

Original Articles.

Tea and *Indigofera*
Endecaphylla.

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Introductory.

IN the Year Book of the Department of Agriculture for 1926 the details of a trial of the above cover crop in tea, which had then been recently started, were published. These details will be now briefly recapitulated.

In all, ten acres were planted with *Indigofera* during the North-East monsoon of 1925. Eight acres of this area had been previously under a manurial experiment and only the results from these plots will now be considered. Six of these plots are subdivided into half-acre plots, making in all fourteen plots from which records are available.

Planting was done from cuttings; clumps of two or three cuttings being put in two feet apart in every row. Nine months later a practically complete and uniform cover was formed, except in a few poor steep patches where the cover crop took longer to establish.

It was decided that as far as possible the conditions after the planting of the cover crop should be kept exactly the same as existed before, and therefore that no cultural treatment of the *Indigofera* should be attempted other than that found necessary to enable the manures to be applied.

The same systems of manuring, plucking, and pruning have been continued throughout.

The growing of a ground cover crop in tea is more or less of an innovation in Ceylon, and before embarking on such a venture the practical planter will rightly ask the following questions.

1. "What is it going to cost?"
2. "Will it absorb more labour than I can spare?"
3. "What will it cost to get rid of it, if I want to?"
4. "How is it going to affect my yields?"

or, to put the matter in one sentence—" Will it pay ? " Some attempt will be made to answer these questions from the results of two years' experience with this cover crop in old tea at Peradeniya.

Expense.

Without undertaking any digging or forking in of the *Indigofera* the following operations are obligatory.

(1) **Planting.**—The actual cost of planting, exclusive of purchase of seed or cuttings, was, on the Experiment Station, Rs. 5·23 per acre, including the cutting of the creepers and their transport over about half a mile. In this case, however, clumps of cuttings were put into two feet apart in every row as it was desired to establish a uniform cover as soon as possible. If the quick establishment of a cover is not a matter of urgency planting even 6 ft by 6 ft. would probably result in a good cover in one or two years' time, depending on the elevation of the estate. Planting clumps of two or three cuttings together 4 ft. by 2 ft., as was done on the Experiment Station, entails some 20,000 cuttings for an acre, and, at the present departmental rate of Rs. 3·00 per 1,000, these cuttings would cost Rs. 60·00.

If cuttings are planted 6 ft. by 6 ft. however, about 3,000 cuttings costing Rs. 9·00 per acre would suffice; and, if this spacing were adopted the actual planting would not cost more than say Rs. 2·00 per acre, making a non-recurring cost of Rs. 11·00 per acre.

If time is of no particular object however planting material can be much more cheaply obtained than by purchase of cuttings. Sowing seed in the field is not recommended but a pound of seed sown in a nursery would probably provide sufficient cuttings to plant at least two acres. The present Departmental price of seed is Rs. 2·00 per pound. Or again, 1,000 cuttings planted 2 ft. by 2 ft. in a nursery would probably provide planting material for at least ten acres of tea. Ten acres of tea on the Experiment Station were actually planted up 4 ft. by 2 ft. with the cuttings obtained from about 1/16 acre. Another plan, now being adopted by some estates, is to plant up a small area of tea and gradually extend the cover with cuttings obtained from that area.

It will be seen that the cost of planting up an estate will vary largely according to the spacing adopted and the method of obtaining the necessary planting material. It is considered, however, that if time is of no particular consideration, there is no necessity to spend more than Rs. 4·00 per acre on the whole operation, including cost of planting material.

(2) **Cutting for Manuring.**—Manure was first applied to the Experiment Station tea under *Indigofera* five months after planting the cover crop. The cover was not then thick enough to render any special measures necessary and the manure was spread and forked in by envelope-forking more or less regardless of the *Indigofera*. The *Indigofera* suffered no set-back from this treatment. The next manuring was done a year later when a thick cover was established. The method then adopted was to employ gangs of one man and two women; the man made a vertical cut through the creeper with a grass knife down the middle of the row to be manured, while the women followed with mamoty forks and dragged the creeper to the sides of the row. The ground was thus sufficiently cleared for manuring and fork-ing, though many *Indigofera* roots were left in the row. This operation cost Rs. 4.75 per acre. On a subsequent occasion, when the cover had grown a good deal thicker the operation cost Rs. 5.98 per acre.

