Life Science Informatics Publications

Research Journal of Life Sciences, Bioinformatics, Pharmaceutical and Chemical Sciences

Journal Home page http://www.rjlbpcs.com/

RJLBPCS

ISSN 2454-6348

Original Research Article **DOI - 10.26479/2016.0204.16**

INTERCROPPING LEGUMINOUS CROP PLANT WITH NON-LEGUMES

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ABSTRACT: In the current study Intercropping leguminous crop plant with non-legumes in order to achieve higher productivity from leguminous and / or non – leguminous crop plants various cultivation practices are used in agriculture which include crop rotation, mixed cropping and intercropping, proper soil and water management, weed control, used of manures and chemical fertilizer etc. out of these techniques, intercropping is considered as an age-old traditional cropping system. Cultivation of two or more crop plants simultaneously on the same piece of land in rows is called as intercropping However, when the two or more crops are simultaneously grown without any row arrangement, it is known as mixed cropping. This leads to the production of foliage with high nitrate content which is unfit for animal nutrition. Therefore, judicious use of fertilizer nitrogen has to be made to prevent deterioration of soil as well as to produce nutritious fodder free from nitrates.

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1.INTRODUCTION

In the earlier days intercropping was considered as a primitive practice but Howard (1916) critically studied the cultivation gram along with wheat in India and indicated an advantage in doing so for sustainable yield. Subsequently (Aiyer, 1949; Norman, 1974; and Jodha, 1979) confirmed that improved stability in the yield can be obtained due to intercropping, which is followed in many developing countries.During cultivation of two crops in an intercropping system, legume and non-legume combination is often used. When these crops grow simultaneously there is better use of growth resources as the two component crops complement each other. This results into greater nutrient uptake (Patel et al., 1968; Dalal, 1974, Nataraj and willey, 1980). Lipman (1913) pointed out that soluble nitrogenous compounds secreted by the legumes are utilized by adjoining non-legume

crops. In addition, intercropping reduces the pressure of weeds to the extent of 50 to 75% (Bentilan and Harwood, 1973; Rao and Shetty, 1977).Other cause work on intercropping was initiated in this Deparment by Kasture, (1982) to attain maximum fodder productivity. She cultivated Sorghum and cowpea either in sole or in intercropping systems with various proportions and measured the yields of dry matter and crude protein from them (Kasture and Mungikar, 1981). It was observed that cultivation of Sorghum with cowpea gives more dry matter and protein yiels than their monocultures. Kasture and Mungikar, (1984) pointed out that cultivation of Sorghum with cowpea or Dolichos, and maize with cowpea or Dolichos was also beneficial in giving higher dry matter and protein productivity. Intercropping of maize with cowpea with various proportion, when cultivated during the summer of 1981 and 1982 in 1:1 proportion, was however, not beneficial (Kasture and Mungikar,1985). It was also pointed out that intercropping of maze with coepea in summer had no effect on the chemical composition of foliage. It is thus felt that the success in an itercropping system is governed by the season. Reddy and Mungikar (1985-86) observed little response due to fertilizer application to maize +cowpea intercropping system. Thus, the use of fertilizer in an intercropping system should be made critically (Reddy and Mugikar,1985-86). Studies on intercropping of two perennial fodder crops i.e. ucerne and hybrid Nipier grass was undertaken by Dakore and Mungikar (1986). The result indicated that the two crops can natural resource more efficiently if they are cultivated simultaneously in association with each other, resulting in increased biomass productivity. A field trial with sorghum and cowpea intercropping system with two row directions, E – W and N – S, did not increased productivity of intercropping system (Kasture and Mungikar, 1987a).The intercropping system of Sorghum with cowpea and Sorghum with Dolichos showd higher yield than the Sorghum sole cropping (Kasturi et al., 1987). An intercropping system with 3 rows of maize alternating with 3 rows of cowpea was found benificia (Dakore and Mungikar,1988). Mungikar (1988) showd that an intercropping system makes better use of light energy resulting in higher total productivity. Basole and Mungikar (1996) showed advantages of either maize or Sorghum with cowpea. Bhuktar and Mungikar (1999) studied competition between cowpea and Sorghum when cultivated together. Bhukta (1999) gave an account on intercropping of fodder crops. Bhuktar and Mungikar (1998-1999) reveled competitive relationship between bajra and cowpea. The land resource can be used on better way due to intercropping (Bhuktar and Mungikar, 2000). Performing of maize improved due to its association with cowpea (Bhuktar and Mungikar, 2001).The result obtained in this laboratory by earlier works tempted the author to undertake studies on intercropping to observe and advantages in doing so. For this purpose, four field trials were undertaken on the farm located at the Botanical garden. The main objective was to evaluate the performance of various fodder crops under sole and intercropping system. The result is presented on following pages in the form of tables, illustrations and the discussion.

