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Evaluation of fodder yield and its quality of barley and ryegrass sown alone or intercropped with berseem clover.

Helmy, Amal, A. ; Wafaa M. Sharawy and Hoda I. M. Ibrahim
Forage Crops Res., Dept., Field Crops Res. Inst., Agric. Res. Center, Giza, Egypt.

ABSTRACT

Two field experiments were conducted at Sids Experimental Agricultural Research Station, (ARC), in 2006/2007 and 2007/2008 seasons to (i) evaluate the performance of two varieties of barley as a multicut forage crop either in pure stand or intercropped with berseem and (ii) comparing berseem, barley and ryegrass as sole crops or intercropped to determine the best grass- legume combination for maximum yield and better forage quality. Total fresh forage yield of pure stand ryegrass was superior to those of barley *cv*. Giza 123 and barley *cv*. Giza 2000 by 13.61 and 15.03 t fed^{-1}, respectively. Barley *cv*. Giza 123 outyielded Giza 2000 by 1.42 t fed^{-1}. Total fresh forage yield of intercropped berseem with barley *cv*. Giza 123 surpassed those of berseem + barley *cv*. Giza 2000 and berseem in pure stand by 10.8 and 11.4 percent, respectively. Total fresh forage yield of berseem + ryegrass was lower by 3.96 t fed^{-1} than that of berseem + barley *cv*. Giza 123, but higher by 1.27 and 1.49 t fed^{-1} than those of berseem + barley *cv*. Giza 2000 and berseem in pure stand, respectively. Barley *cv*. Giza 123 was better companion with berseem than *cv*. Giza 2000. Ryegrass showed better stand persistence and duration than the barley. Total dry forage yield followed the same trend of fresh forage yield, but the magnitude of difference was greater. Intercropping of berseem with forage grasses lead to improve forage quality through balancing crude protein (cp), Total Digestible Nutrients (TDN) and Ca/P ratio. It could be concluded that to maximize forage yield and its quality per unit area by intercropping barley *cv*. Giza 123 and Egyptian clover 50%:50%.

Keywords: Berseem, Egyptian clover (*Trifolium alexanderinum*, L.), ryegrass (*Lolium multiflorum*, L.), barley (*Hordeum vulgare*, L.), forage intercropping, quality.

INTRODUCTION

In countries which have limited arable land, water resources and rapid annual increase in population, food supply is far less than the needs. In such countries (e.g. Egypt) the researchers efforts are directed to improve yield production and nutritive value of the cultivated crops including forages. Intercropping and mixture crops (legumes and grasses) are also effective techniques to raise the productivity of cultivated land and produce high quality feed. Egyptian clover or berseem, (*Trifolium alexanderinum*, L.) is one of the best annual crops for winter forage production. Berseem is the main livestock feed in Egypt due to its high protein production and relatively low production cost. However, berseem often contains high moisture and low dry matter especially in first cut. On the other hand, grass and cereal crops grown for forages (barley, ryegrass and oats) have high dry matter production and low protein (Eskandari *et al*., 2009), thus low forage quality. Since high quality forage optimizes the productivity of animals, increasing the quality of berseem is one of the best methods of improving overall feeding efficiency.

Intercropping, which is defined as the growing of two or more crop species simultaneously in the same field during a growing season (Ofori and Stern, 1987), is important for the development of sustainable food production system, particularly in cropping systems with limited external inputs (Adesogan *et al*., 2000). Bingol *el at*., 2007 found that all mixture of vetch and barely had significantly higher digestible dry matter and crude protein yield. Strydhorst *et al*. (2008) reported that legumes intercropped with barely resulted in higher forage quality than pure barely. Also, forage quality in terms of NDF and ADF was improved by intercropping of grass with annual legumes (Yolcu *et al*., 2009).

Intercropping of legumes with grasses leads to some of potential benefits such as higher productivity and profitability (Yildirim and Guvence, 2005), improvement of soil fertility through the addition of nitrogen by fixation and execration from the component legumes (Hauggaard-Nielsen *et al*., 2001), efficient use of resources (Knudsen *et al*., 2004), reducing damage caused by pests, disease and weeds (Banik *et al*., 2006), and improving forage quality through the complementary effects of two or more crops grown simultaneously on the same area of

land (Ross *et al*., 2004, Lithourgidis *et al*., 2006 and Bingol *et al*., 2007).

