CHAPTER 1
AGRONOMY

1.0 Introduction

The main goal of the agronomy programme is to develop appropriate cultural practices for clonal and seedling tea for different types of producers and environments. The objectives of the research work are:

(i) To identify optimum levels of tea nutrition for different soil types and under different cultural and climatic conditions
(ii) To investigate alternative plucking and pruning methods
(iii) To identify optimum irrigation practices
(iv) To evaluate a range of establishment practices

1.1. Responses to Major Nutrients

1.1.1 Responses to Nitrogen under irrigated and rain fed conditions

A trial was established under rainfed conditions at Thornwood Estate, Mulanje and at Khongoloni Estate, Mulanje and Bandanga Estate, Thyolo to investigate the response of young clonal tea to nitrogen at 75, 175, 275, 375, 475 and 575 nitrogen kilogram ha-1 as a 15:3:5 compound fertiliser in a split application (Malenga, 1999d). The test clones were different at each site except for the sites in Mulanje which had two common clones – PC 108 and PC185.

Over a four-year period, PC 185 under irrigated conditions gave the highest mean annual yield of up to 4 metric tons made tea ha-1 when it received 475 kilogram nitrogen ha-1 (Figure 1.1.). In contrast PC185 did not respond to nitrogen under both rainfed and irrigated conditions. Similar response under both growing conditions was obtained with PC108.

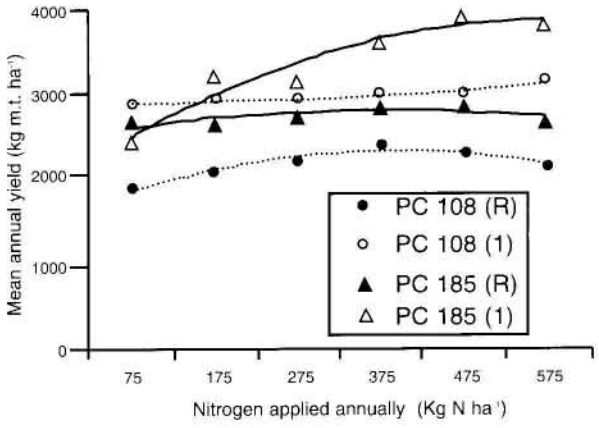

Figure 1.1 Mean annual yield response to nitrogen during years 1-5 for clones PC 108 and PC185 under rainfed (R) and irrigated (I) conditions in Mulanje district

Conclusion

Results from the trial suggest that under irrigation, PC 185 may require up to 400 kilogram nitrogen ha^{-1} whereas under rainfed growing conditions, only about 75 kilogram nitrogen is apparently required. PC 108 young tea apparently requires not more than 75 kilogram nitrogen ha^{-1} under both irrigated and rainfed conditions.

1.1.2 Clones x Nitrogen x Phosphate x Potash Trial

This trial was planted in 1986 under irrigation at Nsuwadzi Estate, Mulanje in a factorial treatment arrangement. The treatments are shown in Table 1.1. The nitrogen was applied as a split application in October-November and January, whilst the phosphate and potash were applied once in October-November. Only responses to nitrogen of the test cultivars is shown in Table 1.4

Table 1.1 Treatments used in the Nutritional trial

Clones	Nitrogen (kg ha^{-1})	Phosphate Kg $P_2 0_5$ ha^{-1}	Potash Kg k_20 ha^{-1}
Polyclonal tea	75	0	35
SFS 150	225	35	70
PC 80/PC 87 composite	300	70	140
PC 81	375	140	210

Three year mean yields of the composite material PC 80 scion on PC 87 rootstock are shown in Table 1.2. This composite had the highest mean annual yield of about 6.4 tons m. t. ha^{-1} with the highest yields of 7.0 tonnes ha^{-1} at 300 and 475 kilogram nitrogen ha^{-1}.

Table 1.2 Mean annual made tea yield (kg ha^{-1}) of mature clonal tea at four nitrogen levels

	Nitrogen application rate (kg ha^{-1})					
Type of tea	**75**	**225**	**300**	**375**	**Mean**	**No CV%**
Polyclonal	4756	5139	4654	5032	**4895**	
SFS 150	5011	5853	6142	5533	**5635**	
PC 80/PC 87	4774	6697	7114	7008	**6398**	
PC 81	4930	5997	5459	5680	**5517**	
Clones			***			
Nitrogen			***			
Clones x Nitrogen			772			

Clones PC 81 and SFS 150 yielded up to 6 tons m.t. ha^{-1}, with a significant (P=0.001) response to nitrogen at 225 kilogram nitrogen ha^{-1}. Polyclonal tea yielded up to 5.1 tons ha^{-1}, which was not significant.

Conclusion

The results suggested that mature SFS 150 and composite plants of PC 80 on PC 87 required more than 225 kilogram nitrogen ha^{-1} for optimum productivity whereas PC 81 and polyclonal required around 225 kilogram nitrogenha^{-1}. However, more work was needed to confirm these results.

1.1.3 Nitrogen x Phosphate x Potash

This trial was initiated at Kawalazi in 1995 in a field planted to clone PC 81. The trial was initially under rainfed conditions but was subsequently irrigated from 1997. Three rates of nitrogen (150, 300, 450 kilogram ha^{-1}), phosphate (30, 60, 90 kilogram ha^{-1}) and potassium (50, 100, 150 kilogram ha^{-1}) were applied annually.

