THE

Tea Research Institute

OF

Ceylon

BULLETIN No. 25

Annual Report for the Year 1943

Published by
THE TEA RESEARCH INSTITUTE OF CEYLON,
ST. COOMBS, TALAWAKELLE.

The Tea Research Institute of Ceylon.

SCIENTIFIC STAFF.

Director	...	Roland V. Norris, D.Sc. (Lond.), M.Sc. (Manc.), F.R.I.C.
Department of Mycology.		
Mycologist	...	C. H. Gadd, D.Sc. (Birm.)
Assistant Mycologist	...	T. E. T. Bond, Ph.D. (Cantab), M.Sc.
Assistant	...	C. A. Loos. (Reading)
Department of Agricultural Chemistry.		
Agricultural Chemist	...	T. Eden, D.Sc. (Manc.), A.R.I.C,
Research Assistant	...	Vacant
Assistant	...	E. N. Perera
Field Assistants	...	M. Piyasena
	...	F. P. Jayawardana
Department of Biochemistry.		
Biochemist	...	J. Lamb, M.Sc. (Lond.) A.R.I.C., A.I.C.T.A.
Research Assistant	...	H. B. Sreerangachar, M.Sc. (Bombay), B.Sc. (Mysore). A.R.I.C., A.I.I.Sc,
Assistants	...	V. Mendis
	...	E. L. Keegel
	...	P. R. Perera
Department of Entomology.		
Entomologist	...	C. B. Redman King, M.A. (Cantab.). M.C.
Assistant Entomologist	...	G. D. Austin [on military service]
Assistant	...	D. J. William
Field Assistant	...	W. T. Fonseka
Department of Plant Physiology.		
Plant Physiologist	...	F. R. Tubbs, Ph.D. (Lond.), D.I.C., A.R.C.S., F.L.S. [on military service]
Voluntary Worker	...	Mrs. T. E. T. Bond, M.Sc. (Reading)
Assistant	...	M. H. E. Koch
Field Assistant	...	F. H. Kehl
Small-Holdings Officers.		
	...	R. L. Illankoon [on military service]
	...	M. B. Boange (Acting)
	...	F. D. Tillekeratne

Superintendent, St. Coombs Estate ... J. A. Rogers

NOTE.

The Laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and letters and enquiries should be addressed to the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle. Telegraphic Address:—Research, Talawakelle; Telephone, Talawakelle 44 (Private Exchange). It is particularly requested that letters should not be addressed to officers by name

EIGHTEENTH ANNUAL REPORT

OF THE

BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON

FOR 1943

Foundation.—The Tea Research Institute was established by Ordinance No. 12 of 1925, dated the 27th October, 1925. The Constitution of the Board is laid down in that Ordinance; the personnel on the 1st day of January, 1943, was:—

Ex-Officio Members

The Hon'ble the Financial Secretary (Hon'ble Mr. H. J. Huxham, C.M.G.)
The Director of Agriculture (Mr. E. Rodrigo, C.C.S.)
The Chairman, Planters' Association of Ceylon (Mr. N. H. Wykeham Dulling).
The Chairman, Ceylon Estates' Proprietary Association (Mr. R. Mann).

Representatives of the Planters' Association of Ceylon.

Mr. R. G. Coombe
Mr. G. K. Newton.
(Vacant).

Representatives of the Ceylon Estates Proprietary Association.

Major J. W. Oldfield, C.M.G., O.B.E., M.C.
Mr. J. C. Kelly.
Mr. W. H. Gourlay

Representative of the Low-Country Products Association.

Mr. W. P. H. Dias.

Representative of the Small-Holders

Adigar Sir T. B. Panabokke, (Chairman).

Chairman.—Adigar Sir T. B. Panabokke.

Secretary.—Dr. Roland V. Norris.

Solicitors.—Messrs. Julius & Creasy.

Auditors.—Messrs. Ford, Rhodes, Thornton & Co.

Registered Office.—The Victoria Commemoration Building, Kandy.

Mr. H. St. Cole-Bowen was nominated by the Planters' Association of Ceylon as one of their representatives as from 22nd January, 1943, to fill the vacancy caused by the resignation of Mr. J. D. Hoare.

The following nominations of Members of the Board were renewed during the year for further periods of three years:—

(i) Adigar Sir T. B. Panabokke as Representative of the Small-Holders by H. E. the Governor as from 2nd February, 1943.

(ii) Mr. W. H. Gourlay by the Ceylon Estates' Proprietary Association with effect from 1st February, 1943.

(iii) Major J. W. Oldfield and Mr. J. C. Kelly by the Ceylon Estates' Proprietary Association with effect from the 31st December, 1943.

Four meetings of the Board were held during the year, the average attendance being nine.

COMMITTEES

Finance Sub-Committee.—The Chairman, T. R. I.; the Chairman, Planters' Association of Ceylon; the Chairman, Ceylon Estates' Proprietary Association; Major J. W. Oldfield, C.M.G., O.B.E., M.C.; Mr H. St. J. Cole-Bowen, Mr. J. C. Kelly and the Director, T. R. I.

This Committee held two meetings during the year.

Estate and Experimental Sub-Committee.—The Director, T. R. I. (Chairman); the Chairman, T. R. I.; the Visiting Agent (Mr. H. Tonks); the Superintendent, St. Coombs; Messrs. R. G. Coombe, D. T. Richards, R. H. Horne, W. J. Craig, E. de la Mare, G. K. Newton and Dr. T. Eden (Convener).

This Committee met three times.

Medical Scheme Sub-Committee.—The Chairman, T. R. I.; the Director, T. R. I. and Mr. G. D. Austin (representing the Junior Staff).

Trustees of the Junior Staff Provident Fund.—The Chairman, T. R. I.; the Director, T. R. I.; Mr. R. G. Coombe and Mr. E. N. Perera (representing the Junior Staff).

Visiting Agent.—Mr. H. Tonks continued to act as Visiting Agent and paid three visits of inspection to St. Coombs during the year. The thanks of the Board are due to him for his valuable advice.

FINANCE

The total receipts amounted to Rs. 379,168, made up as follows:—Cess Rs. 369,009, Profit on St. Coombs Estate Working Account Rs. 3,549 and Miscellaneous Receipts Rs. 6,610. Receipts were thus Rs. 49,092 lower than in 1942. This result was chiefly due to the decreased profit from St. Coombs.

Expenditure on Revenue Account, comprising Research Revenue Expenditure at Rs. 247,331, Interest charges on the Government Loan Rs. 32,948, and Depreciation at Rs. 39,930, amounted to Rs. 320,209 as against Rs. 313,127 in 1942. There was thus a surplus on Revenue Account of Rs. 58,959, the corresponding figure for 1942 being Rs. 115,132.

Capital expenditure was incurred to the extent of Rs. 55,345, this sum comprising nett expenditure on assets of Rs. 13,552, and Rs. 41,798 representing repayment of the Government Loan. The expenditure on assets was on Estate Account.

Nett liquid assets as at 31st December, 1943, after allowing for specific liabilities, such as the accrued interest on the Government Loan and Furlough and Passages Reserve, amounted to Rs. 484,948. The liability under the Depreciation Reserve at the same date was Rs. 518,452 while the balance due to Government on Loan Account was Rs. 567,702.

ST. COOMBS ESTATE

The year 1943 was most unfavourable for crop, weather conditions being consistently adverse. A very severe drought occurred in the first four months of the year with the result that April, normally the heaviest cropping month of the year, yielded only 9,681 lb. made tea. The monsoon broke early in May and for the rest of the year continuously wet and sunless weather was experienced, the rainfall (estate gauge) at 124.68 inches being, in spite of the early drought, the second heaviest since the Institute moved to St. Coombs, while the sunshine figures from May to December were 319 hours below average.

The above factors, combined with reduced manuring, reduced the total crop to 172,048 lb. (166,387 lb. graded tea and 5,661 lb. Broken Mixed) as against 222,588 lb. (212,801 lb. graded tea and 9,787 lb. Broken Mixed) in 1942.

The entire crop, with the exception of the small amount used for local consumption, was sold to the Ministry of Food, the nett price received, including off-grades, being 98.21 cents per lb.

Cost of production was greatly increased owing to the small out-turn and increased cost of Dearness Allowance, and amounted to 95.53 cents per lb. on total crop. Of this Dearness Allowance accounted for 19.86 cents.

The combined effect of the above factors was to reduce the profit on the estate to Rs. 3,549 as against Rs. 49,234 in 1942.

The 1937 clearings were brought into light plucking during the year. It is of interest to note that the two acres planted on the contour (5 feet by 1½ feet) gave 678 lb. per acre, though pruned in September. This compares with 219 lb. in the rest of the area planted 4 ft. by 3 ft. and pruned in August, and the yield for the old tea of 610 lb. per acre.

PUBLICATIONS

Owing to the shortage of staff and pressure of other work only two parts of *The Tea Quarterly* could be issued in 1943. Bulletin No. 24, Annual Report for 1942, was also published. Subscriptions for publications amounted to Rs. 2,368, the amount being reduced owing to subscribers in the Far East being unable to receive the publications.

ACKNOWLEDGMENTS

Cordial thanks are due to the Ceylon Association in London who have, as usual, given the Institute much assistance. The usual cordial co-operation has continued with the Planters' Association of Ceylon, the Ceylon Estates' Proprietary Association and other bodies concerned in the Tea Industry.

Thanks are also due to the Ceylon Chamber of Commerce, Colombo, for the use of their Committee Room for Meetings of the Board held in Colombo.

The Audited Statements of Accounts and the Balance Sheet for 1943 are attached together with the reports of the Visiting Agent and of the Director and Scientific Staff dealing with the research activities of the Institute.

ROLAND V. NORRIS,

Secretary

THE TEA RESEARCH INSTITUTE OF CEYLON

BALANCE SHEET AS AT 31st DECEMBER. 1943

LIABILITIES

	Rs. Cts.	Rs. Cts.
CREDITORS & CREDIT BALANCES:—		
Accrued Interest on Loan	7,805·90	
Sundry Creditors—Estate ..	10,003·42	
Sundry Creditors—Research ...	7,997·24	
Subscriptions for Publications received in advance	29·91	
Contribution for Upkeep of Kowlahena Cart Road received in advance	301·00	26,137·47
FURLOUGH RESERVE:—		
At 31st December, 1942 ...	10,867 96	
Additions during 1943	10,345·00	
	21,212·96	
Less: Payments during 1943	2,059·38	19,153·58
DEPRECIATION RESERVE:—		
At 31st December, 1942 ..	479,021·30	
Less: Alcosa Blower, being difference between cost and sum realised ...	500·00	
	478,521·30	
Credited at 31st December, 1943	39,930·55	518,451·85
Carried over		Rs. 563,742.90

ASSETS

		Rs. Cts.	Rs. Cts.
DEBTORS & DEBIT BALANCES:—			
Principal Collector of Customs (since received) ...		29,795·03	
Moray Estate, Maskeliya ...		15·00	
L. Barton—Bungalow Rent for November and December including Telephone Rental and Electricity		355·85	
Bosanquet & Skrine Ltd.—Cost of 2 Copies Annual Report ...		5·00	
Fertiliser Control Bureau ...		744·86	
Refund from Shell Co. of Ceylon Ltd.		11·70	
L. Barton—Cost of Phonograms, Tr. Calls, Coolies, Firewood for December recovered ...		45·64	30,971·08
SUNDRIES—RESEARCH:—			
Ceylon Association in London £ 6,967·14·1 ...		92,902·72	
Research Staff ...		1,606·03	
Suspense Account		36·56	
Accrued Interest on Fixed Deposits		1,381·56	
		95,926·87	
SUNDRIES—ESTATE ...		1.386·94	97,313·81
STOCKS-IN-HAND:—			
Tea 30.871 lb.		30,617·26	
Rice ...	1 538·16		
Stock ...	17,09347		
Chillies ...	20·00		
Kurakkan ...	1.499·30		
Kollu ...	4,979·17		
Wheat ...	33·93		
Gram ...	108·85		
Bajiri ...	501·01		
Sholam ...	2,562·04		
Millet ...	4,661·93		
Sugar ...	23·10		
Kerosene Oil ...	118·80	33,139·76	63,757·02
Carried over			Rs. 192,041·91

THE TEA RESEARCH INSTITUTE OF CEYLON

BALANCE SHEET AS AT 31st DECEMBER, 1943—(*contd.*)

LIABILITIES	Rs. Cts.	ASSETS	Rs. Cts.	Rs. Cts.
Brought forward	Rs. 563,742·90	Brought forward		192,041·91
		INVESTMENTS		
		£2,300·0·0 3½% War Loan ...	32,434·76	
		£2,063·18·1 4% Funding Loan ...	29,928·06	
		Rs. 30,000/- 3½% War Loan 1957/62	29,512·50	
		Rs. 15,000/- 3 % Defence Bonds	15,000·00	
		Rs. 20,000/- 3 % ,, ,,	20,000·00	
		Rs. 40 000/- 3½% National Loan	40,000·00	166,875·32
		CASH:—		
		On Fixed Deposit ... 115,173·95		
		On Current Account ... 44,002·97		
		N. B. I. Ltd., N'Eliya ... 1,854·92		
		In hand ... 558·78	161,590·62	
		Estate—N.B.I. Ltd. Colombo, 10,126·94		
		,, In hand 927·63	11,054·57	172,645·19
		FUNDS OVERSPENT		
		To 31st December, 1942 35,793·82		
		Capital Expenditure, 1943 13,551·77		
		Govt. of Ceylon Loan a/c. 41,793·46	91,139·05	
		Less: Revenue Account 1943	58,958·57	32,180·48
	Rs. 563,742·90			Rs. 563,742·90

We have audited the books of the Tea Research Institute of Ceylon and have obtained all the information and explanations required by us. The allocations of Capital Expenditure and of Research Revenue Expenditure as made by the Director have been accepted by us.

We are not in a position to say whether the Reserves made for Depreciation are adequate.

Subject to the foregoing reservations the above Balance Sheet, in our opinion, is properly drawn up so as to exhibit a true and correct view of the financial affairs of the Institute at 31st December, 1943, according to the best of our information and the explanations given to us, and as shown by the books.

(Sgd.) FORD, RHODES, THORNTON & CO.,
Chartered Accountants

Colombo, 1st May, 1944

THE TEA RESEARCH INSTITUTE OF CEYLON

Dr. **CAPITAL ACCOUNT AS AT 31st DECEMBER, 1943** **Cr.**

EXPENDITURE

	To 31-12-42 Rs. Cts.	Additions in 1943 Rs. Cts.	Items Scrapped off 1943 Rs. Cts.	Total Rs. Cts.
To Land, Including Development	880,677·12	8,890·41	—	889,567·53
,, Buildings and Lines	945,349·69	1,712·34	—	947,062·03
,, Furniture and Equipment	82,439·30	—	—	82,439·30
,, Laboratory Equipment	42,786·29	—	—	42,786·29
,, Experimental Machinary	29,705·38	—	—	29,705·38
,, Machinery—Estate	131,581·37	3,749·02	800·00	134,530·39
,, Motor Road Roller	7,386·03	—	—	7,386·03
,, Motor Car	4,025·00	—	—	4,025·00
	2,123.950·18	14,351·77	800·00	2,137,501·95

St. Coombs.

RECEIPTS

	Re. Cts.	Rs. Cts
By Government of Ceylon;— Loan on Mortgage at 5½% per annum ...	4,000,000·00	
Less : Repayments to 1943 ...	432,297·69	567,702·31
,, Revenue Applied to Capital Purposes to 31-12-42	1,478,660·59	
do ,, 31-12-43	58,958·57	1,537,619·16
,, Funds Overspent to 31-12-42	35,793·82	
Less : 1943 underspent	3,613·34	32,180·48
		Rs. 2,137,501·95

(Sgd.) **ROLAND V. NORRIS,**
Director.