Intercropping of berseem (*Trifolium alexanderinum* L.) with ryegrass or barley may improve forage quality and yield. Benefits of mixture include increasing dry matter yields, which is mainly due to the benefit of the associated grass from nitrogen fixed (BNF) by the legume. This benefit is a result of nitrogen transfer (N^+) (Vallis *et al*., 1977 and Ta and Faris, 1987), develop the protein content and improve the nutritive value of forage. These findings were also reported by other researchers (Abou-Raya and Ibrahim, 1973; Radwan *et al*., 1977; Hefni *et al.,* 1978; Nor El Din *et al*., 1992; Abo-Kerisha *et al*., 1996, Abd El Sattar, 1999 and Abdel-Aziz *et al*., 2007).

Animal production in Egypt is severely limited by marked seasonal feed deficits where the supply is less than the demand. Therefore, one of the proposed ways to overcome the problem is to expand mixture or intercropping cultivation of berssem with ryegrass or barley to increase the production of unit area and improve the quality of the resulted forage. The objectives of this study were to (i) evaluate the performance of two varieties of barley as a multicut forage crop either in pure stand or intercropped with berseem and (ii) comparing berseem, barley and ryegrass as sole crops or intercropped to determine the best grass – legume combination for maximum yield and better forage quality.

MATERIALS AND METHODS

The present investigation was carried out at Sids Experimental Station Farm, ARC, during 2006/2007 and 2007/2008 winter seasons to investigate the productivity and forage quality of berseem, ryegrass and barley sown in pure stands compared to the intercropped berseem with either ryegrass or barley. Physical and chemical soil analyses for the experimental site (0 - 30 cm soil layer) were carried out according to Chapman and Pratt (1961) and Jackson (1967) to determine soil properties of the experimental sites which are presented in Table, 1.

Table 1: Physical and Chemical analyses of the experimental soil at (0 –30 cm soil depth).

Soil property	2006/2007	2007/2008
Mechanical analysis:	21.13	21.18

Sand % **Silt %** **Clay %** **Soil texture**	**34.70** **44.60** **Clay**	**34.80** **44.35** **Clay**
Chemical analysis: **pH** **EC dsm^{-1}** **Total N %** **Available (K) ppm** **Available (P) ppm** **Organic matter (%)**	 **8.44** **1.03** **0.57** **0.92** **10.03** **2.02**	 **8.40** **1.02** **0.56** **0.91** **9.35** **2.01**

The experimental design was a randomize complete block with four replicates. Each block contained seven treatments (1) pure stand barley (*cv*. Giza 123); (2) pure stand barley (*cv*. Giza 2000); (3) pure stand ryegrass (*cv*. Caramba); (4) intercropped berseem (*cv*. Giza 6) + barley (*cv*. Giza 123); (5) intercropped berseem (*cv*. Giza 6) + barley (*cv*. Giza 2000); (6) intercropped berseem (*cv*. Giza 6) + ryegrass and (7) pure stand berseem (*cv*. Giza 6). Plot size was 10.5 m^2. The sowing dates were 15th and 10th of October in the first and second season, respectively. Seeding rates were 20 kg fed^{-1} for pure berseem; 40 kg fed^{-1} for pure barley; 18 kg fed^{-1} for pure ryegrass and the intercropped plots were sown by 50% legume + 50% grass, in alternative rows – 20 cm apart.

Berseem clover (*cv*. Giza 6) was inoculated with the appropriate *Rhizobium trifolii*. All plots received 30 kg P_2O_5 fed^{-1} before sowing. Potassium sulphate (48% K_2O) was added at the rate of 50 kg fed^{-1}. Nitrogen fertilizer was added as ammonium nitrate (33.5% N) at the rate of 60 kg N fed^{-1} for barley and ryegrass and 20 kg N fed^{-1} for berseem in pure stand or intercropped with barley or ryegrass. The N fertilizer was divided into four equal doses and the first dose was applied after 15 days from seeding, then after each cut prior to irrigation.

Four cuts were taken after 7, 13, 17 and 21weeks from sowing in both seasons. Cutting started when plants were about 40-50 cm high and the stubble height was about 5 cm from soil surface.

Studied traits included:

A- Forage yield

1- Plant height (cm) of ten plants in each plot was measured from soil surface to the junction of the top most leaf.