2. MATERIALS AND METHODS

Agronomy

All field trial was conducted on the research farm Dr. Babasaheb Ambedkar Maathwada University Botanical garden during August 2005 to February 2007. The land was prepared by ploughings and cross ploughings. It was then made good for sowing by applying Farm Yard Manure (FYM) at a rate of 1200 kg/ha to undertake agronomic trials. A piece of land was divided into 18 plots of equal size, each bearing an area of 9.03 m^2. The sowing is done by hand, either by broadcasting the seed and / or by drilling them in rows spaced 30.5 cm apart. Table 1 gives data on the crops taken during the four field experiments along with sowing and harvesting dates, duration of the crops and net size of the plots harvested. Since the crops were to be harvested for vegetative phase of growth slightly higher seeds rates were used to get abundant foliage. A minimum use of fertilizer was made, while in some experiments fertilizer were not at all used. The two fertilizer i.e. N and P_2O_5 were applied through urea and single superphosphate respectively. The fertilizers were applied in one or two equal doses at an interval of 30 to 40 days. All crops were raised under irrigation and whenever necessary weeding was done by hand. As far as possible the use of insecticides and pesticides was avoided, except during field trials undertaken in monsoon when the insecticides were spread to control aphids and mites.

Field techniques

Total four field trails were conducted for experimental purpose. The treatments offered for all experiments were replicated three times in randomized block design (Table 1)*Sorghum (Sorghum bicolar* (L.) Moench) and *Dolichos (Lablab niger* Medicus syn. *Dolichos lablab* L.) were selected for experimental I undertaken during August to October 2005. The two crops were cultivated as sole crops and in addition, there were four intercropping patterns wherein the two component crops were sown in rows with either 2:1, 1:1 and 1:2 proportion with alternate one or two rows of each. In the fourth cropping pattern was mixed cropping, wherein a mixture of *Sorghum* + *Dolichos* seeds in equal proportion was sown by broadcasting without any row arrangement. *Sorghum* and *Dolichos* were sown at the seed rate of 50 and 90 kg/ha respectively. The intercropping pattern is illustrated in Fig. 1. The sowing was done on August 26, 2005 and the crop was harvested for green foliage on October 13, 2005 i.e. 49 days after sowing.*Sorghum* (*Sorghum bicolar* (L.) monench) and cowpea (*Vigna unguiculata* (L.) Walp subsp. *Cylindric* (L.) Eseltine) in the place of *Dolichos* were selected for experiment II undertaken during December 2006 to February 2007. These two crops were cultivated as sole crops and in addition *Sorghum* + cowpea were cultivated in intercropping systems. The two component crops were sown in rows with either 2:1, 1:1 and 1:2 proportions with alternate one or two rows of each crop along with mixed cropping pattern. The *Sorghum* and Cowpea were sown at the seed rate of 50 to 60 kg/ha respectively. The cropping pattern is illustrated in fig. 1. The sowing was done on December 14, 2006 while the green foliage was harvested on February 23, 2007 i.e. 72

days after sowing.Maize (*Zey mays* L.) was taken in place of *Sorghum* along with *Dolichos (Lablab niiger* Medicus syn. *Dolichos lablab* L.) for experiment III. The two crops were cultivated under sole cropping systems, using the seed rates as in experiment I. the intercropping system contained simultaneous cultivation of these two component crops in rows with 2:1, 1:1 and 1:2 proportions. Maize and *Dolichos* mixed cropping system was also undertaken. A seed rate of 80 kg/ha was employed for maize while it was 90 kg/ha for *Dolichos*. The sowing was done on November 16, 2005 and the crops was harvested on January 24, 2006 i.e. 70 days after sowing.

