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EFFECT OF THE STAGE OF CUTTING ON THE YIELD, CHEMICAL COMPOSITION AND NUTRITIVE VALUE OF BERSEEM

By

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SUMMARY

Early cutting of berseem at a height of 30-35 cm. increased the number of cuts by one and the green yield by 17.31% more than late cutting at 60-70 cm. Dry matter was decreased with early cutting. and crude protein content of the dry matter was increased while crude fibre was decreased.

Digestion coefficients of the different nutrients varied within narrow limits but early cutting increased the digestion coefficients slightly over late cutting. Early cutting increased the yield of the different nutrients and starch value.

Phosphorus content increased with early cutting while Ca and Mg concentrations were comparable with the two systems of cutting.

Introduction and Review of Literature

Several attempts have been directed to increase the yield of nutrients supplied by berseem, quantitatively and qualitatively. One attempted procedure is cutting berseem at early stages of growth to increase the number of cuts and the yield of nutrients. Prescott. (1920), Woodman et al, (1933), Wilsie and Hollowell, (1948), Watson and Nash, (1960), and Laila, (1962) indicated that crude protein decreased with advancing maturity while crude fibre increased. Woodward et al, (1939),

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Paci, (1949), Badr, (1955), Dent, (1955), Davies and Davies, (1956), Cooper, (1956) and Abou-Sayed and Nasieb, (1958) stated that cutting pasture at early stages of growth increased its quality as well as its quantity. The number of cuts, yield and the nutritive value of early cut were higher than of late cut pasture.

Material and Methods

The experiments were undertaken at the Experimental Farm, Faculty of Agriculture, Giza, Egypt (U.A.R.). During three successive years (1958-1961) 7, 12 and 6 feddans, respectively, were cultivated with Miskawi berseem as the source of experimental material. Each plot was divided into two sectors. Early cutting was practiced on one of the sectors when the average height of plants was 30-35 cm., a height found to be practicable after several preliminary trials. On the other sector the common practice of cutting at an average height of 60-70 cm. was followed. In the first and second years digestibility trials were carried out by using two Ossimi rams in each trial. Metabolic cages used were quite similar to those used by Maynard (1956) and Ghoneim (1961). A preliminary period of 5 days preceded each collection period of 7 days. Berseem was offered twice daily in equal portions and water was offered ad-lib. A daily sample of 500 gm. of berseem was taken and dried at 60°C for 24 hours. One tenth of the fresh faeces was taken daily just after collection and dried at 105°C for 24 hours. Composite samples of both berseem and faeces were prepared from the daily samples taken. Starch values were calculated according to Kellner (1926).

Analytical Methods

The analytical methods followed ordinary conventional procedures. Abou Hussein (1958), A.O.A.C. (1955) and Ghoneim et al (1951). Duplicate or triplicate samples of 2-3 grams each were applied for each determination.

Calcium and magnesium were determined by the varsinate method described by Richards (1954). Vogel's (1951)

method was used to precipitate phosphorus as ammonium phosphomolybdate and Ghoneim's (1951) procedure was followed to determine the phosphorus gravimetrically.

Results and Discussion

1.—*The yield of berseem* :

There was one more cut per year when berseem was harvested at a height of 30-35 cm. rather than at 60-70 cm. The number of cuts in the former case was 4, 5 and 5 during the first, second and third experimental years, respectively, while in the latter case there were 3, 4 and 4 cuts as shown in Table (1).

TABLE 1.—**Comparison between the Yield of Berseem per Feddan at Different Cuts with the Two Systems of Cutting During the Three Experimental Years.**

The Cuts	1st. exp. year		2nd exp. year		3rd exp. year	
	Cutting	Height	Cutting	Height	Cutting	Height
	30—35 cm.	60—70 cm.	30—35 cm.	60—70 cm.	30—35 cm.	60—70 cm.
	kg.	kg.	kg.	kg.	kg.	kg.
1st. cut	4368	5456	2500	3050	4760	6075
2nd. cut	5104	4276	2825	4338	5845	5220
3rd. cut	4457	5150	3087	4310	4280	5480
4th. cut	3017	—	4000	1200	5210	1390
5th. cut	—	—	1120	—	2325	—
Total . .	16946	14882	13532	12898	23420	18165

In other words, cutting at 30-35 cm. increased the yield of berseem in the three successive years by 13.87, 4.92 and 28.93%, respectively, the average being 17.31%. These results are in agreement with the results obtained by Paci, (1949), Badr, (1955), Dent, (1955) and Abou-Sayed an Nasieb, (1958) who found that cutting forage crops at early stages of growth increased the number of cuts and the quantity of green herbage

2.—*Chemical Composition* :

The dry matter in berseem increased with maturity, and was lower when cut at 30-35 cm. than at 60-70 cm. The increases of the dry matter content in the successive cuts were parallel to the increases of all other constituents on fresh matter bases.

