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Intercropping Cowpea (*Vigna Sinensis* L.) with Sorghum (*Sorghum Bicolor* L.) for Animal Feeding during Summer Season

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INTERCROPPING cowpea on sorghum hold good chance to become popular as fodder. Such attempt can be easily fitted in a cultiple cropping pattern for the crop rotation in Egypt and for maintaining a continuous supply of green fodder throughout summer season, as well as a balance diet. Studying the proper rate of seed admiture, it was found that kg./fed. cowpea with 8 kg/fed. sorghum does not affect seriously the yield of sorghum grain.

On the other hand, green and dry yields increased significantly, due to intercropping cowpea with sorghum at the rate of 15 and 25 kg seeds being 22.15 and 22.42 ton green yield/fed., respectively (4.57 and 4.66 ton dry matter/fed.), compared with 15.62 ton green yield/fed. (3.39 ton DM) obtained from sorghum planted in pure stand.

Concerning the nutritive analysis and feeding values, cowpea as a legume forage crop had higher CP, ash, Ca and P contents than solid serghum. Intercropping cowpea with sorghum improved the forage qualities of the mixture especially in digestibility coefficients, nutritive value (TDN and SV), DCP, nutritive ratio and daily intake by bulls as compared with sorghum in pure stand.

Dependence on improving local food and feed resources for both animals and human is a "must" for right policy in most countries particularly in Egypt. Efforts row are directed to increase the available green fodder in summer by using forage varieties such as hybrid sorghum which is power for dual purpose, or intercropping legumes with grasses to increase quality and quantity of green fodder.

A partial solution for such scarcity is to apply intercropping of some leguminous and gramineous summer fodder crops such as maize or sorghum. The Food and Agriculture Organization (1972), recommended cowpea and soybean as most suitable legume varieties for intercropping with sorghum. Faris *et al.* (1976) indicated that intercropping sorghum + cowpea was superior than other crops. This might fit well with the crop rotation in our case.

It has been observed that the highest yield of fresh and dry forage was obtained by intercropping cowpea with napier grass (Gabra, 1984). Moreover, the legume/grass mixture improved the feed qualities for animal production (Beshay, 1980; Gabra, 1984; Gabra *et al.*, 1984, Gabra and Sherif, 1985 and Sherif and Gabra, 1985).

The main target of this study is to provide livestock with green fodder during summer season, as well as, to study proper rate of seed admixture of cowpea and sorghum which supply a profitable green fodder and does not have a serious effect on sorghum grain yield.

Material and Methods

Field Experiments

This study was conducted at El-Marg Farm in 1984. *Sorghum bicolor* (L.) Moench, var. pioneer 815 and cowpea (*vigna Sinensis* L.) were chosen for testing. The rate of seed admixture and their combination were as follows :

Treatment	Sorghum Kg.	Cowpea Kg.
A	—	15
B	—	25
C	8	15
D	8	25
E	8	—

Seeds were drilled in rows. In the case of admixture between both crops seeds of sorghum and cowpea were sown in an alternating rows 30 cm apart. In case of single crop treatments, seeds of sorghum sown in rows 60 cm apart and 30 cm for cowpea apart. All treatments received 40 kg N fed. in one dose after 15 days from sowing. All other necessary agricultural practices were carried out. One cut of green fodder as well as grain yield were taken from sorghum, where as three successive cuts were taken from cowpea intercropped between sorghum rows and three

cuts were taken from solid cowpea. The experiments were designed in a randomized complete blocks design with four replicates each. The area of each plot was 3 × 4 m^2 (equal 1/350 fed.).

The sowing date was 16*th* June 1984. Six kirrats (1/4 feddan) was divided into equal plots, sown in plantations every 3 days to keep the suitable heights needed in the metabolism trials. After harvesting the grain of sorghum, plants of sorghum, cowpea in pure stands and sorghum/cowpea mixtures were cut for the metabolism trials.

Grain and forage sampling and analysis : For grain sorghum yield, after 106 days from sowing the grain was harvested and yield was determined as ton/fed. After harvesting, the green stems of sorghum were cut only for determining the green yield of herbage. Cowpea was cut at 60-65 cm height after planting and after each cut.