2- **Fresh forage yield (t fed^{-1}): plants were hand clipped and weighed in kg/plot then, converted to t/fed.**
3- **Dry forage yield (t/fed.): 100 gm plant samples from each plot were dried at 105 °C till constant weight and dry matter percentage (DM %) was estimated. The dry forage yield (t fed^{-1}) was calculated by multiplying fresh forage yield ((t fed^{-1}) X dry matter percentage.**
4- **Plants of intercropped plots were hand clipped and separated into grass and legume components and weighed to determined fresh forage yield and estimate the grass percentage in each plot.**
5- **Berseem plants roots of first and second cuts were examined to determine nodules number (No. nod/10 plants) and dry weight of nodules (mg/10 plants).**

B- Chemical composition

Chemical analysis followed the conventional methods outlined by the Association of Official Chemists (A.O.A.C., 1990). Plant samples of each cut in both years were dried, ground and saved in labeled plastic bags for chemical analysis. Samples were analyzed in the Forage Crops Research Dep. Lab. at Giza to determine crude protein (CP), crude fiber (CF), ether extract (EE) and ash. Calcium (Ca) and Phosphorus (P) were detected at Regional Center for Food and Feed (RCFF), ARC. Digestible crude protein was calculated according to the equation of McDonald *et al*. (1978). DCP = CP X 0.9115 – 3.67.

Total digestible nutrients (TDN %) was calculated according to the equation of Naga and El-Shazly (1971). TDN = 0.87 (OM + 1.25 X EE) – CP X 1.44, where OM = 100 – Ash

Data were statistically analyzed according to procedure outlined by Snedecor and Cochran (1980) using MSTAT-C computer program ver. 4 (1986). Homogeneity of variance was done for the two seasons by using Bartlett test according to Gomez and Gomez (1984). Data of the two years combined are presented and discussed due to the homogeneity of the two years.

RESULTS AND DISCUSSION

Fresh forage yield

Results of fresh forage yield for the individual cuts and total fresh forage yield (combined over two seasons) of the investigated crops are presented in Table,2 .Total fresh forage yield of pure stand ryegrass was superior to those of barley *cv*.

Giza 123 and *cv*. Giza 2000 by 13.61 and 15.03 t fed^{-1}, respectively. This superiority could be attributed to better persistence for ryegrass compared to barley that was reflected in an extra cut from ryegrass per seasons. Rye grass provided four cuts per season, while barley plants vanished after the third cut, Table, 2 and Fig. 1.

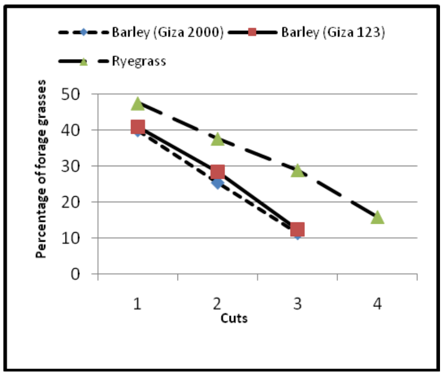
It is roteworthy that fresh forage yield of first cut of pure stand barley, averaged over varieties, exceeded that of ryegrass by 10%, but sharply declined thereafter, Table, 2. Fresh forage yield of barley in the second and third cuts was decreased by 51.9 and 73.4 % relative to first cut, respectively. Fresh forage yield of ryegrass was decreased by only 22.1 and 20.3 % in the same period, Table 2. These results could be mainly attributed to the high tillering capacity of ryegrass compared with barley in the subsequent cuts (Rizk *et al*., 2005). The obtained results also revealed that ryegrass maintained better forages availability and distribution throughout the season compared with barley, Table, 2. Results in the same table also indicted that fresh forage yield of the two cultivars of barley sown in pure stands did not significantly differ. However, yield of *cv*. Giza 123 was consistently higher but not significant than that of *cv*. Giza 2000 and the Increase in total yield (1.42 t fed^{-1}) should not be economically ignored.

Total fresh forage yield of intercropped berseem with barely *cv*. Giza 123 was the highest and significantly surpassed those of berseem + barley *cv*. Giza 2000 and berseem in pure stand by 10.8 and 11.4 percent, respectively, Table 2. In spite of berseem intercropped with ryegrass showed better persistence than barley as illustrated in Fig. 1, but its total fresh forage yield was lower by 3.96 t fed^{-1} than that of berseem + barley *cv*. Giza 123. On the contrary, it was higher by 1.27 and 1.49 t fed^{-1} than those of berseem + barley *cv*. Giza 2000 and berseem in pure stand, respectively, Table, 2. These yield differences although not statistically significant but should be considered.