THE TEA RESEARCH INSTITUTE OF CEYLON

LOAN ACCOUNT

	Rs. Cts.			Rs. Cts.
To GOVERNMENT OF CEYLON LOAN Account	Rs. 1,000,000·00	By REPAYMENTS PRINCIPAL :— To 31st December, 1942	...	390,504·23
		,, To 31st December, 1943	...	41,793·46
		,, Balance	...	567,702·31
	Rs. 1,000,000·00			Rs. 1,000,000·00

(Sgd.) ROLAND V. NORRIS,
Director

THE TEA RESEARCH INSTITUTE OF CEYLON

ESTATE WORKING ACCOUNT AS AT 31st DECEMBER, 1943

EXPENDITURE		Rs. Cts.	INCOME		Rs. Cts.
To Estate Expenditure—Revenue	...	164,359·92	By Tea Sales—Tea Commissioner	170,251 lbs.	169,740·21
,, Charges ...	...	2,415·88	,, Do —Local	268 ,,	256·58
,, Balance Carried Forward	...	3,548·59	,, Do —Broken Mixed	127 ,,	19·05
			,, Do —Biochemical Dept.	28 ,,	28·00
			,, Motor Road Roller Account	...	280·55
		Rs. 170,324·39			Rs. 170,324·39

REVENUE ACCOUNT AS AT 31st DECEMBER, 1943

Dr. Cr.

		Rs. Cts.	Rs. Cts.		Rs. Cts.
To Administration of the Board:—					
Planters' Association of Ceylon		240·00		By Balance from Estate Working Account	3,548 59
Travelling of the Board	...	1,407·65		,, Tea Cess	369,009·73
Clerical Staff	...	8,522 80		,, Interest	6,215·45
Telephone Operators	...	1,204·40		,, Rent of Caddy	60·00
Office Peon	...	896·40		,, Miscellaneous Receipts ...	300·00
Postages	...	43·29		,, Guest House Account ...	34·50
Stationery	...	1,237·75			
Advertising	...	8·91			
Telegrams, Trunk Calls, etc.	...	53·80			
Printing		Credit 180·00			
Auditors' Fee	...	738·94			
Contingencies	...	169·48	14,743·42		
		Carried over	Rs 14,743·42	Carried over	Rs. 379,168·27

THE TEA RESEARCH INSTITUTE OF CEYLON

REVENUE ACCOUNT AS AT 31st DECEMBER, 1943—*(contd.)*

	Rs. Cts.	Rs. Cts
Brought forward		14,743·42
To PERSONAL EMOLUMENTS OF SCIENTIFIC STAFF:—		
Director ...	22,500·00	
Mycologist ...	20,250·00	
Agricultural Chemist ...	20,250·00	
Plant Physiologist ...	8,955·54	
Entomologist ...	11,282·32	
Biochemist ...	5,659·13	
Asst. Mycologist ...	10,737·50	99,634·49
,, EMOLUMENTS OF JUNIOR AND SUB-SCIENTIFIC STAFF:—		
Junior Scientific Staff ...	44,283·90	
Lab. Attendants & Fieldman	6,926·69	51,210·59
,, LABORATORY:—		
Equipment and General Working Expenses ...	2,571·55	
Special Provision for Joint Research on Chemistry of Tea	5,017·41	7,588·96
,, LIBRARY AND PUBLICATIONS:—		
Library ...	1,976·61	
Publications ...	280·39	2,257·00
,, SMALL-HOLDINGS:—		
Salaries and House Allowances	7,465·46	
Travelling and General Expenditure ...	2,732·59	10,198·05
Carried over		Rs. 185,632·51

Brought forward	Rs. 379,168·27
Carried over	Rs. 379,168·27

THE TEA RESEARCH INSTITUTE OF CEYLON

REVENUE ACCOUNT AS AT 31st DECEMBER, 1943—(*contd.*)

		Rs. Cts.	Rs. Cts.
	Brought forward		185,632·51
To	FIELD AND FACTORY EXPERIMENTS:—		
	Agricultural Chemist ...	3,920·25	
	Plant Physiologist ...	165·43	
	Miscellaneous Field Experiments	143·55	
	Factory Experiments ...	1,964·28	6,193·51
,,	TRAVELLING OF STAFF:—		
	Officers' Expenses ...	2,059·12	
	Insurance of Car and Licence ...	148·67	
	Drivers' Wages ...	1,753·20	
	Drivers' Batta ...	225 05	
	Running Expenses and Repairs...	2,059·99	6,246·03
,,	MAINTENANCE OF BUILDINGS:—		
	Laboratory ...	23·75	
	6 Senior Staff Bungalows ...	736 12	
	13 Junior Staff Bungalows ...	1,036 08	
	3 Clerks' Bungalows ...	242·61	
	Miscellaneous Lines and Buildings	729·92	
	Passara Buildings ...	54·00	
	Rest House ...	99 01	2,921·49
,,	GENERAL SERVICES:—		
	Electric Power ...	6,787·58	
	Mechanic ...	1,276·30	
	Telephone Rent and Maintenance of Lines ...	543·50	
	Roads ...	250·00	
	Sanitation ...	1,396·78	
	Water Supply ...	1,605·02	
	Tappal, Lorry and Book Fees ...	264·00	
	Upkeep of Grounds ...	1,408·97	
	Rest House ...	826·24	14,358·39
	Carried over	Rs. 215,351·93	

		Rs. Cts.
	Brought forward	379,168·27
	Carried over	**Rs. 379,168·27**

THE TEA RESEARCH INSTITUTE OF CEYLON

REVENUE ACCOUNT AS AT 31st DECEMBER, 1943—*(contd.)*

		Rs. Cts.	Rs. Cts.
	Brought forward		215,351·93
To MISCELLANEOUS:—			
Incidentals	...	192·16	
Provident Fund, Senior Sc. Staff		12,281·78	
Do Junior Scientific Staff		5,189·90	
Do Sub-Staff	...	1,488·95	
Ceylon Nursing Association and Fraser Nursing Home	...	135·00	
Passages	...	6,000·00	
Medical Fees Sub-Staff	...	228·70	
Medical Scheme Junior Staff	...	1,233 00	
Insurances	...	4.332·16	
Watchmen and Caretakers	...	658.04	
Observatory Allowance	...	240·00	31,979·69
,, GOVERNMENT OF CEYLON LOAN INTEREST ACCOUNT	....		32,947·53
.. DEPRECIATION	...		39,930·55
.. Balance	...		58,958·57
		Rs.	379,168·27

	Rs. Cts
Brought forward	Rs. 379.168·27
	Rs. 379,168·27

St Coombs,

ROLAND V. NORRIS,
Director.

REPORT

ON

ST. COOMBS ESTATE

FOR 1943

The following short report on the working of St. Coombs' Estate for 1943, is specially written for inclusion in the Tea Research Institute's Annual Report for that year, and it is in addition to the usual Visiting Agent's reports on the property.

Superintendent.—Mr. J. A. Rogers.

Acreage :—

	A.	R.	P.
Tea in Bearing	264	1	06
Tea in Partial Bearing (1937) ...	20	0	00
Tea New Clearing (1938) ...	16	0	00
Tea Nurseries	1	1	08
Fuel Clearings	36	0	00
Reserve available for planting ...	27	1	09
Building Sites, etc.	26	2	22
Waste Land, Swamps, etc.	23	1	14
Total ...	414	3	19

Weather :—

Rainfall registered in 1943—124.68 inches—257 Wet Days
Rainfall registered in 1942—104.82 inches—248 Wet Days
Increase ... 19.86 inches— 9 Wet Days

Climatic conditions in 1943 were most unfavourable and disastrous in regard to crop on St. Coombs. There was an exceptionally severe drought for the first four months of the year (January to April), followed by the early arrival on the 11th May, of the South West Monsoon which was a very prolonged one, with more or less continuous wet weather, and an unusual lack of sunshine from May to December; in fact during that period of eight months the sunshine hours recorded were 319 hours below average.

Crop :—

	1943	1942
Estimate	200,000 lbs.	190,000 lbs.
Graded Tea harvested ...	166,387 „	212,801 „
Off Grades harvested (Broken Mixed)	5,661 „	9,787 „
Total ...	172,048 lbs.	222,588 lbs.

The total crop for 1943 showed a decrease of 50,540 lbs. as compared with the record crop harvested in 1942.

Yield per acre (Graded Tea Only):—

	1943	1942
Old Tea	610 lbs.	785 lbs.
1937 Clearing ...	260 „	271 „

The 1937 Clearing was pruned in August-September.

Prices on Total Crop Sold (inclusive of Broken Mixed):—

	Gross Average per lb.	Nett Average per lb.
1943—170,614 lbs.	99.63 cents	98.21 cents
1942—219,365 lbs.	95.23 cents	92.68 cents

Profit on Estate Working:—

1943	Rs. 3,549.00
1942	„ 49,234.00

Cost of Production (Revenue Account):—

	1943	1942
Estimate ...	83.15 cents per lb.	67.41 cents per lb.
Actual cost on Total Crop	95.53 cents per lb.	69.15 cents per lb.

Dearness Allowance included in above cost figures was as follows:—

	1943 On Total Crop Cts.	1942 On Total Crop Cts.
To Labourers ...	17.85	8.44
To Factory Staff ...	1.10	—
To Subordinate Staff ...	.91	—
	19.86	8.44

Capital Expenditure.

1943—Rs. 14,352.00	or on Total Crop	8.16 cents per lb.
1942—Rs. 15,751.00	or on Total Crop	7.07 cents per lb.

Manuring.—The programme, revised in view of the Fertiliser Rationing Scheme, of 240 acres was completed. No deliveries were made after November under this scheme owing to lack of supplies.

Pruning.—The programme was completed at a cost of Rs. 16.70 per acre. It has been decided that the pruning cycle shall be reduced from a 4-year to a 3-year cycle.

The main reasons for this reduction in the pruning cycle were:—

(a) From data of fields due for pruning it was established that the very mixed jat old fields were not suited to long cycles without substantial cropping loss, and that, as artificials are now rationed to approximately 50 per cent of the normal supply of plant food (Nitrogen), it was considered that the four-year cycle would not prove economic as long as Fertiliser Rationing continues.

(b) By shortening the pruning cycle under present conditions plucking is made easier and cheaper, which in view of labour conditions is a consideration these days.

Green Manuring.—Large quantities of leaf-fall were incorporated into the soil after pruning. Any available green manure, augmented by loppings of Wild Sunflower from ravines, was forked in with applications of artificials, as well as when leaf-fall was forked in.

Supplying.—3,170 tea stumps were put out as supplies in Field No. 4.

Weeding.—The whole acreage was gang weeded on Estate Account at a cost of Rs. 2.86 per acre, (as compared with a cost of Rs. 2.16 in 1942), 1943 was an extremely troublesome year for weeds, owing to the continuous wet weather from May to December, and weeding absorbed more adult labour than usual in consequence.

On St. Coombs Estate all weeds are removed except the *Polygonum* species which are left, and which form a useful ground cover. This system has proved successful on this estate.

Of the 3,144 acres estimated, 2,926½ acres were actually weeded during the year, a shortage of 217½ acres.

Grass weeds were more noticeable during 1943 especially on the clearings, and under the *Polygonum* cover in the old tea. *Drymaria* was on the increase.

However by careful supervision weeding has been kept well under control, with the minimum of scraping and loss of top soil.

New Clearings.—The 1937 clearings continued to be lightly plucked until pruned in August-September, and yielded 260 lbs. per acre.

The 1938 clearing was also pruned, and is now making satisfactory progress and growth.

Some 4,300 supplies were put out in all the Clearings.

The manuring of these Clearings was delayed until next year after having come back from pruning.

Labour.—At the end of 1943 there were 366 working labourers on the estate, (as compared with 373 at the end of 1942). This is equivalent to 1.38 working labourers per acre in full bearing, or 1.22 per acre on the full acreage in tea. Out-turn has been very satisfactory, varying between 80 per cent in July and December and 91 per cent in March. In regard to output, there has been a tendency for labour to do rather less work, particularly in weeding which is an unpopular work, but also in plucking, judging by averages plucked during the last 3 years, though this may partly be due to the difficulty in plucking good averages from mixed jat fields in their fourth year from pruning.

During 1943, 59 labourers proceeded to, and 44 returned from India. Local movement was negligible, only 8 labourers having been paid off and 7 taken on, this indicates a well-established and settled labour force.

Labour has been rather short due to the increased demands for weeding, and the reduced average plucked.

The average number of labourers lent to the Tea Research Institute per month was 683.

Lines.—There are 148 line rooms up to Government Standard. Further repairs to drains and ramps, etc. will be necessary when cement again becomes available for such purposes.

Factory and Machinery.—The factory building was maintained in first-class order. Machinery was also well kept and in good order. The Moore's "Chota" sifter (estimated in 1942) was delivered and installed in 1943. Extensive repairs and renewals have again been necessary to the furnace of the Empire drier.

A Sirocco-Wallsend Oil Burning Equipment is to be installed for use in both driers, as firewood supplies have caused anxiety and the situation is likely to deteriorate.

General.—The 1943 crop was extremely disappointing, chiefly due to exceptionally unfavourable weather conditions throughout the year, and also no doubt partly due to the reduced manuring during the last two years.

The large shortfall in crop resulted in very high cost of production, and negligible profit.

The tea however continued to be healthy in appearance and capable of yielding well with favourable weather and ample sunshine.

The estate has been maintained in thorough good order, in spite of increased difficulties, and Mr. Rogers has put in another year's conscientious work.

HUBERT TONKS.
Visiting Agent.

METEROLOGICAL OBSERVATION, 1943

ST. COOMBS.

MONTH	TEMPERATURES							RAINFALL		RAIN DAYS		SUNSHINE	
	Mean Maximum	Difference from average 1931-1940	Mean Minimum	Difference from average 1931-1940	Adopted Mean	Mean on grass	Mean Relative humidity	Inches	Difference from average 1931-1940	Days	Difference from average 1931-1940	Hours.	Difference from average 1931-1940 Hours
January	74·9	+1·2	55·7	- 0·1	65·3	49·8	71	1·15	- 2·97	6	- 5	232·60	+37·60
February	76·4	+ 0·3	54·3	- 0·1	65·4	48·0	67	0·77	- 2·13	6	- 2	208·00	- 22·52
March	78·8	+ 1·6	53·0	- 2·3	65·9	46·0	62	1·59	- 2·6	9	- 3	260·41	+ 25·95
April	78·3	+ 1·0	56·5	- 1·3	67·4	52·6	72	3·61	- 2·69	12	- 4	216·85	+ 12·61
May	72·8	- 2·0	59·8	- 0·1	66·3	59·1	82	26·59	+ 14·21	24	+ 5	115·22	- 43·38
June	67·8	- 3·0	60·2	- 0·2	64·0	60·2	92	19·16	+ 6·75	30	+ 3	56·03	- 38·25
July	67·4	- 2·4	59·0	- 0·5	63·2	59·1	88	17·58	+ 4·91	27	+ 1	67·98	- 40·16
August	70·2	- 0·8	58·0	- 1·0	64·1	58·4	88	7·96	- 1·73	23	- 2	105·12	- 15·04
September	69·2	- 3·0	58·3	+ 0·2	63·8	58·8	89	11·85	+ 3·37	26	+ 5	78·83	- 68·09
October	71·3	- 1·9	58·8	+ 1·1	65·0	59·4	85	7·83	- 1·40	29	+ 7	96·03	- 52·30
November	71·5	- 1·7	56·6	- 0·8	64·0	54·8	84	8·38	+ 0·21	22	+ 2	141·02	- 13·25
December	73·7	nil	56·7	- 0·5	65·2	52·8	78	9·93	+5·00	23	+ 8	137·37	- 48·39
Annual	72·7	-0·89	57·2	- 0·47	65·0	54·9	80	116·40	+ 20·88	237	+14	1715·46	- 275·22
	Means							Totals					

REPORT

OF

THE DIRECTOR,

TEA RESEARCH INSTITUTE OF CEYLON

FOR 1943

Owing to paper restrictions, this report is issued in a condensed form, particularly in regard to technical matters concerning which fuller details will be found in the Departmental reports attached.

Finance.—Receipts were Rs. 49,092 lower than in 1942, this being almost entirely due to the reduced profits on St. Coombs Estate which fell from Rs. 49,234 in 1942 to Rs. 3,549 in the year under report. Expenditure on Revenue Account amounted to Rs. 320,209 as against Rs. 313,127 in the previous year. The surplus on revenue account was therefore Rs. 58,959, the figure for 1942 being Rs. 115,132. Full details of receipts and expenditure will be found in the report of the Board and the audited accounts given earlier in this report.