Rs. 5:00 per acre can be taken as a fair average for clearing alternate rows.

The frequency of this operation will of course depend on the manurial programme. It will be assumed that on an average one manuring of alternate rows is given per annum.

(3) **Weeding.**—If the cover crop is to be given every chance in its young stages and it is desired to prevent grasses and other weeds getting in it is probable that during the first year weeding costs will increase about fifty per cent. During the second year they might be put at the normal rate, or less; and in subsequent years at fifty per cent. less than normal, including the cost of removing the creepers which grow up through the bushes.

Actual figures are not available on the Experiment Station owing to a transition during the period in question from estate account weeding to contracts, and then back again to estate account weeding. Once established, the cover crop has been found effectually to keep down most weeds, including cora, but excepting couch grass. The clearing of the creepers which grow up through the bushes is a very easy matter since the creeper does not twine round or cling to the bush—it was largely for this reason that *Indigofera* was selected as a cover crop for tea. On one estate this work is entrusted entirely to the plucking kangannies, and the actual weeding expenditure is very small. On the Experiment Station when the cover was established contracts were given out for weeding, including the clearing of the creepers from the bushes, at Re. 1.50 per acre. Trouble was experienced in getting the contractors to clear the bushes of creepers and estate account weeding was resumed.

Savings in Expenditure.

It has been indicated that a saving in weeding costs is to be expected, at the latest after the second year.

The question of drains also has an important bearing on the financial side of the question. On the Experiment Station the creeper has been allowed to completely cover the drains and no further cleaning is done. The cover is so thick that there is practically no "run off" and money usually expended on upkeep of drains—with the possible exception of road drains—can be saved. Assuming that the normal annual cost of upkeep of drains is Rs. 3.00 per acre this could safely be reduced to Re. 1.00 per acre. There will be some planters and Visiting Agents who will maintain that the creeper should be cleared from the drains and these cleaned out in the ordinary way. Even if this is done, however, there will be a considerable saving, for experience on the Experiment Station, and on one estate, has shown that practically no silt is to be found in drains in a field covered with *Indigofera*.

Summary of Expenditure and Savings.

It will now be possible to draw up a rough summary of the probable additional expenditure involved and savings effected.

1st year.

Expenditure per acre.	Savings per acre.
Planting and planting material	
Rs. 4.00	
Extra cost of weeding (say from Rs. 2.00 to Rs. 3.00)	
,, 1.00	
Nett increase per acre	
,, 5.00	
2nd year.	
Cutting for manuring	Saving in clearing drains
Rs. 5.00	Rs. 1.00
Supplying <i>Indigofera</i> vacancies	
,, .50	
Total	
Rs. 5.50	Rs. 1.00
Less savings	
,, 1.00	
Nett increase per acre	
Rs. 4.50	

3rd and Subsequent years.

Cutting for manuring	Rs. 5·00	Saving on weeding	Rs. 1·00
		Saving on clearing drains	„ 2·00
			„ 2·00
	<hr/>		<hr/>
Total	Rs. 5·00		Rs. 3·00
Less savings	Rs. 3·00		<hr/>
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Nett increase per acre	Rs. 2·00		
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I do not consider the above estimate in any way optimistic. One Indigofera enthusiast has stated that "Weeding is a thing of the past."

It is to be noted that the above figures are only concerned with actual immediate expenditure involved or savings likely to be effected. Probable ultimate benefits and their bearing on yields and profits will be discussed later.

Labour.

It may be contended that apart from the question of funds, the control of the cover crop will absorb more labour than can often be spared. It will be seen however that for the absolutely essential operations the labour required is largely balanced by a saving of labour on other works, and the nett amount of additional labour required when the creeper is fully established is very small.

Moreover the extra expenditure and attendant employment of labour can, by planting a small area at a time, or by wide spacing of the cuttings, be spread over several years. This indeed would almost invariably be done in practice.

Eradication.