Table 2: Fresh forage yield (t fed^{-1}) of berseem, barley and ryegrass as affected by planting in pure stand or intercropping (combined over two years).

Treatments	Cuts (t fed^{-1})				
	1st Cut	2nd Cut	3rd Cut	4th Cut	Total
Barley (*cv*. Giza 123)	11.29	5.47	3.14	-	19.90

Barley (*cv*. Giza 2000)	10.68	5.10	2.70	-	18.48
Ryegrass	9.98	7.77	7.95	7.81	33.51
Berseem + barley (*cv*. Giza 123)	14.08	15.97	13.58	9.83	53.46
Berseem+barley (*cv*. Giza 2000)	12.68	13.70	12.80	9.05	48.23
Berseem + ryegrass	13.36	13.69	12.75	9.70	49.50
Berseem	12.53	13.50	12.88	9.10	48.01
LSD 0.05	1.83	2.45	2.30	1.33	4.11



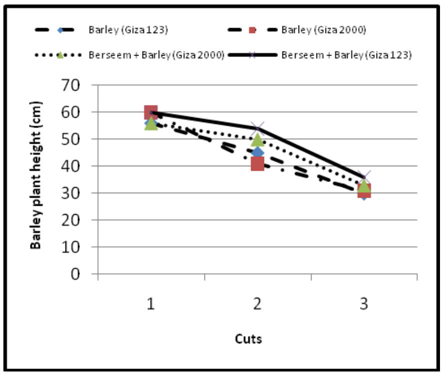


Fig. 1: Forage grasses % intercropped with berseem

Fig. 2: Barley plant height in pure and intercropped with berseem

Concerning, the significant differences between the two cultivars of barley when intercropped with berseem, barley *cv*. Giza 123 showed a success as a companion intercropped with berseem more than barley *cv*. Giza 2000. Holland and Brummer (1999) reported that cultivars of barley and oats differed in their competitiveness in intercropping. Increasing forage production of berseem + barley *cv*. Giza 123 may be due to healthy N2- fixing berseem plant nodules in first and second cuts (Table 3) significantly enhanced growth and yield of barley that reflected in increasing of plant height, Fig. 2.

Table 3: Nodules number (10 plants) and dry weight (mg / 10 plants) of berseem in pure stand or intercropped with barely or rayegrass (over two years)

Treatment	Nodules number		Nodules dry weight	
	1st Cut	2nd Cut	1st Cut	2nd Cut

Berseem + barley (*cv*. Giza 123)	320	390	298	448
Berseem+ barley (*cv*. Giza 2000)	285	335	271	399
Berseem + ryegrass	281	310	252	389
Berseem	270	295	245	365
LSD 0.05	8.2	9.6	10.2	11.3

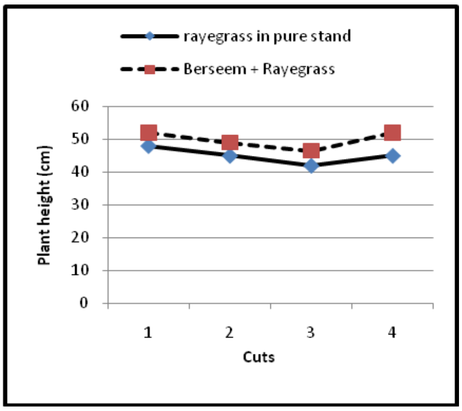
Dry forage yield

Results of dry forage yield for the individual cuts and total yield (combined over two years) of the investigated crops are presented in Table, 4. The obtained results followed the same trend of fresh forage yield, but the magnitude of difference was greater.

Total dry forage yield of pure stand ryegrass surpassed those of barley *cv*. Giza 123 and *cv*. Giza 2000 by 2.08 and 2.26 t fed^{-1}, respectively. Total dry forage yield of pure stand barley *cv*. Giza 123 exceeded that of *cv*. Giza 2000 by 7.7 percent but not reached to the level of significant, Table 4. It is noteworthy that intercropping grasses with berseem improved dry forage yield compared to growing grasses or berseem in pure stands.

Table 4: Dry forage yield (t fed^{-1}) of berseem, barley and ryegrass as affected by planting in pure stand or intercropping (combined over two years).