St. Coombs Estate.—Details of the year's working are given in the report of the Visiting Agent (*vide ante*). Weather conditions were exceptionally unfavourable, four months' severe drought at the beginning of the year being followed by eight months' continuously wet and sunless weather. The effect of the drought may be gauged from the fact, that in April normally the heaviest cropping month on St. Coombs, less than 10,000 lbs. of made tea were obtained. As a result of such conditions the total crop was reduced by 50,000 lbs. There was but little local labour movement and no labour troubles were experienced on the estate. There was, however, a tendency for labour to do rather less work, and due to this factor, combined with the increased numbers required for weeding, labour was rather short.

Staff.—The Entomologist (Major C. B. Redman King), the Plant Physiologist (Major F. R. Tubbs) and the Small-Holdings Officer (Captain R. L. Illankoon) were on military duty throughout the year. The Biochemist (Capt. J. Lamb) was similarly employed until the middle of December when he was relieved and returned to his normal duties at St. Coombs.

Mrs. J. Bond, M.Sc. again gave voluntary assistance in the Physiological Department and her assistance in the work on tea selection and propagation has been much appreciated.

A large proportion of the Director's time was occupied with the control and operation of the Fertiliser Rationing and Distribution Scheme.

He was also in charge of the Biochemical Division until December when Mr Lamb returned to duty, and continued to serve on the Special Committee of the Chemical Society of Ceylon appointed by Government to advise Government Departments on technical matters arising out of the war.

Dr. Gadd, in addition to his own duties, has remained in charge of the Entomological Division and of the Physiological Section.

Dr. Eden throughout the year continued to assist the Planters' Association of Ceylon in connection with matters concerning the Dearness Allowance and related problems.

Fertiliser Rationing and Distribution.—The scheme organised in 1942 (*vide* Bulletin No. 24, p. 19) continued in force throughout 1943, more than 2,000 tea and rubber estates, covering some 440,000 acres of tea, and 300,000 acres of rubber, being provided for. As has previously been pointed out, rubber receives the full amount of manure considered necessary for the maximum production of the commodity, issues being, however, limited to such quotas. In the case of tea, however, the position is very different, estates being severely rationed, particularly in regard to nitrogen.

The scheme worked smoothly and the quarterly distributions were regularly made until the last quarter of the year when, owing to short supplies, the final tea manure issue had to be cut by 12½ per cent. Issues of rubber manure were made in full.

Since then the position in regard to tea manure has become more and more uncertain and the prospects of obtaining in 1944 even the present rationed quota of nitrogen are not promising. In this connection strong representations have been made to the appropriate authorities pointing out the urgent necessity for tea manure if a serious fall in crop is to be avoided. There can be no doubt that the authorities in question fully appreciate the position but there are obvious difficulties in maintaining the required supplies.

In these circumstances it is again necessary to stress the urgent necessity for green manuring on the most liberal scale. By this means much can be done to slow down the inevitable setback which must result from a continued shortage of fertilisers.

Advisory Work.—Enquiries as in the previous year have been limited by war conditions involving the absence of so many superintendents on service, while transport restrictions render it almost impossible for planters from a distance to visit the Institute. Enquiries have, perhaps, been chiefly concerned with questions of cultivation and weeds, matters which are of particular topical interest in view of the fertiliser position, the shortage of labour and the prevailing weather conditions.

Advisory work to small-holders in the Kadugannawa-Gampola and Baddegama areas has continued, officers being stationed in both these areas. With the demand for full production every effort has been made to encourage a reasonable standard of plucking and so meet the inevitable tendency to go all out for quantity regardless of the quality of the leaf taken.

Publications.—Two numbers of *The Tea Quarterly* were issued in 1943 together with Bulletin No. 24, Annual Report for 1942.

Technical.—Only the briefest summary is here given of the work of the various Divisions; full details will be found in the reports of the staff which follow.

Biological.—Apart from attention to what may be called the routine diseases and pests, work in the Mycological and Entomological Divisions has been chiefly concerned with Eelworms, *Phloem necrosis*, Shot-hole Borer and Nettle Grub.

The Eelworm, *Anguillulina pratensis*, which attacks mature tea has been identified in four more estates during the year, bringing the total of known infected estates to seventeen.

Two further species of eelworm attacking Dadap have been identified, viz., *Anguillulina erythrinae* and *Hoplolaimus brachyurus*. Neither of these species has so far been observed to attack tea. *Hoplolaimus brachyurus*, which seems to be less prevalent than *A. erythrinae*, also invades *Tephrosia vogelii*.

Observations of the incidence of *Phloem necrosis* at St .Coombs and other centres suggest that at the elevation of St. Coombs the average annual increase is about 5 per cent. At higher elevations the disease, as was to be expected from other observations, spreads more rapidly and above 6,000 feet the percentage incidence of the disease may be doubled in not more than one year.

The frequency of the disease, its intensity and its rate of spread all seem to increase with elevation and the total incidence at high elevations may be as much as 25 per cent. At lower elevations this is of course greatly reduced, partly no doubt due to the larger proportion of high-jat tea which, as has been reported previously, is much less liable to infection. About 4,000 feet still seems to be the critical elevation below which the disease seldom occurs.

From the practical aspect, the previous recommendation made still holds good, namely that bushes should be removed only when they become unproductive.

In last year's report attention was called to the fact that the incidence of shot-hole borer rose to a maximum in the second year from pruning and then diminished. This observation has been confirmed by experiments in which the total number of broken branches has been ascertained through a three-year cycle. The number in a seven-month period of the second year was more than six times that in the corresponding period of the third year.

It has been generally assumed that liberal manuring leading to vigorous growth of the bush brings about quicker healing and thereby reduces breakages. It is of much interest to note, therefore, that in the experiments under review breakages were greatest in the highest yielding plots. The increase in yield due to the application of manure has been accompanied by a higher incidence of breakages. It is true that the loss in crop due to such breakages has been less than the increase in crop brought about by the manure, a nett increase in yield resulting from manuring, but this somewhat surprising finding suggests that the direct effect of manures on shot-hole borer is something quite different from what has hitherto been assumed.

Details of observations on Nettle Grub will be found in the report of the Entomologist. It seems clear that Nettle Grub is normally kept reasonably under control by naturally occurring parasites or predators and information is accumulating in regard to such agents. Little however is at present known as to the factors which occasionally lead to a breakdown of such natural control. In regard to Nettle Grubs generally it would perhaps not be unfair to say that they are more a pest of the pluckers than of the tea.

Agricultural.—The Institute's main manurial experiments have now completed four three-year pruning cycles and the results, which have been very consistent, may be considered to be on a firm basis. Nitrogen applications, in spite of their marked influence on yield, have relatively little effect on the nitrogen content of the leaf. Doses of potash, on the other hand, have an exactly opposite effect, the potash in the leaf being materially increased with no significant change in yield. Phosphoric acid is intermediate in effect though here again the effect on composition is greater than that on yield.

Among results of practical importance arising from these trials are firstly, confirmation of the Institute's recommendation of incremental doses throughout the cycle, and secondly the undoubted fact that adequate manuring has a cumulative effect of lasting value.

It has been noted in previous reports that responses to nitrogen in the Passara experiments have been much less marked than at St. Coombs. The results discussed under shot-hole borer in relation to manurial applications (*vide ante*) would seem to suggest the explanation of this anomaly. Prolonging of the cycle of the manurial experiment to three years has resulted in a reliable response to nitrogen in the third year, which can be explained by the reduced intensity of shot-hole borer attack in this period. It seems evident that in the earlier part of the cycle the manurial effect was largely masked by the loss due to shot-hole borer.

Attention is invited to the results of the cultivation and weeding experiment described in the report of the Agricultural Chemist. Any loss due to weeds has by the end of the second cycle been reduced below that caused by intensive cultivation.

The importance of the weeding problem at the present time has led to an extension of this experiment by the inclusion of further treatments in order, if possible, to find some satisfactory alternative to clean weeding with its concomitant disadvantages. In view of the widespread belief among planters that the recent marked increase in weeds is largely due to the substitution of ammonium sulphate by groundnut cake, the figures quoted by Dr. Eden in his report in regard to the weed growth on the Institute's manurial plots will be of interest.

Physiological.—Work on tea selection has reached what may be considered the end of the first stage in so much as the selections made have now been put out as clones, 74 such clones having been planted in the field. While further selected material may of course be obtained, an interval must now elapse until the clones reach the plucking stage when final tests on their yielding capacity and manufacturing qualities can be made. In a few cases light plucking has commenced but this is mostly from preliminary selections made rather for other qualities than proved high yields.

Details will be found in the report of tests carried out on various new green manure species. Of these, *Tephrosia toxicaria* and *Crotalaria recta* which were referred to in last year's report, do not appear to merit further trial. On the other hand, *Sesbania cinerescens* has given very promising results and *Tephrosia eriosemoides* and *Cytosus proliferum*, though they have grown but slowly at St. Coombs, deserve further investigation.

In many green manure plants the seeds are extremely hard and require special treatment if germination is not to be unduly delayed. Suggestions for such treatment are given in the report.

Biochemical.—Work has continued on the nature of the enzyme system of tea. Attention was called in last year's report to the interesting fact that copper is an essential component of this system and this point has been further investigated. During the work on tea selection bushes have been found which for all practical purposes do not ferment, and in such bushes it has been found that the enzymic copper content is only about one-fourth or one-fifth of that from a normally fermenting bush. The copper content can be increased by injection of the bush with a copper solution or by dipping the plucked shoots in such a solution. Such treatment has resulted in a marked increase in "fermentation," the latter term being however placed between inverted commas since such fermentation was not entirely normal since, while the colour of the liquors was greatly improved, the infusions were still much greener than normal. This curious point is being further investigated and is of interest since it rather suggests that the enzyme system may be rather more complex than was anticipated.

Determination of enzyme activity has suggested that this is at a maximum in the leaf during the cold months of the year. This may be of significance in view of the fact that this is the period when quality is also at its highest.

Rolling experiments have continued on similar lines to those made in the previous year. Present observations confirm the view put forward in earlier reports that in rolling it is the conditions at the *centre* of the table that count and there is a sound basis for the present tendency to try out battenless rollers in which the door is fitted with a cone only. The design of this cone is of course of great importance and work is being put in hand to investigate this point. Rolling is undoubtedly one of the most unsatisfactory processes in tea manufacture and some further development is badly needed.

Reference may be made here to the work on the chemistry of tea which has been in progress in London during the past two or three years. This work is being jointly financed by Ceylon, India and the Netherlands. Work so far has been almost entirely concentrated on the chemistry of made tea, the object being to ascertain the constituents of such teas and their relationship to the characteristics of the tea. Considerable progress has been made in this work but it now appears likely that it will have to be extended to a similar examination of green leaf. Such a development would have an important advantage as the work would then link up with the investigations on manufacture which are in progress in the producing countries. It is hoped it will be possible in the near future to make arrangements for this modification in the programme.

In view of the demand which arose during the year for green tea, the Institute carried out small scale experiments in which the customary steaming of the leaf was replaced by immersion of the leaf in boiling water. This modification seemed necessary since many factories in which green tea was formerly made had disposed of the steaming plant, and high pressure boilers were difficult to obtain. Satisfactory green tea was made by the "immersion" method but this had one great defect in that, as was to be expected, some of the soluble matter of the leaf was extracted during the process and the out-turn of made tea to green leaf was thereby appreciably reduced.

Acknowledgments.—We have, as usual, to express our thanks to the Ceylon Association in London, the Planters' Association of Ceylon and the Ceylon Estates Proprietary Association for their support and co-operation.

Particular thanks are due to Messrs. Forbes & Walker in connection with tea shipments, to Mr. R. H. Horne for his invaluable help in reporting on experimental tea samples and to Messrs. C. J. Speer and R. C. Kerr for similar assistance.

It is a pleasure to acknowledge the assistance received from many agency firms and superintendents and in particular Messrs. George Steuart & Co., and the Superintendent, Gonakelle Estate in regard to the Passara Sub-Station, and Messrs. Leechman & Co., and their superintendents in connection with the investigation on *Phloem necrosis*.

Our cordial thanks are again recorded to Mr. H. Tonks for advice given in his capacity as Visiting Agent.

We have as usual received much encouragement and assistance from headmen and village committees in connection with our small-holdings work.

In conclusion, the Director wishes to express his appreciation of the support and loyal service received from all members of his staff during a difficult year.

The Reports of the Scientific Staff are appended.

ROLAND V. NORRIS,
Director.

REPORT

OF

THE MYCOLOGIST

FOR 1943

Staff.—There has been no change in the staff of the Division of Mycology during the year. In addition to his own duties the Mycologist was in charge of the Divisions of Entomology and Plant Physiology throughout the whole year, and he acted for the Director during his absence on leave in December.

The Assistant Mycologist continued his study of the *Phloem necrosis* disease of tea and allied problems. He was also in charge of the herbarium and carried out the advisory work concerning weeds and green manures which in normal times is performed by the Plant Physiologist. His report on weeds will be found in the Plant Physiologist's report, while his report on *Phloem necrosis* is included here under that heading.

Advisory.—179 letters were received and 198 were despatched. 88 consignments of diseased plants were received for examination and report; of these 71 were tea, 4 Grevillea, 3 Gums, 2 Dadap and 8 others. No disease was unusually prominent.

Publications :—

Bond, T. E. T.—"White Spot" of turnips: a disease new to Ceylon. *Tropical Agriculturist*, XCVIII, pp. 17-18 (1943).

—— Pod spot of Okra (*Hibiscus esculentus* L.) and a leaf spot of *Hibiscus rosa-sinensis* L. in Ceylon. *Tropical Agriculture* (Trinidad), XX, pp. 67-70. (1943).

—— The "Phloem necrosis" virus disease of tea in Ceylon. I. Introductory account, symptoms, and transmission by grafting. *Ann. Appl. Biol.* (awaiting publication).

Poria Root-Disease.—The root-disease caused by *Poria hypolateritia* still continues to be the commonest root-disease of tea sent to the laboratories for identification. An account of the experimental work in connection with the treatment of this disease was published in 1937. In that paper (Gadd 1937) I advocated the removal of every diseased bush and pointed out that as the majority of the infected bushes appear healthy above ground it is advisable to remove a ring of healthy bushes as well in order to ensure that no diseased bush is overlooked. Figure IV of that article was of a plot which had been treated in that way. It may be of

interest that no further death has occurred in that plot nor in many others treated similarly. Figure III represented a plot treated from time to time as diseased bushes became evident and from which the removal of healthy bushes was avoided. More bushes were removed from that plot in 1937, 1939, 1941 and 1943, and still one cannot be sure that the fungus has been eradicated from the area. It is also becoming evident that losses from the plot will exceed the number which would have been removed had a complete ring of healthy bushes been uprooted at the first treatment.

When a plot has been thoroughly treated, supplies may be planted immediately without using a test plant, like *Tephrosia*, to determine whether infectious material remains in the soil.

Cercosporella theæ.—Although weather conditions appeared unusually favourable for *Cercosporella* only two cases of the disease were reported during the year. The most severe damage was done in a gum nursery at an elevation of 5,500 to 6,000 feet where about 6,000 young plants were heavily infested and killed. Infection appeared to originate from the leaves of old gum trees in the vicinity.

Horsehair Blight.—Possibly because of somewhat abnormal weather, Horsehair blight (*Marasmius equicrinis*) has been rather more prevalent on low-country estates than usual. The fungus gets its common name from the appearance of its mycelium which forms smooth, tough black cords closely resembling horsehair, which run in all directions over branches and leaves. The threads are attached at places to leaves and twigs and when the leaves die they remain adherent to the mycelium until they decay. Consequently bushes or trees with horsehair blight have a very untidy appearance, with tangled mycelium, dead leaves and twigs hanging from the branches. At first sight one is apt to jump to the conclusion that the fungus is parasitic and that the dead leaves are evidence of its parasitism. Petch (1915) after a very through study of the fungus came to the conclusion that it was not a parasite. The absence of mycelium from the internal tissues and the fact that the mycelium grows only when attached to dead tissues bear out his view that horsehair blight is merely epiphytic, obtaining its nourishment at first from the dead bark of older branches and later from the dead leaves and twigs in the tangle.

Horsehair blight is spread mainly by spores although mycelium transferred from one bush to another will grow and become attached if suitable places are selected. A warm moist atmosphere is required by the fungus and for that reason it is found mainly in the moist low-country and flourishes best on tea bushes shaded by trees.