While phosphate and potash were applied once in each year, nitrogen was split twice.

There were no yield responses to increasing levels of phosphate and potassium but response to nitrogen realized in 1998/99 was significant (Table 1.3).

Table 1.3 Made tea yield (kg ha^{-1}) of clone PC81 at three levels of N, P and K application 1997/98 and 1998/99.

Made tea yield (kg ha^{-1})			
Treatments	1997/98	1998/99	Mean
Nitrogen: kg ha^{-1}150	4605	5601	5103
300	4944	6162	5533
450	4804	6318	5561
Mean	**4784**	**6027**	**5399**
Phosphorus: kg ha^{-1}30	4616	5802	5209
60	4801	6260	5531
90	4936	6018	5477
Mean	**4784**	**6027**	**5406**
Potassium: kg ha^{-1}50	4735	5896	5315
100	4795	6002	5398
150	4823	6183	5503
Mean	**4784**	**6027**	**5405**
Nitrogen	NS	**	*
Phosphate	NS	NS	NS
Potash	NS	NS	NS
LSD (P = 0.05)	1057	1329	1015
CV%	10.8	10.7	9.1

Conclusion

Subject to confirmation, these results suggested that mature PC 81 plants required not more than or around 300 kilograms nitrogen ha^{-1} for optimum productivity at Kawalazi tea estate. The results further suggested that as low as 30 kilogram P and 50 kilogram K ha^{-1} was adequate for sustainable production for PC 81 at this estate.

1.1.4 Clones x Nitrogen Trial

The response of clones SFS 150, SFS 204, PC 1 and PC 81 to nitrogen at levels of up to 700kilogram ha^{-1} was investigated in two trials initiated in 1978 under rainfed conditions at Mimosa Tea Research Station (MTRS). The fertilizer was applied as a single application on SFS 150 and SFS 204 and split once on PC1 and PC81. The mean response to nitrogen over six seasons (1993/94 to 1998/99) was determined.

All four clones responded significantly (P = 0.05) to nitrogen up to a rate of 575 kilogram ha^{-1} (Figure 1.2) and thereafter yields started to decline suggesting the optimum level was achieved at 575 kilogram nitrogen ha^{-1}.

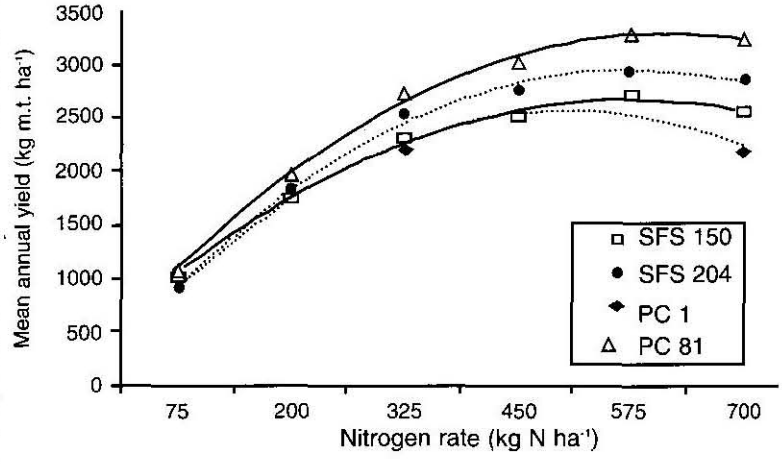

Figure 1.2. *Mean annual yield response (kg m.t. ha^{-1}) to nitrogen of four clones over six seasons (1993/94 to 1998/99)*

The highest annual yields of 3.3 tons made tea ha^{-1} were obtained from PC81, whilst clones SFS 204, SFS 150 and PC 1 yielded 2.9, 2.7 and 2.6 t ha^{-1} respectively at 575 kilogram nitrogen ha^{-1}.

Conclusion

Results from this trial showed that clonal tea responded positively to high levels of nitrogen and the optimum nitrogen level for SFS 150, SFS 204 and PC 81 appeared to be above 500 kilogram ha^{-1} while for PC 1 it was around 400 kilogram ha^{-1}.

1.2 Other nutrients

1.2.1. Zinc

The effects of zinc carriers and frequency of application on the yield of Indian hybrid seedling tea were investigated over three years from 1995/96 to 1997/98 as described by Malenga (1999c). Zinc was applied annually at a rate of 4 kilogram ha^{-1} in either two or four applications, and in five different forms (Zintrac, Zinphos, zinc oxide, zinc sulphate, and zinc chelate) with and without a wetting agent ('Armo-blen at 500ml ha^{-1}).

Results in Table 1.4 show that there was no significant yield response to zinc application or to the different methods of application.

Table 1.4. The mean annual yield response (kilogram m .t. ha^{-1}) of Indian hybrid tea to zinc over three seasons, 1995/96 to 1997/.