There is the Planters' third hypothetical question, "What will it cost to get rid of it if, I want to?"

No satisfactory answer to this question is at present forthcoming. The creeper is deep rooted and complete eradication would doubtless be an expensive operation.

It is considered improbable however that the desire or necessity will arise. Moreover, those cautiously minded will doubtless satisfy themselves as to the results achieved by the creeper over a limited area before embarking on extensive planting.

Yields.

All the plots which were included in the manurial experiment mentioned in the first section of this article were planted with Indigofera in 1925. It is therefore necessary to take the two-year inter-pruning period previous to this planting (1923-25)

as a basis of comparison—a not altogether satisfactory proceeding.

Table I shows the actual yields of green leaf from the plots in question for the two periods 1923 pruning to 1925 pruning, and 1925 pruning to 1927 pruning.

Table 1.
Actual yields of Green Leaf from Plots planted with Indigofera.

Plot.	Area. Acres.	1923 Pruning to 1925 Prun- ing. Before Planting Indigofera. lbs.	1925 Pruning 1927 Pruning. After planting Indigofera.	Increase or decrease. lbs.	Percentage Increase or Decrease.
141 A	... $\frac{1}{2}$	2369	2163	- 206	- 9
141 B	... $\frac{1}{2}$	2422	2181	- 241	- 8
142 A	... $\frac{1}{2}$	2363	2375	+ 12	+ $\frac{1}{2}$
142 B	... $\frac{1}{2}$	2376	2344	- 32	- 1
143 A	... $\frac{1}{2}$	1787	1774	- 13	- $\frac{1}{2}$
143 B	... $\frac{1}{2}$	1948	1914	- 34	- 2
145	... 1	4588	4105	- 483	- 10
146 A	... $\frac{1}{2}$	3257	3160	- 97	- 3
146 B	... $\frac{1}{4}$	3319	3297	- 22	- $\frac{1}{2}$
147 A	... $\frac{1}{2}$	3165	3076	- 81	- 3
147 B	... $\frac{1}{2}$	2874	3052	+ 178	+ 6
148 A	... $\frac{1}{4}$	1967	2125	+ 158	+ 8
148 B	... $\frac{1}{2}$	2039	2122	+ 83	+ 4
149	... 1	7145	7493	+ 348	+ 5
Total	... 8	41619	41181	- 438	- 1
Rainfall; inches for Crop period	...	198.77	186.46	- 12.31	- 6

There is a good deal of fluctuation in the behaviour of the plots, but viewed as a whole they indicate more or less of a standstill. There is a nett total decrease amounting to 1% in the second period.

Owing to the fact that there are an unequal number of supplies coming into bearing annually in the different plots a census of bushes actually in bearing was taken in the middle of each period, and Table 2 gives the yields of green leaf from each plot worked out to a full acre, or half acre, of 2722 or 1361 bushes as the case may be.

Table 2.

Yield of Green Leaf from Plots planted with Indigofera worked out from Census of Bushes in bearing to a Full Acre or Half acre of 2722 or 1361 bushes.

Plot.	Area. Acres.	1923 Pruning to 1927 Pruning. Before planting Indigofera. lbs.	1925 Pruning to 1927 Pruning. After planting Indigofera. lbs.	Increase or Decrease. lbs.	Percentage Increase or Decrease.
141 A	... $\frac{1}{2}$	- 3438	2867	- 571	- 16
141 B	... $\frac{1}{2}$	- 3484	2824	- 660	- 19
142 A	... $\frac{1}{2}$	- 3406	3362	- 44	- 1
142 B	... $\frac{1}{2}$	- 3064	2785	- 279	- 11
143 A	... $\frac{1}{2}$	- 2771	3174	+ 403	+ 15
143 B	... $\frac{1}{2}$	- 3407	3853	+ 446	+ 21
145	... 1	- 5595	5488	- 107	- 2
146 A	... $\frac{1}{2}$	- 3784	3833	+ 49	+ 1
146 B	... $\frac{1}{2}$	- 3983	4904	+ 921	+ 27
147 A	... $\frac{1}{2}$	- 4515	3964	- 551	- 17
147 B	... $\frac{1}{2}$	- 3843	4529	+ 686	+ 23
148 A	... $\frac{1}{2}$	- 3053	3213	+ 160	+ 1
148 B	... $\frac{1}{2}$	- 2777	2719	- 58	- 3
149	... 1	- 8525	8986	+ 461	+ 6
Total	... 8	- 55645	56501	+ 656	+ 1 $\frac{1}{2}$