The yield of each plot was recorded to the nearest 10 g. Kg. from fresh weight and grains were taken randomly from each plot for chemical analysis, immediately green samples were chopped then throughly mixed. Green samples and grains (300 g each) were dried at 60-70°C air equilibrated, then ground to pass through 1 mm sieve and kept for chemical analysis.

Metabolism trials : Three trials were carried out to determine the digestibility coefficients and feeding value of sorghum, cowpea and their mixture. Three Balladi cattle bulls about 245 Kg body weight were used. Each trial composed of 10 days preliminary period followed by 8 days collection period. Feces were quantitatively collected using collection bags.

The grain, forage and feces were chemically analysed according to A.O.A.C. (1980).

Phosphorus were determined according to colourmetric method of Fisk and Subbarow (1952). Feed and fecal calcium contents were determined using the Bye Unican atomic absorption apparatus.

The data were statistically analysed according to steel and Torrie (1960). Duncan's multiple range test was applied whenever possible.

Results and Discussions

Grain Yield

It is clear from Table 1 that highest grain yield of sorghum was that of treatment E. (solid sorghum). Intercropping with 15 and 25 kg of cowpea resulted a decrease of 6.51 and 14.40% of sorghum grain yield. More reduction in grain sorghum yield was apparently observed when using higher seed rates of cowpea in the mixture. This may be due to competition between the two crops for environmental factors. Comparable results were reported when soybean were intercropped with maize by Galal and Abdel-Rasol (1962) and Tahran (1970) and in cowpea intercropped with sorghum by Hassan and Gabra (1982).

Table (1): The effect of intercropping cowpea with sorghum on grain and fodder yields (ton/fed.)

Treats.	No. of Cuts		Fresh Yield		Dry Yield	
	Cowpea	Sorghum	Grain	Forage	Grain	Forage
A	3	-	-	11.18^{D}	-	2.20^{C}
B	3	-	-	12.32^{C}	-	2.41^{C}
C	3	1	2.61^{B}	22.15^{A}	2.40	4.57^{A}
D	3	1	2.43^{C}	22.42^{A}	2.23	4.66^{A}
E	-	1	2.78^{A}	15.62^{B}	2.55	3.39^{B}

A, B, C, D not followed by the same letter are significantly different at 0.01 level (Duncan's multiple range test).

Green and Dry Yields : The green fodder yield was increased significantly ($P < 0.01$) due to intercropping in comparison with that obtained from sorghum sown alone. Data indicated an increase of green fodder yield in the mixtures by 41.80 and 43.53% when intercropping took place at the rate of 15 and 25 kg. cowpea seeds + 8 kg. sorghum/fed., respectively, as compared with sorghum alone. Statistical analysis for total green forage showed that the L.S.D. at 1% level of probability was 0.95 ton/fed.

The increase of gree nfodder may be attributed to the increase of population density on a given piece of land. These results are in agreement with those obtained by Yazmuradov (1972), Has-

san and Gabra (1982) and Farid and Ghobrial (1976) who obtained higher green yield from intercropping sweet sorghum with cowpea as compared to the yield of the sweet sorghum alone.

Similar trend was observed in case of dry forage (Table 1). It was increased significantly ($P < 0.01$) for intercropping patterns compared with solid sorghum. This increase amounted 1.18-1.27 ton/fed. for treatments C and D, respectively. Analysis of variance showed that dry matter yield in solid cowpea was the lowest while dry matter production of sorghum occupied an intermediate position.

It could be observed that the green and dry yields of cowpea intercropped with sorghum were lower than its yields in pure stand. The green yields of intercropped cowpea were 6.53 and 6.80 ton/fed. with the seed rates of 15 and 25 kg/fed., respectively being 41.59 and 44.8% lower than the green yield of cowpea alone. This might be due to the increased shading with increased population of sorghum. Such shading is believed to be the principal factor causing the decrease of cowpea yield. Competition between the species depended on plant population and sorghum leaf area which affected radiation level in the plant canopy. In this connection, Shukla *et al.* (1970) and Gabra (1984) found that the green yields of berseem and alfalfa intercropped on napier grass were decreased than their yields in pure stands by 10-20%.

