Bull. Fac .Agric., Cairo Univ., 68:237-250 (2017).

EFFECT OF CUTTING INTERVAL AND INTERCROPPING SYSTEM OF MONOCOT EGYPTIAN CLOVER WITH BARLEY ON GRAIN, FORAGE YIELD AND NUTRITIVE VALUE OF MIXTURE.

(Received: 28.11.2017)

By
A.M. Abdel-Galil , * H.A. Ashmawy, ** S.S.M. Abo Feteih and * H.E.A. El-Nady

*Crop intensification Research Department, *Barley Research Department, ** Forage Crop Research Department , Field Crops Research Institute, Agriculture Research Center, Giza*

ABSTRACT

The present experiment was carried out at Giza Experiment Station, ARC, Giza, Egypt, during 2013/14 and 2014/15 winter seasons. The aim was to study the effect of three cutting intervals after sowing date [50 days (C_1), 75 days (C_2) and at harvest 150 days (C_3)] under three intercropping systems barely and berseem T_1= (100%:25%), T_2= (100%:50%) and T_3= (100%:75%) of barley (c.v. Giza 2000): Fahl berseem, respectively. In addition to two sole stands of the two crops according to the technical measures for both crops, to examine its effect on grain yield for barely and forage yield from a mixture of barley and Fahl berseem, competitive relationships and total income. The experiment was arranged in split plot based on randomized complete block design in three replications. Results showed that cutting at harvest day 150d (C_3) had significant effect on spike length, grain number spike^{-1}, 1000 grain weight and straw yield of barley. Whereas, cutting after 75 day (C_2) had significant effect on fresh yield, dry forage, nutrient value of barley and Fahl berseem mixture. Effect of intercropping system (T_3) was meaningful on plant height, spike length, grain number spike^{-1}, grain yield and straw yield of barley, as well as intercropping system (T_3) had significant effect on the number of branches plant^{-1}, leaves stem^{-1} ratio and fresh, dry yields, nutritive value of barley and Fahl berseem mixture. Cutting interval x intercropping system (C_3xT_3) had significant effect on spike length, grain number spike^{-1}, 1000 grain weight, biological yield, grain yield and straw yield of barley in both seasons. Whereas, cutting interval after 75 days and intercropping system (C_2xT_3) gave the highest values of fresh, dry forage yield and nutritive value of barley and fahl berseem mixture in both seasons. The highest land equivalent Ratio (LER) and economic returns . (C_2xT_3) demonstrated superiority of the intercropping system to sole barley culture. It is evident that cutting interval at 75 day and cropping system T_3 (100% barley+75% fahl berseem) may be the best practice to maximize the economic return of grain and forage yields for farmer.

Key words*: *Barley (Hordeum vulgar L), Fahl Berseem (Trifolium alexandrinum L), Cutting intervals, Intercropping systems, Nutritive value, LER, Total income.

1.INTRODUCTION

Increasing agricultural production to meet increasing demand for food sources is inevitable (FAO, 2006). Intercropping is the cultivation of two or more plant species at the same time in the same field in their growth period where most of the plants are in close proximity to each other (Caballero *et al.,* 2001). One of the main reasons that farmers all around the world are eager to use intercropping system is that the yield obtained from intercropping is more than monoculture in the same field (Yang *et al.,* 2009). Increasing production at intercropping may be related to reduction of weed growth, reduction of pest and disease damages (Sekamatte *et al.,* 2003), and more growth rate and better use of available resources (Gustave *et al.* 2008). Cutting interval is an important agronomic factor which greatly influences the micro climate of the field and eventually yields and quality parameters of agricultural crops. Potential benefits of intercropping berseem clover with cereal crops include increased total dry matter (DM) yields, improved forage quality, reduced fertilizer needs, and increased subsequent crop yield (Stout *et al.* 1997). Abou- Kerisha, *et al*. (1996) indicated that seeding 75%, 50% and 25% fahl berseem, plus 25 %, 50% and 75% barley in

complement mixtures gave more yield than pure fahl berseem. They also evidenced that mixing fahl berseem with barley resulted in higher values barley traits as compared to pure stand barley. Berseem improved the forage quality and yields of barley–ryegrass–legume intercrops more than did annual *Medicago* and *Lespedeza* species. Radwan *et al.*, (1983) reported that seed of fahl berseem can be produced by inter-seeding with grain barley without reducing grain yield. Intercropping of fahl berseem with barely aimed to providing the farmers green forage and rising grain yield of barely with improved soil fertility. The main aims of this study were to examine the effects of cutting intervals and intercropping systems on forage yield, forage nutritive value, grain yield and beneficial index of intercropping system, improving the proportion of protein, fiber and forage yield competitive relationships and total income, in a mixture of barley and fahl berseem.

2.MATERIALS AND METHODS

Two field experiments were carried out at Giza Experiment Station, ARC, Giza, Egypt, during 2013/2014 and 2014/2015 seasons. Soil was analyzed according to Page *et al.* (1982). Soil texture was clay loamy and its characteristics are shown in Table (1).

The objective of this study was to investigate the effect of cutting intervals under three intercropping system of barley (*Hordum vulgare* L.); Giza 2000 with the Mono-cut Egyptian clover (fahl berseem). Three cutting intervals and three intercropping systems was arranged in split plot based on randomized complete block design in three replications. The main plots were devoted for cutting intervals, whereas intercropping systems occupied subplots.

The tested treatments were as follows:

Cutting intervals (C) after sowing date (15^{th} November in two years) :

C1- was taken after 50 days, C2- interval after 70 days and C3- after 150days at harvested day.

Intercropping systems (T) (based on seed weight).

T1-100% barley (50kg fed^{-1}) +25% fahl berseem (5 kg fed^{-1}).

T2-100% barley (50kg fed^{-1}) + 50% fahl berseem (10kg fed^{-1}).

T3-100% barley (50kg fed^{-1}) +75% fahl berseem (15kg fed^{-1}).

In addition, two sole stands of the two crops as recommended on seed rates barley 50 kg fed^{-1} and fahl berseem 20 kg fed^{-1}, were used.

Barley was sown in plot size 10.0 m^2 (10 rows 0.5 m length at a distance at 20cm apart) and fahl berseem was broadcasted in barley plots. Phosphorus and potassium fertilizers were applied prior to land preparation at the rate of 30 kg P_2O_5 fed^{-1} and 24 kg K_2O in the form of super phosphate (15.5% P_2O_5) and potassium sulfate (48% k_2O), respectively. Nitrogen fertilizer was applied in the form of ammonium nitrate (33.5%) in three equal doses; the first dose was at sowing and the other two doses were applied at 21 and 35 days after sowing.

At cutting: ten plants from the inner row of barely and berseem intercropping and solid crops were taken randomly to determine yield parameters, while the yield fed^{-1} was determined from the whole plots.

The studied growth and yield parameters are recorded as follows (after separating the barley and fahl berseem in plots):

A. barley: plant height (cm), spike length (cm), number of kernels $spilke^{-1}$, spike kernels weight (g),1000-kernel weight (g), biological yield (ton fed^{-1}), grain yield (ton fed^{-1}), straw yield (ton fed^{-1}), fresh forage yield and dry forage yield.

B. Berseem: (Mono-cut variety) plant height cm, no. of branches, leaves/ stem ratio%, fresh yield ton fed^{-1}, dry yield ton fed^{-1}, seed yield ton fed^{-1} and straw yield ton fed^{-1}

C. Agronomic and Chemical Composition

Nutritive value; sub sample of 0.5 m x 0.5 m=0.25 m^2 weighted as fresh and dried at 65º C and weighed to determine DM % for all treatments. Plant samples of each unit were

Table (1): Mechanical and chemical analysis of the experimental soil.

Coarse Sand(%)	Fine Sand%	Silt(%)	Clay(%)		Soil texture	OM		$CaCO_3$(%)
6.0	5. 3	38.3	50.4		Clay Loamy	1.17		1.43
pH	EC (dS/m)	Cations (meq/l)				Anions (meq/l)		
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO^{-}	Cl^{-}	SO^{--}
7.80	1.15	9.32	2.88	22.20	0.76	1.40	10.60	16.05

collected, weighted, dried and ground in a grinding mill. The samples were analyzed according to AOAC (2000) to determine crude protein (CP), crude fiber (CF). Total digestible nutrient (TDN) was calculated as TDN= 50.41+1.04CP-0.07CF, according to Church (1979) and digestible crude protein (DCP was calculated as DCP= (CP X 0.9115) - 362) according to Mcdonald *et al*. (1978).