Experiment IV was undertaken with maize and cowpea wherein the crops were cultivated under either sole, mixed or intercropping systems (2:1, 1:1, and 1:2) as mentioned in earlier experiments. The two crops were sown with a seed rates of 80 kg/ha for maize and 60 kg/ha for cowpea. The duration of the crop was 63 days i.e. from February 9, 2006 to April 12, 2006.

Growth of the plants

At the age of 45 day for experiment I and 60 days for other experiments five plants of each crop from the plots were randomly selected. Height of each plant was measured and the number of leaves were counted. Chlorophy II content in randomly selected leaves was estimated following Arnon (1949) as described by Sadasivan and Manickam (1972). In case of *Dolichos* and cowpea the plants were uprooted carefully. The roots were washed and number of nitrogen fixing nodules were Growth of the plants. At the age of 45 day for experiment I and 60 days for other experiments five plants of each crop from the plots were randomly selected. Height of each plant was measured and the number of leaves were counted. Chlorophy II content in randomly selected leaves was estimated following Arnon (1949) as described by Sadasivan and Manickam (1972). In case of Dolichos and cowpea the plants were uprooted carefully. The roots were washed and number of nitrogen fixing nodules were counted. Fresh weight of individual plants were taken. The plants were then chopped into pieces and dried in oven at 95C to determine dry weight per plant.

Sampling and analysis

The green foliage was harvested normally at the preflowering stage. Maize, cultivated during experiment III and IV was harvested few days after flowering. The harvesting of the crop for fodder was usually done early in the morning with a steel cutter. Fresh fodder yield obtained per plot under sole and intercropping systems was recorded. The samples of green fodder were immediately brought into the laboratory, chopped into 2-3 pieces, dried in over at 95 till constant weight, dry matter (DM) content was determined and dry samples were used for analysis.

Calculations

The yield of green fodder and dry matter (DM) were calculated from the weight of the foliage per unit area of ground and its dry matter (DM) content. Land equivalent ratio (LER) was worked out by determining the ratio of yield of an individual crop in a mixture to its yield in a sole crop (Motha and De, 1980).

$$LER = \frac{\text{Yield of the crop in intercropping system}}{\text{Yield of the crop in sole cropping system}}$$

Total LER was expressed by adding the fractions obtained for two component crops in a mixture. Data for the yields were analyzed by standard statistical methods of "Analysis of variance" and the critical difference (C.D.) was calculated following Panse and Sukhatme (1978), and Mungikar, (1997 and 2003).

3. RESULTS AND DISCUSSION

Experiment – I

Crop*: Sorghum* and *Dolichos*

Time Duration (August 26, 2005 to October 13, 2005)

During present field trial HY. SSG – Heera variety of *Sorghum* and local variety of *Dolichos* were cultivated in sole and intercropping systems with various proportions as shown in table 1. In sole and intercropping system both the crops grew well with suitable canopy structure. The performance of these two crops in both cropping systems is given in table 2. When cultivated alone, the plants of *Sorghum* were 67 cm tall. The height of the plant remains unchanged in all intercropping systems except when *Sorghum* and *Dolichos* were cultivated in 2:1 ratio, when the height of the *Sorghum* significantly increased to 74 cm. height of the *Dolichos* plant was 58 cm in sole cropping system which increased to 90 cm when one row of *Sorghum* was alternating with two rows of *Dolichos.* The number of leaves per *Sorghum* plant were six and they remained constant in all cropping systems, while there were 10 to 12 leaves per plant of *Dolichos.* The number of nodules per *Dolichos* plant were seven when it was grown alone, which increased to nine due to its association with *Sorghum.* The fresh weight of *Sorghum* plant significantly increased from 4.83 g to 11.42 g due to its association with *Dolichos* were observed due to intercropping and it ranged from 10.43 to 12.71 g. Similar trend was observed with dry weight of the two plants. Significant increase in dry weight of plant was reported in both the crops when they were growing in association with each other.