Rainfall; inches for

Crop period	...	198.77	186.46	-12.31	- 6
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Again we notice considerable fluctuation in the plots. When the number of bushes in bearing is taken into consideration a nett gain of 1 $\frac{1}{2}$ % over the whole area is shown. Again more or less of a standstill is indicated. It will be noticed that the rainfall for the second period was 12.31 inches less than for the first period.

There are no other tea plots on the station which have received precisely the same treatment during the two periods under discussion but the actual yields of green leaf of some of the other plots are quoted in comparison—in Table 3.

Table 3.

Plot.	Area. Acres.	1923	1925	Increase or Decrease.	Percentage Increase or Decrease.
		Pruning to 1925 Pruning. lbs.	Pruning to 1927 Pruning. lbs.		
144	... 1	6182	6358	+ 176	+ 3
150	... 1	8474	9208	+ 734	+ 9
155	... 1	7326	4780	- 2546	- 35
163	... 1	2926	3178	+ 252	+ 9
164	... 1	2532	2613	+ 81	+ 3
Hillside	... 8	7861	9496	+ 1535	+ 2
Total	... 13	35301	35533	+ 232	+ $\frac{1}{2}$

The outstanding feature in this table is the large decrease in plot 155. This was due to the loss of a large number of bushes after pruning. *Rhizoctonia bataticola* and *Diplodia* were found on most of the specimens sent in for examination.

Without plot 155 the remaining plots show an increase of 9% in the second period.

The Superintendents of four neighbouring estates have also kindly furnished yields for the two periods in question. These are as follows:—

Percentage Increase or Decrease of Period October 1st, 1925, to September 30th, 1927, compared with period October 1st, 1923, to September 30th, 1925.

Estate A	... + 5%
Estate B	... - 13%
Estate C	... + 24%
Estate D	... + 19%

It is understood that various factors will influence such yields and the comparison is only a rough one.

It appears to be indicated however that in spite of the deficiency in actual rainfall the second period was a favourable one for tea yields and it seems possible that during the first two years of its presence the Indigofera may have exerted a slightly depressing effect upon yields of tea.

The obvious improvement in the physical texture of the soil, however, the increasing layer of organic matter covering the surface, the diminution of soil erosion, and the healthy appearance of the tea, all give grounds for hope that yields will almost certainly eventually increase.

Soil Analyses.

Soil samples were taken for analysis by Mr. A. W. R. Joachim, Agricultural Chemist before pruning in 1925, and again before pruning in 1927. Samples were not taken in plot 149 in 1925 and the 1927 analyses of this plot is therefore omitted.

The following figures and remarks are taken from the Agricultural Chemist's Report on the samples.

Table 4.

		141A	141B	142A	142B	143A	143B	
Coarser Soil Particles	... 1925	59·15%	55·28%	53·41%	58·47%	58·71%	52·05%	
(F.Gravel+C.Sand)	... 1927	59·97%	60·04%	60·87%	60·62%	58·99%	51·04%	
Finer soil Particles	... 1925	21·55''	25·99''	18·95''	22·09''	23·64''	26·81''	
(Silt+F.Silt+Clay)	... 1927	22·71''	20·52''	19·82''	18·18''	24·27''	29·48''	
		145	146A	146B	147A	147B	148A	148B
Coarser Soil Particles	... 1925	55·70%	54·49%	57·65%	56·99%	62·32%	61·62%	53·53%
(F.Gravel+C.Sand)	... 1927	56·19%	62·87%	59·48%	58·18%	60·86%	62·52%	63·80%
Finer Particles	... 1925	26·45''	26·02''	22·63''	22·93''	16·63''	20·05''	24·59''
(Silt+F.Silt+Clay)	... 1927	23·09''	18·04''	20·89''	21·08''	19·04''	14·53''	15·51''

“ Table 4 shows the results of mechanical analysis in 1925 and 1927. The analysis shows that the soils are all light, sandy and gravelly loams, and that compared to the samples taken two years ago they have on the whole slightly greater proportions of fine gravel and coarse sand, the quantities present now varying between 50% and 63%. The proportion of the finer soil particles in the 1927 samples is correspondingly less and now varies between 16% and nearly 25%.