Treatment	Control	ZnO	ZnS04	Chelate	Zintrac	Zinphos
2 x 2 kg	3873	3943	3737	3575	40976	4069
4 x 1 kg		4036	3930	3813	4261	3932
No WA		3856	3932	3676	4211	4085
WA added		4023	3735	3712	4127	3916
Mean	**3873**	**3989**	**3834**	**3694**	**4169**	**4000**

Note: WA= wetting agent

In 1998, one trial in Malawi and another in Zimbabwe were initiated to investigate the response of clonal tea to zinc application (Malenga and Mukumbarezah, 2001). In Malawi three different clones, SFS 150, SFS 204 and PC1, received zinc in the form of zinc oxide, Zintrac and Zinphos in two applications of 2 kilogram of zinc per year. In Zimbabwe, the response of clone PC 110 to zinc oxide and zinc metalozate were tested. In both trials, tea yield and quality were assessed.

There were no statistically significant yield differences in Malawi between the zinc treatments (Table 1.5). However, there was a yield response of 660-430 kilogram ha^{-1} (5 – 9%) to the application of Zintrac in both years. In contrast, tea that received zinc oxide and Zinphos yielded similarly to the control in both years.

Table 1.5. The effects of zinc application on the annual yield (kg m. t. ha^{-1}) of clones SFS 150, SFS 204 and PC 1 during 1998/99 and 1999/2000.

Season	1998/99				1999/2000			
Treatments	**SFS 150**	**SFS 204**	**PC 1**	**Mean**	**SFS 150**	**SFS 204**	**PC 1**	**Mean**
Nil zinc	5081	4526	4173	**4594**	5325	5105	5336	**5255**
Zinc oxide	5217	4733	4130	**4693**	5343	4895	5351	**5196**
Zintrac	5876	4912	4282	**5023**	5663	5518	5375	**5519**
Zinphos	5547	4595	4174	**4772**	5421	4999	5035	**5151**
Mean	**5430**	**4691**			**5438**	**5129**	**5274**	
Clones x zinc carriers	NS				NS			
LSD (P = 0.05)	1007				913			
CV%	10.3%				8.4%			

In Zimbabwe and in both years, the yield of tea that received zinc oxide was significantly (P = 0.05) higher than that of the control (Table 1.6). All metalozate treatments tended to increase the yield, as compared to the control, but not significantly. The mean yield of the zinc oxide treatment was also 17-21% higher than that of the metalozate treatments.

Table 1.6. The effects of zinc application on the yield (kg m. t. ha^{-1}) of clone PC110 during 1998/99 and 1999/00.

Treatments / Year	1998/99	1999/00	Mean
Nil zinc	2113	2207	2160
ZM 3.42l ha-1 once	2398	2281	2339
ZM 0.5l ha-1 twice	2457	2628	2542
ZM 0.5l ha-1 4 times	2177	2530	2354
ZM 0.25l ha-1 4 times	2435	2408	2422
Zinc oxide	2805	2853	2829
LSD (P = 0.05)	540	597	515
CV %	11.0%	11.7%	10.3%

Note: ***ZM = zinc metalozate***

Conclusion

The application of 4.0 kilogram zinc ha^{-1} annum^{-1} as one application or split twice in any form on SFS 150, SFS 204 and PC 1 was not beneficial in Malawi. There was however a yield benefit in applying zinc oxide on PC 110 in Zimbabwe.

1.1 Liming trials

Phosphate x Dolomitic Lime

This trial, at Mianga Estate, Thyolo, was initiated in 1988 on clonal tea SFS 150 and SFS 204 that had been planted in 1976 (Malenga, 1999e). Lime was applied at a rate of 1 ton ha^{-1} annually for ten years, in comparison to an untreated control. Phosphate was applied at rates of 0, 50, 100 and 150 kilogram P_2O_5 ha^{-1} annually.

Over four pruning cycles, there was no significant yield response to liming (Table 1.7), probably because the initial soil pH of about 4.3 was within the optimum range for tea production. There was, however, a significant response to phosphate application in all four pruning cycles.

Table 1.7 The effects of lime and phosphate application on the mean annual made tea yield (kg ha^{-1}) of SFS 150 and SFS 204 for the periods 1988-91, 1991-94 and 1994-96 and 1996-98.

Pruning Cycles				
	Triennial Cycles		Biennial Cycles	
Treatments	**1988-91**	**1991-94**	**1994-96**	**1996-98**
Nil phosphate	1495	2423	2923	4543
50kg P_2O_5 ha^{-1}	1610	2639	3164	4956
100kg P_2O_5 ha^{-1}	1722	2814	3303	4969
150kg P_2O_5 ha^{-1}	1736	2894	3447	5094
Mean	1641	2693	3209	4891
Nil lime	1684	2735	3228	4919
1 t lime ha^{-1} per year	1598	2650	3190	4862
Mean	**1641**	**2693**	**3209**	**4891**
Phosphate	**	***	**	*
Lime	NS	NS	NS	NS
SE	179	251	307	472
CV%	10.9	9.3	9.6	9.6

Lime x Potash Trial

This trial was initiated at Lauderdale tea estate, Mulanje, in 1993 in an area planted to China hybrid tea. Lime was applied twice, in 1993 and 1995, at rates of 0, 1, 2, 4 and 8 tons ha-1 on each occasion. Potash was applied annually at rates of 83, 140 and 197 kilogram K_2O_5 ha^{-1}. The initial soil pH at this site was about 3.9.

