

Woody perennials on and as bunds in Vertisols

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ABSTRACT

An experiment was conducted during 1991-96 to identify suitable tree species to plant on farm bund and also to screen tree species for live bund on Vertisols. Among 7 tree species planted on farm bund, the maximum plant height was found with subabul (*Leucaena leucocephala*) (7.60 m), followed by siris (*Albizzia lebbeck* Benth.) (7.01 m) and the least in anjan (*Hardwickia binata* Roxb.) (4.20 m). The grain yield of arable crop, viz. sorghum [*Sorghum bicolor* (L.) Moench] was highest (1,186 kg/ha) when it was grown with *Hardwickia binata* and minimum when it was grown with *Leucaena leucocephala* (425 kg/ha).

In another study (1992-95) screening of 6 different tree species for live bund was taken up. Among the different tree species, the maximum green-biomass yield was recorded in *Gliricidia maculata* (H.B. & K.) Steud. (45.64 q/ha) and the minimum in *Albizzia amara* Boiv. (9.69 q/ha). The grain yield of arable crop, viz. safflower (*Carthamus tinctorius* L.), was highest when safflower was grown with *Gliricidia* as live bund (7.66 q/ha) and the lowest with *Leucaena leucocephala* (3.87 q/ha).

Key words : Woody perennials, Bunds, Grain yield, Vertisol

Major soil types in Northern Dry Zone of Karnataka are Vertisols and constitute nearly 80% of the land in the Zone, with annual precipitation of 600 mm. The rainfall is highly erratic causing serious soil erosion, thereby affecting soil health adversely. The arable crops grown in this region cover the land generally for a season of about 3-4 months duration. The rainfall occurring during the uncropped period goes unutilized because of the absence of any crop or vegetation, often causing serious soil erosion. The continuous efforts of implementing soil and water conservations resulted in many methods of conservations and the contour bunds

are vastly used systems. This practice has resulted in wastage of about 6-8% of valuable land. Besides the high cost of constructing contour bunds, they are susceptible to frequent breaching due to swelling and shrinking of bunds in Vertisols (Gaddanakeri, 1991). These bunds can be efficiently brought under production by growing woody perennials on them. Therefore, it is appropriate to incorporate tree cultivation on existing contour bunds which will help to stabilize the bunds and the under-utilized bund area (6-8%) can be economically utilized. However, it is important to identify such woody perennials to grow on farm bunds, which will have least effect on

the companion field crops.

Another technology recommended for soil and water conservation in Vertisols is alley cropping with woody perennials. Alley cropping is an agroforestry practice in which arable crops are grown between managed perennial hedge rows spaced at regular intervals. The hedge rows are cut back at planting and kept pruned during cropping to reduce competition with crops. The popular woody perennial grown as hedge row is *Leucaena* in Vertisols of northern Karnataka. But due to devastating effects of psyllid bug (*Heteropsylla cubana*) the practice of alley cropping with *Leucaena* is losing its ground (Korwar, 1992). This has necessitated the identification of alternative woody perennials for alley cropping in Vertisols.

MATERIALS AND METHODS

A field experiment was conducted in medium black soils at Bijapur, during 1991–96 to evaluate the performance of 7 dryland tree species for their suitability to grow on farm bunds. The experiment was laid out in randomized block design with 3 replications. Six-month-old saplings of 7 tree species were planted on farm bunds with an intra-row spac-

ing of 3 m. The farm bunds were laid on the contour lines with the specified dimension for medium black soils (top width 0.6 m, basal width 3.3 m, height 0.68 m, side slope-horizontal : vertical ratio 2 : 1 cross section area 1.31 m²).

The sorghum crop was grown at 45-cm-row spacing and all the cultural practices were adopted as per recommended package of practices.

The observations on plant height, diameter at breast height, crown ratio and crown spread at the end of fifth year were recorded. The crown ratio is the ratio of crown length : total height of tree. The crown spread is the spread of branches in north-south and east-west direction with reference to the main stem of tree and it is expressed in m. The competition effect between tree crops and field crop was assessed by recording the border effect and yield of companion sorghum crop.

Another field experiment involving alley cropping with 6 different tree species and safflower was taken up in medium black soils at Bijapur for 1992, 1994 and 1995 under rainfed conditions. The experiment was laid out in randomized block design with 4 replications. The tree species which were used as

Table 1. Silvicultural characters of different woody perennial on farm bunds and their effect on yield of sorghum in Vertisols

Tree species	Plant height (m)	DBH (cm)	Canopy N-S (m)	Spread E-W (m)	Crown ratio	Sorghum grain yield (kg/ha)	Border effect (m)
<i>Acacia nilotica</i>	5.45	13.59	5.00	3.94	0.58	543	8.9
<i>Albizia lebbeck</i>	7.01	14.34	5.91	4.86	0.55	578	8.1
<i>Azadirachta indica</i>	5.71	08.99	3.50	4.24	0.58	621	7.8
<i>Cassia siamea</i>	5.45	07.78	3.38	3.27	0.54	766	6.7
<i>Dalbergia sissoo</i>	5.06	06.43	3.04	2.96	0.57	935	4.5
<i>Hardwickia binata</i>	4.20	05.22	1.51	1.37	0.49	1186	3.1
<i>Leucaena leucocephala</i>	7.60	12.63	5.85	4.95	0.58	425	7.1
CD (P = 0.05)	0.638	2.064	0.666	0.342	NS	11.6	1.88
CV	16.91	9.71	12.000	10.35	15.87	18.42	14.24