Although horsehair blight gives tea bushes a very untidy appearance the bushes suffer no real ill-effect. The conditions which favour horsehair blight also favour many other fungi some of which are parasitic and therefore detrimental to tea. One or other of these fungi may occur with horsehair blight on the same bushes and as the horsehair blight is obvious and unmistakable, the ill-effect of the less apparent parasite is apt to be attributed to horsehair blight.

A collection of empty bagworm cases (species unidentified) to which numerous short lengths of horsehair blight mycelium were attached was received from a low-country estate. The bagworms had apparently cut

the 'horsehair' into short lengths, about 1-inch long and had cemented the pieces on the outside of their cases, so giving them a black bristly appearance. The mycelium, however, made no growth in this unusual position.

EELWORMS

Anguillulina pratensis.—During the year this parasitic eelworm has been found attacking tea on four more estates which brings the total of known infected estates to 17, four of which have infested nurseries.

Thorne (1939) has drawn attention to the fact that the specific name *Pratylenchus pratensis* (=*Anguillulina pratensis*) includes a complex group of forms and species. In a letter to the writer he states that in America there are at least two forms which cannot be separated by diagnostic characters. One population, of which the males are unknown, is rarely harmful. The other is a bisexual form which attacks numerous host plants and in many places causes severe damage. Only the bisexual form has as yet been found in Ceylon and specimens have been sent to Dr. Thorne for comparison with his collections.

Parasites on Dadap.—The deterioration of Dadaps which has been very evident for some years on many estates has been attributed largely to the effect of the root knot eelworm *Heterodera marioni*. Two other eelworms *Anguillulina erythrinae* (Zimm) Goodey and *Hoplolaimus* sp. have also been found to feed on Dadap roots but it is difficult to estimate the full extent of the damage caused by each individually.

We are indebted to Dr. T. Goodey of the Institute of Agricultural Parasitology, England, for identification of *A. erythrinae* and to Dr. G. Steiner of the U. S. A. Division of Nematology for the information that the species of *Hoplolaimus* is new and that he proposes to call it *H. brachyurus*.

The habits of these two eelworms are alike. The adults are found free in the soil or with their heads inserted in the roots. Eggs have not been found but it is assumed that they are laid in the soil. Larvae are most frequently found entirely within the small feeding roots. They do not form large colonies in old roots as *A. pratensis* does, though they frequently are found in small groups. Attacked roots have small dead areas where the larvae have entered and where the adults have fed, and it is probable that heavy infestation leads to the death of the feeding roots.

More important than the fact that these eelworms will attack Dadaps is the question whether they will also attack tea. Mr. Loos has occupied himself with this problem and his results to date may be briefly summarised. *A. erythrinae* appears to be the commoner species and is frequently found in tea soils collected from the vicinity of Dadaps, but so far the worm has not been seen to feed on tea. Nor has *Hoplolaimus* sp. been found on tea roots. In pot experiments both species breed freely and increase in number when Dadap seedlings are grown in the pots, but not when tea seedlings are planted. *Tephrosia vogelii* has also been included in the experiments and where this plant occupies the pots *Hoplolaimus* sp. increases in number and invades the roots, but *A. erythrinae* does not.

PHLOEM NECROSIS

Dr. T. E. T. Bond has contributed the following report:—

Little new experimental work directly concerned with *Phloem necrosis* has been undertaken during the year. Considerable time has been spent in writing up existing results for publication and valuable data have also been obtained from the study of flushing behaviour and other botanical aspects of the growth of healthy tea.

Field Observations.—The St. Coombs observation plots were recorded in April and the results to date can be summarised as in Table I below:—

TABLE I

Incidence of *Phloem necrosis* on St Coombs

	Plots (677 bushes)		Single Rows (1,134 bushes)	
	Year	% P. N.	Year	% P. N.
	1939	18·6	1939	4·3
	—	—	1940	2·8
	1943	37·2	1943	14·0
Average annual increase		5·0 %		2·3%

The percentages given are cumulative values for "necrotic" and "suspected" bushes together and consequently measure the potential rather than the actual severity of the disease; many of the bushes included may easily remain of average productivity for many years. The difference in rate of spread between the plots and rows is in accordance with expectation, the "plots" having been put down in areas known to be relatively severely necrotic, the "rows" having been selected more or less at random for the purpose of a field survey. These St. Coombs observations will in future be repeated once every pruning cycle only.

A plot of about 300 bushes on the Uva side which has been under observation since 1940 was also recorded. The figures obtained, namely 11.2 per cent in 1940 and 23.8 per cent in 1943, give an average annual increase of 4.2 per cent, which is in close agreement with the St. Coombs data.

The various field plot records have been re-examined this year from the point of view of the actual distribution of necrotic bushes within the areas concerned (see T. R. I. Bulletin No. 22, p. 40). The general impression of the "patchiness" of the disease is fully confirmed and abundant evidence is forthcoming to indicate a dual means of spread, *viz. a discontinuous*, more or less random dispersal affecting bushes relatively remote from the nearest centre of infection, and a *continuous*, bush-to-bush spread in addition. From this it follows that the rate of spread of *Phloem necrosis* as determined from field plots will vary according to the size and position of the plot and the length of time during which the disease has been present within the area concerned. Thus, a high rate of spread will be given by a small plot on the edge of an advancing "patch," a lower rate by a plot situated near the centre of one or more older

patches expanding beyond its boundaries. The figures given above for St. Coombs and the Uva plot point to a doubling in the percentage incidence of the disease every three years or so and this is believed to be fairly representative of necrotic areas at less than 5,000 feet elevation. At higher elevations, *e.g.*, above 6,000 feet, the period of doubling may be reduced to less than one year.

The *average* intensity of *Phloem necrosis* in the affected areas as a whole is of interest in view of the large acreage potentially involved, reaching a total of perhaps 150,000 acres or nearly a third of the acreage under tea in the Island. Here again the effect of elevation must be taken into account since, although the disease occurs almost universally above 4,000 feet, the frequency of the disease, its average intensity and, as far as can be ascertained, its rate of spread, all tend to increase with increasing altitude. For the highest estates, the estimated incidence of *Phloem necrosis* can be deduced from the figures available for the removal of non-productive bushes which in some cases is practised on a very large scale. Supplementing these deductions by the evidence from the field plot records, it seems likely that the *total* incidence of *Phloem necrosis* in all recognizable forms is here at least 20-25 per cent. At the lower elevations, however, no reliable estimate is possible owing to the high proportion of recent, *high-jat* fields which are practically free from the disease, and to the sporadic distribution of the necrotic bushes. Any estimate of the incidence of *Phloem necrosis* is, of course, liable to be considerably increased if allowance be made for the occurrence of symptomless "carriers" (see below).

Rogueing Experiments.—The purpose and method of these two experiments in the Kandapola district have been fully described in the last two Annual Reports (T. R. I. Bulletins, No. 23, pp. 35-7; No. 24, pp. 28-9). The data which have been collected from them can be summarised briefly as follows:—

In the "A" or unrogued plots the spread of the disease was initially more rapid than in either the "B" or "C" plots. Subsequently, the rate of spread declined until, at present, the disease appears to be very near its maximum level at an incidence of about 80 per cent. In other words, the 'A' plots can be regarded as 'saturated' with the disease and the remaining 20 per cent of bushes still 'healthy' are expected to remain so, with very few exceptions.

In the 'C' plots, the intensive rogueing reduced the rate of spread of the disease from the start so that here the disease is still comparatively far from its saturation level and its spread continues, slowly and more or less uniformly. Thus, this year, the rather paradoxical situation has emerged in which the number of new diseased bushes recorded in the 'C' plots has actually exceeded, for the first time, that recorded from the unrogued 'A' plots.

Taking the experiment as a whole, it can be shown mathematically that *complete* rogueing every six months has reduced the potential rate of spread of the disease by at least two-thirds of the calculated value for the unrogued plots and that *partial* rogueing (as in the "B" plots, where only those bushes judged by the estate to be non-productive are removed) has also been effective to a certain extent.

These conclusions obviously cannot be considered to have any practical bearing on the problem of the control of *Phloem necrosis* in the

field: there is no question of rogueing, either partial or complete, being an *economic* method of arresting the spread of the disease. From this point of view, the current recommendation of the Institute as to the treatment of *Phloem necrosis* still holds good, namely, that bushes believed to be necrotic should be removed only if they are considered to be non-productive, *i.e.*, if the space which they occupy would better be filled by a healthy supply. On the contrary, the chief value of the experiments has been in the evidence which they afford as to the probable means of spread of the disease. The fact that rogueing, within such small and unisolated areas of tea (each plot is of about 100 bushes), should have had any effect at all is considered to confirm the existence of bush-to-bush spread and to demonstrate its relative importance as compared with random dispersal. The complete arrest of bush-to-bush spread by rogueing would not be expected on account of the inevitable "lag" between infection and the development of externally recognizable symptoms: in any case, there are possibilities of bush-to-bush transmission during the six-month intervals between rogueings. Thus, the continued and gradual spread of the disease within the 'C' plots is only in part due to infection by random dispersal from outside, and the big difference in potential rate of spread between these and the 'A' plots would need to be further increased adequately to represent the effect of the additional, unimpeded spread from bush to bush within the latter plots.

Mechanical Inoculations.—As noted on a previous occasion (T. R. I. Bulletin No. 22, p. 40), the bush-to-bush spread of *Phloem necrosis* could most conveniently be accounted for by a mechanical transfer of inoculum in the form of plant sap, during the operations of plucking or pruning. This hypothesis was discounted as unlikely on *a priori* grounds and received no support whatever from the earlier attempts at mechanical transmission experimentally. However, the recent discovery of the existence of "carrier" varieties — plants which can be infected by the virus and yet show no recognisable symptoms of the disease — pointed to the necessity of reinvestigating this aspect of the work. It is possible, for instance, that the failure to transmit the disease may have been due to an unfortunate choice of "carriers," or even of plants completely immune to infection, as experimental material: no genuinely susceptible plants may ever have been inoculated. Consequently, a new mechanical inoculation experiment has been carried out this year using proved susceptible *low jat* clones. In all, 54 plants were inoculated, *i.e.*, 6 of each of 9 clones. The inoculum consisted of expressed sap of (a) necrotic leaves and shoots, (b) necrotic root bark, (c) healthy shoots as control, and it was introduced either by (1) inserting a fleck of absorbent cotton, soaked in the inoculum, under the bark of the stem of the healthy plant, or (2) by needle-prick on the leaves and young stems. The experiment was performed in July, since when the plants inoculated have made good growth without any apparent indications of infection.

Insect Inoculations.—There has been no opportunity of continuing the life-history studies with Brown Scale (*Saissetia coffeae*) during the year. The inoculations carried out last year to healthy, *low jat* cuttings (see T. R. I. Bulletin No. 24, p. 29) have been under observation for the past eighteen months and have shown no indications of infection so far.

"False Necrosis."—The position with regard to this remains satisfactory. A certain amount was noticed in the main stock of *low jat* cuttings maintained for future experimental work and the plants affected, about

10 per cent of the total, are being kept under observation. It has become obvious that the phloem tissue in tea is peculiarly sensitive to changing conditions of growth and that, in leaves examined at random, groups of dead or disorganised (*i.e.*, necrotic) cells may easily be found in the phloem. Such a condition may also be induced by insect punctures or other minute injuries and, besides, the death and degeneration of the outer layers of phloem cells is a natural concomitant of growth as has been amply demonstrated by the anatomical studies with healthy tea. Confusion with the early stages of true *Phloem necrosis* is very likely to arise in some instances and the only remedy is to segregate the affected plants and await the development of further symptoms, if any. The possibility of genuine natural transmission of the disease to these *low jat* clones must always be borne in mind as, while they are known to be susceptible from the grafting experiments previously reported, no special protection against possible insect vectors can be given to them.

Grafting Experiments.—More "couple grafts" were made in April and May on the old seedling graft plants with a view to further confirmation of the "carrying" capacity of the old *high jat* seeding stocks which was established last year. However, owing to the consistently wet weather and lack of sunshine during the rest of the year, the survival rate of these grafts has been exceedingly low, only about 5 per cent remaining. No further grafts were attempted during the N. E. season.

Cuttings are being propagated from the old grafted plants to see if the "carrying" capacity will still be retained in the progeny, *i.e.*, after separation from the original, necrotic scion.

A batch of about 200 root grafts was made in May, to test the effect of callusing the roots in sand for about six weeks previously. However, no improvement was noticed over the usual method of grafting within a day or two of collecting the roots from the field.

Physiological Experiments.—A point of great interest in regard to any virus disease of the *Phloem necrosis* type is its effect on the movement of dissolved substances through the phloem (usually spoken of as *translocation*) and on the daily variations in starch content of the leaf. Certain preliminary experiments were carried out early in the year, using normal healthy leaf for a start. The method used consisted of following the changes in fresh and dry weight of uniform discs of leaf tissue removed by means of a cork-borer. The effects of varying the size of the individual disc and the number of discs in a sample were examined for samples taken at different times of the day and from leaves exposed to various alternations of daylight and darkness. The results obtained were rather conflicting and indicate that the difficulties of this type of experiment may be greater in the case of tea than, for example, in cotton or other herbaceous plants for which the method has proved valuable hitherto.

The disappearance of starch from a darkened leaf can be followed by visual examination of sectioned material treated with iodine solution. This is a relatively gradual process and some starch may remain even after a week in darkness. The actual changes in dry weight observed from day to day were also low, of the order of about 1 per cent only of the general mean per sample, and usually failed to attain significance. It appears in general that, as compared with certain other plants, both starch hydrolysis and the translocation of the resultant sugars may be

slow in tea and that the loss in weight in the leaf due to nocturnal translocation in any case tends to be obscured by the relatively high proportion of residual dry matter represented by the cell walls and cuticle.

In view of these difficulties, and in the absence of any clear-cut indications as to the most profitable line of attack for the future, the experiments have been shelved for the time being. They might profitably be reconsidered when further necrotic and healthy material of known clonal origin is available. From a wider point of view, the whole question of the carbohydrate economy of the tea bush is of prime importance, for instance, as affecting the starch reserves in the roots and recovery from pruning. Further illustration of this will be found in the Agricultural Chemist's discussion of the hard plucking experiment, elsewhere in this Bulletin.

Flushing Behaviour.—The anatomical and other studies undertaken originally as a background to the *Phloem necrosis* investigations led to conclusions of sufficient general interest to warrant a more intensive study of the normal flushing behaviour of tea in its developmental aspects. A consistent theory has now been built up which interprets the flushing process in terms of the growth rates of the several leaves and their internodes as affected by the fluctuating vascular supply to the apical bud.

Through the co-operation of the Agricultural Chemist, certain bushes in the No. 3 Field manurial experiment have been made available for a further study of the nutritional aspects of the problem. Data have been collected for the length and content of the tipping shoots and a total of 540 young banji shoots tagged for following their subsequent development during 1944.

C. H. GADD,
Mycologist.

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REPORT

OF

THE ENTOMOLOGIST

FOR 1943

Staff.—The Entomologist remained on active service with the military forces and the Mycologist continued in charge of the Division during the whole year.

Advisory.—367 letters were received and 445 were despatched. 41 consignments of insects were received, of which 13 consisted of mites and 5 of nettle grubs. No insect pest was unduly prominent during the year.

Publications.—In addition to articles in *The Tea Quarterly* the following papers have been prepared for publication :—

Gadd, C. H.—An unusual correlation between insect damage and crop harvested.—*Ann. Appl. Biol.* 31 pp. 47-51 (1944).

Gadd, C. H.—A further note on an unusual correlation between insect damage and crop harvested. (Awaiting publication).

Tea Chest Borers.—Two consignments of plywood for tea chests invaded by borer beetles were received. In both cases the pest was *Heterobostrychus aequalis* Waterhouse.

White Grub.—The term white grub is applied to a very large number of Chafer beetle larvae. The identity of most species in the adult stage is known but little is known of their larvae. A start has been made to identify the various white grubs found in the vicinity of the St. Coombs laboratory.

Dorylus orientalis.—This red ant is best known as a pest of plants as it feeds on the underground parts, tubers and roots. Hutson (1933) has published a short account of its habits in which he states that the worker ants live entirely underground and, so far as is known at present, their nests are situated fairly deep down. *D. orientalis* is of particular interest because although the majority of species of *Dorylus* are undoubtedly carnivorous or entomophagous, *D. orientalis* is herbivorous. In November, an estate superintendent in the Dimbula district reported that a plague of red ants was infesting some of his lines, and that the labourers complained of being unable to sleep owing to the rather vicious biting by the ants. Specimens proved to be *D. orientalis*; I am indebted to the Director of the Colombo Museum for verification of the identity. The earth floors were dug to a depth of 18 inches and sprinkled with lime wherever the ants were seen, after which there were no further complaints.