Results in Table 1.8 show that there was a significant tea yield response to liming in the first biennial cycle (1993-95) but not in the two subsequent cycles probably because the soil pH had increased to over 4 which is suitable for tea production. The final soil pH of the plots that had received more than 16 tons ha^{-1} of lime was over 5. This indicated that such high rates increased the soil pH. There was also no yield response to the application of potash in all three pruning cycles.

Table 1.8. The effects of lime and potash application on the mean annual yield (kg m. t. ha^{-1}) of China hybrid tea during three biennial cycles 1993 – 95, 1995-97 and 1997-99.

Treatments	Mean annual yield (kg m. t. ha^{-1})		
	1993-95	1995-97	1997-99
Nil lime	3412	4365	4390
1 t ha^{-1} x 2	3401	4366	4245
2 t ha^{-1} x 2	3617	4313	4324
4 t ha^{-1} x 2	3596	4379	4145
8 t ha^{-1} x 2	3730	4254	4248
Mean	**3551**	**4335**	**4270**
83 kg K2Oha^{-1} y^{-1}	3554	4462	4303
140 kg K2O ha^{-1} y^{-1}	3476	4242	4301
197 kg K2Oha^{-1} y^{-1}	3623	4302	4207
Mean	**3551**	**4335**	**4270**
Lime	*	NS	NS
Potash	NS	NS	NS
SE	230	341	366
CV%	6.5	7.9	8.6

Conclusion

Results showed that there was no yield benefit in applying lime to fields with pH of about 4.3 and lime application to fields with initial pH of around 4.0 apparently benefited in the first three years. There was some response to phosphate application.

1.2 Irrigation

Irrigation x Fertilizer x Clones

A trial to investigate the response of young clonal tea to irrigation and fertilizer was initiated in 1995/96 at MRS (Malenga, 1998c). Three clones (PC108, PC 198 and S15/10) and one composite (PC 105/RC3) were subjected to nil, 25%, 50% and 100% replacement of a 40mm deficit, determined using an open Class A pan. From 1995 to 1997, there were disruptions to the irrigation, and so the results have not been reported. From 1997 to 1999, the trial was irrigated as planned. Main effects of irrigation and clones on yield are reported in Table 1. 9.

Table 1.9. The effects of irrigation on the mean annual made tea yield (kg ha^{-1}) of four clones during the biennial cycle 1997-99.

Irrigation regime	Yield	Clones	Yield
Nil	2844	PC108	3762
25%	3404	PC105/RC3	3472
50%	3238	PC198	3386
100%	3795	S15/10	2660
Mean	**3320**	**Mean**	**3320**
LSD (P = 0.05)	388	LSD (P.05)	790
CV%	5.8	CV%	11.8

Replacement of 25% of the irrigation requirement resulted in a significant (P = 0.05) yield increase. However, the highest yields were obtained by 100% replacement, which gave a 33% yield increase, as compared to the unirrigated control.

PC108 gave the highest yields, whilst S15/10 (from Kenya) performed relatively poorly, even under full irrigation.

Conclusion

Although 100% replacement of 40 mm deficit gave the highest yields, 25% replacement would be more cost effective and more attractive, taking into account availability of irrigation water and pumping costs.

1.3 Plucking and pruning

1.3.1 Shear Harvesting

Harvest Methods and Pruning Cycles

This trial, conducted on Indian hybrid seedling tea at Mimosa, was designed to investigate the effect of different plucking methods and pruning cycles on tea yield and
leaf quality (Nyasulu, 2001). Hand and shear harvesting (with and without a step) treatments were superimposed on 2, 3 and 4 year pruning cycles in 1995.

Over a four year period from 1995/6 to 1998/9, neither the harvesting methods nor the type of shear had any significant effect on tea yield (Figure 1.3). However, yields tended to be slightly higher for the shear harvesting treatments as compared to hand plucking treatments.

Length of pruning cycle had no significant effect on yield, although yields were slightly lower under 2-year, as compared to 3 and 4- pruning year cycles (Figure 1.4). On a 2-year cycle, yields by shear harvesting tended to be higher than by hand, although not significantly so.

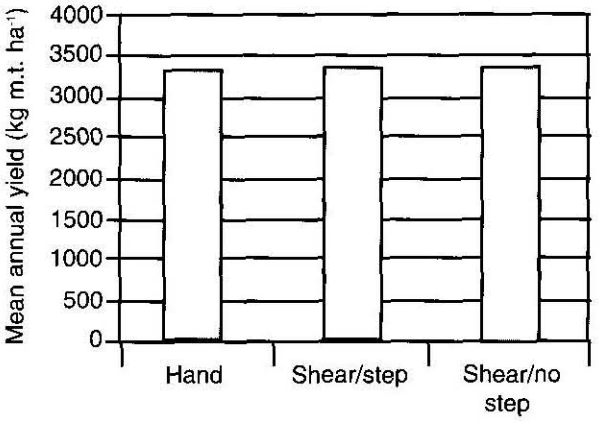

Figure 1.3. The Effect of harvesting method and the shear step on the mean annual yield (kg ha^{-1}) of seedling tea during the period 1995/96 to 1998/99.

