RESEARCH PAPER *International Journal of Agricultural Sciences,* January to June, 2010, Vol. 6 Issue 1 : 74-77

Investigation on different alley cropping systems in vertisols of northern dry zone of Karnataka

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ABSTRACT

An experiment was conducted during *Rabi* season on deep black soil at Regional Agricultural Research Station, Bijapur. The study indicated that, the observations on growth and yield parameters differed significantly due to hedge row species and *Rabi* sorghum varieties. Among the hedge row species, rubble check (control) recorded significantly higher grain and stover yield (1084 and 1450 kg ha^{-1}, respectively) followed by *G. sepium* (955 and 1333 kg ha^{-1}, respectively). The *Rabi* sorghum variety M 35-1 recorded significantly higher grain and stover yield (823 and 1220 kg ha^{-1}, respectively) as compared to DSV-4. The interaction effects were found to be significant. Combination of rubble check (control) with *Rabi* sorghum variety M 35-1 noticed significantly higher grain and stover yield (1109 and 1473 kg ha^{-1}, respectively) followed by rubble check with DSV-4 (1067 and 1424 kg ha^{-1}, respectively) which were at par with each other.

Key words : Alley cropping, Sorghum, Hedgerow, Coppicing, Rubble check.

INTRODUCTION

There are ten agro-climatic zones in Karnataka, out of which five are classified as dry zones. Northern dry zone is the largest of all the zones in the state of Karnataka and second largest zone in the country which occupies an area of 41.90 lakh hacters (Anonymous, 2000). Dryland ecosystems have become fragile because of low and erratic rainfall, improper soil and water conservation practices and lack of perennial vegetation. The practice of agriculture in such areas is causing foster degradation of land resulting in loss of fertility and productivity. The soils of this region are predominantly black (80%), containing montmorillonite clay and hence crack heavily on drying. Normally earthen bunds are constructed on the controls for effective soil and water conservation. But these bunds are not durable, occupies six to eight per cent of the area which is also not covered by any vegetation. Keeping these problems in mind an alternative land use system like leucaena based alley cropping or hedge row cropping was developed and recommended for practice in the region. In due course of time the emergence of psyllid bug (*Heterospylles cubana*) which caused devastation effect on leucaena productivity and heavy seeding of leucaena resulting in weed manure in the field. This necessitated the identification of alternate hedge row species for alley cropping in black soils to replace leucaena. Therefore, thrust has been laid on identifying alternate land use systems which are productive on sustainable basis

The hedge row species should have the ability for better coppicing even under adverse edaphic and climatic conditions to produce higher green biomass production. Besides, it should also produce more number of coppice shoots for effective soil and water conservation. It is also necessary that the hedge row species should have pinnate leaves so that it intercept less light and allows availability of more solar radiation to the associated field crop. Therefore, keeping in view of identifying alternative hedge row species to replace leucaena and appropriate *Rabi* sorghum variety compatible to the system were to be worked. In view of the above facts, the present investigations were undertaken to study the effect of different hedgerow species on associated *Rabi* sorghum varieties growth and yield attributes and biomass of hedgerow species in different alley cropping systems in Northern dry zone of Karnataka.

MATERIALS AND METHODS

The experiment was conducted at Regional Agricultural Research Station, Bijapur Farm of University of Agricultural Sciences, Dharwad, Karnataka state during *Rabi* season for two years. The soil of experimental site was deep black soil (vertisol), having pH 8.5 and EC 0.48 dS m^{-1}, 120 kg ha^{-1} available Nitrogen, 8.5 kg ha^{-1} available P2O5, 570 kg ha^{-1} available K2O and 0.60% organic carbon. The experiment was laid out in a split plot design with four replications. The fourteen treatment combinations comprised seven hedgerow tree/ shrub species *viz.*, H_1: *Leucaena leucocephala,* H_2: *Gliricidia sepium,* H_3: *Cassia saimea,* H_4: *Albizia lebbeck,* H_5: *Desmenthus virigatus,* H_6: *Dalbergia sissoo* and H_7: Control (rubble check) in main plots and