Paniscus levis.—Towards the end of October large swarms of an Ichneumon, mainly males, were observed hovering round tea bushes just coming into leaf after pruning, in a field at St. Coombs. I am indebted to the Government Entomologist, Dr. B. A. Baptist, for identification of the insect as *Paniscus levis*. The swarms persisted through November and disappeared early in December. *Paniscus* is a genus of parasites, but no other insects, possible hosts, could be found on the tea bushes nor was any information obtained as to where the parasites came from. Some species of *Paniscus* are parasitic on noctuid larvae including cut worms, but experiments to ascertain whether this species would attack cut worms gave negative results. This observation is of interest because of the very large number of parasites observed and their curious habit of swarming around tea bushes for no apparent reason.

SHOT-HOLE BORER

Manuring and Branch Breakage.—The experiment referred to in the last annual report under this heading was brought to a conclusion in September when the bushes were pruned on the completion of a three-year cycle. The first collection of broken branches was made on January 31st, 1942, when 2,689 were removed. These probably consisted of all that had accumulated up to that time. Afterwards the broken branches were counted and removed weekly after each plucking. In all, 77,014 broken branches were removed from the whole experimental area of 3.2 acres during the plucking cycle. That is equivalent to 24,067 branches per acre. In Table 1 are given the mean number of broken branches removed after each pluck for each month of 1942 and 1943. It will be seen that the breakages per pluck increased until June 1942; afterwards, they steadily decreased until February 1943 and then became fairly constant until September when the bushes were pruned.

TABLE I.

Mean number of broken branches per pluck in an area of 3.2 acres during 1942 and 1943 — the second and third years from pruning.

Month	1942		1943	
	No. of plucks	Mean No. of broken branches	No. of plucks	Mean No. of broken branches
January	—	—	4	405
February	4	1,205	4	266
March	4	860	4	246
April	4	1,579	5	271
May	5	1,744	4	231
June	4	2,450	4	262
July	5	2,250	5	282
August	4	1,729	4	283
September	4	1,162	1	230
October	5	734	—	—
November	4	571	—	—
December	5	537	—	—

These figures clearly demonstrate a fact to which attention was drawn in the Annual Report for 1941, viz. that shot-hole borer attack increases during the second year and tends to fade out during the third year from

pruning. During the months February to August inclusive, 51,261 branches were broken in 1942, whereas in the corresponding months of 1943, the third year from pruning, the broken branches numbered 7,929 which is less than one-sixth of the previous year's number. The loss of crop resulting from the removal of 24,067 branches per acre must be appreciable though there is no obvious method of estimating the exact amount. But whatever the true quantity is, the greatest part was undoubtedly lost during the second year from pruning.

The most surprising result of the experiment perhaps is that the plots which gave the highest yields had, on the average, the greatest number of breakages. The results up to the end of the second year have already been discussed in detail (Gadd, 1943), so the evidence for the above statement need not be reproduced here. In the third year from pruning the plots which lost the largest number of branches again on the average gave the highest yields. This obviously is not a case of cause and effect: the removal of branches which normally would contribute to the harvest cannot of itself lead to increased yields.

This experiment was originally laid down by the Agricultural Chemist to determine, amongst other things, the relative value of different manures for tea in the dry zone. In experiments elsewhere he has amply demonstrated that increase in yield follows the application of nitrogenous manures in proportion to the amount of nitrogen applied, yet in this shot-hole borer infested area he has not, until this year, been able to demonstrate with certainty that expected effect of manuring. The entomological observations discussed here appear to explain, at least in part, the apparent failure of the tea to respond as expected to the application of nitrogenous manures.

It now appears that manuring did have a beneficial effect, but at the same time the damage caused by shot-hole borer was increased, *i.e.*, there were more broken branches in the manured plots. Simultaneously one factor, nitrogenous manure, tended to increase yield while another increased shot-hole borer attack, tended to decrease it. What then was recorded as increase in yield resulting from manuring was really only what was left of it after shot-hole borer had reduced it. Of course the extra damage caused by the borer did not eliminate the whole of the benefits from manuring, but it reduced the increase in yield to such an extent that one could not be absolutely certain of its reality.

In 1942 it was decided to extend the pruning cycle to 3 years for various reasons, one of which was that another experiment had indicated that the shot-hole borer attack would diminish during the third year. By extending the plucking and entomological observations over the third year answers to two questions could be obtained. One was: "Will the shot-hole borer attack diminish as expected?" or in other words "Will the damage caused by the borer diminish appreciably during the third year." The answer to that question as already shown was a definite 'Yes.' The other question was: "Will the decrease in insect injury enable the beneficial effect of manuring to be demonstrated." The Agricultural Chemist in his report gives the answer 'Yes.'

Since 1903, when Green first expressed the view that by suitable cultivation tea bushes could be maintained in such a vigorous condition that damage by shot-hole borer could be automatically and continuously

healed, its validity has never been doubted. The experiment here discussed throws grave doubts on this view and opens up a wide field for investigation.

TEA TORTRIX

Occurrence.—Tea tortrix (*Homona coffearia*) was reported from five estates in the Bogawantalawa, Dimbula and Matale districts during the year and three of them sent specimens to the laboratory. In no instance was the attack severe and the parasite *Macrocentrus homonae* was found plentifully in the three collections examined.

Macrocentrus homonae.—This parasite has now firmly established itself in all districts where it exercises efficient control of the tortrix pest. In this connection the following observation may be of interest. Tortrix has never been regarded as a major pest of tea in the dry zone, but in 1938 the pest was reported to be doing slight damage in Madulsima and a small collection of *Macrocentrus* was liberated to deal with it, apparently with success. Towards the end of 1943 two masses of fresh cocoons were found on one bush in the nettle grub observation plot at Passara. The host insects were not identified with certainty but were assumed to be tortrix though no living tortrix caterpillars were found. One mass gave rise to 31 males and the other to 13 males and 16 females, 29 *Macrocentrus* adults in all.

The fact that numerous parasites emerge from each tortrix caterpillar has given rise to the view that the female *Macrocentrus* easily locates the tortrix caterpillars and attains her purpose of egg-laying without difficulty (King, 1937). When the parasites are watched at work it soon becomes apparent that they have no idea where the tortrix larvae lie hidden in the webbed leaves. The female stabs with her ovipositor into every crevice and hole she can find in the webbed leaves, and each stab is purely at random. If she strikes a caterpillar it is just a lucky hit. She cannot drive her ovipositor through a leaf, nor can she distinguish between webbed leaves containing tortrix and those from which the larvae have been removed; she will work equally industriously on both. When parts of the webbed leaves are removed so that the observer can see the exact position of the host the parasite's actions and movements appear extremely stupid, yet by persistent endeavour she usually manages to register at least one hit on the caterpillar. When that happens the caterpillar 'jumps' as though pricked with a needle and quickly moves away. If it is pricked two or three times the caterpillar usually leaves its hiding place and begins to make another elsewhere. The parasite has never been seen to attack the caterpillar while in the open, and freshly webbed leaves are tolerably safe for the tortrix larva until holes have been eaten through them.

As the stabs made by the ovipositor are rapid and the struck caterpillar jumps away equally rapidly, the tip of the ovipositor is within the body for a small fraction of a second. During that short time an egg is laid. The egg is, however, polyembryonic and gives rise not to one individual only but to about 28 — twinning on a grand scale. This fact accounts for the emergence of numerous parasites from one host and is one of the reasons why *Macrocentrus* has proved so efficient in the field

A detailed study of the habits and life history of *M. homonae* has been made, a full account of which is being prepared for publication elsewhere.

NETTLE GRUBS

Occurrence.—Nettle grubs were reported from 7 estates in Uva during the year; 3 of the estates were in the Badulla district, two each in Passara and Haputale districts. The species concerned were the fringed nettle grub (*Natada nararia*) and the blue-striped nettle grub (*Parasa lepida*). The last-named nettle grub was also reported from an estate in the Ratnapura district. In no case was the infested area very extensive nor was the attack very severe.

Weekly observations were continued in an acre of tea on Gonakelle Estate, Passara, until June; afterwards the examinations were made at fornightly intervals. Although nettle grubs were present throughout the year not more than 17 living specimens could be collected from 40 bushes on any one occasion. In all, 224 were found on 34 occasions; on one occasion only was none seen; the mean number of nettle grubs from 40 bushes per examination was therefore 6.6. *Natada nararia* was found on 29 occasions, the maximum number was 17 and the mean 4.1. *Thosea* species made their appearance in March and reached a maximum, 13, in September; they were found on 23 occasions, and the mean number was 3.9. *Narosa conspersa* occurred on 10 occasions though never more than 2 were seen at a time. Four specimens of *Spatulifimbria castaneiceps* were found, one on each of four occasions. *Parasa lepida* was not seen in the area at any time during the year. These observations indicate clearly that conditions, at least in the area under observation, were such as to prevent any marked increase in nettle grub numbers. What the controlling factors are is a question of considerable interest and importance.

Neoplectrus maculatus.—In the last annual report mention was made of small parasites belonging to the tribe *Euplectrini* which were found to cause considerable mortality among nettle grubs, particularly *Natada nararia*. These parasites have now been identified as *Neoplectrus maculatus* and *Platyplectrus natadae*. They were frequently found in the observation plot mentioned above, during 1943 which has enabled a detailed study of their habits and life history to be made. A full account of the commoner parasite *Neoplectrus maculatus* is being prepared for publication so it will be sufficient to mention here that the adult female is a predator killing nettle grub for food and the larval stage is parasitic. The nettle grubs die as soon as the parasites enter their bodies. There can be no doubt that *N. maculatus* normally plays an important part reducing a nettle grub population to a minimum.

Other Factors.—The above-mentioned parasites are not the only factors which tend naturally to control nettle grubs. The Braconid *Fornicia ceylonica* was occasionally encountered in the observation plot but its usefulness is limited by a hyperparasite known as *Ceraphron* sp.

One solitary specimen of *Natada* affected by wilt disease was found in the observation plot during the year. This disease may play an important role during a nettle grub epidemic in reducing the population, but it evidently is of minor importance when nettle grub numbers are small, as in 1943.

Parasa lepida.—Nettle grubs in general attract more attention than other pests doing an equal amount of damage to tea bushes, because they literally make their presence felt by the labour force. Nettle grubs are armed with stinging hairs, the points of which when touched by the bare

skin break off and cause an intense irritation and a rash. The blue striped nettle grub is one of the largest nettle grubs and has particularly poisonous spines; consequently a relatively small attack may attract attention more by the distress caused amongst the labour force than by damage caused to the tea. This species is probably easier than others to deal with because of its gregarious habits. The eggs are laid in masses and the caterpillars do not disperse far but remain together till they are full grown when they leave the bushes to pupate. This habit facilitates collection, if places where the nettle grubs are seen or felt are suitably marked to indicate to the collectors the localities requiring special attention.

Small collections of this nettle grub were received from five estates during the year. The only parasite bred from them was the **Braconid** *Apanteles parasae* Rohw. about which little is known.

C. H. GADD,
Acting Entomologist.

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REPORT

OF

THE AGRICULTURAL CHEMIST

FOR 1943

Staff.—Dr. J. G. Shrikhande relinquished his post as Research Assistant to take up an appointment as Assistant Professor of Sugar Chemistry (Organic) at the Imperial Institute of Sugar Technology, Cawnpore, United Provinces, India, with effect from November 15th, 1943.

Advisory.—Letters received numbered 245 and those despatched 163. The marked decrease on previous years shown by these figures, is due to the operation of fertilizer rationing. Another reason is that enquiries about weeds and green manures have been handed over to Dr. Bond. Formerly this division acted as a clearing house for identifications which were referred to the Botanist, Department of Agriculture.

Food Production.—Work in connection with Food Production has also diminished for two main reasons; firstly because the organization of estate food production has been dealt with directly by the Land Commissioner, and secondly because the attempts of up-country estates to raise crops have generally ended in the growing of root crops. These crops are the only ones suitable for the climatic and cultural conditions at high elevations, and their management and possibilities are adequately understood by estate staffs generally.

Cost of Living Index.—The Agricultural Chemist in his capacity as statistical advisor to the Planters' Association gave evidence before the Sub-Committee of the War Council appointed to review the Cost of Living Index and the Dearness Allowance on estates. Subsequently the grosser inaccuracies in the computation of the Dearness Allowance were eliminated. At the rates ruling at the end of 1943 the annual saving due to these corrections exceeds Rs. 10,000,000. The method of calculating the Dearness Allowance for mid and low-country districts is still erroneous.

MANURIAL EXPERIMENTS

Nitrogen Responses.—During the past year a review of the main experiment on nitrogen, phosphoric acid and potash response has been made. Some of the distinctive results of this experiment have been dealt with year by year as they have emerged. Others only become noticeable after a prolonged period, and as the experiment has now completed four three-year pruning cycles new aspects of manuring are beginning to reveal themselves. A case in point is that of the response to nitrogen. It was early seen that within a single pruning cycle response increased with time; as the bush grew more foliage, so its power of using added nitrogen increased. How long that increase can be maintained is not

certain. In the experiment in question there is very little difference between performance in the second and third years. This is shown in Table I(a) where the response is tabulated as pounds of tea produced by one pound of added nitrogen. The region of response used is that lying between 40 and 80 lb. of nitrogen per acre, but the same result would have been given by a lower range, since, as has frequently been mentioned in these reports, response is strictly proportional to the various quantities used, provided the comparison is confined to a stated time period. What would have happened if the cycle had been prolonged for a fourth year is not known, but it is reasonable to assume that the fourth year response would not have been appreciably greater than the third and might have been less.

TABLE 1.

Manurial Nitrogen Responses
Pounds tea per lb of nitrogen applied

Cycle	1st year (including tippings)	2nd year	3rd year	4th year
	(a) Three-year Cycle Experiment			
1	1.4	3.7	4.0	—
2	2.8	4.4	4.8	—
3	1.9	2.9	3.8	—
4	4.2	6.2	6.4	—
	(b) Four-year Cycle Cultivation Experiment			
	0.9	1.5	3.6	6.2

TABLE 2.

Yield in lb. per acre for cycles (a) and (b) above.

Cycle	1st year (including tippings)	2nd year	3rd year	4th year
(a) 4	833	1,084	740	—
(b)	531	862	1,143	1,251

These results are from one experiment only, but the cultivation experiment includes manurial treatments also differing by forty pounds of nitrogen, so that a similar comparison is available from that trial. This field completed a four-year cycle in 1943 at the same time as the manurial experiment finished its last three-year cycle. For three years therefore there was a general similarity in climatic conditions. This field behaved somewhat differently. The responses are given in Table I(b). There is the same increase from early to late years in the cycle but the *rate* at which that response increases as the years succeed one another does not diminish as in the former example. After the second year the response augments at a steady rate as is shown by the fact that if the differences between second-third and third-fourth year figures are compared, they will be found to be approximately equal.

The reasons for this different behaviour cannot be definitely stated on such incomplete evidence. There were differences in both age and jat of the tea, and there were striking differences in the yield patterns over the cycles (Table II). The three-year cycle showed a drop in yield in the third year, but the four-year field gave no such falling away. There is evidence that the yield patterns of the cycles are reasonably stable from cycle to cycle, and if this be so, difference in jat seems to be the more likely underlying cause. Whilst further evidence is being collected, one practical point is confirmed by these results: the later applications of nitrogenous fertilizer are more efficiently used than the earlier, and the advisory practice of incremental doses of fertilizer throughout the cycle is confirmed.

Table I(a) brings out another feature of the long-term experiment. Except in the third cycle there is a progressive increase in efficiency of nitrogen as the cycles succeed one another. The third cycle included the years 1937 to 1940 and the droughts of 1938 and 1939 affected yields severely. The increase in efficiency is not very different whether we take the first, second or third years as example. The first has increased by 2.8 lb., the second by 2.5 lb. and the third by 2.4 lb. There is every appearance that efficiency is building up to a maximum value. It may be a coincidence that the highest values in the two experiments are so nearly alike, but it is interesting to find that the Tocklai Experimental Station gives 6.4 as the typical response for mature tea under their conditions. (P. H. Carpenter. *Empire Journal of Experimental Agriculture* 1938, **6**, 1).