Table 3 gives an account on chlorophyll content in the leaves of *Sorghum* and *Dolichos* cultivated in either sole or in intercropping systems. The chlorophyll content in both the crops remained unaffected due to cropping pattern however the plant of *Dolichos* showed significant increase in chlorophyll content when it was growing in association with *Sorghum* in 1:2 ratio (Fig.2). The yields of green fodder and dry matter from these two crops are presented in table 4. When cultivated alone, *Sorghum* yielded 5337 kg/ha green fodder and 747 kg/ha dry matter. The values for *Dolichos* were 3371 kg/ha and 539kg/ha respectively for green fodder and dry matter yields. On the basis of total green fodder and dry matter yields obtained in various intercropping combinations, cultivation of *Sorghum* and *Dolichos* in 2:1 ratio was found suitable in giving sustainable yield (Fig.3). this was also indicated by the value of total LER, 1.07 for green fodder are 1.01 for dry matter. All other intercropping combinations failed to give yield advantage as indicated by the values of LER which were less than 1.0. Earlier experiments undertaken in this laboratory by Kasture (1982), Kasture *et al.,* (986, 1987), Kasture and Mungikar (1984), Dakore (1985) and Bhuktar and Mungkiar (1998) showed yield advantage, due to the cultivation of these two crops in intercropping system, however, during present investigation it was not experienced, probably due to unfavourable condition for their growth.

Experiment – II

Crop : *Sorghum* and cowpea

Time of cultivation : (December 14, 2006 to February 23, 2007.)

In the present experiment HY.SSG variety of *Sorghum* and konkankanya variety of cowpea were cultivated were cultivated in sole as well as intercropping systems with various proportions or shown in table 1. In sole and intercropping systems both crops grew well with suitable canopy structure. The performance of these two crops in sole and intercropping systems is given in table 5. When the plants of *Sorghum* was cultivated alone, the height was 154 cm. the height of the plant remained unchanged in all other intercropping systems, except when *Sorghum* and cowpea were cultivated in 1:1 ratio in rows and on these plots the height of the *Sorghum* plant significantly increased to 161 cm. a significant decrease in height of *Sorghum* plant to 145 cm was observed in an intercropping system with 2:1 proportion. The height of cowpea plant was 40 cm in sole cropping system, which significance increased to 46 cm when one row of *Sorghum* was alternating with tow rows of cowpea. The height was least (36 cm) in mixed cropping system.

The number of leaves per *Sorghum* plant ranged from 7 to 9 in all intercropping systems

except when *sorghum* and cowpea were cultivated in 1:1 ratio wherein the number of leaves significantly increased to 9. The number of nodules per *cowpea* plant were 14 when it was grown alone, which increased to 15 due to its association with *Sorghum.* The fresh weight of sorghum plant was 5.43 g when it was grown alone, but in all intercropping systems it significantly increased within the limits of 7.67 to 10.70 g due to the association with cowpea. Reverse was the case with cowpea wherein fresh weight of the plant was 32.83 g when it was grown alone, however, it decreased in all intercropping systems except when *Sorghum* and cowpea were cultivated in 1:2 proportion, where the weight of cowpea plant significantly increased to 33.25 g. The dry weight of *Sorghum* plant was 0.79 g in sole cropping system which increased significantly within the range of 1.70 to 2.10 g in all intercropping combinations except in the intercropping system with 2:1 proportion where the weight decreased to 1.34 g. in case of cowpea, dry weight of the plant was 4.10 g when it was grown alone. On the other hand, all cropping patterns showed decrease in dry weight except when *Sorghum* and cowpea were cultivated in 1:2 propotion where the dry weight of cowpea plant signficiantly increased to 4.82 g. Table 6 gives information on chlorophyll content in the leaves of *Sorghum* and cowpea cultivated in either sole or intercropping systems. The chlorophyll content in both the crops remained unaffected due to cropping pattern however, in both cases significant increase in chlorophyll content was noticed when they were growing in association with each other in 1:1 proportion. The data on chlorophyll content is also represented in fig 4. Table 7 represent an account of yield of green fodder and dry matter yields from these two crops. The yield of green fodder from *Sorghum* was 20013 kg/ha and dry matter 2922 kg/ha, when 2922 kg/ha, when cultivated alone. The values for cowpea were 6599 kg/ha for green fodder and dry matter yields respectively. On the basis of total green fodder and dry yields obtained in various intercropping combinations, cultivation of *Sorghum* and cowpea in rows with 1:1 proportion was beneficial for yield advantage, while 2:1 ratio gave yield benefit for only dry matter (Fig. 5). Cultivation of *Sorghum* and cowpea in 1:2 proportion failed to give yield advantage as indicated by the value of total LER 0.9 for green fodder and 0.86 for dry matter.