Land equivalent ratio (LER)

LER is determined as the sum of the fractions of the yield of the intercrops relative to their sole crop yields (Willey and Rao, 1980). Land Equivalent Ratio (LER) was determined according to the following formula:

$$LER = \frac{Y_{ab}}{Y_{aa}} + \frac{Y_{ba}}{Y_{bb}}$$

Where Yaa = Pure stand yield of barley, Ybb= Pure stand yield of fahl berseem, Yab= Mixture yield of a when combined with b. Yba = Mixture yield of b when combined with a.

Economic evaluation

The economic evaluation included the following three parameters:

1- Average of input variables as well as the total costs of inter cropping berseem Fahl and barely production including fertilization treatments and other cultural practices applied during the growth stages (*i.e.,* average land rent is not included).

2- Net farm return of inter cropping berseem Fahl and barely production as affected by the applied treatments. It is calculated as the difference between the grain and forage yield value (according to the actual price) and the total costs.

All fertilizers and seed prices as well as the costs of all farm operations are based on the official and the actual market prices determined by the Egyptian Ministry of Agriculture **(**Anonymous, 2014). Total costs included values of production tools and requirements such as seeds, fertilizers, irrigation, laborers, power, machinery and other general or different costs.

The obtained data were statistically analyzed according to Snedecor and Cochran (1980). Bartelett's test of homogeneity indicated no statistical evidence for heterogeneity. Thus, combined analyses of variance for two experimental sites in each experiment were done. Treatment means were compared using least significant differences LSD at probability level of 5 %.

3. RESULTS AND DISCUSSION

3.1. Agronomic traits of barley crop

3.1.1. Plant height and Spike length

Data presented in Table (2) show the means of plant height and spike length growth characters in 2013/2014 and 2014/2015. Plant characters such as plant height and spike length, were significantly affected due to the cutting intervals. Without cutting at harvest day (C_3) gave the highest plant height (87.35 and 93.98 cm) and spike length (8.50 and 9.90 cm) in 2013/14 and 2014/2015,respectively. It also showed significant effect on plant height and spike length due to the intercropping system, where (barley 100% + barseem 75%) (T_3) gave the highest plant height (70.33 and 75.67 cm) and highest spike length (8.77 and 9.10 cm) in the 1st and 2nd seasons, respectively.

The most success in high plant density at intercropping is related to more attraction of sunlight at early plant sowing stage and better competition of this system with weed (Boquet *et al.,* 2003).

For the interaction effect of cutting intervals x intercropping system, on plant height, the higher values (88.3 and 95.3 cm) were obtained from use (C_3 x T_3) in the 1st and 2nd season respectively. While, the tallest spike length, (10.2 and 9.7) were obtained from use (C_1 x T_1) in the 1st and 2nd season respectively.

The combined analysis over the two seasons showed significant effects for the interaction of cutting intervals x intercropping system, the tallest plants (91.8cm) were produced by (C_3 x T_3), while the tallest spike length (10.15cm) was produced by (C_1 x T_2). Increase of barley plant height at intercropping may be related to increasing of N availability which was fixed by legume. These results agree with Sara *et al.,* (2014) who investigate the intercropping of barley (*Hordeum vulgare* L.) and *(Trifolium resupinatum* L.)

3.1.2. Yield and yield component of barley

3.1.2.1. Number kernels spike^{-1}, Spike kernels weight and 1000-kernel weight

Results in Table (3) showed that the number of kernels Spike^{-1}, spike kernels weight and 1000-kernel weight were significantly affected by cutting intervals ($p \leq 0.05$). The results showed that the highest number of grains spike^{-1} (58.85 and 53.1), spike kernels weight (3.59 and 5.65g) and the highest 1000-kernel weight (61.3 and 59.1g) were recorded by cutting intervals (C_3), in the 1st and 2nd season respectively.

Table (2): Average of plant height and spike length of barley as affected by cutting interval and intercropping system and their interaction in 2013/14 and 2014/15 at Giza.

Treatments	2013/2014		2014/2015		Combine	
	Barley		Barley		Barley	
	Pl-Ht (cm)	SP-L (cm)	Pl-Ht (cm)	SP-L (cm)	Pl-Ht (cm)	SP-L (cm)
Cutting*:						
C_1	61.33	9.60	65.85	8.55	63.59	9.08
C_2	48.20	8.00	51.68	8.15	49.94	8.08
C_3	87.35	8.50	93.98	9.90	90.66	9.20
LSD at 5%	3.4	0.6	3.2	0.7	2.9	0.4
Intercropping system **:						
T_1	66.43	8.63	69.57	8.10	68.00	8.37
T_2	65.90	8.83	68.87	8.63	67.38	8.73
T_3	70.33	8.87	75.67	9.10	73.00	8.73
T_4	59.83	8.77	67.90	9.63	63.87	8.99
LSD at 5%	4.0	0.5	3.2	0.5	2.3	0.3
$C_1 \times T_1$	63.3	10.2	60.7	9.7	62.0	9.95
$C_2 \times T_1$	48.3	7.2	52.0	8.3	50.2	7.75
$C_3 \times T_1$	87.7	8.5	96.0	9.3	91.8	8.90
$C_1 \times T_2$	66.0	10.0	69.0	10.3	67.5	10.15
$C_2 \times T_2$	45.0	8.3	44.3	7.3	44.7	7.80
$C_3 \times T_2$	86.7	8.2	93.3	8.3	90.0	8.25
$C_1 \times T_3$	67.7	8.7	68.0	8.3	67.8	8.50
$C_2 \times T_3$	55.0	8.5	63.7	7.7	59.3	8.10
$C_3 \times T_3$	88.3	8.5	95.3	8.3	91.8	8.40
$C_1 \times T_4$	48.3	9.5	65.7	11.3	63.7	10.40
$C_2 \times T_4$	44.5	8.0	46.7	9.3	45.6	8.65
$C_3 \times T_4$	86.7	8.8	91.3	8.3	89.0	8.55
Average	65.6	8.7	70.5	8.9	68.1	8.8
LSD at 5%	9.0	0.95	7.2	1.1	5.0	0.8
CV	9.82%	9.64%	7.09%	9.37%	7.68%	9.36%

***cutting intervales:** C_1= at 50 days ,C_2=at 75 days, and C_3=at harvest

****Intercropping systems** :T_1=100% barley +25% fahl berseem.
T_2=100% barley + 50% fahl berseem.T_3=100% barley +75% fahl berseem and T_4=100% barley (sole seeding).

Shendy (2015) showed that the cutting treatment (without and one cut)had significant effect on the number of spikes m^2, 1000 kernels weight (g), number of kernels spike^{-1}, kernels weight (g),straw yield (t fed^{-1}) grain yield(t fed^{-1}) and protein contents (%). The intercropping system showed significant differences in the number of kernels Spike^{-1}, spike kernels weight and 1000-kernels weight T_3 gave the highest number of kernels spike^{-1} with an average of (51.8 and 46.03), spike kernels weight with an average of (3.01 and 5.38g) and 1000-kernel weight with an average of (59.1g and 59.8g) in the 1st and 2nd season respectively. These results are in agreement with those of Shendy (2015).

Number of kernels spike^{-1}, spike kernels weight and 1000-kernels weight were significantly influenced by the interaction of cutting intervals and intercropping system in both seasons. (C_3 x T_3) gave the highest number of kernels spike^{-1} with an average (65.7 and 66.7) in 2013/2014 and 2014/2015. Also (C_3 x T_3) gave the heaviest kernel weight (3.56 and 5.60) in the 1st and 2nd season respectively. For 1000- kernel weight, (C_3 x T_3) gave the heaviest 1000- kernel weight (61.2 and 59.3) in the 1st and 2nd season respectively.