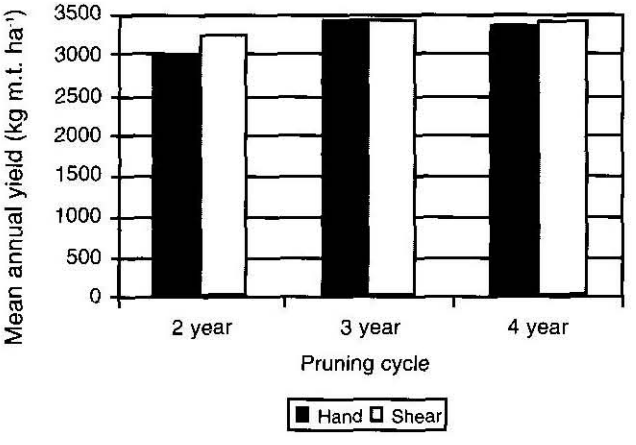

Figure 1.4. The effect of the length of the pruning cycle on the mean annual made tea yield (kg ha^{-1}) of seedling tea during the period 1995/6 to 1998/9

Conclusion

Shear plucking apparently had no significant effect on yield of seedling tea, particularly under the growing conditions of this trial.

Harvest Methods on Clonal Tea

This trial, initiated in 1995, compared the use of hand and shear harvesting methods on clones SFS 204 and PC 1 (Nyasulu, 2001). Results from the trial are shown in Figures 1.5 and 1.6).

Over a four-year period, the mean annual yield was not significantly affected by the harvesting methods. Although, while there was virtually no difference between the two methods in the first two seasons (Figure 1.5), hand plucking however tended to edge over shear plucking from the third season.

Tea quality, as assessed by taster's valuation, was not also affected by the harvest method (Figure 1.6)

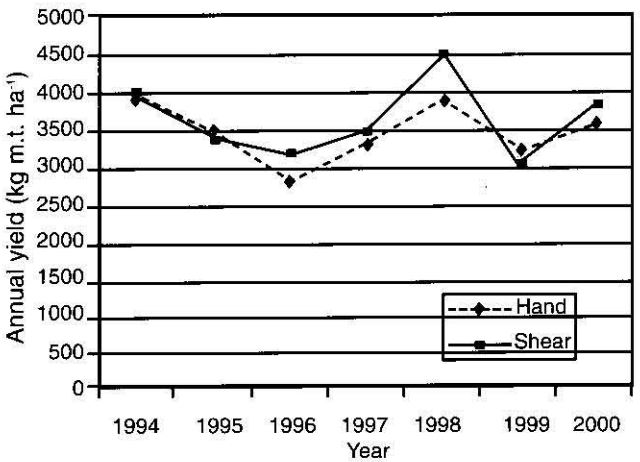

Figure 1.5 The effect of harvesting method on the mean annual made tea yield (kg ha⁻¹) of clonal tea during the period 1994/95 to 1999/2000.

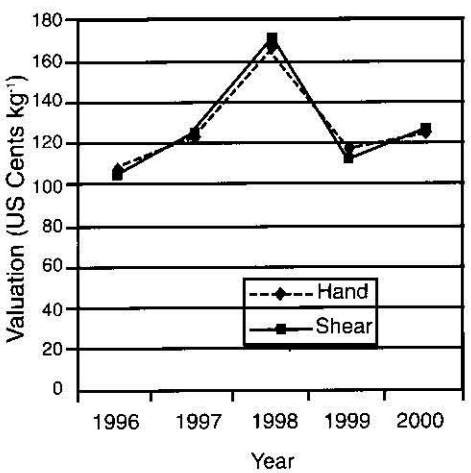

Figure 1.6. The effect of harvesting method on the valuation (US Cents) of clonal tea during the 1995/96 to 1999/2000 season

Conclusion

Shear harvesting apparently did not affect both yield and made tea quality of clonal tea.

1.3.2. Mechanical Harvesting

Zimbabwe

In 1998, two trials, one on seedling tea and another on clonal tea, SFS 150, were initiated at Clearwater Estate, Chipinge, Zimbabwe, to investigate the effects of mechanical harvesting practices on tea yield (Mukumbarezah, 2001c). The experiments used a Jachacha machine, which is also currently used under commercial conditions in Zimbabwe. Round lengths of 10/11, 14 and 21 days were tested in combination with different rates of table height rise, as compared to hand harvesting.

Results in Figure 1.7 show that there was a significant (P=0.05) yield loss of seedling tea resulting from mechanical harvesting on a 10/11 or 14 day round, as compared to hand harvesting after three years of the trial. Yield of clonal tea, was significantly reduced on a 10/11 day round,