Experiment - III

Crop : Maize and *Dolichos.*

Time of cultivation (November 16, 2005 to January 24, 2006)

During present experiment, two crops i.e. Maize (African tall) and *Dolichos* (Konkan Bhushan) were cultivated. The treatments offered for this field trials were same as those in the previous experiment (table 1). In sosle and intercropping systems both the crops grew better with favorable canopy

structure. The performance of these two crops is given in tale 8. When the plants of maize were cultivated alone, the height of the plant was 97 cm,, which increased significantly due to the cultivation in 1:1 and 1:2 proportion, i.e 117 cm and 110 cm respectively. The height of cowpea was 37 cm in sole cropping system. It remained unchanged in all intercropping systems except when maize and *Dolichos* were cultivated in 1:1 ratio where the height of the *Dolichos* significantly increased to 41 cm. The number of leaves per maize plant were 8 in sole cropping pattern, which significantly increased in all intercropping patterns. However, in case of *Dolichos* decrease in number of leaves was experience due to its cultivation with maize (table 8). The number of nodules per *Dolichos* plant were 6 in sole cropping system in which decreased significant in all intercropping system except when maize and *Dolichos* were cultivated in 1:1 porportion in rows wherein he nmber of nodules increase significantly upto 7.He frshweight of maize plant was 89.33g when I was grown alone. In all intercropping system it significantly increased within the range of 95.30 to133.87g except when maize and *Dolichos* were cultivated in 1:1 ratio where intercropping system the crop grew with favourable canopy structure. The performance of these two crop is given in table 11, when the plant of maize were cultivated alone, the height of plant was70.53 cm which decreased significantly in all intercropping combinations. The height of cowpea plant was 23.60 cm in sole cropping system, which increased significantly in 2:1 and1:1 propertion i.e. 56.93 cm and 46.8. cm respectively. The number of leaves per maize plant were 7.47 in sole cropping system. The number of leaves remained unchanged in all intercropping system. In cowpea the number of leaves per plant were 9.13 which increased significantly in all intercropping pattern. Number of nodules per cowpea plant were 10.66 in sole cropping system which decreased significantly in all intercropping pattern. Table 12 represent an account of yield of green fodder and dry matter from these two crops. The yield of green fodder of maize was 81488 kg/ha and dry matter 1304 kg/ ha when cultivated alone. The value of cowpea where 5459 kg/ha and 983 kg /ha respectively for green fodder and dry matter yield (fig.8). On the basis of total green fodder and dry matter yield obtained in various intercropping system, cultivated of maize yield obtained in various intercropping system, cultivated of maize and cowpea in 1:2 gives yield advantage as was indicated by the value of total LER; 1.04 for green fodder and 1.03 for dry matter. The remaining combition failed to give yield advantage.

4. CONCLUSION

Fodder crop play an important role in livestock management. Regular feeding of farm and diary animals with required quantity of fresh green, nutritious fodder is essential for their better growth and performance. Several fodder crops are found suitable for cultivation and use in animal nutrition in this region. These includes non-leguminous crops viz., *Sorghum,* maize, bajara, oat, hybrid Napier grass while leguminous species viz., Lucerne, mung, cowpea *Dolichos* etc. earlier research work on agronomic aspects of these crops indicated that they can be grown successfully in Marathwada region

to provide nutritious green fodder round the year.In order to increase the productivity of green fodder per unit land area, the use of fertilizer nitrogen has been widely advocated. Application of fertilizer nitrogen enhance vegetative growth of the plant and produce large proportion of green fodder, which is soft, lush, palatable and rich in crude protein content. However, there are some limitations in using fertilizer nitrogen for increased productivity. Continuous use of fertilizer nitrogen may damage soil character including soil microflora and this results into reduction in soil sustainability. In addition, it has been observed that in subtropical country like India where excessive use of fertilizer nitrogen is employed, the nitrogen in the form of nitrate gets accumulated in the leaves for the want of subsequent assimilation in organic molecules. This leads to the production of foliage with high nitrate content which is unfit for animal nutrition. Therefore, judicious use of fertilizer nitrogen has to be made to prevent deterioration of soil as well as to produce nutritious fodder free from nitrates.An age old alternative to raise the crops and obtained maximum foliage from them with limited use of nitrogen fertilizer is intercropping.During this cropping system, a leguminous crop is cultivated in association with a non-leguminous component. When both the crops grow together, they complement each other in spite of competition for space, water or nutritive value. It has been proved by earlier research workers from this laboratory that intercropping of leguminous crop plants with cereals results into yield advantage. Taking in this view, four field experiments were undertaken during present investigations to confirm the results obtained by earlier workers.During this field trails either maize of *Sorghum* was cultivated with either cowpea or *Dolichos* in intercropping systems with various proportions. The results obtained on growth performance and productivity of such intercropping combinations though revealed favourable interaction, the yield advantage was not achieved except when maize and *Dolichos* cultivated together (Figs. I, II). The failure in obtaining yield advantage during present investigation may be due to the unfavourable environmental conditions or seasons.