These results are in agreement with, Abou – Kerisha *et al.,* (1996) who showed that sowing 25% fahl berseem plus 75% barely gave the highest number of kernels^{-1} spike and kernels weight spike^{-1}. While, 50% fahl berseem plus 50% barley gave the highest 1000-kernal weight. The combined analyses over the two seasons showed that the highest value of the number of grains spike^{-1} (66.20), spike kernels weight (4.58g) and 1000-kernel weight (60.3g) were produced from (C_3 x T_3).

Table (3): Average of no. grains /spike (K/SP), spike kernel weight (SKW), and 1000 kernels weight (100KW) of barley as affected by cutting interval and intercropping system and their interaction in 2013/14 and 2014/15 at Giza.

Treatments	2013/2014			2014/2015			Combine		
	No. of grains spike	Spike kernels weight	1000 kernels weight	No. of grains spike	Spike kernels weight	1000 kernels weight	No. of grains spike	Spike kernels weight	1000 kernels weight
Cutting*:									
C_1	51.93	2.88	57.7	48.50	5.43	57.41	50.22	4.16	57.4
C_2	41.65	2.44	57.9	47.35	5.28	54.3	44.50	3.86	56.1
C_3	58.85	3.59	61.3	53.10	5.65	59.1	55.98	4.62	60.2
LSD at 5%	4.3	0.26	0.24	5.4	0.34	3.15	3.5	0.20	1.11
Intercropping system:**									
T_1	50.00	3.04	59.4	52.13	5.49	55.4	51.07	4.27	57.4
T_2	51.87	3.03	59.2	52.53	5.48	55.2	52.20	4.26	57.2
T_3	51.80	3.01	59.1	46.03	5.38	59.8	48.92	4.20	59.5
T_4	49.57	2.80	58.2	47.90	5.48	51.9	48.73	4.14	55.1
LSD at 5%	3.8	0.23	0.13	4.4	0.26	2.11	2.7	0.16	0.9
$C_1 \times T_1$	53.7	3.15	58.6	55.0	5.60	57.0	54.35	4.38	57.8
$C_2 \times T_1$	42.3	2.55	59.3	51.7	5.23	54.3	47.00	3.89	56.8
$C_3 \times T_1$	54.0	3.51	60.2	49.7	5.63	55.0	51.85	4.57	57.6
$C_1 \times T_2$	56.3	3.15	57.1	52.3	5.20	53.7	54.30	4.18	55.4
$C_2 \times T_2$	37.3	2.17	57.1	42.3	5.33	48.0	39.80	3.75	52.6
$C_3 \times T_2$	62.0	3.77	60.5	63.0	5.90	60.0	62.50	4.84	60.3
$C_1 \times T_3$	49.0	2.75	56.9	42.7	5.23	50.7	45.85	3.99	53.8
$C_2 \times T_3$	45.7	2.71	59.1	48.7	5.30	43.3	47.20	4.01	51.2
$C_3 \times T_3$	65.7	3.56	61.2	66.7	5.60	59.3	66.20	4.58	60.3
$C_1 \times T_4$	48.7	2.45	58.2	44.0	5.70	54.0	46.35	4.08	56.1
$C_2 \times T_4$	41.3	2.34	55.9	46.7	5.27	44.3	44.00	3.81	50.1
$C_3 \times T_4$	58.7	3.60	60.5	53.0	5.47	57.3	55.85	4.54	58.9
Average	50.81	2.97	58.7	49.7	55.0	53.1	50.2	4.4	57.9
LSD at 5%	6.9	0.33	3.30	5.6	2.20	4.25	6.1	0.35	2.9
CV	12.14%	12.97%	3.67%	15.4%	7.10%	7.10%	13.12%	8.93%	4.91%

***cutting intervales:**
C_1= at 50 days C_2=at 75 days C_3=at harvest
****Intercropping systems :T_1=100% barley +25% fahl berseem. T_2=100% barley + 50% fahl berseem.**
T_3=100% barley +75% fahl berseem. T_4=100% barley (sole seeding).

3.1.2.2. Biological yield (t fed^{-1})

The data in Table (4) showed that the biological yield was significantly affected by cutting intervals ($p \leq 0.05$). The highest value of biological yield (12.19 and 11.53 t fed^{-1}) was produced from cutting intervals (C_3), in the 1st and 2nd seasons respectively. The combined analyses over two seasons showed the highest biological yield (11.86 t fed^{-1}), which was produced from cutting intervals (C_3). The intercropping system showed significant differences in the biological yield; (T_1) gave the highest biological yield with an average of (11.01 and 9.42 t fed^{-1}**)** in the 1st and 2nd seasons, respectively. Also, it was noticed that (T_3) gave higher averages of biological yield (10.21 t fed^{-1}) in combined analysis over the two seasons. The interaction effect between cutting intervals x intercropping systems was significant (C_3xT_3) produced the highest value of the biological of yield 11.78 and 11.48 t fed^{-1}, in the 1st and 2nd seasons respectively. The combined analyses over two seasons showed that the highest value of the biological yield (11.63 t fed^{-1}) was produced from (C_3xT_3). These findings are in agreement with those of Sara *et al.* (2014) and Abou – Kerisha *et al.,* (1996).

3.1.2.3. Grain Yield (t fed^{-1})

The data in Table (4) showed significant differences among cutting intervals and intercropping system as well as the interaction between cutting intervals and intercropping system of grain yield in 2013/2014 and 2014/2015. Grain yield gave (3.54 and 3.40 t fed^{-1}) with cutting intervals (C_3),in the 1st and 2nd season respectively. As combined over two seasons, the highest grain yield (3.47 t fed^{-1}) was also produced from cutting intervals (C_3). These findings are in agreement with those of Shendy (2015).

Table (4): Average of biological yield (BY), grain yield (GY) and straw yield (SY) of barley as affected by cutting interval, intercropping system and their interaction in 2013/14 and 2014/15 at Giza.

Treatments	2013/2014			2014/2015			Combine		
	BY (t fed^{-1})	GY (t fed^{-1})	SY (t fed^{-1})	BY (t fed^{-1})	GY (t fed^{-1})	SY (t fed^{-1})	BY (t fed^{-1})	GY (t fed^{-1})	SY (t fed^{-1})
Cutting*:									
C_1	9.90	2.55	7.35	8.48	2.05	6.43	9.19	2.30	6.89
C_2	7.88	1.96	5.92	7.22	2.03	5.19	7.55	1.99	5.56
C_3	12.19	3.54	8.65	11.53	3.40	8.13	11.86	3.47	8.39
LSD at 5%	1.87	0.93	1.33	1.86	0.89	1.96	0.89	0.16	1.85
Intercropping system:**									
T_1	11.01	2.74	8.27	9.42	2.25	7.17	10.21	2.50	7.72
T_2	10.04	2.65	7.39	9.35	2.72	6.63	9.69	2.69	7.01
T_3	9.77	2.90	6.87	8.44	2.64	5.80	9.10	2.77	6.33
T_4	9.13	2.43	6.70	9.10	2.36	6.74	9.12	2.40	6.72
LSD at 5%	1.80	0.47	0.73	1.26	0.77	1.20	1.47	0.47	0.99
C_1 x T_1	10.99	2.62	8.37	9.31	1.75	7.56	10.15	2.19	7.97
C_2 x T_1	8.41	1.90	6.51	7.23	1.82	5.41	7.82	1.86	5.96
C_3 x T_1	13.63	3.69	9.94	11.71	3.17	8.54	12.67	3.43	9.24
C_1 x T_2	10.05	2.48	7.57	8.68	2.14	6.54	9.37	2.31	7.06
C_2 x T_2	8.67	2.10	6.57	8.41	2.56	5.85	8.54	2.33	6.21
C_3 x T_2	11.4	3.38	8.02	10.95	3.46	7.49	11.18	3.42	7.76
C_1 x T_3	9.86	2.88	6.98	7.56	2.21	5.35	8.71	2.55	6.17
C_2 x T_3	7.66	2.07	5.59	6.27	1.89	4.38	6.97	1.98	4.99
C_3 x T_3	11.78	3.75	8.03	11.48	3.82	7.66	11.63	3.79	7.85
C_1 x T_4	8.69	2.20	6.49	8.38	2.10	6.28	8.54	2.15	6.39
C_2 x T_4	6.76	1.75	5.01	6.95	1.83	5.12	6.86	1.79	5.07
C_3 x T_4	11.95	3.34	8.61	11.96	3.15	8.81	11.96	3.24	8.71
Average	9.99	2.7	7.31	9.07	2.5	6.58	9.53	2.6	6.95
LSD at 5%	1.90	0.80	1.50	2.20	0.83	1.67	1.90	0.52	3.58
CV	20.87%	12.80%	24.12%	20.29%	16.52%	26.40%	19.58%	13.93%	23.94%

***cutting intervales:**
C_1= at 50 days C_2=at 75 days C_3=at harvest
****Intercropping systems :** T_1=100% barley +25% fahl berseem. T_2=100% barley + 50% fahl berseem.
T_3=100% barley +75% fahl berseem. T_4=100% barley (sole seeding).