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two *Rabi* sorghum varieties *viz.*, V_1: DSV-4 and V_2: M 35-1 in sub plots. The paired (60 cm) hedgerows were spaced at 30 cm apart on contour lines and were regularly pruned to a height of 15 cm above ground level till initiation of this experiment. *Rabi* sorghum cultivars were sown with a spacing of 65 cm x 15 cm. All agronomic practices were carried out as per scheduled to raise the crop. Growth parameters such as plant height and number of leaves per plant were measured at every 30 days interval. Yield parameters *viz.*, grain weight per plant, 1000 grain weight and grain and stover yield were measured after the harvest of crop. The observations were taken for two years and the mean/pooled analysis was taken for interpreting results. Data was subjected to statistical analysis to draw the valid conclusion (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

Growth attributes :

The growth attributes like plant height and number of green leaves at harvest of *Rabi* sorghum were significantly influences by different hedge row species and *Rabi* sorghum varieties (Table 1).

The plant height of *Rabi* sorghum was differed significantly by different hedge row species. The maximum plant height was recorded in case of control (174.15 cm) followed by *G. sepium* (172.26 cm). The lowest plant height was recorded in case of *L. leucocephala* (154.74 cm). The plant height differed significantly due to *Rabi* sorghum genotypes. The higher plant height was produced by M 35-1 (166.75 cm) as compared to DSV-4 (156.18 cm). The treatment combinations showed significant differences. The sorghum plant height was maximum in case of *G. sepium* with M 35-1 (184.23 cm) followed by control with M 35-1 (175.38 cm) and DSV-4 (173.19 cm) and were at par with each other. The minimum values were produced by *L. leucocephala* with DSV-4 (148.52 cm).

The number of green leaves at harvest followed the same trend as that of 90 DAS. The maximum number of green leaves was noticed in case of control (4.74) closely followed by *G. sepium* (4.55) which were at par. The minimum number of green leaves was recorded by *A. lebbeck* (3.04). The *Rabi* sorghum varieties did not show significant difference. However, among the treatment combinations, the maximum number of green leaves were produced by *G. sepium* with M 35-1 (4.72) closely followed by control with M 35-1 (4.57) which were at par with each other. The minimum was recorded in case of *A. lebbeck* with DSV-4 (2.85). The similar observation on growth parameters was made by Gaddanakeri (1991).

Table 1 : Growth and yield attributes of *Rabi* sorghum as influenced by different hedge row species and sorghum varieties (mean data of two years)

Treatments	Plant height at harvest (cm)	No. of green leaves at harvest	Grain weight $plant^{-1}$ (g)	1000 grain weight (g)
Hedge row species (H)				
H_1 – *Leucaena leucocephala*	154.74	3.35	17.42	24.05
H_2 - *Gliricidia sepium*	172.26	4.55	21.34	26.44
H_3 - *Cassia saimea*	160.80	4.01	18.45	24.32
H_4 - *Albizia lebbeck*	155.73	3.04	15.53	22.75
H_5 - *Desmanthus virigatus*	165.35	3.57	18.72	25.38
H_6 - *Dalbergia sissoo*	157.93	3.80	15.69	22.53
H_7 - Control (Rubble check)	174.15	4.74	23.09	27.03
S.E. ±	6.12	0.26	0.36	0.40
C. D. (P=0.05)	12.33	0.54	0.80	0.98
Varieties (V)				
V_1 - DSV-4	156.18	3.57	17.43	23.81
V_2 - M 35-1	166.75	3.80	18.29	24.67
S.E. ±	1.68	0.14	0.28	0.15
C. D. (P=0.05)	4.10	NS	0.64	0.36
Interaction				
$H_1 V_1$	148.52	3.27	16.94	23.63
$H_1 V_2$	161.65	3.43	17.95	24.46
$H_2 V_1$	164.85	4.28	20.70	25.95
H_2V_2	184.23	4.72	21.98	26.93
H_3V_1	157.80	3.96	18.28	24.04
$H_3 V_2$	167.34	4.07	18.63	24.59
$H_4 V_1$	154.69	2.85	15.35	22.32
$H_4 V_2$	157.73	3.13	15.72	23.17
$H_5 V_1$	161.77	3.53	18.13	25.15
$H_5 V_2$	167.16	3.62	19.32	25.60
$H_6 V_1$	150.05	3.57	15.26	21.80
$H_6 V_2$	160.86	3.89	16.13	23.25
$H_7 V_1$	173.19	4.30	21.65	25.80
$H_7 V_2$	175.38	4.57	23.00	26.48
S.E. ±	4.96	0.31	0.31	0.36
C. D. (P=0.05)	11.85	0.64	0.69	0.80
C.V.%	15.80	15.92	14.20	12.20