Treatments	Cuts (t fed^{-1})				
	1st Cut	2nd Cut	3rd Cut	4th Cut	Total
Barley (*cv*. Giza 123)	1.31	0.74	0.48	-	2.53
Barley (*cv*. Giza 2000)	1.26	0.67	0.42	-	2.35
Ryegrass	1.16	1.07	1.21	1.17	4.61
Berseem+barley (*cv*. Giza 123)	1.59	1.83	1.62	1.31	6.35
Berseem+barley (*cv*. Giza 2000)	1.38	1.52	1.48	1.18	5.56
Berseem + ryegrass	1.37	1.69	1.62	1.33	6.01
Berseem	1.21	1.42	1.52	1.32	5.47
LSD 0.05	0.25	0.28	0.26	NS	0.31



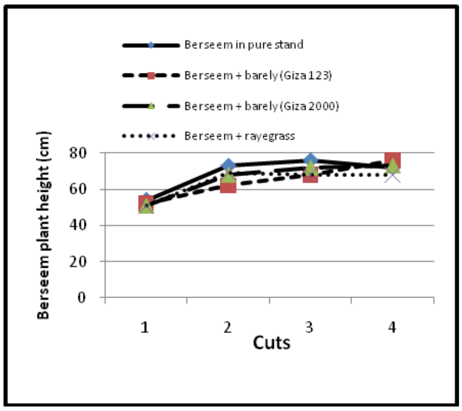


Fig. 3: Ryegrass plant heights (cm) in pure stand and intercropped with Berseem

Fig. 4: Berseem plant height in pure stand and intercropped with grasses

The highest and significant total dry matter yield resulted from berseem intercropped with barley *cv*. Giza 123, which out yielded those of berseem + barley *cv*. Giza 2000, berseem + ryegrass and berseem in pure stand by 14.2, 5.7 and 16.1 percent, respectively. Total dry forage yield of berseem intercropped with ryegrass was significant and higher than that of berseem in pure stand by 9.9 percent, Table 4. These results might be explained by the beneficial effect of closer roots of berseem which led to increase of plant height, Figs 3 and 4. The obtained results are in agreement with Holland and Brummer (1999), Ross *et al*. (2004) and Ioannis and Dhima (2008) but in disagreement with Stoute *et al*. (1997) and Rizk *et al*. (2005).

Chemical composition:

Crude protein:

The investigated treatments varied significantly in crude protein content, within and among cuts, Table 5. Berseem in pure stand consistently had the highest crude protein concentration which ranged from 17.2% in the first cut to 12.7% in the last. Crude protein level declined over time as the stand aged. The higher values of crude protein in berseem are due to the symbiotic fixation, which is reflected in the high number and dry weight of nodules, Table 3. Stoute *et al*., 1997 reported that berseem fixed about 188 kg N ha^{-1} when measured with N^{15}. In

addition, legumes have greater leaves to stem ratio which is a primary sites of photosynthesis and enzymes activity, protein concentration is generally greater in leaves than stem (McAndrews, *et al*., 2004).

Ryegrass in pure stand had the lowest crude protein that ranged from 10.7% in the first cut to 8.7% in the last, Table 5. Crude protein of pure stand barley, averaged over varieties, was the highest in the second cut (12.8%) compared with that of the first (11.68%) and last cut (10.77%). However, crude protein *cv*. Giza 123 surpassed that of *cv*. Giza 2000 by 4% in the first and second cuts, that may attributed to genetic effect, Table 5. These results are in accordance with the results of Abdel-Aziz *et al*. (2007).

Crude protein values of the intercropped treatments were intermediate between the respective values of the extremes (i.e. grass or berseem in pure stands). The values of berseem + barley (averaged over cultivars) ranged from 13.4% in the first to 12.6% in the last cut, whereas, it ranged from 13.0% in the first to 10.2% in the last cut for berseem + ryegrass, Table 5. These results indicate that intercropping legumes (e.g. berseem) with grass (e.g. barley or ryegrass) balances crude protein content in the produced forage which leads to improving nutrient value, livestock bloat avoidance and not loses of important element. The previous results are in agreement with Ross *et al*. (2004) and Ioannis and Dhima (2008).

Crude fiber

Crude fiber of pure stand barley was the highest in the first cut and declined as the stand aged. Crude fiber of barley, averaged over cultivars, ranged from 27% in the first cut to 25.2% in the last, Table 5. The decline in crude fiber of barley may be explained by thinned stems and/or better leaf/ steam ratio in successive cuttings. These results can be supported by those of crude protein in the same table. Crude fiber of pure stand ryegrass increased from 24.24% in the first cut to 28.96% in the last. Crude fiber of pure stand berseem followed the same trend and ranged from 21.5% in the first cut to 27.8% in the last, Table 5.