Crude protein tended to decrease during the successive cuts while crude fibre increased. Early cutting increased the crude protein and decreased the crude fibre relative to late cutting. Ether extract and N.F.E. contents fluctuated without any special trends in the successive cuts. The behavior of ash content was the same as that of crude protein, tending to decrease as plants aged. The average percentages of the different nutrients in the three successive experimental years are summarized in Table (2).

3.—*Digestion coefficients* :

The digestibility of all nutrients except ether extract varied within narrow limits of 10% or less among different cuts. The variations of the digestion coefficients of ether extract were higher, being 15-20%. Early cutting increased the digestibility of all nutrients slightly over that at late cutting. The mean digestion coefficients are shown in Table (3).

TABLE 2.—**Average Composition of Various Cuts of Berseem over Three Years.**

The Cuts	Dry Matter	Composition of Dry Matter				
		Crude Protein	Ether Extract	Crude Fibre	N.F.E.	Ash
	%	%	%	%	%	%
Cutting at 30-35 cm.						
1st. cut	10.66	23.82	4.04	17.16	37.68	17.63
2nd. cut	13.46	21.65	4.16	18.67	39.33	16.19
3rd. cut	13.70	19.68	3.93	21.52	40.24	14.62
4th. cut	19.11	17.97	4.20	23.58	40.87	13.39
5th. cut	21.60	18.15	4.59	27.68	36.76	12.83
Cutting at 60-70 cm.						
1st. cut	11.87	20.25	3.92	19.39	39.93	16.50
2nd. cut	13.75	17.81	3.83	23.70	39.66	15.01
3rd. cut	17.95	16.80	3.68	27.31	38.64	13.57
4th. cut	21.58	17.45	4.53	29.78	37.67	10.57

TABLE 3.—Average Digestibility of Nutrients of Berseem at Two Stages of Cutting over Two Years

Nutrients	Cutting Height	
	30-35 cm.	60-70 cm.
	%	%
Dry matter	66.10	61.50
Organic matter .	69.99	65.33
Crude protein . .	79.13	70.10
Ether extract . . .	65.14	58.02
Crude fibre . . .	48.99	46.03
N.F.E.	78.57	76.07

4.—*The digestible nutrients :*

Cutting at 30-35 cm. increased the digested crude protein and ether extract while it decreased the digested crude fibre compared to cutting at 60-70 cm. The averages of digestible nutrients with the two systems of cutting are summarized in Table (4).

TABLE 4.—**Average Digestible Nutrients of Various Cuts of Berseem over Two Years**

The Cuttings	Digested dry matter in green	Digested nutrients on dry matter basis			
		Crude protein	Ether extract	Crude fibre	N.F.E.
	%	%	%	%	%
Cutting Height 30-35 cm.					
1st. cut.	7.02	19.09	3.75	8.00	29.27
2nd. cut.	8.47	17.65	3.03	9.13	30.37
3rd. cut	8.22	15.64	2.80	10.43	30.46
4th. cut.	10.13	13.78	2.92	11.44	31.44
5th. cut.	13.35	13.23	3.42	13.08	27.25
Cutting Height 60-70 cm.					
1st. cut	6.71	15.33	2.38	8.30	30.23
2nd. cut	8.13	11.87	2.25	11.49	30.07
3rd. cut	10.01	11.80	2.35	12.71	28.09
4th. cut	13.38	12.57	2.72	13.62	28.21

5.—The nutritive value :

The starch value of berseem increased with the successive cuts on fresh basis while it followed an opposite trend on moisture free basis. Early cutting increased the starch value relative to late cutting.