NS-Non significant

Yield attributes :

The yield attributes like grain weight per plant and 1000 grain weight of *Rabi* sorghum differed significantly due to different hedge row species and *Rabi* sorghum varieties (Table 1).

Among the different hedge row species, maximum grain weight per plant was recorded in case of control (23.09 g) which was significantly superior over all treatments followed by *G. sepium* (21.34 g). Whereas *A. lebbeck* (15.53 g) recorded significantly lowest value. The grain weight of M 35-1 (18.29 g) was significantly superior to DSV-4 (17.43 g). Among all the treatment combinations significantly highest grain weight per plant was produced by control with M 35-1 (23.00 g) followed by *G. sepium* with M 35-1 (21.98 g) which were at par. The lowest value was noticed in case of *D. sissoo* with DSV-4 (15.26 g).

The rubble check (control) produced significantly higher 1000 grain weight (27.03 g) closely followed by *G. sepium* (26.44 g) which were at par with each other. Whereas lower 1000 grain weight was noticed with *D. sissoo* (22.53 g). Significantly superior 1000 grain weight was produced by sorghum genotype M 35-1 (24.67g) compared to DSV-4 (23.81 g). Among the treatment combinations, the 1000 grain weight was significantly superior in case of *G. sepium* with M 35-1 (26.93 g) closely followed by control with M 35-1 (26.48 g) which were at par with each other. The lowest value was recorded by *D. sissoo* with DSV-4 (21.80g).

Grain and stover yield :

The grain and stover yield of *Rabi* sorghum was influenced by different hedge row species and characters of *Rabi* sorghum varieties (Table 2) Among the different hedge row species tested, rubble check (control) recorded significantly higher grain and stover yield of *Rabi* sorghum (1084 and 1450 kg ha^{-1}, respectively) followed by *G. sepium* (955 and 1333 kg ha^{-1}, respectively). The lowest was noticed with *D. sissoo* (604 and 1016 kg ha^{-1}, respectively). Between the *Rabi* sorghum varieties, M 35-1 was found significantly higher grain and stover yield (823 and 1220 kg ha^{-1}, respectively) over DSV-4 (746 and 1135 kg ha^{-1}, respectively). Among the different treatment combinations significantly higher grain and stover yield were produced by control with M 35-1 (1109 and 1473 kg ha^{-1}, respectively) and DSV-4 (1067 and 1424 kg ha^{-1}, respectively) followed by *G. sepium* with M 35-1 (999 and 1352 kg ha^{-1}, respectively) and DSV-4 (939 and 1309 kg ha^{-1}, respectively) which were at par with each other. The lowest value was produced by *D. sissoo* with DSV-4 (593 and 1007 kg ha^{-1}, respectively). The higher grain and stover yield of *Rabi* sorghum was recorded with G. sepium as compared to other hedge row

Table 2 : Yields of *Rabi* sorghum and biomass of different hedgerow species as influenced by *Rabi* sorghum and *Rabi* sorghum varieties (mean data of two years)