The intercropping system showed significant differences in grain yield. T3 gave the highest grain yield with an average of (2.90 and 2.64 t fed^{-1}**)** in the 1st and 2nd seasons, respectively. (T_3) gave the highest grain yield (2.77 t fed^{-1}) in combined analysis over the two seasons. The interaction effect between cutting intervals and intercropping system was highly significant (C_3x T_3) produced the highest value of grain yield(3.75 and 3.82 t fed^{-1}), in the 1st and 2nd season respectively.(C_3 x T_3) gave the highest grain yield with an average of (3.79 t fed^{-1}) in combined analysis over the two seasons. Similar results were obtained Sara *et al.,* (2014) and Abou-kerish *et al*.,(1996).

3.1.2.4. Straw Yield (t fed^{-1})

Data presented in Table (4) revealed high significant differences among cutting intervals and intercropping systems as well as the interaction between them for straw yield in 2013/2014 and 2014/2015 seasons. Straw yield gave (8.65 and 8.13 t fed^{-1}) with cutting intervals (C_3**)** in the 1st and 2nd season respectively. As an average over the two seasons, cutting intervals gave the highest straw yield (15.76 t fed^{-1}).

The intercropping system showed significant differences in straw yield; (T1) gave the highest straw yield with an average of (8.27 and 7.17 t fed^{-1}**)** in the 1st and 2nd season respectively. Intercropping system (T3) gave the highest straw yield (7.72 t fed-1) in combined analyses across the two seasons.

Interaction effect between cutting intervals and intercropping system was highly significant. Cutting intervals x intercropping system (C_3 x T_1) produced the highest values of straw yield (9.94 and 8.54 t fed^{-1}) in the 1st and 2nd season respectively. Also cutting intervals x intercropping system (C_3xT_1) produced the highest value of straw yield (9.24 t fed^{-1}) in

combined analysis over the two seasons. These results are in agreement with those of Shendy (2015 and Sara *et al.,* (2014) and Abou- Kerisha *et al* ., (1996).

3.1.2.5. Barley fresh and dry forage yield

Data in Table (5) show the means of fresh and dry yield in 2013/2014 and 2014/2015. Effect of different cutting intervals on fresh and dry was significantly affected by the cutting intervals. Cutting at 75 days (C_2) gave the highest values for fresh yield (9.12 and 7.04 t fed^{-1}) and dry forage (1.77 and 1.44 t fed^{-1}) in the 1st and 2nd seasons, respectively.

for fresh forage and (1.36 and 0.97 t fed^{-1}) for dry yields were obtained from use (C_2 x T_2) in the 1st and 2nd seasons, respectively.

The combined analysis over the two seasons showed significant effects for the interaction of cutting and intervals x intercropping system, the highest fresh and dry yield were produced by (C_2 x T_2).

Abou – Kresha *et al.,* (1996) showed that the highest fresh, dry and crude protein yields was obtained from Siko barely variety at 50%barley. Also, mixing fahl with 25% barley 50% and 75% barley gave 80, 56 And 26% of seed yield

Table (5): Average of fresh and dry yield of barley as affected by cutting interval, intercropping system and their interaction in 2013/14 and 2 014/15 at Giza.

Treatments	Fresh yield (t fed^{-1})			Dry yield (t fed^{-1})		
	2013/14	2014/15	Combine	2013/14	2014/15	Combine
Cutting*:						
C_1	4.56	4.66	4.61	0.80	0.85	0.83
C_2	9.12	7.04	8.08	1.77	1.44	1.60
C_3	----	----	----	----	----	----
LSD at 5%	2.0	1.46	1.94	0.33	0.84	0.50
Intercropping system:**						
T_1	5.08	4.93	5.00	0.99	0.95	0.97
T_2	5.92	4.50	5.21	1.06	0.97	1.06
T_3	5.07	4.63	4.85	0.93	0.91	0.92
T_4	7.36	6.04	6.70	1.38	1.19	1.28
LSD at 5%	1.2	1.32	1.50	0.23	0.54	0.44
C_1 x T_1	4.05	4.55	4.30	0.75	0.83	0.79
C_2 x T_1	6.08	5.32	5.70	1.23	1.07	1.15
C_3 x T_1	----	----	----	----	----	----
C_1 x T_2	4.50	4.52	4.51	0.75	0.83	0.79
C_2 x T_2	7.33	4.67	5.20	1.36	0.97	1.13
C_3 x T_2	----	----	----	----	----	----
C_1 x T_3	4.20	4.78	4.49	0.73	0.88	0.80
C_2 x T_3	5.85	4.57	5.21	1.12	0.95	1.04
C_3 x T_3	----	----	----	----	----	----
C_1 x T_4	5.82	4.78	5.30	1.03	0.89	0.96
C_2 x T_4	8.91	7.29	8.10	1.74	1.51	1.62
C_3 x T_4	----	----	----	----	----	----
Average	5.84	5.04	5.44	1.09	0.98	1.04
LSD at 5%	2.5	2.20	2.36	0.40	0.85	0.75
CV	16.11%	22.74%	19.54%	10.1%	8.2%	8.2%

***cutting intervales: C_1= at 50 days C_2=at 75 days C_3=at harvest**

****Intercropping systems :T_1=100% barley +25% fahl berseem. T_2=100% barley + 50% fahl berseem. T_3=100% barley +75% fahl berseem. T_4=100% barley (sole seeding).**

The intercropping system showed significant differences in fresh and dry yield. (T_2) gave the highest values for fresh forage yield with an average of (5.92 and 4.50 t fed^{-1}) and dry forage 1.06 and 0.97 yield (t fed^{-1}) in the1st and 2nd seasons, respectively. For the interaction effect of cutting intervals x intercropping system, on fresh and dry yield of barley, the highest values (7.33 and 4.67 t fed^{-1}) of fahl berseem. Similar results were obtained by Abou – Kerisha *et al.,* (1996), and Sara *et al.,* (2014) and Shendy (2015).

3.2. Agronomic traits of Fahl Berseem

3.2.1. Growth traits

Data in Table (6) showed the effect of cutting intervals, intercropping system and their interaction in 2013/2014-2014/2015 and it's combined on growth traits (plant height, number

Table (6): Average of plant height (PH) number of branches per plant (Br/plant) and leaves stem ratio% (L/St%) of Fahl berseem as affected by cutting interval, intercropping system and their interaction in 2013/14 and 2 014/15 at Giza.