Nutritive Analysis

Data in Table 2 showed that the grain sorghum contained 91.83% DM (being the highest than the green forages). On DM basis, the grain had higher EE and NFE and lower CF and ash. But on fresh basis, it had higher CP, EE, NFE and Ash. Chemical composition of the grain in this study was similar to those mentioned by Ghoneim (1964), and Hassan and Gabra (1982).

Concerning the chemical analysis of the green forage (Table 2), results indicated that sorghum in pure stand contained the highest DM% being 21.54% followed by the mixtures and finally cowpea in pure stand. Statistical analysis of variance showed no significant difference between DM percentages of cowpea sowing at 15 kg seed/fed. or 25 kg seed/fed. Also, sowing cowpea alone with seed rates of 15 kg or 25 kg/fed. did not affect the chemical composition.

On DM basis, CP percentage were significantly higher ($P < 0.05$) in cowpea and lower ($P < 0.05$) in the solid sorghum. Mixing cowpea with sorghum increased the CP content in the mixtures than pure stand of sorghum. Cowpea and the mixtures were higher in EE% than sorghum forage alone. Crude fibre content in sorghum forage was significantly the highest ($P < 0.05$) followed by the mixtures and cowpea in pure stand. However, the contrary was showed in NFE contents, sorghum in pure stand and the mixtures contained higher NFE% than cowpea in pure stand. Similar trend was recorded for ash content in the herbage (Table 2).

Results on fresh basis (Table 2) indicated that CP% was the highest in cowpea alone followed by the mixtures and solid sorghum. The trend of EE, CF, NFE and ash were similar to that showed on DM basis.

Table 2: The chemical composition of grain sorghum and the fodder obtained from sorghum, cowpea and their mixtures.

Treatments	No. of cuts	DM	CP	EE	CF	NFE	Ash	Ca	P	Ca/P ratio
					Fresh Basis %					
Sorghum grain	1	91.85^{a}	10.40^{a}	2.60^{a}	4.21^{a}	71.75^{a}	2.87^{a}	-	-	-
A, Cowpea 15 kg	3	19.71^{d}	3.32^{b}	0.41^{a}	5.11^{c}	8.52^{a}	2.36^{d}	0.31^{a}	0.07	4.69^{a}
B, Cowpea 25 kg	3	19.54^{d}	3.34^{b}	0.43^{c}	4.85^{c}	8.73^{c}	2.19^{a}	0.32^{a}	0.07	4.50^{a}
C, [M] mixture 1	1	20.65^{c}	2.63^{c}	0.52^{b}	5.82^{b}	9.26^{b}	2.42^{d}	0.21^{b}	0.07	3.15^{a}
D, [M] mixture 2	1	20.78^{c}	2.66^{c}	0.42^{c}	5.86^{b}	9.25^{b}	2.57^{c}	0.23^{b}	0.06	3.73^{b}
E, Sorghum	1	21.54^{b}	2.05^{d}	0.42^{c}	6.59^{a}	9.78^{b}	2.70^{b}	0.13^{a}	0.06	2.27^{a}
					DM Basis %					
Sorghum grain	1	100	11.32^{c}	2.83^{a}	4.59^{d}	78.14^{a}	3.12^{c}	-	-	-
A, Cowpea 15 kg	3	"	16.86^{a}	2.10^{c}	25.93^{c}	43.16^{c}	11.95^{b}	1.58^{a}	0.34^{a}	-
B, Cowpea 25 kg	3	"	17.11^{a}	2.22^{a}	24.82^{c}	44.63^{b}	11.22^{b}	1.62^{a}	0.36^{a}	-
C, [M] mixture 1	1	"	12.74^{b}	2.51^{b}	28.19^{b}	44.82^{b}	11.74^{b}	1.01^{b}	0.32^{a}	-
D, [M] mixture 2	1	"	12.82^{b}	2.04^{c}	28.32^{b}	44.51^{b}	12.31^{a}	1.12^{b}	0.30^{b}	-
E, Sorghum	1	"	9.53^{d}	1.98^{d}	30.58^{a}	45.39^{b}	12.52^{a}	0.59^{c}	0.26^{c}	-

a, b, c, d, e Not followed by same letter are significantly different at 0.05 level (Duncan's multiple range test).