Treatments	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Leaf biomass (kg ha^{-1})	Woody biomass (kg ha^{-1})
Hedge row species (H)				
H_1 - *Leucaena leucocephala*	645	1032	1671	1166
H_2 - *Gliricidia sepium*	955	1333	2118	1699
H_3 - *Cassia saimea*	687	1100	1211	879
H_4 - *Albizia lebbeck*	630	1034	890	789
H_5 - *Desmanthus virigatus*	867	1246	1149	609
H_6 - *Dalbergia sissoo*	604	1016	977	722
H_7 - Control (Rubble check)	1084	1450	-	-
S.E. $\pm$	34.83	49.86	56.18	53.40
C.D. (P=0.05)	83.20	109.58	116.32	106.24
Varieties (V)				
V_1 - DSV-4	746	1135	1603	1079
V_2 - M 35-1	823	1220	1482	971
S.E. $\pm$	33.48	36.12	45.40	44.10
C.D. (P=0.05)	52.16	72.52	109.6	92.32
Interaction				
$H_1 V_1$	634	1013	1531	1241
$H_1 V_2$	667	1051	1482	1091
$H_2 V_1$	939	1309	2118	1953
H_2V_2	999	1352	2039	1717
H_3V_1	670	1084	1100	842
$H_3 V_2$	698	1126	1149	740
$H_4 V_1$	605	1010	919	875
$H_4 V_2$	648	1056	975	795
$H_5 V_1$	854	1225	1104	674
$H_5 V_2$	889	1270	1117	597
$H_6 V_1$	593	1007	807	603
$H_6 V_2$	628	1041	818	530
$H_7 V_1$	1067	1424	-	-
$H_7 V_2$	1109	1473	-	-
S.E. $\pm$	61.84	89.4	78.4	72.3
C.D. (P=0.05)	138.4	187.8	185.32	151.4
C.V.%	15.63	14.80	15.20	14.60

species. This was might be due to gliricidia had an erect growth habit and thick live bund with more number of coppice shoots per plant. This has facilitated better soil moisture conservation as well as higher light transmission at all the stages of crop growth resulted higher growth component of *Rabi* sorghum like plant height and green leaves per plant. Ultimately, these components have contributed toward higher grain and stover yield production of sorghum by gliricidia hedge row in alley cropping system. These results are in confirmity with the findings of Kalaghatagi *et al.* (1998). Under similar situations, Itnal (1987) at Bijapur, Rao *et al.* (1991) at Hyderabad have observed that growth component of sorghum were influenced by the hedge row crop and these in turn influenced the stover yield. The findings of Shrivastav and Ram Mohan Rao (1989) revealed that the branching habit of hedge row leucaena caused a reduction of 28 per cent in *Rabi* sorghum yields, suggesting the use of erect growing type of hedge row species to minimize competition for light.

Biomass of hedge row species :

During both the years, the hedge row species exhibited similar trends in terms of biomass production (Table 2).

The leaf, woody and total biomass production was highest in case of *G. sepium* (2118, 1699 and 3817 kg ha^{-1}, respectively) followed by *L. leucocephala* (1671, 1166 and 2837 kg ha^{-1}, respectively). The lowest production was recorded with *A. lebbeck* (890, 789 and 1679 kg ha^{-1}, respectively). The *Rabi* sorghum genotypes significantly influenced on leaf, woody and total biomass yield. The DSV-4 recorded higher leaf, woody and total biomass (1603, 1079 and 2682 kg ha^{-1}, respectively) as compared to M 35-1 (1482, 971 and 2453 kg ha^{-1}, respectively). Among all the treatment combinations *G. sepium* with DSV-4 produced significantly higher leaf, woody and total biomass (2118, 1953 and 4071 ha^{-1}, respectively) followed by *G. sepium* with M 35-1 (2039, 1717 and 3756 ha^{-1}, respectively) which were at par with each other. The lowest value was recorded by *D. sissoo* with DSV-4 and M 35-1. The superiority in green biomass production of gliricidia mainly attributed to its better coppicing ability, vigorous growth and its genetic potential. The studies conducted at Bijapur by Kalaghatagi *et al.* (1998) recorded higher green biomass yield of gliricidia, in gliricidia + safflower hedge row cropping system. Similarly, Haggar and Beer (1993) have found higher green biomass production by gliricidia in gliricidia + maize alley cropping system.

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Received : June, 2009; Accepted : August, 2009