Treatments	2013/2014			2014/2015			Combine		
	Pl-Ht (cm)	No. of Br plant^{-1}	L /St %	Pl-Ht (cm)	No. of Br plant^{-1}	L /St Ratio %	Pl-Ht (cm)	No. of Br plant^{-1}	L /St Ratio %
Cutting:									
C_1	78.83	4.33	22.64	69.08	4.80	21.79	73.96	4.57	23.25
C_2	87.59	4.82	22.34	76.35	5.03	22.65	81.97	4.93	22.50
C_3	87.57	6.45	23.86	83.14	6.79	22.03	85.36	6.62	22.94
LSD at 5%	5.54	0.25	1.0	7.98	0.62	0.97	4.04	0.28	0.93
Intercrop system:									
T_1	75.50	5.41	23.03	71.53	6.00	22.17	73.52	5.71	22.60
T_2	79.81	4.62	22.83	72.20	5.09	22.10	76.01	4.86	22.47
T_3	81.48	4.49	22.74	74.83	4.83	22.09	78.16	4.66	22.42
T_4	95.20	6.32	23.18	86.18	6.25	22.30	90.69	6.29	22.74
LSD at 5%	3.59	0.21	0.78	5.62	0.38	0.68	3.20	0.23	0.68
C_1 x T_1	65.50	4.77	22.63	65.50	5.43	22.03	65.50	5.10	22.33
C_2 x T_1	84.40	5.03	22.57	72.50	5.50	21.77	78.45	5.27	22.17
C_3 x T_1	76.60	6.43	23.90	76.60	7.07	22.70	76.60	6.75	23.30
C_1 x T_2	76.47	3.73	22.63	65.57	4.17	22.50	71.02	3.95	22.33
C_2 x T_2	85.03	4.10	22.10	73.20	4.50	21.77	79.12	4.30	21.93
C_3 x T_2	77.93	6.03	23.77	77.83	6.60	22.50	77.88	6.32	23.13
C_1 x T_3	78.13	3.80	22.57	69.50	4.13	22.03	73.82	3.97	23.10
C_2 x T_3	86.80	3.83	21.97	75.90	4.17	21.77	81.35	4.00	21.87
C_3 x T_3	79.50	5.83	23.70	79.10	6.20	22.00	79.30	6.02	22.28
C_1 x T_5	95.20	5.01	22.75	75.76	5.50	22.11	85.48	5.26	22.43
C_2 x T_5	94.16	6.40	22.75	83.73	5.94	21.88	88.95	6.17	22.32
C_3 x T_5	96.24	7.55	24.04	99.06	7.31	22.91	97.65	7.43	23.48
Average	83.00	5.21	22.95	76.19	5.54	22.16	79.59	5.38	22.56
LSD at 5%	6.22	0.36	1.04	9.73	0.66	1.02	5.47	0.36	1.01
CV%	4.43	4.24	4.26	7.51	6.98	7.41	6.05	5.90	6.00

***cutting intervales:**
C_1= at 50 days C_2=at 75 days C_3=at harvest
****Intercropping systems : T_1=100% barley +25% fahl berseem. T_2=100% barley + 50% fahl berseem.**
T_3=100% barley +75% fahl berseem. T_4=100% barley (sole seeding).

of branches plant^{-1} and leaf/stem ratio). Cutting intervals showed a significant effect on plant height, the number of branches/plant and leaves/stem ratio. The results showed that the highest plant height (87.57 and 83.14cm), no. of branches plant^{-1} (6.45 and 6.79) were recorded by cutting intervals (C_3), as well as, from leaf stem ratio % (23.86 and 22.03) with increasing cutting interval in the 1st and the 2nd seasons, respectively.

The intercropping system showed significant differences for plant height, the number of branches plant^{-1} except leaves stem^{-1} ratio traits among different intercropping system. The results showed that the highest plant height was recorded by intercropping system (T_3). It gave (81.48 and 74.83cm) whereas, (T_1) gave no. of branches plant^{-1} (5.41 and 6.00) and leaf stem ratio% (23.03 and 22.17) in the 1st and 2nd seasons, respectively. For the interaction effect of cutting intervals x intercropping treatments on growth traits, the highest values for plant height, number of branches plant^{-1} and leaves stem^{-1} ratio traits were obtained from (C_3 x T_3) in 1st and 2nd seasons. The combined analysis over the two seasons showed significant effects for the interaction of plant height, the number of branches plant^{-1} and leaves stem^{-1} ratio caused by (C_3 x T_3). These findings are in harmony with Abd El-Gawad, (1993), Haggag *et al.,(* 1995) and Abdel-Zaher *et al.,* 2009**.**

3.2.2. Fresh and dry forage yield

Data presented in Table (7) show the means of fresh and dry forage yield in 2013/2014 and 2014/2015. Cutting intervals showed a significant effect on fresh and dry forage yield. The results showed that the highest fresh yield was recorded by cutting intervals (C_2) gave (4.55

and 4.54 t fed^{-1}) and dry forage yield (0.89 and 0.87 t fed^{-1}) in the 1st and the 2nd seasons respectively.

The intercropping system showed a significant difference on fresh and dry forage yield among different intercropping system. The results showed that the highest value of fresh yield were recorded by intercropping system (T_3) gave dry forage yield (3.99 and 3.41 t fed^{-1}) and dry yield (0.65 and 0.66t fed^{-1}) in the 1st and 2nd seasons, respectively. The interaction effects between cutting intervals x intercropping system were significant in the 1stand 2nd seasons, (C_2 x T_3) produced the highest value of fresh yield forage yield (3.7 and 3.7 t fed^{-1}) and dry yield (0.71 and 0.81 t fed^{-1}) in the 1st and 2nd season respectively. The combined analysis over the two seasons showed significant effects for the interaction by (C_2 x T_3) from fresh and dry yield.

Effect of different cutting intervals on these traits indicated that increase of cutting intervals caused an increase of plant height and the number of branches/plant^{-1} except leaves stem ratio %. This result may be due to the long period of growth for accumulated forage yield. Whereas, harvest day interval was the best interval for all growth traits at the two season and combined. These increases seem to be attributed to increasing yield components *i.e.* plant height, leaves/stem ratio and the number of branches. These results are in agreement with Nor EL-Din *et al.,* (1984) and Abdel-Gawad (1993).

The obtained results revealed that barley is a crop which can be used as a sole crop or in mixture system with fahl berseem, but it is important to determine cutting interval, which produce the greatest forage yield and grain yield from barley. On the other hand, growth habit of berseem in mixture treatments was less than pure stand, indicating the great competition resulting from barley plants shading effects, as well as the effect of intra specific competition among berseem plants, when intercropping pattern

Table (7): Average of fresh yield t/fed (FY), dry yield T/fed (DY), seed yield Kg/fed (SY) and hay yield t/fed (HY) of Fahl berseem as affected by cutting interval, intercropping system and their interaction in 2013/14 and 2014/15 at Giza.

Treatments	2013/2014				2014/2015				Combine			
	fresh yield t fed^{-1}	dry yield t fed^{-1}	seed yield t fed^{-1}	Straw yield t fed^{-1}	fresh yield t fed^{-1}	dry yield t fed^{-1}	seed yield t fed^{-1}	Straw yield t fed^{-1}	fresh yield t fed^{-1}	dry yield t fed^{-1}	seed yield t fed^{-1}	Straw yield t fed^{-1}
Cutting:												
C_1	2.82	0.49	----	----	2.90	0.54	----	----	2.86	0.51	----	----
C_2	4.55	0.89	----	----	4.54	0.87	----	----	4.80	0.88	----	----
C_3	----	----	0.226	2.12	----	----	0.227	2.24	----	----	0.226	2.18
LSD 5%	1.63	0.01	---	--	1.37	0.01	---	---	1.41	0.02	----	---
Intercropping system:												
T_1	1.67	0.32	0.106	1.84	1.63	0.30	0.103	1.91	1.63	0.31	0.105	1.88
T_2	3.20	0.56	0.127	1.98	3.20	0.62	0.125	2.00	3.21	0.59	0.126	1.99
T_3	3.99	0.65	0.302	2.23	3.41	0.66	0.319	2.37	3.01	0.65	0.310	2.30
T_4	7.30	1.36	0.368	2.41	7.70	1.48	0.357	2.69	7.68	1.42	0.362	2.55
LSD 5%	1.63	0.01	21.6	0.13	1.37	0.26	0.02	0.12	1.41	0.24	21.43	0.11
C_1 x T_1	1.29	0.24	----	----	1.31	0.24	----	----	1.31	0.24	----	----
C_2 x T_1	2.05	0.42	----	----	1.95	0.37	----	----	1.95	0.37	----	----
C_3 x T_1	----	----	0.106	1.84	----	----	0.103	1.91	----	----	0.105	1.88
C_1 x T_2	2.69	0.45	----	----	2.71	0.52	----	----	2.71	0.52	----	----
C_2 x T_2	3.70	0.69	----	----	3.70	0.71	----	----	3.70	0.71	----	----
C_3 x T_2	----	----	0.127	1.98	----	----	0.125	2.00	----	----	0.126	1.99
C_1 x T_3	2.29	0.39	----	----	2.31	0.43	----	----	2.31	0.43	----	----
C_2 x T_3	3.70	0.71	----	----	3.70	0.81	----	----	3.70	0.81	----	----
C_3 x T_3	----	----	0.302	2.23	----	----	0.319	2.37	----	----	0.310	2.30
C_1 x T_5	5.10	0.89	----	----	5.50	1.03	----	----	5.30	1.03	----	----
C_2 x T_5	9.54	0.88	----	----	9.86	1.94	----	----	9.66	1.94	----	----
C_3 x T_5	----	----	0.368	2.41	----	----	0.357	2.69	---	----	0.362	2.55
Average	3.80	0.58	0.23	2.12	7.68	0.76	0.23	2.24	3.88	0.76	0.23	2.18
LSD at 5%	0.66	0.04	----	----	1.43	0.34	-----	------	1.52	0.30	----	----
CV%	6.18	9.12	----	-----	6.23	9.1	-----	------	7.89	7.91	----	----