NS, Non-significant

Table 2. Performance of different woody perennials as live bund and their effect on yield of safflower in Vertisols

Species	Green-matter yield (q/ha)				Safflower yield (q/ha)			
	1992	1994	1995	Average	1992	1994	1995	Average
<i>Perennial pigeonpea</i>	21.10	14.34	15.78	17.07	6.63	4.48	5.20	5.43
<i>Desamanthus virgatus</i>	35.00	17.70	19.90	24.20	5.80	3.28	4.07	4.38
<i>Albizia amara</i>	9.60	9.60	9.87	9.69	9.68	5.98	7.38	7.57
<i>Gliricidia maculata</i>	37.50	52.80	46.64	45.64	8.88	6.71	7.38	7.66
<i>Leucaena leucocephala</i>	46.50	26.04	32.33	34.96	4.35	3.51	3.75	3.87
<i>Sesbania sesban</i>	32.50	13.51	16.79	20.93	5.28	5.95	5.22	5.48
CD (P = 0.05)	14.98	09.98	04.59		4.84	12.69	3.67	
CV	22.60	19.67	13.03		23.34	11.68	19.63	

NS, Non-significant

livebunds were planted in 2 rows with 30 cm distance between them and the distance between 2 live bunds was 30 m. The length of each live bund was 30 m. Safflower crop was raised between 2 live bunds during winter (*rabi*) season of every year. The crop was planted at a row spacing of 60 cm and all the recommended cultural practices were followed. The tree species were planted on 16 June 1991 and from second year onwards safflower crop was raised in the alleys of live bunds. After establishment of live bunds, 3 cuttings were made every year at an interval of 75–90 days. The observations of green-foilage yield of different alley crops and yield of safflower over 3 years were recorded. The competition effect between alley crops and field crop was assessed by recording yield of companion safflower crop. The rainfall received during the experiment was 438, 506 and 708 mm in 1992, 1994 and 1995 respectively compared with the 585 mm normal rainfall.

RESULTS AND DISCUSSION

The maximum plant height was recorded with *Leucaena leucocephala*, followed by *Albizia lebbeck* (Table 1). These 2 species were at par but significantly superior to other species, viz. *Azadirachta indica*, *Cassia siamea* and *Acacia nilotica*. The findings support the results of Itnal (1987). The lowest plant height was recorded in *Hardwickia binata*. The diversity in plant height may be partly due to genetic variation and partly due to chance factors favouring certain seedlings.

Albizia lebbeck had the highest dbh which was at par with that of *Acacia nilotica* and *Leucaena leucocephala*. The least dbh noticed in *Hardwickia binata*, which was at par with *Dalbergia sissoo*. Similar trend was reported by Devaranavadgi and Murthy (1995).

The crown canopy spread (NS) was high-

est in *Albizzia lebbeck*, followed by *Leucaena leucocephala*. The least canopy spread was recorded in *Hardwickia binata* 1.51 m (NS) and 1.37 m (EW).

The highest grain yield of sorghum was recorded in *Hardwickia binata*, followed by *Dalbergia sissoo* and the least in *Leucaena leucocephala*.

In agroforestry systems, the tree species should cause least effect on field crops with minimum competition for light, water and nutrients (Itmal 1987). The agroforestry wisdom prescribes the optimization of yields of tree and field crops for acceptability of new models. The present trend indicates that *Hardwickia binata* and *Dalbergia sissoo* are quite suitable for planting on farm bunds due to minimum border effect and highest *rabi* sorghum yield. The effect of woody perennials on field crops can be further minimized by root pruning and canopy management.

The green-fodder (green matter) yield of all the tree species differed significantly in all the 3 seasons (Table 2). On an average, *Gliricidia maculata* gave the highest green biomass yield, followed by *Leucaena leucocephala*. *Albizzia amara* gave the lowest green-matter yield among all the tree species. It indicates the fast-growing ability of *Gliricidia maculata* and *Leucaena leucocephala* under drought-prone areas when the soil moisture is a limiting factor.

Safflower seed yield also differed significantly in all the live bund tree species during the 3 years. During 1992, safflower yield was highest when *Albizzia amara* was used as live bund, whereas during 1994 and 1995, as well as on the average basis, safflower yield was higher where *Gliricidia maculata* tree species was used as live bund, followed by *Albizzia amara* live bund.

The yields of safflower were lower when *Desmanthus virigatus* and *Leucaena leucocephala* tree species were used as live bunds. This indicates that among 6 tree species, *Gliricidia maculata* can be used as live bund with least adverse effect on annual crop (safflower) and with higher green leaf manure. *Gliricidia maculata* was to be the most promising hedge row species in psyllid-infested area (IRDC, 1988). Further, alley cropping of *Gliricidia maculata* with other field crops could be tested with certain silvicultural manipulations like root pruning and canopy management.

REFERENCES

- Devaranavadi, S.B. and Murthy, B.G., 1995. *Advances in Agricultural Research in India* 4 : 73-77.
- Gaddanakeri, S.A. 1991. Ph.D. Thesis, University of Agricultural Sciences, Dharwad.
- IRDC. 1988. International Development Resource Centre. *Sustainable Agriculture News* 1, 2 : 1-12.
- Itmal, C.J. 1987. Ph.D. Thesis, University of Agricultural Sciences, Dharwad.
- Korwar, G.R. 1992. Ph.D. Thesis, University of Agricultural Sciences, Dharwad.