The increase in crude fiber of ryegrass and berseem over time can be explained by leaf defoliation and/or increase in stem portion of the stand. Crude fiber of intercropped berseem with barley, averaged over two cultivars, ranged from 24.4% in the first cut to 27.7% in the last, whereas, that of berseem + ryegrass ranged from 23.84% in the first to 27.66% in the last, Table 5.

Ash

Barley, ryegrass and berseem in pure stands or intercropped had high percentages of ash. These percentages slightly decreased by successive cuts. Intercropping of berseem with barley did not increase ash percentage for all the three cuts, Table 5. On the other hand, intercropping of berseem with ryegrass resulted in positive increase in ash percentage in all cuts (3.37%). There were significant differences between the two cultivars of barely in ash percentage. Barley (*cv*. Giza 2000) had higher ash percentage than that of *cv*. Giza 123. This might be explained by the ability of this cultivar to scavenge more elements than the other. These results confirmed with the finding of Nor El-Din *el al*., 1992 and Abdel-Aziz *el al*., 2007.

Oil

Berseem in pure stand had the highest EE percentage (1.8 – 1.55%) from first to fourth cut respectively. The lowest values resulted from barley in pure stand, Table 5. No significant differences were detected between barley and ryegrass when intercropped with berseem.

Digestible crude protein (DCP)

Data in Table (5) showed that highest values of DCP were obtained from berseem either in pure stand or intercropped with grasses, while the lowest values were obtained from barley and ryegrass in pure stands, Table 5. We can also observe that increasing DCP% by increasing of CP% in all successive cuts. Intercropped berseem with barley *cv*. Giza 123 had higher DCP% (8.77, 9.37, 8.41) than intercropped berseem with barley *cv*. Giza 2000. We can also observe that DCP% of berseem + ryegrass was lower than that of berseem + barley in all successive cuts. This might be due to decreasing CP% of the companion ryegrass.

Table 5: Chemical constituents (%) of barley, ryegrass and berseem as affected by planting in pure stand intecropping (combined over two years).

Treatment	Cut1							
	CP	CF	Ash	EE	OM	NFE	DCP	TDN
Barley (1)*	11.92	27.22	15.40	1.55	84.60	43.91	7.20	58.13
Barley (2)*	11.44	26.83	14.90	1.55	85.10	45.28	6.76	59.25
Ryegrass	10.70	24.24	14.70	1.60	85.30	48.76	6.08	60.54
Berseem + barley (1)	13.65	24.29	14.18	1.62	85.82	46.26	8.77	56.77
Berseem +	13.15	24.51	14.25	1.61	85.75	46.48	8.32	57.41

barley (2)								
Berseem + ryegrass	13.01	23.84	15.70	1.65	84.30	45.80	8.19	56.41
Berseem	17.20	21.50	15.10	1.80	84.90	44.40	12.01	51.05
LSD 0.05	0.35	0.09	0.08	0.05	-	-	0.11	0.09
	Cut 2							
Barley (1)*	13.05	23.57	14.54	1.48	85.46	47.36	8.23	57.17
Barley (2)*	12.55	25.63	12.97	1.48	87.03	47.37	7.77	59.26
Ryegrass	10.44	24.70	14.57	1.50	85.43	48.79	5.85	60.93
Berseem + barley (1)	14.31	24.14	12.70	1.63	87.30	47.22	9.37	57.11
Berseem + barley (2)	13.88	24.60	12.54	1.64	87.46	47.34	8.98	57.88
Berseem + ryegrass	13.05	26.10	13.05	1.62	86.95	46.18	8.23	58.62
Berseem	15.44	25.20	12.73	1.81	87.27	44.82	10.40	55.66
LSD 0.05	0.15	0.11	0.08	0.05	-	-	0.13	0.10
	Cut 3							
Barley (1)*	10.81	25.10	14.00	1.50	86.00	48.59	6.18	60.88
Barley (2)*	10.73	25.35	13.73	1.52	86.27	48.67	6.11	61.26
Ryegrass	9.57	26.20	12.90	1.50	87.10	49.83	5.05	63.63
Berseem + barley (1)	13.25	27.80	13.93	1.57	86.07	43.45	8.41	57.51
Berseem + barley (2)	12.12	27.60	12.73	1.57	87.27	45.98	7.38	60.18
Berseem + ryegrass	12.00	27.00	13.69	1.58	86.31	45.73	7.27	59.53
Berseem	14.05	26.30	13.13	1.70	86.87	44.82	9.14	57.20
LSD 0.05	0.14	0.12	0.08	NS	-	-	0.13	0.08
	Cut 4							
Barley (1)*	-	-	-	-	-	-	-	-
Barley (2)*	-	-	-	-	-	-	-	-
Ryegrass	8.70	28.96	12.26	1.50	87.74	48.58	4.26	65.44
Berseem + barley (1)	12.65	25.17	13.73	1.53	86.27	46.92	7.86	58.50
Berseem + barley (2)	12.61	25.66	13.69	1.53	86.31	46.51	7.82	58.59
Berseem + ryegrass	10.20	27.66	13.56	1.51	86.44	47.08	5.63	62.16
Berseem	12.70	27.80	13.20	1.55	86.80	44.75	7.36	58.91
LSD 0.05	0.14	0.09	0.09	NS	-	-	0.11	0.08