To sum up, both within and between cycles there is evidence that an adequate manuring programme, steadily pursued, produces important cumulative effects of lasting value. This may be cold comfort at present when fertilizers are restricted, but it shows the inadvisibility, in unrestricted conditions, of cutting out manuring programmes, without serious consideration, as soon as costs become difficult for the time being; a procedure adopted perhaps because a stroke of the pen will immediately make a saving of several cents a pound in cost of production.

Composition of Foliage Leaf.—A further long-term feature is the change in composition of the foliage, *i.e.*, pruned leaf, caused by different manurial treatments, and its relation to yield responses. The yields of foliage leaf follow the same general pattern as those for flush, *i.e.*, nitrogen increases yield in proportion as the quantity applied increases; phosphoric acid gives a smaller effect, and potash gives no significant effect at all.

Table III shows the variation in yield and in composition of the leaf expressed as percentages of the mean.

The changes in composition wrought by manuring are all highly significant. Nitrogen, the fertilizer which produces the greater variation in yield, has the least effect on composition. For this a possible explanation is that as soon as the elaborated nitrogen reaches a certain concentration in the tissues, it is transported elsewhere and used to promote new growth. At the other extreme is the behaviour of the potash content which varies more markedly than the others though the application of the fertilizer affects yield not at all. There is evidently a luxury consumption of potash by the tea plant.

Nitrogen Response at Passara.—In last year's report comment was made on the absence of any such striking results in the manurial experiments at Passara as are given by nitrogen applications at St. Coombs. It was pointed out that the seasonal droughts on the other side of the Island would not account for the observed facts. During the year another line of approach to the problem has been opened by the work of the Entomological Department. It now seems highly probable that losses of branches by shot-hole borer attack have diminished yield responses in this experiment ever since its inception. The details of the entomological work have been reported in *The Tea Quarterly*, Vol. 16, p. 30. In brief, shot-hole borer appears to be at its maximum activity in the second year. During the last cycle of the experiment the pruning cycle was extended from the customary two years to three, so that the behaviour of both shot-hole borer and yield could be studied in the third year when the borer attack had virtually ceased. The final yield results show that in this year, for the first time, a reliable response to nitrogen was obtained. It is still not a large response, and each pound of nitrogen applied has only produced 2.5 lb. of tea, which compares unfavourably with the figures mentioned for other experiments earlier in this report. In order to explore the position more fully an alteration is being made in the manurial programme for the new cycle. No manure at all will be given in the first year, which is known from other data to be a period of low response generally. In the second year the normal doses will be given (Nitrogen at the 40 lb. per acre level); and during the last year a double dose will be applied. This alteration in incidence of manuring will leave unaltered the total quantity applied. The procedure is unorthodox, but there is evidence to support it, and only by experimenting outside the bounds of a relatively settled tradition can progress be made.

TABLE III.

Variation in Yield and Composition of Foliage Leaf at various nutrient levels.

Per cent of Mean.

	N		Phos.acid		Potash	
	Yield	content	Yield	content	Yield	content
N_{40}	91	97	P_0 94	83	K_0 99	81
N_{60}	101	100	P_{30} 100	103	K_{20} 100	102
N_{80}	108	103	P_{60} 106	114	K_{40} 100	117
Sig. diff.	8·2	2·5	8·2	4·9	8·2	4·9

CULTIVATION AND WEEDS

The cultivation and weeding experiment has completed its second cycle which was extended to four years. In considering the contrasts between the two cycles a recapitulation of the scheme of treatments will be helpful.

The selectively weeded plots have grasses removed at intervals regulated by the vigour of their growth, but not more frequently than once a month. When necessary, the tall weeds are slashed with a knife to prevent them fouling the plucking table. Half of these plots are forked in both rows simultaneously once a year when manures are applied. The others receive in addition double row cultivation at two other times. The three cultivations are carried out in June, September and December. Treatment in the first quarter is omitted. The clean weeded plots are given a monthly weeding round, as on estates. They too receive the single cultivation in respect of half their number, and the intensive treble cultivation as regards the rest. The experiment is also equally divided between a single manurial dose which includes 40 lb. per acre of nitrogen and a double dose giving 80 lb. The manures are given at the same time in one application yearly.

Table IV gives the percentage gain or loss in yield for both cycles due to weeds and intensive cultivation respectively. The other treatments to which these plots are subjected balance one another in each category.

TABLE IV.

Effect of Cultivation and Weeds on Yield of Tea.
Percentage gains or losses

	1st year	2nd year	3rd year	4th year	Cycle
		(a) Due to Weeds.			
1st Cycle	−5.0	**−10.0**	**−7.5**	—	**−8.6**
2nd Cycle	**−7.4**	**−7.0**	−1.4	*+4.3*	−1.5
		(b) Due to Intensive Cultivation.			
1st Cycle	0	**−6.0**	**−5.9**	—	**−5.3**
2nd Cycle	**−3.8**	−1.6	*−3,2*	*−4.7*	*−3.4*

The figures in bold type refer to losses that are reliably substantiated; those in italics are on the border line between significance and non-significance, whilst those in ordinary Roman type are not of sufficient size to be counted on.

In the first cycle, weeds exert a dominant effect after the first year and the cycle as a whole shows a significant loss of yield on their account. In the second cycle the effect is shown earlier because, unlike the first cycle, there is a history of weed growth preceding it. The harmful effect wears off in the third year and becomes a gain which just fails to achieve reliability. The effect on the whole cycle is to reduce the harmful effect to dimensions too small for significance. At this stage in the experiment it would be hazardous to generalise. Continuation of the trial will show whether the change from first to second cycle, and within the second cycle, is a stage in the establishment of equilibrium conditions which may ultimately favour the selective weeding plots. Intensive cultivation gives consistently lower yields throughout both cycles, but the effect is appreciably diminished in the second.

The relatively small crop losses due to weeds indicate that the weeds do not unduly prejudice the utilization of fertilizers by the tea under the existing conditions. This is confirmed by comparing the manurial response on the clean-weeded and selectively-weeded plots, data for which are given in Table V. The higher manurial application only becomes really effective in the third and fourth years of the second cycle and the illustration is restricted to these two years. The results show that to all

TABLE V.

Manurial Response in Relation to Weeds.
lb. per acre increase in crop for 40 lb.N.

		3rd year	4th year
Selective weeding	...	147	251
Clean weeding	...	145	242
Difference	...	2	9
Significant difference	...	38	55

intents and purposes there is no difference in response under the two systems. Clear cut as these results are, they are not suitable evidence from which to draw hasty generalisations. The Institute is seeking to explore a policy alternative to clean weeding in the interests of control of soil erosion and the maintenance of soil fertility. These data show, so far, that there are circumstances where control is adequate enough to reduce crop losses to an extent much smaller than might have been thought possible. But losses there still are after seven years. As a general policy, a modification of present methods would only be acceptable if positive gains could be shown at a reasonable cost. Our function is to give accurate information on the agricultural problem. The economic one is the province of the planter. There is no reason to believe that the practical problem will be of the same degree of difficulty everywhere. Moreover, though soil deterioration is an incontrovertible fact, it is a slow process measured in years, unless there is wanton recklessness, and its antidote is likely to be slow also. Weeding and cultivation provide another instance where experiment, including experiment by the planter, is needed outside the sphere of strict orthodoxy.

Weed Growth in General.—The past year has been one of prolific weed growth, for which the weather has been ideal. Reference to the meteorological data will show that, after a spell of dry weather suitable for the production and maturation of seeds of annuals, there were only 41 days in the months succeeding April on which rain did not fall. There were over 20 inches excess rain, and 14 days above the average in rain days. This favourable climate coincided with the substitution of groundnut cake for sulphate of ammonia as the standard nitrogenous manure and led some to speculate as to whether the former had a preferential effect in stimulating weeds.

In April, 1943 the factorial manurial experiment was pruned, and the succeeding months provided excellent conditions for weed growth on this experiment before the shade of the growing tea could exert an appreciable effect. Amongst the treatments included in this experiment is one where for 12 years groundnut cake has been used exclusively as the source of nitrogen. In order to gain information on the point in dispute, weeds

were allowed to grow freely on this experiment till the last week in August. The weeds were then collected and spread out till the soil adhering to their roots was dry. They were then screened over a green leaf sifter to remove this soil, weighed, sampled and dried to give accurate dry matter yields for every plot.

The groundnut cake plots gave a weed yield of 483 lb. dry matter per acre and the sulphate of ammonia 473 lb. The difference is too small to be of account, and disposes of the contention that groundnut cake is a determining factor.

It was, however, perfectly evident from the appearance of the plots themselves that manurial treatment was markedly affecting weed growth. In over twenty years' experience of manurial experiments of various sorts, I have never seen anything more conspicuous. Some plots carried a complete cover of weeds whilst others were only partly colonised. The dividing line between plot and plot needed no marking posts or wire to define it. Inspection showed that the heavily weeded plots were those dressed with superphosphates. On account of the labour involved and the importance of harvesting the weeds in a short space of time, only half the replications of the experiment was used. This reduced the accuracy of the experiment, and it is probable that the heavier doses of nitrogen had some effect too, but the phosphatic effect stands out as of over-riding importance.

The yields obtained are:—

	Weeds lb. dry matter per acre.
P_0 ...	169
P_{30} ...	587
P_{60} ...	597

As with flush yields of tea, the extra 30 lb. of phosphoric acid gives no appreciable response.

Further work on nutrient removal by weeds is in hand and the Plant Physiological Department is investigating botanical aspects of the problem.

PLUCKING EXPERIMENT

An interim report on the plucking experiment was given last year. The points noted were the superior yield given by the areas plucked to the fish-leaf (instead of leaving one foliage leaf), and the marked decrease in flush size on the fish-leaf plots. To the end of the third year the yields per acre were: fish-leaf 762 lb. per annum; normal plucking 514 lb. per annum.

In view of these results, and bearing in mind that on fish-leaf plots the foliage leaf, which has to support the carbohydrate economy of the bush, is not increasing with time as it is on the normal plots, the question of stored carbohydrate reserves in the roots becomes of interest.

On three occasions at 14, 20 and 25 months from pruning, root samples of comparable size have been taken from all plots and examined for

starch content — 64 samples from each type of plucking. After preparation by staining with iodine they have been graded into four classes and given points; three for complete blackening; two for medium, and one for slight blackening. Zero has been reserved for a complete absence of starch. On two occasions only has a zero sample been found. The highest marking either treatment can get is 192. The actual scores on the three occasions are shown in Table VI.

TABLE VI.

Starch Reserves in Roots.
Points scored — Maximum possible 192.

Months after pruning	Plucking to	
	Fish-leaf	Single Leaf
14 ...	176	181
20 ...	165	177
25 ...	176	187
Mean ...	172	182

The differences between the two treatments are small and, up to the present, of little importance. Only at the 25th month can a reliable difference be statistically confirmed. *It is necessary to emphasize that these results only refer to tea at high elevations*; at low and mid-country altitudes, where carbohydrate deficiency is known to develop frequently even on normally plucked tea, entirely different effects may be produced.

The diminution of flush size on the fish-leaf plots is so marked that there may be repercussions in the quality of the manufactured leaf. This aspect is under examination by the Biochemical Department.

T. EDEN,
Agricultural Chemist.

REPORT

OF

THE PLANT PHYSIOLOGIST

FOR 1943

Staff.—The Mycologist remained in charge of the Division of Plant Physiology during the year. The work in connection with weeds, green manures and cover crops was carried out by the Assistant Mycologist who has contributed the section of this report under that heading.

It is a pleasure again to record our appreciation of the assistance given voluntarily by Mrs. T. E. T. Bond.

Advisory.—134 letters were received and 139 despatched.

Clone Tests.—The number of clones undergoing preliminary trial in the field remained at 74; one was discarded owing to bad establishment and a new one was planted in its place. Nineteen clones are now in plucking, 5 of them having been brought in during the year at an age of from 4 to 5 years. In addition 8 clones have been tipped and will be brought into plucking early in 1944.

Yields.—The first year's light plucking of 14 clones and one row of seedlings was completed during the year. The bushes were 4 to 5 years old when plucking started. Plucking rounds were at 9-day intervals and the green leaf of each clone was weighed separately after each pluck. In order to obtain comparative results it is necessary to express the yield as ounces per pluck per bush. Allowing 3,000 bushes per acre, 40 plucks per year and an out-turn of made teas of 20 per cent of the green leaf weight, a yield of 600 lb. per acre is equivalent to 0.40 ounce per pluck per bush. The highest yielding clone (15 bushes and 41 plucks) gave 0.41 ounce per pluck per bush which represents a yield of at least 600 lb. per acre. The clone with the poorest yield gave rather less than 200 lb. per acre and seedlings of the same gave about 400 lb. per acre. The parent bush of the clone giving the best yield had been selected for yield, but most of the other clones had been selected for characters other than yield, *e.g.*, coloured leaf.

Quality.—The leaf from one mother bush failed to ferment satisfactorily, and the clone derived from that mother bush gives similar non-fermenting leaf. Obviously no matter how heavy a crop such a clone gives, it would have little commercial value. What is required is a high-yielding clone giving leaf of good quality. This aspect of the problem is not being overlooked and quality tests are being made from time to time.

Centering.—In the last Annual Report comment was made on the abnormally heavy losses that occurred in 1941 following centering, and an earlier lighter treatment was suggested as a remedy. In order to test this assumption 8 clones of which there were two rows each were used for a small experiment. One row of each clone was cut back to 5 to 8 inches when about 10 months old. When cut to that height they usually had a few leaves remaining on the cut stem. The other row of each clone was cut back to 2 inches when about 2 years old. The mean diameter of the stems at the cuts was 0.6 inch. Of the first set 3.1 per cent of the centered plants died as a direct result of the centering, whereas losses amounted to 12.9 per cent. when centering was done later. The roots of the dead plants were all found to be deficient of starch and undoubtedly the deaths must be attributed directly to that cause. By centering at such a time and at a height which allows a number of leaves to remain on the plant after centering, the losses can be reduced.

It is of interest that one clone, No. 1,016, gave the greatest loss in each series. This suggests that clones may vary considerably in ability to store starch in their roots and therefore in their ability to withstand pruning. It is well known that starch storage is influenced by elevation but this is the first observation suggesting that it is a genetic character also.

In 1942, clones other than those used for the above experiment were centered at heights varying from 5 to 8 inches. In age the plants varied from 9 months to 2 years. The results of the treatment became apparent during 1943. The object of centering a bush is to induce branching at a low level. Some clones branched satisfactorily, whereas others merely ran up again with a single stem. Obviously, with clones which branch freely it is advisable to induce and encourage branching as early as possible and such clones should certainly be centered early and at not too low a height. Clones which persist in putting out one or two branches only are probably best centered later and at a low level. What effect the branching habit has on yield is impossible to state at present, but if an immediate choice had to be made the writer would select clones with good branching habit.

Early centering has an obvious advantage so far as experimental work is concerned in that it enables the bushes to be brought into plucking earlier, so allowing an earlier valuation of their yielding capacity and quality. By early centering it has been possible to bring some clones into plucking in under 3 years. They were centered at 5 to 8 inches when 9 to 12 months old. Their subsequent pruning was at 22 to 25 months when leaders were cut back to 12 inches and tipping was started when the bushes were 2 years 4 months to 2 years 7 months old.

Losses in the Field.—Losses amongst young plants continued to be severe during the early months of 1943 owing to severe drought and continued attack by white grubs. Of 1,469 plants put out in 1942, a total of 814 had died by the end of 1943 inclusive of deaths in 1942. The vacancies have been filled as occasion permitted, some in 1942 and the remainder during 1943. In all 642 plants have been put out this year, of which 612 were replacements. These were mostly about 1½ years old at the time of planting and by the end of the year only 15 of them had been lost, mainly as a result of insect damage

In the past the plants have probably been put into the field too early, as soon as roots were formed, and often before the buds on the cuttings had burst. At that stage the loss of the parent leaf usually proves fatal. It seems advisable therefore to hold the cuttings longer in the nursery and to avoid North-East Monsoon planting on St. Coombs. Better results have been obtained by planting during the South-West Monsoon.

WEEDS, COVER CROPS, GREEN MANURES, ETC.