The nutritive ratio (1) of berseem tended to be wider and the value number (2) decreased with the successive cuts. This may be due to the increase in crude fibre and the decrease of crude protein in the successive cuts. The data showed a narrower nutritive ratio and a higher value number for berseem cut at 30-35 cm. than at 60-70 cm.

The protein number (3) for berseem fluctuated among the different cuts. The average protein number of early cut berseem was 29.65%. while it was 26.20% with late cutting. The average nutritive value of berseem during the successive cuts with the two systems of cutting are summarized in Table (5).

TABLE 5.—**Average Nutritive Value of Various Cuts of Berseem over Two Years**

The Cuts	Early cut berseem			Late cut berseem		
	Starch Value	Nutritive Ratio	Value Number	Starch Value	Nutritive Ratio	Value Number
	Kg.	1 :	%	Kg.	1 :	%
1st. cut	5.91	2.36	92.20	5.62	2.91	90.50
2nd. cut	7.12	2.66	91.46	6.55	4.02	88.09
3rd. cut	7.11	3.09	89.99	7.92	4.07	84.22
4th. cut.	8.38	3.28	89.39	10.51	3.85	81.72
5th. cut	10.27	3.60	82.98	—	—	—

(1) Nutritive ratio $= \frac{\text{digestible crude protein}}{\text{digestible N.F.E.} + \text{digestible crude fibre} + 2.44 \times \text{digestible crude fat. Kellner, (1926)}}$

(2) Value no. $= \frac{\text{true starch value}}{\text{calculated starch value}} \times 100$

(3) Protein number $= \frac{\text{Digestible crude protein}}{\text{starch value}} \times 100$

6.—*The yield of nutrients* :

The yields of dry matter of the middle cuts were more than the first and last ones. The lowest yield of dry matter was in the last cut. Early cutting increased the yield of the different nutrients (both crude and digested) and the starch value, over late cutting. The average increases in the yields of different nutrients and the starch value, with early over late cutting, for the three experimental years are summarized in Table (6).

7.—*Minerals* :

The average mineral content (P, Ca and Mg) in berseem with the two systems of cutting in the different successive cuts are presented in Table (7). Minerals in berseem on fresh matter basis increased with the successive cuts. The increase was parallel to the increase in the dry matter. On moisture free basis phosphorus decreased with the successive cuts. A highly significant correlation was found between protein and P contents in berseem (0.8149 with 40 pairs of samples in the two systems of cutting). The ranges of P during the whole experimental period were 269-420 and 236-371 mg/100 gm. D.M. for early and late cutting, respectively. Average P concentrations of early cut berseem were 388, 387, 318, 305 and 271 mg/100 gm D.M. in the first through the fifth cuts, respectively. The corresponding figures of late cut berseem were 350, 291, 306 and 268 mg/100 D.M. Early cutting increased the total yield of P by 18.90% more than late cutting.

The Ca and Mg contents did not follow any special trends either among the successive cuts or the two systems of cutting. The ranges of Ca and Mg during the whole experimental period with the two systems of cutting were between 1,203-2,169 and 202-439 mg/100 gm D.M. for the two minerals, respectively.

The Ca/P ratio in berseem increased with the successive cuts. This ratio seemed to be narrower with first cuts than later ones. The width of the Ca/P ratio with later cuts may have been due to a decrease in P content with age. The Ca/P ratio of berseem cut at 30-35cm. appeared to be narrower than that cut at 60-70 cm. The average Ca/P ratio of berseem ranged between 4.31-6.32 : 1 in the different successive cuts.

TABLE 6.—**Average Increase in Yields of Nutrients and Starch Value of Berseem with Early Cutting over Late Cutting**

Nutrients	Crude	Digested
	%	%
Dry matter . . .	13.12	24.09
Crude protein . .	24.99	41.19
Ether extract . . .	22.49	44.66
Crude fibre . . .	-0.50	5.81
N.F.E.	13.56	15.46
Ash	17.77	—
Starch value . . .	26.16%	

TABLE 7.—**Average Mineral Content (P, Ca and Mg) of Various Cuts of Berseem over Three Years**

The cuts	Early Cutting			Late Cutting		
	P	Ca	Mg	P	Ca	Mg
	mg/100g dry matter					
1st. cut	388	1801	261	350	1612	396
2nd. cut	357	1539	351	291	1840	341
3rd. cut	318	1373	319	306	1604	388
4th. cut.	305	1615	287	268	1462	292
5th. cut.	271	1455	351	—	—	—