***cutting intervales:**
C_1= at 50 days C_2=at 75 days C_3=at harvest
****Intercropping systems :T_1=100% barley +25% fahl berseem.**
T_2=100% barley + 50% fahl berseem.T_3=100% barley +75% fahl berseem. T_4=100% barley (sole seeding).

(100% barley +75% berseem) comparing with its sole stand. These results are agreement with those obtained by (Abou-Kerisha *et al.* 1996).

3.2.3. Seed and straw yields of fahl berseem

Data presented in Table (7) show the effect of cutting intervals and intercropping system on seed and straw yield. Fahl berseem only produced seed yield at cutting intervals (C_3) gave (0.226 and 0.227 t fed^{-1}) and straw yield (2.12 and 2.24 t fed^{-1}) in the 1st and 2nd season respectively. The intercropping system gave, significant differences for seed and straw yield traits among different intercropping systems. The results showed that the highest seed yield was recorded by intercropping system (T_3) gave (0.302 and 0.319 t fed^{-1}) and straw yield (2.23 and 2.37 t fed^{-1}) in the 1*st* and 2*nd* seasons, respectively. The combined mean over the two seasons showed that (T_3) gave the highest values of seed and straw yield. Seed of the Fahl berseem could be produced by inter seeding with grain barley. However, seed yield slightly decreased in this case. In contrast, seed yield of pure fahl berseem is higher than fahl berseem sown in mixture with barley. These results were in agreement with Radwan *et al*., (1983) and Abel-Zaher *et al*., (2009).

3.3. Nutritive value, competitive relationships and benefit advantage of cutting interval and intercropping system

3.3.1. Chemical composition and nutritive value

Data presented in Table (8) revealed significant differences among cutting intervals. Forage quality parameters *i.e*. crude protein (CP %), crude fiber (CF %), digestible protein (DP %), and total digestible nutrients (TDN %)were significantly affected due to cutting intervals. The highest values of CP% (13.23), DP% (8.81), and TDN % (66.92), resulted from cutting at 50 days (C_1). However, cutting at 75 days C_2 ranked after cutting at 50 days (C_1). On the other hand cutting in (C_3) led to increases in crude fiber percentage (CF %), where the highest percentage of crude fiber (25.14 %) produced from period (C_3). The effect of cutting at harvest (C_3) during the vegetative and maturity stage may be due to the reduction in photosynthesis which effect dry matter accumulation, which consequently decrease crude protein percentage and increase crude fiber percentage.

The intercropping system percentage had a significant effect on crude protein (CF%), crude fiber (C F%),digestible protein (DP%),and the total digestible nutrients(TDN%). The highest percentages of crude protein (12.82%), digestible protein (8.43%), resulted from (T_2). On the contrary sole fahl berseem recorded the highest percentage of TDN (69.59%), and crude fiber (T_1) recorded highest percentage (25.65%).

The interaction effect between cutting intervals and intercropping system was significant effect on crude protein (CP), crude fiber (CF), digestible protein (DP), and total digestible nutrients (TDN) percentages. The significance of the interactions indicated that the relative performance of the barley- fahl berseem intercropping was not consistent across cutting interval treatments. These findings are in harmony with Abd El-Gawad (1993), Haggag *et al.*, (1995)

Table (8): Forage quality parameters (crude protein (CP %), crude fiber (CF %), digestible protein (DP %), and total digestible nutrients (TDN %)) as affected by cutting interval, intercropping system and their interaction in 2013/14 and 2014/15 at Giza.

Characters Treatments	CP%	CF%	DP%	TDN %
A- Cutting intervals				
50 days	13.23	22.79	8.81	66.92
75 days	11.70	23.43	7.39	66.83
At harvest 150 days	7.96	25.14	3.91	66.43
L.S.D at 5%	**2.86**	**1.38**	**0.40**	**1.25**
B- Intercropping systems				
100% B + 25% F	8.21	25.65	4.14	65.92
100% B + 50% F	12.82	23.05	8.43	66.82
100% B + 75% F	10.86	25.03	6.61	65.69
Barley sole crop	10.80	25.16	6.55	65.60
Berseem sole crop	12.13	20.06	7.79	69.55
LSD at5 %	**0.75**	**1.21**	**0.70**	**1.02**
C- Interaction:	*	*	*	*

3.3.2. Land equivalent ratio (LER)

Data presented in Table (9) and indicate the effect of cutting intervals and intercropping system on land equivalent (LER) for combined seasons.

Effect of different cutting intervals on land equivalent (LER) showed that cutting at 50 days (C_1) gave the highest land usage value (2.48), and the intercropping system, T_3 (barley 100%+ (berseem 75%) gave the highest land usage values (3.12) from land equivalent (LER).

For the interaction effect of cutting intervals x intercropping system on land equivalent (LER), the highest land usage values 2.47 for land equivalent (LER) were obtained from use (C_1 x T_3). However, the relative yield (RY) of

Table (9): Competitive relationships of intercropping pattern with berseem as affected by cutting interval, intercropping system and their interaction in 2013/14 and 2014/15 at Giza (combined analysis).

Treatments	Yield t fed^{-1}				Relative yield %				LER
	Barley		Berseem Fahl		Barley		Berseem Fahl		
	Grain	Forage	Forage	Seed	Grain	Forage	Forage	Seed	
Cutting intervals:									
At 50 days (C_1)	**2.30**	**4.65**	**2.96**	**----**	**1.07**	**0.88**	**0.54**	**----**	**2.48**
At 75 days (C_2)	**1.99**	**6.23**	**4.80**	**----**	**1.11**	**0.77**	**0.49**	**----**	**2.37**
Harvest day (C_3)	**3.43**	**----**	**----**	**0.23**	**1.06**	**----**	**----**	**0.62**	**1.68**
Cropping Systems*:									
100% B + 25% F (T_1)	**2.49**	**5.00**	**1.63**	**0.11**	**1.04**	**0.75**	**0.22**	**0.29**	**2.29**
100% B + 50% F (T_2)	**2.69**	**5.21**	**3.21**	**0.13**	**1.12**	**0.78**	**0.43**	**0.35**	**2.67**
100% B + 75% F (T_3)	**2.72**	**4.85**	**3.01**	**0.31**	**1.14**	**0.72**	**0.40**	**0.86**	**3.12**
Solid Barley	**2.39**	**6.70**	**----**	**----**	**----**	**1**	**----**	**----**	**1**
Solid Berseem	**----**	**----**	**7.68**	**0.36**	**1**	**----**	**1**	**1**	**1**
C_1 x T_1	**2.18**	**4.3**	**1.3**	**----**	**1.01**	**0.81**	**0.25**	**----**	**2.07**
C_2 x T_1	**1.86**	**5.7**	**2.0**	**----**	**1.04**	**0.70**	**0.20**	**----**	**1.94**
C_3 x T_1	**3.43**	**----**	**----**	**0.11**	**1.06**	**----**	**----**	**0.29**	**1.35**
C_1 x T_2	**2.31**	**4.5**	**2.7**	**----**	**1.07**	**0.85**	**0.51**	**----**	**2.44**
C_2 x T_2	**2.33**	**5.9**	**3.7**	**----**	**1.30**	**0.73**	**0.38**	**----**	**2.41**
C_3 x T_2	**3.42**	**----**	**----**	**0.13**	**1.06**	**----**	**----**	**0.35**	**1.40**
C_1 x T_3	**2.55**	**4.5**	**2.3**	**----**	**1.19**	**0.85**	**0.44**	**----**	**2.47**
C_2 x T_3	**1.98**	**5.2**	**3.7**	**----**	**1.11**	**0.64**	**0.38**	**----**	**2.13**
C_3 x T_3	**3.64**	**----**	**----**	**0.31**	**1.12**	**----**	**----**	**0.86**	**1.98**
C_1 x Solid Barley	**2.15**	**5.3**	**----**	**----**	1	**1**	**----**	**----**	**2**
C_2 x Solid Barley	**1.79**	**8.1**	**----**	**----**	1	**1**	**----**	**----**	**2**
C_3 x Solid Barley	**3.24**	**----**	**----**	**----**	1	**----**	**----**	**----**	**1**
C_1 x Solid Berseem	**----**	**----**	**5.3**	**----**	**----**	**----**	**1**	**----**	**1**
C_2 x Solid Berseem	**----**	**----**	**9.7**	**----**	**----**	**----**	**1**	**----**	**1**
C_3 x Solid Berseem	**----**	**----**	**---**	**0.36**	**----**	**----**	**----**	**1**	**1**