[M] Mixture contained the 3 rd cut of cowpea and the 1 st cut of sorghum after harveste the grain.

These results are in accordance with those reported by Gihad (1976), Ghobrial and Gabra (1982) and Hassan and Gabra (1982) with cowpea and sorghum, Ibrahim *et al.* (1978), Gabra (1984) and Gabra and Sherif (1985) with legume/grass mixture.

Regarding Ca and P contents, results in Table 2 showed that on Dm or fresh basis Ca contents were higher in cowpea followed by the mixtures and finally solid sorghum. Intercropping cowpea on sorghum and cutting the two herbage together improved the Ca content in the mixtures than solid sorghum. Results in this

study were in harmony with those found by Gabra (1984) working on cowpea and sorghum. On the other hand, Ibrahim *et al.* (1979) and Sherif and Gabra (1985) mentioned that legumes are richer in calcium than grasses.

Phosphorus content in experimental forages on DM basis was significantly higher ($P < 0.05$) in cowpea alone followed by the mixtures and solid sorghum (Table 2). However, there was no significant differences among the treatments on fresh basis. The values of P in this study are in agreement with those found by Gabra (1984).

Combining Ca and P results, the Ca/P ratio with tested forage appeared to increase significantly ($P < 0.05$) with cowpea alone than mixtures and solid sorghum. Mixing cowpea with sorghum improved significantly ($P < 0.05$) the Ca/P ratio. The ratios obtained here are within the range obtained by Gabra (1984).

Digestibility Coefficients and Nutritive Value

Digestibility Coefficients

Mean apparent digestibility coefficients of cowpea, sorghum and their mixture are presented in Table 3. Results showed that DM, OM, CP and NFE were significantly higher ($P < 0.05$) in cowpea alone than sorghum and its mixture. However, EE and CF digestibilities were significantly higher ($P < 0.05$) in the mixture than other treatments. Mixing cowpea with sorghum for feeding animals increased significantly ($P < 0.05$) the digestibilities of DM, CP, EE, CF and NFE than solid sorghum. Similar results were also reported by several workers (Ibrahim *et al.*, 1978, Beshay, 1980, Gabra, 1984 and Gabra and Sherif 1985).

The OM digestibility showed higher figures than DM digestibility. This was due to the fact that DM of eaten forages had lower ash (11.22-12.52%) than fecal DM (19.50-33.59% having wide range among bulls.

Results of digestibility coefficients with bulls fed green cowpea, sorghum and their mixture in this study were higher than those found by Gabra (1984) with cowpea, sorghum and grass/legume mixture fed to sheep. In this connection Poppi *et al.* (1981) indicated that the digestibility coefficients of nutrients were higher in cattle than sheep when fed on green herbage.

Nutritive Value

The feeding values (TDN and SV) are presented in Table 3. As fed, sorghum alone contained the highest TDN than the other treatments being significantly on 0.05 level. Results showed no significant difference among the three treatments in SV%. However, on DM basis, cowpea in pure stand had significantly higher ($P < 0.05$) TDN and SV% than sorghum alone and its mixture. Intercropping cowpea with sorghum improved significantly ($P < 0.05$) the feeding values of the mixture than solid sorghum. Results in this study were in agreement with those found by Gihad (1976) and Gabra (1984) with cowpea and sorghum in pure stands, and Gabra and Sherif (1985) with legume/grass mixture.

Regards the DCP (Table 3), it was clear that it increased significantly ($P < 0.05$) in cowpea/sorghum mixture being more than with the pure stand sorghum either on fresh or DM basis. The values of DM basis were lowest in sorghum (6.31%), noticeably higher in the mixture (8.90), which agree well with Gabra (1984) and Gabra and Sherif (1985).

Table (3): Digestibility coefficients of sorghum, cowpea and their mixture in metabolism trials with bulls.