The follwing report has been contributed by Dr. Bond :—

Advisory Work.—Fifty-four enquiries were received from 45 estates. They concerned 12 species of green manure shrubs and shade trees and 32 species of cover crops, weeds and miscellaneous plants. The figures reflect the increasing interest in problems of weed growth and green manuring which may be traced to recent abnormal weather conditions and to the shortage of artificial fertilizers respectively. In addition the question of fodder grasses for cattle has also come into prominence in connection with the need for increased food production. Up-country, especially in the Dimbula and Dickoya districts, concern has been expressed at the spread of two recently introduced weeds which are given separate mention below.

(1) **Phalaris arundinacea.**—This is a strong-growing, broad-leafed grass which, as one correspondent says, looks rather like young paddy. It grows along streams and in moist places generally and has a strong creeping root system resembling that of cootch grass, though not so deep. Known as "Bitter Grass" (*Kasappu-pillu*, etc.), it has a bad reputation as liable to cause abortion if fed to cows in calf; at other times, however, there seems to be no reason why it should not be a valuable fodder. As far as can be ascertained, the grass does not flower in Ceylon and, as it is an introduced species not described in Trimen's "Flora" or the supplementary volume issued in 1931, its correct identification was a matter of some difficulty. The name given above was first suggested by Peradeniya as provisional only and, in the absence of the necessary literature, confirmation of this seemed likely to be delayed indefinitely until, in December, a correspondent in the Dickoya district drew attention to the close similarity between "Kasappu-pillu" and the ornamental, variegated grass known in cultivation as "Ribbon Grass" or "Gardener's Garters." Examination of the specimens sent showed that they were indistinguishable except for the variegated habit of the latter, which was easily identifiable as *Phalaris arundinacea* var. *variegata*. The identity of the former with the normal type of *Phalaris arundinacea* was thus confirmed beyond reasonable doubt. The species is native throughout the north temperate regions and is well known in England under the name of "Reed Canary-grass."

(2) **Eupatorium riparium.**—Known in Dimbula at least since 1932, this plant has recently become very prevalent and is causing concern on account of its deep root system and aggressive habit of growth. The plant grows to about 3 feet in height and can be recognised by its dark green, toothed and pointed leaves which are three-nerved at the base, *i.e.* with two prominent veins inserted above the leaf stalk, one on either side of the midrib. In flower, it is rather similar to the common white form of 'Poom-pillu" (*Ageratum conyzoides*), and is very conspicuous on account

of the large patches it forms and which come into flower simultaneously. Such large areas of bloom are to be seen especially during the dry season and occur by roadsides, along streams and ravines and in waste ground generally wherever there is a good supply of moisture.

A native of Mexico (as are so many of our commonest weeds), *E. riparium* is now thoroughly established and eradication is out of the question. However, it will undoubtedly prove troublesome if it is allowed to spread unchecked and a watch should be kept to prevent young plants establishing themselves in the tea. In ravines and other uncultivated ground it may be made use of as a source of green manure for composting and its value for this purpose has long been recognised in Java where the plant grows abundantly. Unfortunately, reliable information is lacking as to whether it is safe to feed to cattle and Peradeniya suggests that care should be taken as one other species at least of the same genus is known to be poisonous. In any case, cutting across before flowering would be advisable wherever possible to prevent seeding.

T. R. I. Herbarium.—More than a hundred sheets were added during the year, including 72 new species. The herbarium now contains 497 sheets of 330 species, representing 214 genera in 84 families of flowering plants. About 150 species have been identified from St. Coombs and adjacent estates, of which 66 are known to occur as weeds in the tea.

We are indebted to the Botanist, Peradeniya, for forty-three identifications and for other information supplied during the year.

Weed Ecology.—The pruning of the No. 3 field manurial experiment early in the year provided an opportunity for studying the effect of manuring on weed growth. Very marked differences in the density of weed cover as between different plots were noticeable, especially between plots receiving different amounts of phosphorus. These are described more fully in the report of the Agricultural Chemist, elsewhere in this Bulletin. Aspects under investigation by this Division include the question of the composition of the weed flora as affected by manuring, and the occurrence and viability of buried weed seeds in the soil. Results of sufficient interest have been obtained to justify the continuance of this joint investigation during 1944.

New Green Manure Species.—Thirty packets of seed were distributed during the year from St. Coombs and a few others from Passara. Notes on the growth of individual species are given below, following which the section on "Hard seeds" should also be consulted. Two of the species included in last year's Report, namely *Tephrosia toxicaria* and *Crotalaria recta*, are probably not worth any further trial — the former on account of its slow growth and the latter on account of its very high susceptibility to insect pests. One new species from Australia, ***Cytisus proliferus***, has been under trial during the year and will be dealt with first.

(1) **Cytisus proliferus** — "Tagasaste" — A generous consignment of seed was received from South Australia through the good offices of the Agricultural Chemist and of the Waite Agricultural Research Institute, Adelaide. This leguminous plant is highly valued as a green manure shrub in Australia and many other countries and, judging from MacMillan's "Tropical Planting and Gardening," is not altogether unknown in Ceylon, having been grown with some considerable success in Nuwara Eliya Whether it is still under cultivation there is not known. So far, growth

at St. Coombs has been disappointingly slow and the plant appears to have suffered from the excessive rainfall. At Passara, however, more promising results have been obtained. Further trials will be carried out at both stations during 1944.

(2) **Tephrosia eriosemoides.**—The experimental plantings have continued to grow well both at St. Coombs and Passara, and plenty of seed is now available. A trial under field conditions at St. Coombs has been disappointing, the establishment of the young plants having been much delayed as a result, apparently, of the weather. Given good conditions at the start, however, this plant should prove quite useful and it deserves further trial in other districts.

(3) **Sesbania cinerescens.**—This plant has fully justified the favourable impression which it created last year. Basket plants were put out in July over about half an acre of the clonal plots at St. Coombs and are already about 6 feet in height. At Passara, a height of from 10-15 feet has been reached after 14 months and at both stations the plants have proved to be well resistant to wind. Seed is formed in abundance and ample stocks are available for distribution.

(4) **Mimosa bracaatinga.**—This continues to grow well and a number of requests for seed has been received. On St. Coombs, a few trees failed to recover after severe lopping. Unlopped, the trees make an effective windbreak and would be worth considering primarily from this point of view.

(5) **Albizzia sumatrana.**—This tree is doing extremely well at Passara and has proved to be less susceptible to wind damage than *A. falcata.*

Hard Seeds.—The occurence of "hard" seeds among the various leguminous plants under trial was noted in last year's Annual Report (T. R. I. Bulletin No. 24, p. 47) and as a method of inducing even germination a vigorous scarification by shaking with sand was recommended. Subsequent experience indicated that this method was not, in fact, fully reliable and that the whole question of the occurrence and treatment of these "hard" seeds required more thorough investigation. So far, only tentative conclusions have emerged which are summarised below: it is hoped to publish a fuller account later, when the results of experiments still in progress are available.

It should be remembered that "hard" seeds may be presumed to be fully viable, their failure to germinate being due to the impermeability of the seed coat which prevents the entry of water. This fact may be demonstrated by testing "nicked" seeds, in which the entry of water is assured by mechanical rupture or puncture of the seed coat: these have so far shown little or no loss of germinative capacity.

The proportion of "hard" seeds varies with the species concerned and may also be affected by the age of the sample. Thus, in *Tephrosia eriosemoides*, the proportion of "hard" seeds fell from about 90 per cent on harvesting to 60 per cent or less a year later; in *Sesbania cinerescens* it fell similarly from more than 70 per cent to about 30 per cent. On the other hand in *Mimosa bracaatinga* it has remained more or less constant at about 30 per cent, while in *Cytisus proliferus*, so far, almost every seed has remained "hard" and germination is unusually protracted. Thus, in a sample of 100 seeds of the latter plant put to test in February, only

one seed had germinated by the end of the first four weeks and thereafter one or two seeds germinated each month, up to a total of 19 by the end of the year — a parallel sample of "nicked" seed giving 97 per cent germination in the first fortnight.

In an endeavour to improve on the results obtained by scarification, treatment in acid and in hot water has been tried and the possibility of pre-treatment, *i.e.* the effect of storing the seed after treatment, has also been investigated. In general, the best results have been obtained by the use of acid. The procedure followed was to immerse the seed for 15 minutes in half-strength commercial sulphuric acid, with thorough subsequent washing in water. This method gave 94 per cent germination in *Tephrosia eriosemoides* and up to 80 per cent in *Cytisus proliferus* after 7 and 17 days, respectively. However, with *Sesbania cinerescens*, especially in older samples when the proportion of "hard" seed was less than 50 per cent, there was some evidence that the treatment is liable to cause injury, little improvement being noted as compared with the controls. For hot water treatment, the seeds are immersed for an hour in water maintained at a temperature of from 122°-140°F. (rather hotter than a very hot bath): alternatively, they may be placed in a vessel of hot water, at about 160°F., and left until cold. The hot water process has given up to 70 per cent germination in *T. eriosemoides*, 64 per cent in *S. cinerescens*, about 80 per cent in *Mimosa bracaatinga*; and 55 per cent in *Cytisus proliferus*, all in tests lasting from two to three weeks only.

As far as results are at present available, the seed after treatment either with hot water or with acid may be stored without any lessening of the effect: the "hardness" of the seeds, once broken down, does not re-appear. If this is confirmed, it is hoped that eventually all seed may be pre-treated before distribution, so that a high germinative capacity may be assured. In the meantime, it is recommended that all samples of seed should be treated in hot water before sowing. Probably, to place the seeds in water at 167°F. and leave until cold or for at least an hour is the safest procedure. If scarifying with sand is preferred, the seed should be well shaken or, preferably, trampled for at least ten minutes.

C. H. GADD,
Acting Plant Physiologist.

REPORT

OF

THE BIOCHEMIST

FOR 1943

The Biochemist was away on military duty until the middle of December, the Director being in charge of the Department during his absence. Mr. P. R. Perera, Assistant, was absent on sick leave during most of the year.

Enquiries in regard to manufacture have again been limited. At the present time with the whole of the Ceylon crop bieng taken over by Government at contract rates there is little incentive for superintendents to concern themselves overmuch with improvements in manufacturing conditions, nor, in fact, have they in present circumstances the time to do so. With such conditions prevailing it must perhaps be considered satisfactory that, on the whole, there does not appear to have been any general or marked "falling-off" in the standard of manufacture There has no doubt been some tendency towards coarser plucking but the power possessed by the Tea Commissioner to reduce the prices paid for teas which are below the average standard of the estate concerned has apparently been sufficient to keep this tendency within reasonable bounds.

Tea Fermentation.—Work on the mechanism of tea fermentation, which was referred to in last year's report, has been continued by Mr. Sreerangachar.

As a natural sequel to the important finding last year that copper forms a part of the enzyme system responsible for tea fermentation, two questions demanded consideration, firstly whether the fermentability of leaf varies in proportion to its copper content and secondly whether the treatment of the slow-fermenting bushes with copper would increase their fermentation rate. A systematic estimation of copper in varieties of leaf of known origin, *i.e.* clonal material, and a parallel determination of the fermentation rate of such leaf would be necessary to answer the first question. In such an investigation estimations of enzymic copper are more likely to yield the desired information than the total copper since it has been found that not all the copper present in the leaf is enzymic. A few results obtained seem to indicate a direct relationship between the fermentation rate and the enzymic copper content and it is noteworthy that in the so-called non-fermenting bush the enzymic copper content is only about a fourth or a fifth of that of a normal bush.

An investigation of the second hypothesis requires that the copper status of the leaf on the bush be increased so that its effect on fermentation may be studied. Of the methods available for increasing the copper

content of the bush for experimental purposes, injection seemed to be quite suitable specially in view of the rapidity with which results could be obtained. The well known method of Roach (Annals of Botany (1939) **3**, 199) for branch injections was therefore tried. As a background to the injection of the clonal materials which will eventually have to be carried out, preliminary trials were done on a few random bushes. Observations were confined to estimations of enzyme activity which was taken to indicate the degree of fermentation possible with the leaf. These preliminary studies have shown that on injection of copper sulphate into the bush there is an increase in enzyme content of the leaf from the injected branch.

Injection of a suitable dye (acid fuchsin) revealed that the distribution of the injected copper is by no means uniform amongst the smaller branches and the shoots of the injected branch. Care must, therefore, be exercised in choosing experimental material after injection. Experience has also shown that there is an undetermined interval after injection before any increase in enzyme becomes apparent. In future injection experiments it will also be worth while trying the effect of a few organic copper compounds towards which plants appear to be more resistant.

In the laboratory, introduction of copper into the shoots has also been effected by keeping the flushes with their stalks dipping in a very dilute solution of copper sulphate. Copper is then slowly taken up by the shoots and there is an increase in enzyme content which is found to depend upon (1) the concentration of copper sulphate solution and (2) the period of treatment. In some cases a 5-6 fold increase in enzyme activity was observed, the latter being estimated by the ascorbic acid method.

Leaf from a "non-fermenting" clone was treated as above, manufactured by the individual bush method and sent to the tasters for report. While the control sample kept in water showed practically no colour in the liquor the copper treated sample appeared to have the normal amount of colour in the liquors. Nevertheless there was a peculiarity in that the infusion remained green. An explanation of this curious phenomena must await the results of further experiments which are now in hand.

In order to determine variations in the enzyme content of leaf with respect to season, four individual bushes derived from split seeds were maintained on a 9-day plucking round and enzyme determinations carried out once a month. The enzyme content appears to be at its highest during the cold months of December and January after which there is a gradual fall until a minimum is reached sometime in May. After this it rises once more but shows a fluctuating value throughout the rainy season after which it again rises to the high value of December-January. It appears that the enzyme content is generally negatively correlated with rainfall.

It will be of interest to see if the seasonal fluctuations in enzyme content can be associated with fermentation rates in the factory and also with any of the characteristics of tea made in different seasons. It is perhaps significant that the period of high enzyme activity coincides with the period when "quality" is also high.

During the year a satisfactory explanation of the brown pigment of the tea infusion has been advanced. The leaf chlorophyll undegoes degradation changes during fermentation resulting in the insoluble infusion pigment. The mechanism of these changes is as follows:—

$$\text{Tea tannin} + O_2 \xrightarrow{\text{Polyphenol oxidase}} \text{O-Quinones}$$

$$\text{O-Quinone} + \text{chlorophyll} \longrightarrow \text{Tea tannin} + \text{chlorophyll oxidation products.}$$

Esterase in Tea.—Experiments with the acetone-prepared leaf powder showed the presence of an esterase in tea, which does not appear to have been reported so far in the literature. It is possible that this esterase may have a role to play in the production of the characteristic black tea flavour which is elaborated during fermentation.

MANUFACTURE

Rolling Experiments.—Further experiments were done to find the best procedure for expressing juice rapidly and obtaining even fermentation. The methods followed were the same as those adopted previously (*vide* Annual Report for 1942, p. 49). In the light of the results obtained softer withers were used in Series I and 11 and a shorter fermentation given in Series III.

Series I.

1st roll 30 minutes in "Crescent" roller, bulk passed through Clivemeare roller with light pressure and a third roll of 30 minutes given in a "Crescent" roller with heavy pressure	1st dhool—20% 2nd dhool—70% Big bulk—10%

The experimental samples were slightly preferred to normal 5-roll manufacture. Liquors of the former appeared to be fuller with a little more character than those of the latter which were a little greenish in comparison. The experimental infusions were also brighter and more even. There was no great difference in quality. Although the leaf was more broken with less "make," the variation in leaf was not enough to affect prices except on a very discriminating market.

The same results were obtained even when an M. S. batten or a plain table roller was used instead of the "Crescent" battens for the 2nd roll.

Series II.

1st roll, 60 minutes in "Crescent" roller, 2nd roll in M. S. roller. Dhools passed through Clivemeare roller at very light pressure and rerolled on a plain table with a smooth cone	1st dhool—50% 2nd dhool—40% Big bulk—10%

Here again, the experimental samples were slightly preferred to normal manufacture for the same reasons as in Series I.

The omission of "Clivemearing" and rerolling the two dhools on a plain table made no change in the results.

Series III.