barley increased with increasing the rates of seeding fahl berseem, as well as the (RY) of fahl berseem increased with increasing these rates. These findings are in agreement with those of Kamel *et al.,* (1991), Abdel-Zaher *et al.,* (2009) and Karadage (2004).

3.3.3.Total income

Data presented in Table (10) indicate the effect of cutting and intervals and intercropping system on economic returns such as total gross returns, net returns and benefit to cost ratio benefit to cost ratio (B:C) for combined seasons and compared with each of them as a solid crop due to market price as economic expresser in terms of the farmer. Results showed that cutting intervals at harvest day(C_3) gave the highest values on total gross returns, net returns and (B:C) was achieved by cutting.

Also the intercropping system, (barley 100%+ berseem 75%) (T_3) reached the highest values on the total gross returns, net returns and benefit to cost (B:C), respectively. For the interaction effect of cutting intervals x intercropping system, (C_3 x T_3) gave the highest values on the total gross returns, net returns and (B:C), respectively. On the contrary, the lowest value of net income (L.E. fed^{-1}.) was achieved by intercropping system (T_1) including (100% barley + 25% berseem). The advantage of cropping patterns barley and berseem as economic expresser in terms of the farmer, total income increased in all intercropping system compared to the total income of sole barley treatment. Similar results were obtained by Abd El-Zaher *et al*., (2009).

Conclusion

it could be recommended that the applied cutting interval (at 75 days) and intercropping system (100% barley+75% fahl berseem) must be used under the conditions of the soil at Giza as a good practice to maximize the economic return of grain yield and forage yield.

Table (10): Estimates of costs for inputs farm operations and as affected by cutting interval, intercropping system and their interaction in 2013/14 and 2014/15 at Giza (combined analysis).

Treatments	Yield t fed^{-1}				Gross returns 1000 LE fed-1					Net returns 1000 LE fed^{-1}	Benefit to cost ratio B : C
	Barley		Berseem Fahl		Barley		Berseem Fahl		Total gross return 1000 LE		
	Grain	Forage	Forage	Seed	Grain	Forage	Forage	Seed			
Cutting:											
At 60 days (C_1)	2.30	4.61	2.96	----	13.80	0.70	0.44	----	14.92	10.95	3.75
At 60 days (C2)	1.99	8.08	4.80	----	11.94	0.93	0.72	----	13.59	9.61	3.42
Harvest day (C3)	3.43	----	----	0.23	20.58	----	----	4.52	25.11	21.13	6.31
Cropping Sys.:											
100% B + 25% F (T_1)	2.49	5.00	1.63	0.11	14.94	0.75	0.25	2.10	18.03	14.09	4.58
100% B + 50% F (T_2)	2.69	5.21	3.21	0.13	16.12	0.78	0.48	2.52	19.90	15.86	4.93
100% B + 75% F (T_3)	2.72	4.85	3.01	0.31	16.34	0.73	0.45	6.20	23.72	19.58	5.73
Solid Barley	2.39	6.70	----	----	14.34	1.01	----	----	15.37	11.53	4.00
Solid Berseem	----	----	7.68	0.36	----	----	1.13	7.24	8.39	4.45	2.13
C_1 x T_1	2.18	4.3	1.3	----	13.08	0.65	0.20	----	13.92	9.98	3.53
C_2 x T_1	1.86	5.7	2.0	----	11.16	0.86	0.29	----	12.31	8.37	3.12
C_3 x T_1	3.43	----	----	0.11	20.58	----	----	2.10	22.68	18.74	5.76
C1 x T_2	2.31	4.5	2.7	----	13.86	0.68	041	----	14.94	10.90	3.70
C_2 x T_2	2.33	5.9	3.7	----	13.98	0.89	0.56	----	15.42	11.38	3.82
C_3 x T_2	3.42	----	----	0.13	20.52	----	----	2.52	23.04	19.00	5.70
C_1 x T_3	2.55	4.5	2.3	----	15.30	0.35	0.35	----	16.32	12.18	3.94
C_2 x T_3	1.98	5.2	3.7	----	11.88	0.56	0.56	----	13.22	9.08	3.19
C_3 x T_3	3.64	----	----	0.31	21.84	----	----	6.20	28.04	23.90	6.77
C_1 x Solid Barley	2.15	5.3	----	----	12.90	0.80	----	----	13.70	8.86	3.57
C_2 x Solid Barley	1.79	8.1	----	----	10.74	1.22	----	----	11.96	8.12	3.11
C_3 x Solid Barley	3.24	----	----	----	19.44	----	0.80	----	19.44	15.60	5.06
C_1 x Solid Berseem	----	----	5.3	----	----	----	1.46	----	3.80	2.20	1.16
C_2 x Solid Berseem	----	----	9.7	----	----	----	----	----	6.46	3.54	2.29
C_3 x Solid Berseem	----	----	---	0.36	----	----		7.24	7.24	4.25	2.45

Mean of costs of production inputs over two years LE/fed:

Land preparation Tillage = 450 , Planting= 480, Price of barley and berseem (fahl) seeds = 6 and 20 LE/kg, respectively, irrigation = 400, Ammonium nitrate (33.5% N)= 540 (1 kg N=13.43 L.E), Superphosphate (15.5% P_2O_5)= 450, Potassium sulphate (48% K_2O)= 800, Hoeing and weeding= 720, harvesting= 1000, constant coast= 5400 L.E/fed

Price of ton forage yield= 150 LE. Net return (L.E.fed^{-1}) = Total revenue - Total variable costs Benefit to cost ratio (B : C) L.E. = Total gross returns/ Total variable costs, Net return of invested L.E. = Benefit to cost ratio (B : C) L.E - 1

4.REFERENCES

Abd El-Gawad K. I. (1993). Effect of Cutting Management on Forage, Protein and Seed Yields of Berseem clover (Synthetic 79 var.). Zagazig J. Agric. Res, Zagazig Univ., 20 (1A):67-75.

Abdel-Zaher Sh.R., Abdel-Galil M. A. and Ibrahim Sahar T. (2009). Effect of seeding rates of Fahl berseem mixed with wheat under three rates of nitrogen fertilizer on yield and yield components of both crops J.Agric.Sci. Mansoura Univ., 34(6): 3511.

Abou-Kerisha M.A., Mousa M.E. and Abd EL-Hamid M. (1996). Effect of growing fahl berseem with barley on forage and seed production in middle Egypt. Proc. 7th Conf Agronomy, Mansoura Univ., 9-10 Sept., 1996, Mansoura , Egypt pp:579-588.

Anonymous (2014). "Field Crops Statistical year Book". Ministry of Agriculture and Land Reclamation, Egypt.