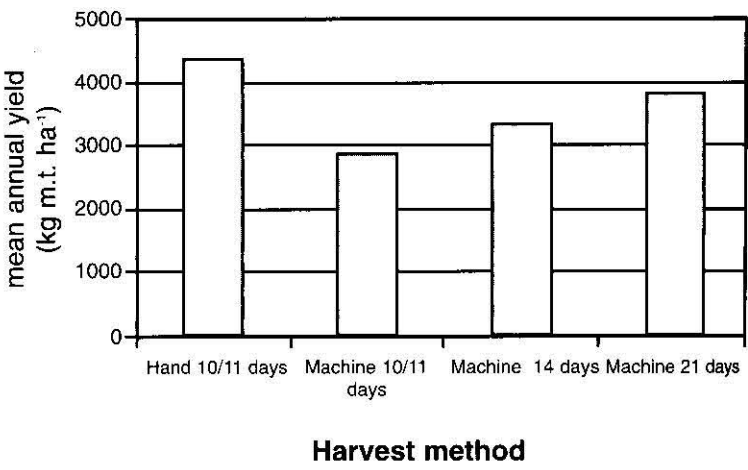

Figure 1.7 The effect of plucking round length on the mean annual yield of made tea of seedling tea over the period of 1998 to 2001.

but yields on 14 and 21 day rounds were similar to those obtained by hand harvesting (Figure 1.8).

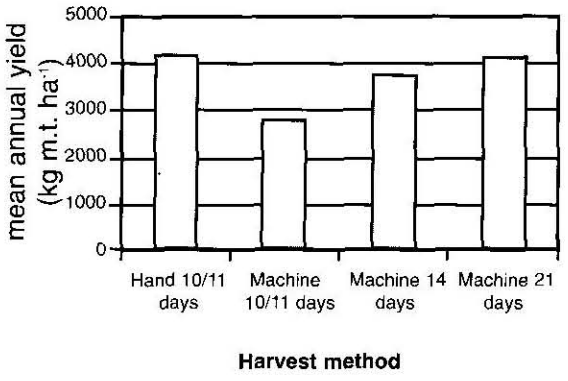

Figure 1.8 The effect of plucking round length on the mean annual yield of made tea of clone SFS 150 over the period 1998 to 2001.

Conclusion

Mechanical harvesting reduced yields of both seedling and clonal tea, particularly on short plucking rounds.

Malawi

In 1999, two trials were initiated in Malawi to investigate the effects of mechanical harvesting using a Jachacha machine (Nyasulu, 2000b). The first trial established on China hybrid tea at Thornwood Estate, Mulanje compared mechanical harvesting on three round lengths (14 and 21 days, plus a 'variable' round, based on assessment of the optimum time to harvest), using different rates of table height rise, as compared to hand harvesting. The second trial established on clonal tea (PC 108) at Sayama Estate, Mulanje used round lengths of 10/11, 14 and 21 days, as compared to hand harvesting. Different rates of table height rise were also compared.

The first season's results showed that mechanically harvested yields were 7% lower in clonal tea and 14% higher in China tea compared to hand plucking (Figure 1.9). On both clonal and seedling tea, longer plucking rounds (14 and 21 days) produced higher yields than shorter rounds (10/11 day and variable round). The 10/11-day round reduced yields on clonal tea under mechanical harvesting as compared to hand.

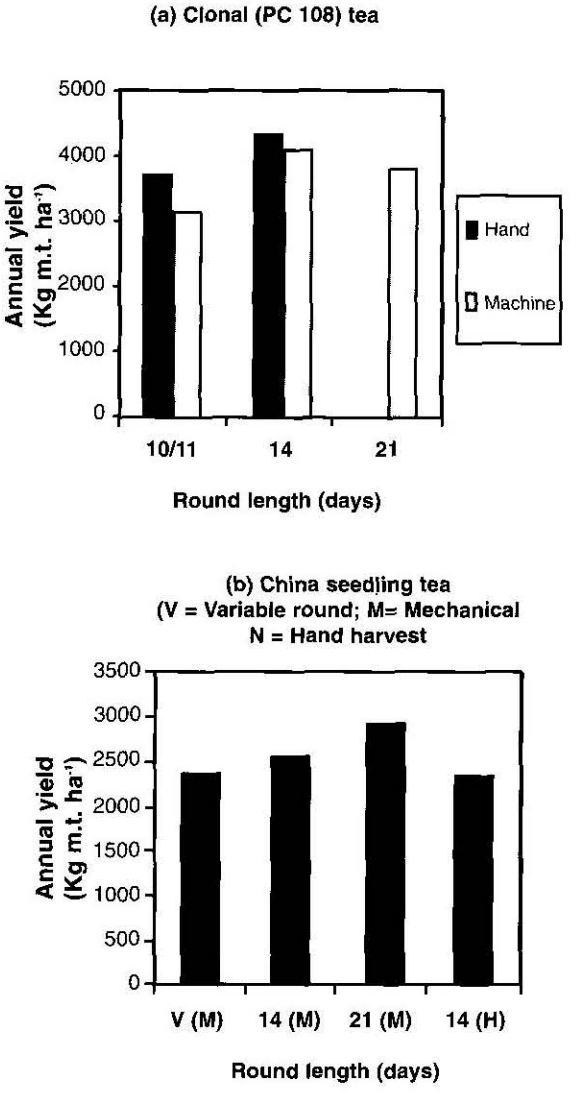

Figure 1.9 The effect of harvesting method and round length on the yield of (a) clonal (PC108) and (b) China seedling tea in the first season (1999/2000)

The effect of different adjustments of height plucking table on yield was not statistically significant. However, raising the plucking table by 1 cm every three rounds on shorter plucking rounds of 10/11 and 14 days on clonal tea resulted

into higher yields and so too raising the plucking table by 2cm gave better results on 21- day rounds. The results on seedling tea were less clear, but raising the plucking table every three rounds gave best yields on 14 day round and every four rounds on 21 day round.

