STUDIES ON INTERCROPPING WITH COPPICE SHOOTS OF *EUCALYPTUS TERETICORNIS* SM.

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VINAYA RAI, R.S., SWAMINATHAN, C. & SURENDRAN, C. 1990. Studies on intercropping with coppice shoots of *Eucalyptus tereticornis* Sm. Arable crops of sorghum (cv.CO.26), pearl-millet (cv.CO.6) and fodder grass (cv.BN.2) were raised in the spaces between one-year coppiced shoots of *Eucalyptus tereticornis* Sm. planted on a 2 m^2 grid. Both crop height and yield were depressed in the intercrop when compared with the monocrop but the magnitude of reduction varied with the crop. Crop height reduction was greatest in sorghum and least in fodder grass. Crop yield impairment was also largest in sorghum (35%) and least in pearl millet (17%) even though the number and size of coppiced shoots of the associated trees were largest for this treatment.

Key words: *Eucalyptus tereticornis* - intercropping with trees - coppice shoots - subterranean competition - competition light

Introduction

Intercropping with trees is an agroforestry system wherein the arboreal and the arable coexist on the same site, but are systematically spaced either in alternate rows or alternate strips so that they conjointly yield higher outputs per unit land area per unit time (Vergara 1984). Though the advantages of the system have been well documented (Lechner & Neumann 1966, Von Hesmer 1970), the agricultural crop can be integrated with the tree with reciprocal benefits only in the initial stages of the trees existence (King 1968). With canopy development over time, the intercrop invariably sustains a yield penalty (Maghembe & Redhead 1982, Redhead *et al.* 1983). Thus, yield of wheat raised in the interspaces of *Eucalyptus tereticornis* Sm. was normal in the first year, declined by 73% in the second year and was virtually nil in the third (Gupta 1986). There are reports on the performance of crops intercropped with 1 to 3-y-old *E. tereticornis* (Kermani 1980, Counto *et al.* 1984, Shaw 1987, Vinaya Rai & Suresh 1988). We report on the effects of intercropping with coppiced shoots of the multipurpose trees.

Materials and methods

The study was carried out at the Forestry Research Station, Mettupalayam, India (11° 19'N; 76° 56'E; 300 *m* a.s.l; precipitation 830 $mm\ y^{-1}$; soil a red loam with a pH 7.1), in a factorial randomised block design replicated four times.

Three arable crops, namely sorghum [*Sorghum bicolor* (L.) Moench] (cv.Co.26), pearl millet [*Pennisetum typhoides* (Burm.f) stapf & C.E. Hubb] (cv.CO.6) and fodder grass (cv.BN.2) were raised in the interspaces of *E. tereticornis* one year after coppicing. The first felling of the trees planted in 2 *m* squares was done six years after planting. The plots measured 16 × 4 *m*. Details of the arable crops are given in Table 1.

Table 1. Details of intercrops

Crop	Espacement (*cm*)	Fertiliser (*kg ha*$^{-1}$)			Duration (days)	Sowing/planting date
		N	P_2O_5	K_2O		
Sorghum	50 × 15	90	45	45	105	15.3.88
Pearl millet	50 × 10	70	35	35	100	15.3.88
Fodder grass	50 × 50	50	50	40	-	15.3.88

At maturity, crop height was recorded on ten random plants in each plot and the mean calculated. In the case of cereal crops, earheads were harvested from the four central rows bounded by the trees in each plot, dried, threshed and the grain yield extrapolated in terms of *t ha*$^{-1}$. For grass, fodder yield for the plot was similarly recorded 65 days after planting and extrapolated for *ha*. Fresh grains possessed a moisture content of 20 to 22% which scaled down to 12% on air drying. The results were analysed for variance and the treatment difference tested (t-test) for significance ($P \leq 0.05$) after Panse and Sukhatme (1967).

Stump diameter at 15 *cm* from ground level, number of coppice shoots per stool height and diameter of coppice shoots were recorded on ten random trees in each plot at the time of sowing (12 months) and at harvest (15 months) of the intercrops.