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Table 1: Details of the agronomic practice undertaken for intercropping

Experiment	Sole Cropping / inter Cropping system	Date of sowing	Date of Harvesting	Duration of the Crop (days)	Net size if the plot harvested (m^2)
I	Sole Cropping Sorghum+Dolichos Intercropping Sorghum+Dolichos 2:1, 1:1B, 1:1R,1:2	Aug. 26, 2005	Oct. 13, 2005	49	9.3
II	Sole Cropping Sorghum+Cowpea Intercropping Sorghum+Cowpea 2:1, 1:1B, 1:1R,1:2	Dec. 14, 2016	Feb. 23, 2007	72	9.3
III	Sole Cropping Maize + Dolichos Intercropping Maize + Dolichos 2:1, 1:1B, 1:1R,1:2	Nov. 16, 2005	Jan. 24, 2006	70	9.3
IV	Sole Cropping Maize +Cowpea	Feb. 9, 2003	Apr. 12, 2006	63	9.3

Table 2 : Performance of Sorghum and Dolichos in sole and intercropping systems

Crop	Cropping system	Height of Plant (cm)	Number of leaves/plant	Number of nodules/ plant	Fresh wt./ plant (g)	Dry wt./ plant (g)
Sorghum (S)	Sole	67	6	-	4.83	0.99
S:D	2:1	74*	6	-	7.09	1.39
	B - 1:1	67	6	-	6.04	0.95
	R- 1:1	66	6	-	11.42	1.77*
	1:2	66	6	-	8.26	1.58*
Dolichos (D)	Sole	58	11	7	10.43	2.12
S:D	2:1	58	10	3	10.66	2.33
	B – 1:1	60	10	9	12.69	2.62
	R – 1:1	73	11	9	10.39	2.36
	1:2	90*	12*	5	12.71	3.21*

*- Significant at P = 0.05

Table 3: chlorophyll content (mg/g fresh leaf) in Sorghum and Dolichos cultivated in sole and intercropping system

Crop	**Cropping System**	**Chl-a**	**Chl-b**	**Total chlorophyll**
Sorghum (S)	Sole	0.53	0.29	0.82
S+D	2:1	0.34	0.17	0.51
	B – 1:1	0.35	0.20	0.55
	R – 1:1	0.31	0.16	0.47
	1:2	0.56	0.38	0.94
Dolichos (D)	Sole	0.99	0.45	1.44
S+D	2:1	0.89	0.90	1.79
	B – 1:1	0.80	0.39	1.19
	R – 1:1	0.67	0.28	0.95
	1:2	1.71	0.74	2.45
C.D. (P = 0.05)		0.30	0.17	0.45

Table 4: Fodder yield from *sorghum* (HY.SSG-Heera) and *Dolichos* (Local.) under sole and intercropping systems (26-08-2005 to 13-10-2005)

Cropping System	Green fodder (kg/ha.)	%DM	Dry matter (kg/ha.)
Sole Cropping			
Sorghum	5371 (1.00)	14.0	747 (1.00)
Dolichos	3371 91.00)	16.0	539(1.00)
Intercropping			
Sorghum+Dolichos (2:1)			
Sorghum	4544 (0.84)	13.0	591(0.79)
Dolichos	800 (0.23)	15.0	120(0.22)
Total	5344(1.07)		711(1.01)
Sorghum + Dolichos (B 1:1)			
Sorghum	2869(0.53)	12.0	344(0.46)
Dolichos	826(0.24)	14.0	116(0.22)
Total	3695(0.77)		360(0.68)
Sorghum + Dolichos (R 1:1)			
Sorghum	2560(0.47)	15.0	384(0.51)
Dolichos	1191(0.35)	18.0	214(0.39)
Total	3751(0.82)		598(0.9)
Sorghum + Dolichos (1:2)			
Sorghum	2084(0.38)	10.5	219(0.29)
Dolichos	1574(0.46)	15.0	236(0.43)
Total	3658(0.84)		455(0.72)
C.D. (P= 0.05)	1152		
'F' Treatments	36.17**		162
Replicate	1.75^{NS}		8.71*
			0.11^{NS}