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الملخص

تأثير عمر الحشة على الانتاج والقيمة الغذائية والتركيب الكيميائى فى البرسيم

أجرى الحش المبكر للبرسيم عندما وصل طول النباتات ٣٠ — ١٥ سم بينما أجرى الحش المتأخر عندما وصل طول النباتات ٦٠ — ٧٠ سم . ولقد سبب الحش المبكر زيادة عدد الحشات بمقدار حشة واحدة . علاوة على ذلك فقد حقق الحش المبكر زيادة المحصول الأخضر بمقدار ١٧,٢١ عن الحش المتأخر.

ولقد ازدادت المادة الجافة فى البرسيم فى الحشات المتتابعة كما تبين عند دراسة مكونات البرسيم على أساس المادة الجافة تناقص محتويات البروتين الخام والرماد بينما ازدادت محتويات الألياف الخام . أما بالنسبة لمستخلص الايثير والكربوهيدرات الذائبة فكانت نسبتها متذبذبة فى حدود ضيقة بدون اتجاه معين بالنسبة للحشات المتتابعة . وسبب الحش المبكر تناقص محتويات المادة الجافة عن الحش المتأخر أما بالنسبة لمكونات المادة الجافة فلقد ازدادت محتويات البروتين الخام والرماد بينما تناقصت محتويات الألياف الخام .

تغيرت معاملات هضم المركبات الغذائية فى البرسيم فى الحشات المتتابعة — فيما عدا مستخلص الأثير — فى حدود ضيقة (١٠٪ أو أقل) ، أما بالنسبة للفروق فى معاملات هضم مستخلص الأثير فكانت نسبتها (١٥ — ٢٠٪). كما لوحظ أن الحش المبكر سبب زيادة طفيفة فى معاملات هضم المركبات الغذائية المختلفة .

وقد اتخذت المركبات المهضومة نفس الاتجاه بالنسبة للمركبات الخام . كما سبب الحش المبكر زيادة البروتين الخام المهضوم ومستخلص الأثير المهضوم بينما تناقصت الألياف المهضومة عند المقارنة بالحش المتأخر.

ولقد ازداد معادل النشا فى البرسيم فى الحشات المتتالية عند تقديره على الحالة الطازجة بينما سلك اتجاها عكسياً عند تقديره بالنسبة للمادة الجافة وأثبتت التجارب

زيادة القيمة النشوية للبرسيم فى حالة الحش المبكر عن الحش المتأخر وكان معادل النشا للبرسيم فى حالة الحش المبكر هو ٥,٩١ ، ٧,١٢ ، ٧,١١ ، ٨,٣٨ ، ١٠,٢٧ كجم فى الحشة الأولى والثانية والثالثة والرابعة والخامسة على التوالى بينما كانت مثيلاتها الحش المتأخر هى ٥,٦٢ ، ٦,٥٥ ، ٧,٩٢ ، ١٠,٥١ كجم فى الأربع حشات على التوالى .

وبدراسة محصول المركبات الغذائية المختلفة بالنسبة للفدان فى الحشات المتابعة وجد أنها تتبع محصول البرسيم الأخضر — كما تبين أن الحش المبكر سبب زيادة فى محصول المركبات الخام والمهضومة عن الحش المتأخر ما عدا الألياف الخام التى تناقصت كميتها بالحش المبكر . فلقد ازدادت المادة الجافة المهضومة والبروتين الخام المهضوم بمعدل ٢٤,٠٩ ٪ ، ٤١,١٩ ٪ على التوالى بينما ازداد معادل النشا بمعدل ٢٦,١٦ .

وبدراسة المادة المعدنية فى البرسيم وجد أن الفوسفور يتناقص فى الحشات المتتابعة بينما تذبذبت محتويات الكالسيوم والمغنسيوم بدون اتجاه معين . كما وجد أن هناك توافقاً موجباً (+ ٠,٨١٤٩) بين البروتين والفوسفور فى البرسيم ولقد سبب الحش المبكر زيادة محتويات البرسيم من الفوسفور بمقدار ١٨,٩ ٪ عن الحش المتأخر بينما لم تكن هناك فروق واضحة فى محتويات الكالسيوم والمغنسيوم .