AOAC (2000). Official Methods of Analysis of the Association of Official Analytical Agricultural Chemists, 17th Ed. Published by A.O.A.C., Washington D.C.,USA.

Boquet D.J, Koohce K.L and Walker D.M. (2003). Selected determinate soybean cultivar yield responses to row spacing's and planting dates. Agronomy Journal 74, 136-138.

Caballero R.C., Alzueta L.T., Ortiz M.L., Rodriguez R.T. and Barro C. (2001). Carbohydrate and protein fractions of fresh and dried common vetch in three maturity stages. Agronomy Journal.93, 1006-1013.

Church D. C. (1979). Livestock Feeds and Feeding. D&B book, 4th ed., Lne. Corvallis, ISBN 10: 0960158618, Mishawaka, U.S.A.

FAO (2006). Food and Agriculture Organization of the United Nations. Available at Ghanbari A, Lee HC. 2002. Intercropped field beans and wheat for whole crop forage: Effect of nitrogen on forage yield and quality. Cambridge Journal 138, 311-314.

Gustave N.M., Jean F, Ois L. and Xavier D. (2008). Shoot and root competition in

potato/maize intercropping: Effects on growth and yield. Journal Environmental and Experimental Botany 64(2), 180-188.

Haggag M. El-H, Marei Z. M. and El-Nahrawy M. Z. (1995).Performance of mixture on ten ryegrass varieties with Egyptian clover in comparison with pure stand.J. Agric.Sci.Mansoura. Univ.20(11):4537-4547.

Kamel A.S., EL-Masry M.A., EL-Mihi M.M., Metwally I.O. and EL-Gamel A.S. (1991). Effect of seeding rates of fahl berseem in mixtures of wheat and berseem for seed production.Egypt.J.Appl.Sci.,6(8)233-238.

Karadage Y. (2004). Intercropping berseem clover with barley and oat cultivars for forage.Agron. J., 96(6):1719-1729.

Mcdonald P., Edward R. A. and Greenhalgh J. F. (1978). Animal Nutrition. Longman Group Up; London, UK.

Nor EL-Din M.A., Gabra M.A. and Youssef E.Z. (1984). The Effect of nitrogen fertilization productivity of berseem and barley mixtures. Proc. EMCIP Symp. Field Crop Res. Inst. Giza, 2(84): 122-128.

Page A.L., Miller R.H. and Keeney D.R. (1982). Methods of Soil Analysis. Part 2: Chemical and Microbiological Properties. Published in Soil Sci. Amer., Madison Wisconsin, USA.

Radwan M. S., Abd El-Hafeez A. A., Abdallah Hussein M., Abd El Gawad and El Zanaty R. I. (1983). Seed production in Fahl berseem intercropped with barley. Proc. 1st Conf. on Agron. Egypt Soc. Crop Sci. 1: 63-170.

Sara N., Bonjar A. G., Ramroudi M. and Sirousmehr A. (2014). Evaluation of yield and yield components in intercropping of barley with clover. Inte. J., Agron. and Agric. Res. (IJAAR), 5, (4)P: 31-39.

Sekamatte B.M., Ogenga-Latigo M. and Russell-Smith A. (2003). Effects of maize–legume intercrops on termite damage to maize, activity of predatory ants and maize yields in Uganda. Journal of Crop Protection 22(1), 87-93.

Shendy M. Z. (2015). Evaluation of four new barley cultivars protectively intercropped with barsssem clover at different seeding rates in new land in Egypt. Bull. Fac. Agric. Cairo Univ., 66: 29 – 39.

Snedecor G. W. and Cochran W.G. (1980). Statistical methods 7th Ed. Iowa State Univ.USA.

Stout D.G., Brooke B., Hall J.W. and Thompson D.J. (1997). Forage yield and quality from intercropped barley, annual ryegrass and different annual legumes. Grass Forage Sci. 52:298–308.

Willey R.W. and Rao M.R. (1980). A competitive ratio for quantifying competition between intercrops. Exp. Agric., 16: 117-125.

Yang G. D., Aiwang S., Jingsheng L. , Fusheng L. , Zugui L. Hao and Zhandong L. (2009). Crop coefficient and water-use efficiency of winter wheat/spring maize strip intercropping. Journal of Field Crops Research 111(2), 65-73.

تأثير مواعيد الحش ونظم التحميل للبرسيم الفحل مع الشعير على إنتاجية الحبوب والعلف وقيمة المخلوط الغذائية

عبد الجليل محمد عبد الجليل- حسن عبد الجليل عشماوي* -صلاح سالم محمد أبو فتيح **- هانم السيد احمد النادي*

قسم بحوث التكثيف المحصولى ، * قسم بحوث الشعير– ** قسم بحوث محاصيل العلف ، معهد بحوث المحاصيل الحقلية
مركز البحوث الزراعية – الجيزة - مصر

ملخص

أجريت هذه التجربة في محطة التجارب للبحوث الزراعية بمحافظة الجيزة، مصر، خلال موسمي 2014/2013 و 2015/2014 لدراسة تأثير ثلاثة فترات حش من بعد تاريخ الزراعة وهي [50 يوما (C_1) و 75 يوم (C_2) و عند الحصاد بعد 150 يوم (C_3) وكذلك ثلاثة أنظمة تحميل T_1= (100%: 25%) و T_2= (100%: 50%) و T_3= (100%: 75%) من الشعير صنف جيزة 2000: برسيم فحل على التوالي. بالإضافة إلى الزراعة المنفردة لكل من الشعير والبرسيم الفحل طبقا للتوصيات الفنية لمعدلات التقاوي الموصى بها لكلا المحصولين. وكان الهدف من لدراسة تأثير المعاملات على حاصل الحبوب للشعير وحاصل العلف الناتج من خلط الشعير مع البرسيم وتقدير العلاقات التنافسية وإجمالي الدخل من المحصولين. تم زراعة التجربة بتصميم القطع المنشقة مرة واحدة في ثلاث مكررات الرئيسية مواعيد الحش والشقية نظم التحميل . أظهرت النتائج أن: فترات الحش عند الحصاد (C_3) كان لها تأثير معنوي على طول السنبلة وعدد الحبوب فى السنبلة ووزن الـ 1000 حبة . وحاصل القش للشعير. بينما كان ميعاد الحش بعد 75 يوم (C_2) كان لها تأثيرات معنوية على حاصل العلف الأخضر، والعلف الجاف ، والقيمة الغذائية للعلف لمخلوط البرسيم الفحل والشعير. أظهر نظام التحميل (T_3) تأثيرا معنويا على طول النبات ، وطول السنبلة ، وعدد الحبوب في السنبلة وحاصل الحبوب وحاصل التبن للشعير ، و أيضا نظام التحميل (T_3) كان له تأثير معنوي على عدد الفروع على النبات، نسبة الأوراق للسيقان حاصل العلف الأخضر والجاف للبرسيم، والقيمة الغذائية للعلف لمخلوط البرسيم الفحل والشعير.و كان هناك معنوية عالية للتفاعل بين ميعاد الحش ونظام التحميل (C_3xT_3) على طول السنبلة وعدد الحبوب السنبلة ووزن الـ 1000 حبة ، والحاصل البيولوجي وحاصل الحبوب والتبن للشعير في كلا الموسمين. في حين أن التفاعل بين ميعاد الحش ونظام التحميل (C_2xT_3) أعطى أعلى القيم لمحصول العلف الأخضر ، والجاف ، والقيمة الغذائية لمخلوط العلف للبرسيم الفحل والشعير في كلا الموسمين. وسجل معامل استغلال الأرض (LER) العائد الإقتصادى الخاص بالتفاعل بين (C_2xT_3) تفوق عن باقي نظم ألتحميل وكذلك الشعير المنفرد. ولذلك يوصى بميعاد الحش بعد 75 يوم مع نظام التحميل (100% شعير +75% برسيم فحل) لتحقيق أقصى قدر من العائد الاقتصادي للمزارع من حاصل الحبوب و حاصل العلف مقارنة مع الزراعة المنفردة للشعير.

المجلة العلمية لكلية الزراعة – جامعة القاهرة – المجلد (68) العدد الثالث (يوليو 2017):237-250.