to seven months to come to maturity. The average yield of tuber is 11.2 tonnes per hectare giving a profit of Rs.560/- per hectare. The cost benefit ratio is 1:1.2. With a view to increase the net profit per unit area of land, and also to utilize the under employed days of the tapioca farmer, a new pulse and tuber crop based system was tried in the rice fallows. Cowpea was sown on both sides of the ridges in two rows on each side at 25 cm. apart, during the last week of December. Tapioca sets were planted on top of the ridges on the same day. Within twenty days after sowing the crop, cowpea was protected from pests by spraying Dimecron mixed with 22% urea. The crops were fertilized with N.P.K. 44:64:44 Kg. per hectare as basal dose which included additional dose of 10:30:10 for the pulse crop. After the harvest of the cowpea, tapioca was top dressed with 17 kg. each NPK per hectare and earthed up. The pulse crop was harvested in 80 days and tapioca in 217 days after planting the setts. The yield data are given in page 25.

By following the crop mix cowpea and tapioca in rice fallows, the cultivator received an additional profit of Rs.565/- per hectare which is more than double the net profit received from the monoculture tapioca.

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DETAILS OF COWPEA AS AN INTERCROP IN TAPIOCA

Crops	Expendi- ture	Yield obtained	Income	Profit	Cost benefit ratio.	Duration.
Tapioca		i. 10.400 kg Tapioca				215 days
and Cowpea as companion crops.	Rs.3400/-	ii. 90 kg dry seed cowpea iii. 720 kg vegetable pods				84 days
			Rs.4625/-	Rs.1225/-	1:1.36	
Tapioca alone	Rs.2800/-	11200 kg	Rs.3360/-	Rs.560/-	1:1.2	215 days

By cultivating cowpea as intercrop in tapioca the net profit of the farmer could be doubled.

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