Table 5: Performance of *Sorghum* and Cowpea in sole and intercropping systems

Crop	Cropping system	Height of plant (cm)	No. of leaves/plant	No. of nodules/plant	Fresh Wt./ Plant (g)	Dry wt./ plant (g)
Sorghum (S)	Sole	154	8	-	5.43	0.79
S:C	2:1	145	7	-	7.67	1.34
	B – 1:1	153	8	-	10.50	2.10*
	R – 1:1	161*	9*	-	10.70	1.70*
	1:2	154	7	-	9.10	1.82*
Cowpea (C)	Sole	40	15	14	32.83	4.10
S:C	2:1	45*	14	15	21.66	3.36
	B – 1:1	36	12	09	24.00	3.60
	R – 1:1	40	14	10	26.50	3.71
	1:2	46*	14	15	33.25	4.82*

Table 6: Chlorophyll content (mg/g fresh leaf) in sorghum and Cowpea cultivated in sole and intercropping system

Crop	Cropping system	Chl-a	Chl-b	Total Chlorophyll
Sorghum (S)	Sole	1.55	0.64	2.19
S+C	2:1	1.41	0.47	1.88
	B- 1:1	1.43	0.35	1.78
	R – 1:1	1.20	3.75	4.95
	1:2	1.49	0.42	1.91
Cowpea (C)	Sole	1.42	0.43	1.85
S+C	2:1	1.65	0.64	2.29
	B – 1:1	1.51	0.54	2.05
	R – 1:1	0.90	3.88	4.78
	1:2	0.71	0.39	1.10
C.D.(P = 0.05		0.21	1.00	0.92

Table 7: Fodder yield from *Sorghum* (HY.SSG) and Cowpea (Konkan-Kanya) from sole and intercropping systems (14-12-2006 to 23-02-2007)

Cropping System	Green fodder (kg/ha.)	%DM	Dry matter (kg/ha.)
Sole Cropping			
Sorghum	20013(1.00)	14.6	2922 (1.00)
Cowpea	6599(1.00)	12.5	825(1.00)
Intercropping			
Sorghum + Cowpea(2:1)			
Sorghum	14347(0.71)	17.5	2511(0.85)
Cowpea	1471(0.22)	15.5	228(0.27)
Total	15818(0.93)		2739(1.12)
Sorghum + Cowpea (B 1:1)			
Sorghum	15136(0.75)	20.0	3027(1.03)
Cowpea	1753(0.26)	15.5	262(0.31)
Total	16889(1.01)		3289(1.34)
Sorghum + Cowpea (R 1:1)			
Sorghum	15136(0.75)	16.0	2422(0.82)
Cowpea	2026(0.30)	14.0	284(0.34)
Total	17162(1.05)		2706(1.16)
Sorghum + Cowpea(1:2)			
Sorghum	7675(0.38)	10.0	767(0.26)
Cowpea	3443(0.52)	14.5	499(0.60)
Total	11118(0.90)		1266(0.86)
C.D. (P= 0.05)	2498		
'F' Treatments	37.184**		385
Replicate	3.16**		61.81*
			3.23**

Table 8: Performance of Maize and *Dolichos* in sole and intercropping Systems

Crop	Cropping system	Height of plant (cm)	No. of leaves/plant	No. of nodules/plant	Fresh Wt./ Plant (g)	Dry wt./ plant (g)
Maize (M)	Sole	97	8	-	89.33	12.55
M:D	2:1	102	8	-	148.92	10.86
	B – 1:1	95	9*	-	95.30	19.34*
	R – 1:1	117*	9*	-	57.50	20.05*
	1:2	110*	9*	-	133.87	14.77
Dolichos (D)	Sole	37	9	6	13.82	3.43
M:D	2:1	39	8	1	12.64	2.66
	B – 1:1	34	9	5	15.20	2.83
	R – 1:1	41*	9	7*	17.61	3.70
	1:2	38	9	2	13.33	3.19