***(1) = Barley cv.. Giza 123 and (2) = barley cv.. Giza 2000**

Total Digestible nutrients (TDN)

There were considerable differences in TDN between berseem in pure or intercropped stand. The lowest TDN% resulted from berseem cultivated in pure stand in all successive cuts except at the fourth cut. On the other hand, ryegrass had the highest values of TDN, Table 5. In general, intercropping of berseem with forage grasses positively reflected in increasing of TDN% compared with pure berseem. Intercropping of berseem with barley (average of the two cultivars) gave TDN values of 57.09, 57.50 and 58.85% compared to intercropping berseem with ryegrass which gave 56.41, 58.62 and 59.53% for the three successive cuts, respectively.

Improving of TDN due to intercropping berseem with forage grasses was pronounced especially with ryegrass which is continued because of its duration in the stand from first to fourth cut. The obtained results are in agreement with Mostafa *et al*. (1996).

Calcium and Phosphorus

Calcium (Ca) and Phosphorus (P) concentrations were determined in the harvested plants, Table 6. Berseem and barely in pure stands were inferior to pure stand ryegrass in the first and second cut with respect to phosphorus. However, no considerable differences were detected in the third or fourth cut. Berseem in pure stand possessed higher calcium concentration that ranged from 1.88% in the first cut to 2.01% in the last, compared to barley (0.53 – 0.31%) and ryegrass (1.5 – 0.81%). Ca/P ratio ranged from 1.42 to 1.02 for pure stand barley, and from 2.94 to 2.79 for pure stand ryegrass. These values are assumed to properly meet livestock requirements, since, the ratio of the two minerals in bone 2:1 (McDowell *et al*., 1983). The Ca/P ratio in pure stand berseem was highest and ranged from 5.69 to 6.93. Intercropping of berseem with barely or ryegrass successfully modified the Ca/P ratio in the forage. Ca/P ratio in the forage resulting from pure stand berseem was narrowed from (5.69, 5.25. 7.03 and 6.93) to (2.5, 3.23, 5.00 and 5.30) in that resulting from intercropped with ryegrass and to (3.03, 3.60, 5.60 and 6.35) in that resulting from berseem intercropped with barley. These results are in line with Abou-Raya and Ibrahim, 1973 and Abdel-Aziz *et a*l., 2007.

Table 6: Calcium and phosphors percentage of Ca/P ratio of forage crops as affected by planting pure or intercropped stands.

Treatment	1st Cut			2nd Cut			3rd Cut			4th Cut		
	Ca	P	Ca/P	Ca	P	Ca/P	Ca	P	Ca/P	Ca	P	Ca/P
Barley (1)*	0.56	0.39	1.44	0.39	0.33	1.18	0.31	0.31	1.00	-	-	-
Barley (2)*	0.49	0.35	1.40	0.39	0.30	1.30	0.30	0.29	1.03	-	-	-
Ryegrass (3)*	1.50	0.51	2.94	1.25	0.45	2.78	1.00	0.33	3.03	0.81	0.29	2.79
Berseem+ 1	1.07	0.37	2.89	1.20	0.35	3.42	1.80	0.33	5.45	1.90	0.30	6.33
Berseem+ 2	1.05	0.33	3.18	1.25	0.33	3.78	1.85	0.32	5.76	1.91	0.30	6.36
Berseem+ 3	1.06	0.42	2.50	1.26	0.39	3.23	1.55	0.31	5.00	1.59	0.30	5.30
Berseem	1.88	0.33	5.69	1.84	0.35	5.25	2.18	0.31	7.03	2.01	0.29	6.93

*(1) = Barley cv. Giza 123, * (2) = barley cv. Giza 2000 and * (3) = ryegrass

It could be concluded from these results that intercropping berseem with grasses improved crude protein content, TDN and Ca/P ratio in addition to producing more dry matter yield, compared with pure stand berseem. Hence, intercropping legumes with grasses can be used as a suitable management strategy to maximize yield and improve forage quality. It should be taken into consideration that more investigations are needed to study the response of the two barley varieties to frequent cutting in pure stand as well as intercropped with other berseem varieties under different conditions.