Results and discussion

Compared to the respective monocrop, both height and economic yield of the intercrop raised in the interspaces of coppiced shoots were reduced, the overall reduction being 32% for height and 26% for economic yield (Table 2). The depreciation in both crop height and yield was largest for sorghum (39 and 35%), height reduction was least for fodder grass (26%) and yield penalty least for pearl millet (17%). The number of coppiced shoots per stool were greater and the size of the shoot in terms of both height and diameter were larger in plots grown to pearl millet than in plots sown to the other crops (Table 3).

The yield decline in the intercrop obtained in the present study is smaller than that occurring with a 20-*mth*-old young *E. tereticornis* tree (58%) (Vinaya Rai & Suresh 1988), just one-third of the 78% reduction caused by a 2-*y*-old *E. melliodora* tree (Maghembe & Redhead 1982) and a little less than one-fourth of that (92%) ushered in by a 2-*y*-old *E. camaladulensis* tree (Redhead *et al.* 1983). Our study indicates that crops can be raised in the interspaces of one year coppiced shoots of *E. tereticornis* with a smaller yield loss than that obtained with 2-*y*-old trees.

Table 2. Effect of intercropping with *E. tereticornis* on the yield of three arable crops

	Crop height (*m*)		Economic yield (*t* ha^{-1})	
	Monocrop	Intercrop	Monocrop	Intercrop
Fodder grass	1.18	0.87	14.04	10.92
Sorghum	1.65	1.00	3.70	2.40
Pearl millet	1.27	0.91	4.06	3.36
	1.37	0.93	5.59	3.97
	SEd	CD (0.05)	SEd	CD (0.05)
System (S)	0.05	0.12	0.32	0.66
Crop (C)	0.06	0.14	0.37	NS
S×C	0.09	0.20	0.58	NS

Table 3. Growth parameters of coppice shoots of *E. tereticornis* during intercropping

Intercrop	Stool diameter (*cm*)	12 *mth*			15 *mth*		
		Number per stool	Height (*m*)	dbh (*cm*)	Number per stool	Height (*m*)	dbh (*cm*)
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Fodder grass	14.6 ± 3.5	2.57 ± 1.02	5.59 ± 1.58	4.24 ± 1.22	2.50 ± 1.02	6.55 ± 1.89	5.33 ± 1.56
Sorghum	12.4 ± 3.6	2.98 ± 1.11	5.65 ± 0.95	4.31 ± 1.37	2.98 ± 1.16	4.49 ± 1.04	4.99 ± 1.24
Pearl millet	15.4 ± 3.1	3.42 ± 1.63	6.35 ± 0.79	8.84 ± 1.49	3.32 ± 1.43	7.06 ± 1.13	5.74 ± 2.36

In intercropping systems, competition for light has been reported to have a larger influence than either moisture or nutrients (Dhillon *et al.* 1982, Maghembe & Redhead 1982) and dry matter production bears an almost linear relationship with the quantum of intercepted energy (Monteith 1977). Depletion of yield and growth invariably follow reduction in light (Connor 1983). In a study conducted by Srinivasan (1989), light transmission beneath canopy of 32-*mth*-old *E. tereticornis* was only 29% in the morning and 55% in the afternoon. The yield reduction sustained by the intercrops in the present study may be due to a reduction in light availability.

In intercropping systems involving trees and crops, it is assumed that trees, being deep rooted, will abstract water and nutrients from deeper profiles and will offer little, if any, competition in the upper susbtratum (Trenbath 1974). However, studies by Chandrasekariah (1987) and Srinivasan (1989) indicate that in many multipurpose trees including *E. tereticornis,* nearly two-thirds of the total root weight is confined to the top 30 *cm* soil profile. Therefore subterranean competition for water and nutrients cannot be discounted as less significant. The yield reduction sustained by the intercrops in the present study could be due to limitations of light, water and/or nutrients. Both sorghum and pearl millet are CO_4 plants; the lesser yield penalty associated with pearl millet may be because it is more drought tolerant and grows better under low fertility conditions.

Yield loss in the intercrops was smaller with coppiced shoots than with 2-y-old trees and pearl millet yield loss was smaller than that for sorghum or fodder grass.

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