3-roll programme, dhool out-turns being 20, 30 and 40 per cent with 10 per cent big bulk. Same period of fermentation as for 5-roll programme. Lamont-Michie & Crescent battens used for first rolls & M. S. on the last	1st dhool—20% 2nd dhool—30% 3rd dhool—40% Big bulk—10%

In this series of experiments carried out in 1942 a normal manufacture of 5 rolls was definitely preferred. Except for the difference in the number of rolls all other conditions of manufacture were equal. It was thought that on account of the heavier pressures employed in the 3-roll programme a shorter fermentation would effect improvement. Accordingly, a period of fermentation of 2.45—3.45 hours was tried out as compared with one of 3.15—4.15 hours for a 5-roll programme.

The tasters' reports on these teas manufactured during different seasons of the year may be summarised as follows:—

Dry Weather.—B.O.P's and Fannings only of 3-rolls programme preferred on account of slightly more point and quality. Liquors of these samples had less colour and strength and the infusions were greenish in comparison with the 5-roll samples.

South-West Monsoon.—3 rolls given very slight preference. Very little to choose between the quality of these samples and those of the normal manufacture (5 rolls).

North-East Monsoon.—Practically no difference. Not sufficient variation to warrant comment except on a very critical market.

As a matter of interest, temperatures of the leaf at the end of each roll were recorded in some of the experiments in these series and the mean results obtained are set out below.

5-roll programme:—

	Temperature at end of each roll	Temperature of rolling room	Rise of temperature of leaf	Approximate pressures applied. (Wt. of cap inclusive)
1.	70°F.	62; 60	8°	115 lb.
2.	72°F.	63; 61	9°	130 „
3.	74°F.	64; 62	10°	165 „
4.	75°F.	64; 62	11°	165 „
5.	76°F.	65; 63	11°	145 „
3-roll programme:—				
1.	72°F.	61; 59	11°	250 „
2.	73°F.	62; 60	11°	250 „
3.	77°F.	64; 62	13°	250 „

A record was also kept of the moisture contents, made tea and grading out-turns of all the experiments in the Series I-III which averaged out as follows:—

	Series I	Series II	Series III (3-rolls)	Normal manufacture (5-rolls)
(a) % Moisture content in withered leaf	60	61	54	54
(b) % out-turn of made tea to withered leaf	37	36	46	46
(c) % out-turn of grades				
B.O.P.	52	54	59	58
F.P.	8	9	10	12
Fannings	16	15	12	12

Series IV.—A few experiments were carried out on the order of firing the dhools. An order of firing in which the last dhool was fired first seemed to have resulted in a better tea. It is now intended to continue this work both for 5-roll and 3-roll programmes for the different seasons with special reference to flavour and colour.

Series V.—Plain Table Rolling.—Experiments were also carried out using a smooth table fitted with a smooth cone. The results, however, were unsatisfactory, the leaf caking badly whenever pressure was employed and little twist being imparted to the leaf. On the other hand, if pressure was not used the out-turn of dhool was negligible.

Notwithstanding these results, the fact remains that the rolling experiments so far carried out all tend to show that the main action in rolling occurs at the centre of the table and that the nature of the outer portion of the table is of relatively minor importance. Suitable modifications of a central cone may therefore prove the solution of the problem and experiments on such lines are to be carried out.

GREEN TEA MANUFACTURE

A number of experiments were carried out so that some information could be obtained on the boiling process of green tea manufacture as practised in certain parts of India. The method tested out involved the immersion of the fresh leaf in boiling water for varying periods from 5-10 minutes. The rest of the process was almost similar to the steaming process as practised in Ceylon except that no expressor was available to remove the moisture from the leaf immediately the latter was taken from the boiling water. In Ceylon hydraulic or screw presses are normally used for this purpose.

In the small-scale experiments done here very little moisture was removed at that stage. As much as possible, however, was expressed in the first roll before the first firing. Although a few difficulties were experienced in the small-scale experiments due to lack of suitable equipment satisfactory green tea was made by the boiling process.

One outstanding result of this process of manufacture however was the low out-turn of made tea which was to be expected on account of the material leached out by the boiling water. An experiment was done to determine exactly the respective out-turns obtained by the boiling and steaming processes. For this purpose the same bulk of green leaf was used, a part of which was also taken for the manufacture of black tea.

The following out-turns were obtained :—

Steaming method	...	18%
Boiling method	...	15%
Black tea	...	19%

All out-turn figures were low owing to very wet leaf being used. The point of importance, however, is loss in out-turn caused by the boiling method.

Repetition of the experiment gave the same results.

PACKING MATERIALS

(a) **Local Timber.**—Miniature chests made from Ululu and Namada were tested. But for the fact that both woods were not altogether free from borer attack they would be quite suitable for tea chests. Ululu is a softer wood than Namada and on account of the former's greater liability to borer attack extreme caution should be exercised in its use.

(b) **Coconite Tea Chests.**—Storage tests were carried out with these chests and tea so stored was free from taint. No objectionable odours were imparted to teas which were stored for a considerable period in chests made up from this material both lined and unlined.

Freezing of Leaf.—The possibilities of freezing leaf were investigated with the object of trying to obtain more even fermentation as freezing would naturally burst the cells and so enable the juice to be expressed rapidly.

Fresh leaf on freezing was found to discolour in a few hours after thawing. At first the leaf is quite pliable but as withering proceeds it becomes leathery, and from a dark olive-green colour turns into a dull reddish brown. If the withering is carried too far the frozen leaf blackens.

Manufacture of leaf that had been frozen and withered resulted in more colour but less quality. On the other hand, leaf that had been kept in a cold atmosphere for sometime and then withered gave a tea much above the average, and leaf that had been frozen and then manufactured without any withering at all gave a still better tea. These results raise some interesting questions.

1. What effect has preliminary freezing on withering?
2. Is withering really necessary?
3. What is the effect of low temperatures on fresh and withered leaf?

An experiment was designed to include all these factors. The samples derived therefrom were :—

1. Green leaf manufactured without withering.
2. Green leaf frozen and then manufactured without withering.
3. Withered leaf (normal manufacture).
4. Green leaf kept in a cold, humid atmosphere (temperature about 38°F.) for 24 hours and manufactured without withering,
5. Part of frozen green leaf (Sample No. 2) withered and manufactured.
6. Part of withered leaf (No. 3) frozen before manufacture.
7. Part of withered leaf left in a cold, humid atmosphere (temperature about 38°F.) for 24 hours before manufacture.
8. Part of cold green leaf (Sample No, 4) withered and manufactured.

All the above samples were from the same bulk of leaf. Tasting opinion on these teas was as follows:—

Sample No. 1—3rd best tea. Above average.
" " 2—Best tea.
" " 3—One of the worst. Fair colour and quality.
" " 4—Average tea. Very fair quality.
" " 5—The worst. Plenty of colour.
" " 6—Average tea. Good colour.
" " 7—Poor quality tea but very coloury.
" " 8—2nd best tea. Good colour and quality.

Field Experiments.—A few manufactures were done on leaf from the experiment on hard plucking in order to determine the effect of fish leaf and normal plucking on quality.

Clonal Manufacture.—Manufacture of leaf from selected high-yielding clones was done throughout the year.

Miscellaneous.—Routine moisture content determinations of St Coombs teas were made throughout the year. Analyses of manioc for prussic acid content were also carried out, the samples including one which had led to a fatal case of manioc poisoning.

Publications.—The following three communications by Mr. Sreerangachar were published in technical journals during the year:—

1. Nature of the Tea Oxidase System. *Current Science*, 1943, **12**, 185
2. Tea Polyphenol Oxidase — Its Material Nature. *Current Science*, 1943, **12**, 227.
3. Degradation of Chlorophyll during Tea Fermentation. *Current Science*, 1943, **12**, 205.

ROLAND V. NORRIS.
Director

REPORT

OF

THE SMALL-HOLDINGS OFFICER,

BADDEGAMA, FOR 1943

The Working Areas.—With the vital need for intensive food production, small-holders found little time to devote to their holdings. For the protection of his food crops from thieves, stray cattle, and wild animals, he had to sacrifice even his sleep.

The favourable prices paid for rubber induced small-holders to spend more time in increasing their output of rubber. The opening of several Government Rubber Purchasing Depots, easily accessible to small-holders, the supplying of acid, and the paying of attractive prices for their rubber was a further inducement to small-holders to concentrate on the production of rubber.

The benefits that would have accrued to small-holders by the fixation of a minimum price for green leaf, was offset by the increased rates that had to be paid for labour, when available, and the rising costs of living.

There was a shortage of labour, the available labour being absorbed by estates. When labour was available, many a small-holder found he could not pay the rates demanded by the labourer.

There was much uneasiness in the villages, due to the scarcity of foodstuffs and misapprehensions regarding the internal paddy purchase scheme regulations. The suspension of the tea coupon system also reacted adversely. The chance that the progressive small-holder had of obtaining an increased assessment was lost to him.

The issue of manure to paddy cultivators made them take a keener interest in the cultivation of their paddy fields. The organisation and management of village co-operative stores kept most small-holders busy.

The 1942-1943 Competitions.—Against such a background, the repeat competitions in the 1939 and 1940 working areas, did not give the results hoped for. The progressive works carried out by competitors fell far short of competition standard, and the final judging of both competitions has been deferred.

Advisory Work.—There was no change in the petrol ration allowed. This ration was barely sufficient to maintain contact with small-holders in the previous competition areas.

Advisory visits were as follows:—

Revisits to small-holdings	...	1,038
Revisits to estates	...	50
Total visits	...	1,088

On these visits, 389 demonstrations, on various aspects of tea cultivation, were carried out.

Visits by Senior Staff.—During May visits were paid with Dr. Eden to small-holdings and estates where progressive works had been carried out.

Vegetative propagation, pruning, and composting were seen, and necessary advice given. On SK 2105, centering demonstrations were carried out. The close following of advice was reflected in the spread and vigour of the tea here.

A factory was visited, and the quality of green leaf supplied by small-holders was examined. An improvement in the standard of plucking was observed.

One of the small-holdings visited was SK337, referred to in the Annual Report for 1939.

The Chairman, Wanduramba Village Committee, was met.

During June, the Director, T. R. I., was met.

Instructional Leaflets.—Sinhalese translations of the speeches made by the Director, T. R. I. and Dr. T. Eden, at the 1939 and 1940 prize distributions respectively, have been sent to small-holders in areas which it was not possible to visit owing to travelling restrictions.

Office.—13 small-holders visited the office. 44 letters were received and 385 sent out.

F. D. TILLEKERATNE,
Small-Holdings Officer, Baddegama.

REPORT

OF

THE SMALL-HOLDINGS OFFICER,

ARAMBAGAMA, FOR 1943

Weather.—Abnormal wet weather prevailed in 1943. Progress in many directions was thereby retarded.

Advisory Work.—562 visits were paid. These were mainly confined to previously abandoned small-holdings which were re-opened recently. Many holdings were found to have been used as pasture ground for cattle. These owners were advised to stop this harmful practice and to bring them to their former state of production. Good results were observed. Petrol rationing and inability to obtain much needed car equipment prevented a larger number of visits being undertaken.

Fertilisers.—Owing to the difficulty in obtaining supplies of manure from firms, as done hitherto, a large number of small-holders applied for assistance to obtain fertilisers. The Director, Tea Research Institute was kind enough to organise a rationing scheme. Questionnaire forms were filled in by small-holders and sent to the Organiser, who issued permits which were forwarded to the Fertiliser Control Bureau, Colombo, for supply. 16,657 lb. were thus supplied. Delivery and transport at Kadugannawa, Peradeniya, Gampola, Ulapane and Nawalapitiya Railway Stations and their subsequent use were personally supervised by the Small-holdings Officer.

Meetings.—A largely attended meeting of small-holders, bought-leaf suppliers and proprietors of estates was held on the 26th June, 1943, at Wattapola. The chair was taken by Dr. T. Eden, Agricultural Chemist, Tea Research Institute. The meeting dwelt on compost, supply of a better type of green leaf and general improvement of the industry as it affects the small-holder. The meeting was voted a success.

Another meeting was held at Pilimatalawa Tea Factory on September 16th, 1943. The attendance was representative of planters, factory owners, green leaf suppliers and small-holders. The presence of Dr. R. V. Norris, Director, Tea Research Institute, who presided, proved the interest the Institute attaches to the work among small-holders. Various points affecting the welfare of the small-holders were raised at this meeting and satisfactory results are being shown now in some cases.

Competition.—A competition in compost making was held in Kandupalata and Medapalata Korales in Uda-Nuwara. 176 entries were received The interest evinced by the entrants can be gauged by the fact that the principal of a college, headmen and members of village committees were among the competitors. During the preliminary judging, the competitors who were not adhering to rules of the competition were eliminated.

One material which was used in this competition was decayed paddy straw which was lying waste in the thrashing floor. For the final judging, 9 competitors from Kandupalata and 8 from Medapalata were chosen, Dr. T. Eden, Agricultural Chemist, Tea Research Institute, conducted it.

Owing to the adverse weather which delayed the final judging, the prize-giving could not take place before the year was out and was held on January 29th, 1944, at 4-30 p.m. at the Buddhist Mixed School, Lankatilaka, kindly lent by the school authorities. Dr. Eden, Agricultural Chemist, Tea Research Institute, was kind enough to find the time to preside and distribute the prizes at this function. The prize-giving was attended by a large gathering of small-holders, chairmen and members of village committees, headmen and well-wishers.

The prize-winners were as follows:—

Kandupalata

		No.	Name	Small-holding
First Prize	Rs. 25.00	1.	W. A. D. Silva	Aluthkandewatte
Second „	Rs. 15.00	2.	P. B. Nawaratne	Delgahaambahena
Third „	Rs. 10.00	3.	M. B. Nawaratne	Kurudugalla.

Medapalata

First Prize	Rs. 25.00	1.	M. Punchirala	Udagalkotuwawatte
Second „	Rs. 15.00	2.	P. Muthuruhamy	Bodinaanase Kotuwa
Third „	Rs. 10.00	3.	H. Singharaya	Kukulagodawatte.

My special thanks are due to the Ratemahatmaya, Udunuwara and Yatinuwara, and his headmen for the great co-operation and interest taken in this competition. Contribution towards the prizes from the Chairmen, Village Committees, and proprietors of estates are gratefully acknowledged.

In conclusion, my thanks are due to the small-holders and others who helped to make the competition a success.

Food Production.—Most of the small-holdings, with special reference to Chief Headmen's Divisions in Udunuwara and Udapalata, have been brought under cultivation of food crops, such as Diascorea yams and root crops. Leaflets distributed by the Agricultural Department pertaining to food production were explained to the small-holders during my visits.

Demonstrations.—21 pruning demonstrations were given. In most cases the method of rim-lung pruning was demonstrated. A call was received from Bogomunda Estate at Rikilagaskade in Uda-Hewaheta which had not been pruned since Tea Restriction came into force. It was observed that attention to pruning is neglected in this area and it is my intention to pay more visits to this Division in the coming year.

Lock-and-step and reverse slope system of drains have been advocated as the best form for preventing soil-wash.

Plucking.—The method of plucking commonly seen among the small-holders is not satisfactory. When an increase in the price of green leaf is observed the small-holder resorts to untimely tipping and hard plucking. The correct method of plucking was stressed at all talks and meetings.

Soil Erosion.—Measures for prevention of soil erosion were pointed out at different centres. Towards this object, 6,000 Paspalam grass roots were distributed to 30 small-holders. These roots were given free by the Principal, School of Agriculture, Peradeniya, to whom my thanks are tendered. It is hoped to multiply from this issue and make a further distribution in due course.

Headmen.—I attended Division days of the Chief Headmen, Udunuwara and Udapalata and gave talks on various items.

I thank the Ratemahatmaya, Udunuwara and Yatinuwara, D.R.O. Udapalata and Uda Bulathgama, and the Minor Headmen for their continued support.

Village Committees.—I attended a number of meetings of Village Committees where addresses of an advisory nature relative to my work were delivered.

Lectures were also given on food production.

Office.—149 letters were received and 251 were sent out. 16 calls were made by small-holders for advice.

M. B. BOANGE,

Small-Holdings Officer, Arambagama.

The Tea Research Institute of Ceylon.

BOARD OF CONTROL

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(6) Mr. W. H. Gourlay

(C) Representing the Low-Country Products' Association

(7) Mr. W. P. H. Dias

(D) Representing the Small-Holders:—

(8) Adigar Sir T. B. Panabokke, (Chairman).

(E) Ex-Officio Members:—

(9) The Hon. the Financial Secretary

(10) The Director of Agriculture

(11) The Chairman, Planters' Association of Ceylon

(12) The Chairman, Ceylon Estates Proprietary Association

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