Conclusion

Results from these trials indicated that mechanical harvesting reduced yield of clonal tea more than it did on seedling tea and longer rounds of 14 and 21 days were necessary in reducing the negative impacts of mechanical harvesting.

1.3.3. Pruning

Down Pruning Mature Clonal Tea

This trial, initiated in 1996 at Mpeni Estate, Thyolo, compared the effects of a range of pruning treatments on the subsequent yield of clone SFS 204 (Malenga, 1999a). The tea was pruned at 10, 30, 40 and 60cm in early 1997.

Down pruning at 10 and 30cm reduced the subsequent biannual cycle (1997-99) yield to about 2.5 and 4 t ha^{-1} respectively, as compared to over 5t ha^{-1} where the tea was pruned at 40cm (figure 1.10). Pruning at 60cm had no significant effect as compared to 40cm, the recommended pruning height (Figure 1.10).

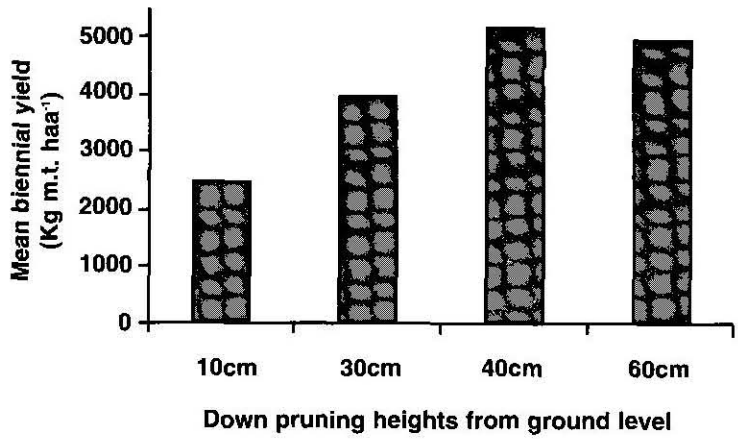

Figure 1.10. The effect of pruning treatments on the subsequent biennial yield (kg m.t. ha^{-1}) of Clone SFS 204

Down pruning clone SFS 204 at 10 cm above ground significantly reduced yields compared to 30, 40 and 60 cm pruning heights. This yield loss persisted until the second biennial pruning cycle.

Conclusion

What can be concluded from these results is that the optimum height for down-pruning could be 40cm. Lower pruning heights could have a long term negative effect on yield.

Clones x Pruning Time

This experiment was initiated in 1997 under rainfed conditions at Mimosa, with the objective of determining the effect of pruning time on the yield of clonal tea. Clones PCs 81, 117, 150, 185, 206 and RC4, and composites PC105/RC4 and PC108/RC4 were annually subjected to three pruning times, 1 March, 15 May and 31 July. Cumulative yields for the period 1997/98 to 2000/01 are shown in Table 1.10.

Overall, the yield of tea pruned in May was the highest, as compared to the yields of tea pruned in March and July. However, there were some clonal differences in response. PC 185 appeared to respond well to late pruning, whilst PC

117 appeared to benefit from early pruning.

The poor and delayed start of the 1999/2000 rainy season greatly affected plant survival, which influenced the clonal yield differences in the following season (2000/01). Clones that survived better gave the higher yields.

Table 1.10. The effect of pruning time on the cumulative yield (kg m.t. ha^{-1}) of clonal tea for the period 1997/98 to 2000/01

Clone	Cumulative yield (kg m.t. ha^{-1})/pruning date			
	1 March	15 May	31 July	Mean
PC 108	4430	4849	4435	4571
PC 105/RC4	4257	5464	4437	4719
PC 108/RC4	5205	5830	5393	5475
RC 4	5454	6680	6126	6087
PC150	5145	6025	5464	5545
PC 185	5072	5869	6044	5662
PC 206	3389	3973	2931	3431
PC117	4190	4188	2665	3681
PC 81	2877	4051	2265	3060
Mean	4446	5214	4418	
Clones				NS
Pruning time				*
Clone x prune time				*
SE mean (clones)				920
SE mean (clones x prune time)				520
CV%				11.1

Note: * significant at P=0.05, NS = not significantly different

Conclusion

Results from the trial showed that the optimum time for pruning mature clonal tea under normal rainy seasons was May and variation between clones in response to this pruning time was observed. Results also showed that PC 117 yielded higher after pruning early than late.

Pruning Time and Nursery Manipulations

This experiment was initiated in 1997 under rainfed conditions at Mimosa (Nyirenda and Mphangwe, 2000). The objective of the trial was to determine the effect of nursery manipulations and pruning timing on the yield of young clonal tea cultivars PC 108 and SFS 150. The treatments were (a) nursery manipulation (untouched or nipped) (b) field establishment (untouched, nipped or decentred) and (c) pruning time (early March or late July).

The yield results for 2000/1 are shown in Table 1.11. The nursery treatments had no residual effect on field yield. However, nipping in the field resulted in a significant (P = 0.05) yield increase, as compared to no manipulation or

decentring. Clones PC108 and SFS 150, responded to early pruning with PC108 giving the highest overall yield.