“It would therefore appear that in spite of the Indigofera there is a washing away of a small proportion of the finer soil particles due to soil erosion.

Table 5.

		141A	141B	142A	142B	143A	143B	
		%	%	%	%	%	%	
Total Nitrogen	... 1925	·066	·085	·092	·068	·058	·100	
“ “	... 1927	·090	·084	·110	·080	·077	·105	
Difference	...	+ ·024	+ ·001	+ ·018	+ ·012	+ ·019	+ ·005	
Organic Matter	... 1925	5·69	3·78	4·15	4·41	3·52	5·14	
“ “	... 1927	5·12	4·64	4·45	4·15	5·42	6·25	
		145	146A	146B	147A	147B	148A	148B
		%	%	%	%	%	%	
Total Nitrogen	... 1925	·189	·104	·096	·108	·091	·083	·084
“ “	... 1927	·082	·072	·092	·080	·071	·077	·096
Difference	...	- ·107	- ·032	- ·004	- ·028	- ·020	- ·006	+ ·012
Organic Matter	... 1925	2·85	4·63	4·43	3·68	3·69	3·95	2·89
“ “	... 1927	4·21	3·28	3·44	3·66	2·99	3·68	4·68
Average Total Nitrogen	...	1925	·094					
“ “ “	...	1927	·087					
Difference Total Nitrogen	...			- ·007				
Average Organic Matter	...	1925	4·06					
“ “ “	...	1927	4·30					
Difference Organic Matter	...			+ ·24				

Table 5 shows the quantities of total nitrogen and organic matter found.

“It will be noted that in five cases there is a distinct increase of over .01% in nitrogen, in four cases a distinct fall, and in four cases hardly any difference. On the whole there is a small decrease in the nitrogen content in the 1927 soil samples over those taken in 1925. These results seem to indicate that while the *Indigofera* did probably increase the supply of soil nitrogen, the amount contributed by it and that applied in manures was in some cases less than that taken up by the tea during the period. In other plots the nitrogen added to the soil by the leguminous crop and the manures was in excess of the requirements of the tea. The different amounts of nitrogen are also probably caused by different manurial treatment. It is also certain that sampling accounts to a certain extent to the differences, it being a matter of extreme difficulty to get a true representative sample from any large extent of soil.

“It is however likely that determinations made at the end of a further two years will give more conclusive results than have so far been obtained.”

Indigofera in New Clearings.

The question of whether *Indigofera* should be planted in new clearings at the same time as the tea, or a season or a year later is open to argument. Supplies planted in an established cover of *Indigofera* on the Experiment Station in 1926 and 1927 have throughout looked remarkably healthy and compare favourably with those in clean weeded plots. This leads one to the view that *Indigofera* and tea may safely be planted in the same season.

Conclusions.

1. *Indigofera endecaphylla* forms a suitable cover-crop for tea and is easily propagated.

2. The expenses of controlling and handling the cover-crop are largely counter-balanced by savings on other works, and the nett additional expenditure is not likely to exceed Rs. 2.00 per acre.

3. Two years' experience on the Experiment Station, Peradeniya, indicates that the presence of *Indigofera* has neither depressed nor increased yields of tea to any marked degree.

4. Analyses of soil before and after planting *Indigofera* show a satisfactory increase of organic matter but the total nitrogen present in the soil has remained more or less stationary.

5. Young supplies come on well among *Indigofera* and the plant may be recommended for new clearings.

6. Further experience is necessary before it can be definitely stated that the planting of *Indigofera endecaphylla* among tea is a paying proposition, but there are good grounds for expecting that it will prove to be so.