Treatments	Digestibility Coefficients						As Fed %			DM basis %			NRI
	DM	OM	CP	EE	CF	NFE	TDN	SV	DCP	TDN	SV	DCP	
Cowpea	67.91 a	69.14 a	73.94 a	59.23 b	60.37 a	76.35 a	12.63 b	10.89 a	2.47 a	64.64 a	55.73 a	16.64 a	4.11 c
Sorgaum	61.45 c	67.14 b	66.15 c	60.11 b	62.42 b	72.59 c	13.13 a	10.63 a	1.36 c	60.96 c	49.35 c	6.31 c	8.65 a
a Cowpea/ sorghum mixture	64.86 b	67.59 b	69.42 b	61.59 a	63.18 a	73.22 b	12.92 a	10.74 a	1.89 b	62.18 b	51.68 b	8.90 b	5.98 b

a, b, c, Not followed by the same letter are significantly different at 0.05 level (Ducan's multiple range test).

a Mixture contained the 3 rd cut of cowpea at 25 Kg seed/ fed. and the 1st cut of sorghum after harvesting the grain.

It was also clear that the mixture had narrow value of nutritive ratio (1:5.98), than with sorghum alone (1:8.65). Improving the NR in the mixture due to the fact that mixing cowpea with sorghum raised both CP and DCP contents. Similar results were reported also by Gabra (1984) and Gabra and Sherif (1985) with legume/grass mixture.

Daily intake of green cowpea, sorghum and their mixture by bulls

The intake of green forage (Table 4) by mature bulls per day decreased significantly ($P < 0.05$) with solid sorghum than cowpea in pure stand and its mixture with sorghum. This trend was reflexed also on DM/100 Kg body weight or per $KgW^{0.75}$. These results were found also by Gabra (1984) and Gabra and Sherif (1985) with grass/legume mixture. The DM/$KgW^{0.75}$ ranged from 91.97 to 104.01 g. in this study which is within the range obtained by Gabra, 1984 (98.79-111.00 g. DM/$KgW^{0.75}$ when bulls were fed green legume/grass mixture. In this connection Shalaby *et al.* (1984) indicated that sheep consumed more DM with sorghum/alfalfa mixture than solid sorghum.

TALBE 4. **Daily intakes from green soroghum, cowpea and their mixture by bulls.**

Treats.	Body weight	DM	Daily intake			$KgW^{0.75}$			
			Fresh	Dry	DM/100 Kg B.W.	DM g.	TDN g.	SV g.	DCP Kg.
	kg.	%	Kg.	g		g.			
Cowpea	245	19.82	32.50^{a}	6441^{a}	2.63^{a}	104.01^{a}	67.23^{a}	57.96^{a}	13.35^{a}
Sorghum	247	21.54	26.60^{c}	5730^{c}	2.32^{c}	91.97^{b}	56.06^{c}	45.39^{c}	5.80^{c}
Mixture	244	20.78	30.40^{b}	6320^{b}	2.59^{b}	102.34^{a}	63.65^{b}	52.90^{b}	9.11^{b}

a, b, c Not followed by the same letter are significantly differen at 0.05 (Duncan's multiple range test).

Concerning the intake from TDN, SV and DCP, results in Table 4 showed that the bulls consumed more nutritive value from cowpea in pure stand followed by the mixture and solid sorghum. The intakes from SV and DCP in this study were higher than those recorded by Abou-Raya *et al.*, 1980 (25 g. SV and 2-4 g. DCP/$KgW^{0.75}$). The intake from SV and DCP could cover the maintenance requirements of animals from energy and protein with surplus for production.

Feed units yield

The feeding value and yield as feed units (TDN, SV and DCP) is presented in Table 5. This was calculated from average composition of each treatment (Table 1), average digestion coefficients of nutrients known from feeding trials with bulls in Table 3.

Results in Table 5 showed that the green and dry yields of sorghum in pure stand were significantly higher ($P < 0.01$) than the yields of cowpea by 26.79 and 40.66%, respectively. Although the TDN and SV yields of solid sorghum were significantly higher than that of cowpea, yet the DCP of cowpea was significantly higher ($P < 0.01$) than sorghum by 42.86%. Increasing the DCP yield of cowpea due to increasing the DCP and DCP% in cowpea than sorghum.