Table 1.11. The effect of nursery/field manipulation and pruning time on the annual made tea yield (kg ha^{-1}) of clonal tea in 2000/01

Treatment	Yield
Untouched in the nursery	1741
Nipped in the nursery	1757
Untouched in the field	1680
Nipped in the field	1915
Decentred	1652
Start prune early March	1805
Start prune end July	1693
PC 108	1806
SFS 150	1693
Mean	1749
Nursery Manipulations	NS
Field Establishment	*
Start of Prune	*
Clones	*
SE	163
CV%	9.3

Conclusion

It can be concluded from the results that nipping of plants in the nursery had no effect on subsequent yield in the field and was therefore not a necessary practice. However, nipping in the field was beneficial and the best time to prune was in March rather than end July.

1.4 Establishment Practices

Effect of Live Mulch on the Yield of Young Tea

The trial was established in Mulanje during 1995, on one year-old irrigated clonal tea (Nyasulu, 1999, 2000a). Four live mulches, Stylosanthes *(Stylosanthes guanensis)*, *Crotalaia grahamiana)*, Groundnuts (*Arachis hypogaea*), and Beans (Phaseolus vulgaris), were grown as live mulches for one year. These were compared to no mulch and dry Guatemana grass (*Tripsicum luxum*). The residual effect of the mulches was determined after the removal of the mulches.

Compared to the no mulch treatment, all live mulches, except Crotalaria, reduced the yield of tea (Table 1.13). Stylosanthes and beans reduced the yield by an average of 12 and 9 percent, respectively. Groundnuts reduced yield in the first season.

The detrimental effect of these treatments on tea yield declined with time up to the fifth year for all live mulch treatments. In contrast, Guatemala grass, used as dead mulch, increased tea yields by 30% in the first season, and by an average of 9 percent over the subseqent 5 plucking seasons. This beneficial effect on yield declined with time, and by the fifth year tea yield was similar to the nil mulch treatment.

Table 1.13. The effect of mulch treatments on the yield (kg m. t. ha^{-1}) of young clonal tea

Treatment/Season	1995/96	1996/97	1997/98	1998/99	1999/00	Mean	% Live mulch
Nil mulch	1497	3272	2442	1222	3993	2485	100
Guatemala	1939	3740	2541	1316	3996	2706	109
Stylosanthes	1211	2720	2071	1048	3851	2180	88
Crotalaria	1528	3569	2424	1266	4044	2566	103
Beans	1305	2827	2133	1156	3921	2268	91
Groundnuts	1380	3320	2523	1281	3995	2500	100

Note: ***Numbers in brackets are percentages of the nil mulch treatment***

1.5 Yield Studies

In 2001, Mr C.N. Mukumbarezah, Research and Extension Officer in Zimbabwe undertook a study on the 'Comparison of Potential and Actual Yields of Tea (Camellia sinensis) in Central and Southern Africa' for his MSc degree (Mukumbarezah, 2001a). The aim of the study was to determine the effect of leaf area index (LAI) and radiation interception and dry matter on the yield in pruned and un-pruned tea of three clones: SFS 150, PC108 and PC105.

LAI differed significantly among cultivars soon after pruning but the difference disappeared after the bushes recovered. Un-pruned tea showed an average LAI of 7.5. Radiation extinction coefficients (actual k-value) for the three clones, determined using linear regression models, were found to be 0.5 for SFS150 and PC105 and 0.6 for PC 108.

1.6 Clonal Replanting

A survey was carried out to determine the clones currently being planted by growers (Nixon, 2001). The main findings were as follows:

Total Area Under Different Types Of Tea

In Malawi, nearly 60% (11,200 ha) of the area under tea was Indian and China hybrid, 14% (2,700 ha) was polyclonal and 26% (4,900 ha). Most of the polyclonal tea was under smallholder tea sector while the rest was under tea estates. The large area under China and Indian tea showed that the replanting of these areas with high yielding clones was slow and this was attributed to a number of reasons such as loss of revenue in early years and long pay back period.

Choice of Clones for Replanting

From 1999 to 2001, 968 ha were replanted in Malawi out of which 603 ha (62%) was replanted with clones PC 105 and PC 108 and 275 ha (27%) with clones PC 110 – 119 and only 30 ha (3%) of the area was planted with more recently clones. Thirty-five hectares were planted with composites. Small area was planted with most recent clones and composites because of limited planting material.

1.9.1 Publications

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Research Foundation (Central Africa) Quarterly Newsletter **126**, 18 –21.

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4. Malenga, N E A (1998b). Effect of plucking methods on yield and quality of clones SFS 204 and PC 1. *Tea Research Foundation (Central Africa) Quarterly Newsletter* **130**, 10 – 13.
5 Malenga N E A (1998c). Effects of irrigation and fertilizer on the yield of clones in the years after planting. *Tea Research Foundation (Central Africa) Quarterly Newsletter* **130**, 13-16.
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14. Martin, P J (1999). Regional Workshop on the mechanical harvesting of tea. *Tea Research Foundation (Central Africa) Quarterly Newsletter* **134**, 3 – 6.
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