quite low in this region which may severely restrict wheat growth.

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Effect of different leys on crop productivity and soil fertility

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Crop and soil productivity can be improved by inclusion of grasses and or pasture legumes in the rotation with grain sorghum [*Sorghum bicolor* (L.) Moench]. Ley farming systems not only provide tonnage forage yield but also enrich the soil health. Grain sorghum is a predominant crop of Bundelkhand region on marginal and sumarginal soils of dryland areas. Eight treatment combinations involving buffel grass (*Cenchrus ciliaris* L.), *Stylosanthes hamata* L. and grain sorghum were laid out in randomized block design with 3 replications on sandy-clay soil, having pH 7.1 and organic carbon 0.36%. The available nitrogen (166.2 kg/ha) and phosphorus (9.24 kg/ha) were low; however, available potassium (472.2 kg/ha) was high. The grass and legume were planted in rows 50 cm apart. *C. ciliaris* and *S. hamata* were sown in 1 : 1 row ratio. The fertilizers were applied @ 80 kg N + 30 kg P_2O_5/ha for sorghum, 40 kg N + 20 kg P_2O_5/ha for *C. ciliaris* and 20 kg N + 30 kg P_2O_5/ha for *S. hamata* and for mixed stand of *C. ciliaris* and *S. hamata*. The *C. ciliaris* and *S. hamata* were sown on 2 July 1990 and 30 July 1991 and sorghum on 10 July 1990, 2 August 1991. The *Cenchrus* and *Stylosanthes* were harvested on 13 October 1990 and 25 October 1991 and sorghum on 14 November 1990 and 26 November 1991. The total rainfall received during the crop period was 1,024.1 mm in 1990 and 891.7 mm in 1991.

Higher productivity of grain sorghum and *Cenchrus* or *Stylosanthes* were recorded in the first year compared with the second year, which was due to variation in amount and its distribution of rainfall. Significantly highest grain (11.8 q/ha) and stover (79.3 q/

Table 1. Productivity and available nutrients in the soil after harvest of different ley-farming systems

Ley-farming system	Yield (q/ha)		Organic carbon (%)		Available nutrient (kg/ha)					
	1990	1991	1990	1991	N		P_2O_5		K_2O	
					1990	1991	1990	1991	1990	1991
Sorghum–sorghum	10.9 (160.0)*	9.6 (60.0)*	0.41	0.41	123.3	120.7	4.52	6.25	371.0	367.3
Cenchrus ciliaris–C. ciliaris	122.4 (44.1)	70.8 (22.6)	0.42	0.44	155.3	156.5	4.94	5.67	404.8	378.0
C. ciliaris–sorghum	113.4 (40.8)	8.2 (57.2)*	0.44	0.44	125.4	117.3	4.83	6.17	404.8	365.8
C. ciliaris + Stylosanthes hamata–C. ciliaris + S. hamata	224.1 (73.4)	120.9 (39.2)	0.43	0.45	171.6	181.4	6.09	5.49	438.3	379.9
C. ciliaris + S. hamata–sorghum	221.7 (72.0)	10.9 (72.4)*	0.43	0.46	166.2	165.2	6.40	5.15	453.4	421.3
S. hamata–S. hamata	145.5 (45.6)	90.7 (28.9)	0.44	0.44	182.5	189.8	5.46	5.58	416.1	367.3
S. hamata–sorghum	181.7 (56.9)	11.8 (79.3)*	0.43	0.43	181.8	172.3	5.46	5.72	404.8	362.6
Sorghum–*S. hamata*	12.0 (195.0)*	87.0 (25.0)	0.40	0.42	122.5	179.0	4.52	5.15	371.0	362.6
CD (P = 0.05)	4.3 (1.6)	2.9 (0.9)								

*Stover yield of sorghum and dry-matter yield of *Cenchrus* and *Stylosanthes* are given in parentheses and grain yield of sorghum, green-fodder and dry-matter yields of forage crops are given as per treatments

ha) yields of sorghum were obtained when sorghum was grown after *Stylosanthes* (Table 1). Significantly higher green-fodder (224.1 q/ha) and dry-matter (120.9 q/ha) yields were recorded with mixed stand of *Cenchrus ciliaris* + *Stylosanthes hamata*, followed by pure stand of *S. hamata* and *C. ciliaris* (Table 1). Gangwar *et al.* (1992) reported that mixed stand of *C. ciliaris* and *S. hamata* gave significantly higher herbage yields than the pure stand of *C. ciliaris* and *S. hamata*.

The organic carbon content was higher (0.47%) in the plots where *Cenchrus* + *Stylosanthes* were raised in previous year and was lowest (0.41%) where grain sorghum was taken. The available N content of the soil was higher (202.6 kg/ha) under pure stand of *Stylosanthes* and lowest value was recorded under pure stand of *Cenchrus* or grain sorghum. The higher content of available soil N under *Stylosanthes* may be because of its fixation from atmosphere into the soil. The available P varied from 5.15 kg/ha under pure stand of *Stylosanthes* to 6.25 kg/ha under grain sorghum. This difference may be attributed to higher P requirement of the legume. The available K showed no specific trend and ranged from 362.6 to 453.4 kg/ha in different ley-farming systems. Chatterjee *et al.* (1974) reported that similar results on physical and chemical properties under different ley-farming systems.

Mixed stand of grass (*C. ciliaris*) and pasture legume (S. *hamata*) may be used for the improvement of soil productivity of dryland for sustaining the crop productivity.

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