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تقييم أنتاجية محصول العلف وجودته عند زراعة الشعير وحشيشة الراى منفردا أو محملا مع البرسيم المصرى

أمل أحمد حلمى ، وفاء محمد شعراوى و هدى محمد إبراهيم أمام
قسم بحوث محاصيل العلف – معهد بحوث المحاصبل الحقلية – مركز البحوث الزراعية – جيزة– مصر

أقيمت تجربتان حقليتان خلال موسمى ٢٠٠٧/٢٠٠٦ ، ٢٠٠٧/ ٢٠٠٨ بمزرعة محطة البحوث الزراعية بسدس - مركز البحوث الزراعية و تهدف هذه الدراسة الى:

١- تقييم سلوك صنفي الشعير جيزة ١٢٣ ، جيزة ٢٠٠٠ كمحصول علف نجيلى متعدد الحشات عند زراعة كل منهما منفردا أو محملا مع البرسيم المصرى صنف جيزة ٦.

٢- مقارنة محصول وجودة العلف الناتج من الشعير والراى جراس والبرسيم عند زراعة كلا منهم منفردا أو محملا (برسيم + شعير ، برسيم + راى جراس).

أوضحت النتائج تفوق المحصول الكلى (مجموع الحشات) للعلف الأخضر الناتج من زراعة الراى جراس منفردا بمقدار ١٣,٦١ ، ١٥,٠٣ طن / فدان على مثيله الناتج من زراعة كل من صنفى الشعير جيزة ١٢٣ وجيزة ٢٠٠٠ منفردا على الترتيب. وقد تفوق محصول العلف الأخضر الكلى لصنف الشعير جيزة ١٢٣ بمقدار ١,٤٢ طن / فدان على مثيله الناتج من الصنف جيزة ٢٠٠٠.

أظهرت أيضا النتائج تفوق محصول العلف الأخضر الكلى للبرسيم محملا مع الشعير صنف جيزة ١٢٣ على مثيله من البرسيم مع الشعير صنف جيزة ٢٠٠٠ أو البرسيم منفردا بنسبة

١٠,٨، ١١,٤% على الترتيب. وكان المحصول الكلى للعلف الأخضر الناتج من زراعة البرسيم مع الراى جراس اقل بمقدار ٩٦و٣ طن / فدان عن البرسيم مع الشعير صنف جيزة ١٢٣ ولكنه كان اعلى بمقدار ١,٢٧ ، ١,٤٩ طن / فدان عن البرسيم مع الشعير صنف جيزة ٢٠٠٠ او البرسيم منفردا على الترتيب .هذا وقد سلك المحصول الجاف نفس إتجاه المحصول الأخضر لكن مع إتساع مدى الفروق بين المعاملات.

اوضحت النتائج ان الشعير صنف جيزة ١٢٣ كان أكثر نجاحا كمحصول مرافق للبرسيم عن كل من الصنف جيزة ٢٠٠٠ وكذا الراى جراس من حيث إنتاجية العلف ولكن الراى جراس كان أفضل من حيث الإستدامة والإستجابة للحش المتكرر وجودة العلف الناتج.

أشارت أيضا النتائج الى ارتفاع القيمة الغذائية للعلف الناتج من تحميل الراى جراس أو الشعير مع البرسيم وانعكس ذلك على تصحيح قيم البروتين الخام والمواد الغذائية الكلية المهضومة. وإتزان نسبة الكالسيوم الى الفوسفور فى محصول العلف الناتج.

توصى هذه الدراسة للحصول على أعلى محصول علف من وحدة المساحة كما ونوعاً وذلك بزراعة البرسيم المصرى مخلوطاً مع الشعير جيزة ١٢٣ بنسبة ٥٠%:٥٠%.

قام بتحكيم البحث

أ.د / أحمد أبو النجا قنديل	كلية الزراعة – جامعة المنصورة
أ.د / محمد أبو زيد النحراوي	مركز البحوث الزراعية