TABLE 5. **The feed units yield obtained from sorghum, cowpea in pure stands and their mixture (ton / fed).**

Treatments	Green ton	Dry ton	TDN ton/fed.	S.V ton	DCP ton
Cowpea	12.32^{C}	2.41^{C}	1.56^{C}	1.34^{C}	0.30^{B}
Sorghum	15.62^{B}	3.39^{B}	2.07^{B}	1.67^{B}	0.21^{C}
Mixture	22.42^{A}	4.66^{A}	2.87^{A}	2.44^{A}	0.39^{A}

A,B,C, Not followed by the same letter are significantly different at 0.01 level (Duncans multiple range test).

On the other hand, the yields of sorghum/cowpea mixture obtained from intercropping cowpea with sorghum were significantly higher ($P < 0.01$) than yields of cowpea or sorghum in pure stands. Intercropping cowpea on sorghum increased the green and dry yields as well as feed units yield. These increases were 86.98, 93.36, 83.97, 82.09 and 30.00% higher than cowpea for green, dry, 1DN, SV and DCP, respectively, and higher than sorghum alone by 43.53, 37.46, 83.65, 83.65, 46.11 and 85.71%.

In Egypt during the summer season about one million feddans were cultivated by sorghum for grain (statistics of Ministry of Agriculture, 1984). Intercropping cowpea on cultivated area of sorghum for animals feeding gave about 0.77 million tons SV and 0.18 million ton DCP (Table 5). The agricultural extensive system, it can infer whenever possible increase the yield under similar studied conditions. This can be obtained without increasing the area under cultivation in the loam soil.

Further investigations are needed to apply the agricultural intensification system in the new reclaimed soils and feeding the different spp. of farm animals on the tested forage under the

new soils condition. Moreover, some studies are also needed on the preservation of sorghum plus cowpea for making silage or hay.

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تحميل لوبيا العلف مع السورجم لتغذية الحيوانات خلال فصل الصيف

ميشيل عوض جبره وشريف يوسف شريف

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أجريت هذه الدراسة كمحاولة لتلاءم نظام التكثيف الزراعى بالدورة الزراعية فى جمهورية مصر العربية وللمحافظة على استمرار التغذية بالعلف الاخضر المتزن غذائيا خلال موسم الصيف ، بزراعة لوبيا العلف بمعدل تقاوى ١٥ ، ٢٥ كيلو جرام للفدان محملة على الذرة الرفيعة بمعدل ٨ كجم للفدان فى قطاعات كاملة عشوائية .

اظهرت النتائج ان زراعة لوبيا العلف محملة على الذرة الرفيعة ادى الى انخفاض محصول الحبوب فى الذرة الرفيعة بنسبة ٦ر٥١ ، ١٤ر٤٠٪ عند الزراعة بمعدل ١٥ ، ٢٥ كجم بذور لوبيا العلف على التوالى عن المحصول الناتج من زراعة الذرة الرفيعة بمفردها .. كما اظهرت النتائج ان محصول العلف الاخضر ازداد معنويا عند التحميل حيث كان المتوسط ١٥ر٢٢ ، ٤٢ر٢٢ طن/فدان (٥٧ر٤ ـ ٦٦ر٤ طن مادة جافة/للفدان) بزراعة لوبيا العلف بمعدل ١٥ ، ٢٥ كجم بذرة محملة على الذره الرفيعة على التوالى مقارنة بالمحصول الاخضر للذره الرفيعة بمفردها حيث كانت ١٥ر٦٢ طن/فدان (٣ر٣٩ طن مادة جافة/فدان) وهذه الزيادة فى محصول العلف الاخضر خاصة المنزرع بمعدل ٢٥ كجم لوبيا تعوض نقص محصول الحبوب للذرة الرفيعة فى نفس المعاملة .

كما اظهرت النتائج ان نسبة البروتين والرماد والكالسيوم والفوسفور تزيد فى لوبيا العلف كمحصول بقولى مقارن بنسبة كل منهم فى السورجم ـ كما ان تحميل لوبيا العلف مع السورجم وحتى المحصولين معا ادى الى تحسين خواص العلف فى المخلوط خاصة معاملات الهضم ، القيمة الغذائية (مركبات كلية مهضومة ، معادل نشا) والبروتين الخام المهضوم ، النسبة الغذائية والمتناول اليومى بواسطة الثيران عند مقارنته بالسورجم المنفرد .