*- Significant At P= 0.05

Table 9: Chlorophyll content (mg/g fresh leaf) in Maize and *Dolichos* cultivated in sole and intercropping system

Crop	Cropping system	Chl-a	Chl-b	Total Chlorophyll
Maize (M)	Sole	0.56	0.39	0.95
M+D	2:1	1.16	0.75	1.91
	B – 1:1	0.83	0.56	1.39
	R – 1:1	0.87	0.60	1.47
	1:2	0.67	0.60	1.27
Dolichos (D)	Sole	1.40	0.96	2.36
M+D	2:1	1.38	0.89	2.17
	B – 1:1	1.38	0.82	1.20
	R – 1:1	1.49	0.78	2.27
	1:2	0.91	0.40	1.31
C.D. (P = 0.05)		0.24	0.14	0.35

Table 10: Fodder yields from Maize (African Tall) and Dolichos (Konkan Bushan) from sole and intercropping systems (16-11-2005 to 24-01-2006)

Cropping System	Green fodder (kg/ha.)	%DM	Dry matter (kg/ha.)
Sole Cropping			
Maize	8511(1.00)	14.1	1196(1.00)
Dolichos	3599(1.00)	19.5	702(1.00)
Intercropping			
Maize + Dolichos(2:1)			
Maize	3399(0.39)	12.4	415(0.34)
Dolichos	581(0.16)	18.2	106(0.15)
Total	3920(0.55)		521(0.49)
Maize + Dolichos (B 1:1)			
Maize	3515(0.41)	14.5	508(0.42)
Dolichos	638(0.17)	18.6	118(0.16)
Total	4153(0.58)		626(0.58)
Maize + Dolichos (R 1:1)			
Maize	3694(0.43)	13.5	496(0.41)
Dolichos	1484(0.41)	19.3	267(0.38)
Total	5179(0.84)		763(0.79)
Maize + Dolichos(1:2)			
Maize	4354(0.51)	15.5	675(0.56)
Dolichos	1772(0.49)	17.8	316(0.45)
Total	6126(1.00)		991(1.01)
C.D. (P= 0.05)	607		
'F' Treatments	27.7*		70
Replicate	0.36^{NS}		37.0**
			3.77*

Table 11: Performance of Maize and cowpea in sole and intercropping systems

Crop	Cropping system	Height of plant (cm)	No. of leaves/plant	No. of nodules/plant
Maize (M)	Sole	70.53	7.47	-
M:C	2:1	59.53	7.46	-
	B – 1:1	53.33	6.80	-
	R – 1:1	60.33	7.40	-
	1:2	52.00	7.00	-
Cowpea (C)	Sole	23.60	9.13	10.66
M:C	2:1	56.93*	11.66*	9.13
	B – 1:1	46.80*	12.06*	6.93
	R – 1:1	27.60	11.26*	7.13
	1:2	26.86	10.56	6.73

Table 12: Fodder yields from Maize (African Tall) and Cowpea (Pusa Falguni) from sole and intercropping systems (09-02-2006 to 12-04-2006)

Cropping System	Green fodder (kg/ha.)	%DM	Dry matter (kg/ha.)
Sole Cropping			
Maize	8148(1.00)	16.0	13.04(1.00)
Cowpea	5459(1.00)	18.0	983(1.00)
Intercropping			
Maize + Cowpea(2:1)			
Maize	3953(0.98)	14.5	573(0.43)
Cowpea	2561(0.46)	18.5	474(0.48)
Total	6514(0.94)		1047(0.91)
Maize + Cowpea (B 1:1)			
Maize	1964(0.24)	15.2	299(0.22)
Cowpea	2417(0.44)	18.5	447(0.45)
Total	4381(0.68)		746(0.67)
Maize + Cowpea (R 1:1)			
Maize	3049(0.37)	15.5	473(0.36)
Cowpea	3246(0.59)	18	584(0.59)

Total	6295(0.96)		1057(0.95)
Maize + Cowpea(1:2)			
Maize	1589(0.19)	15.5	247(0.18)
Cowpea	4645(0.85)	18.0	836(0.85)
Total	6234(1.04)		1083(1.03)dr
C.D. (P= 0.05)	2480		
'F' Treatments	2.49^{NS}		4.99
Replicate	3.80*		6.25**
			3.38*